Journal of Agriculture, Food Systems, and Community Development

Volume 15, Issue 2
Spring 2026



JAFSCD

https://FoodSystemsJournal.org
ISSN 2152-0801 (online only)

Published by the Thomas A. Lyson Center for Civic Agriculture and Food Systems with the support of:

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The *Journal of Agriculture, Food Systems, and Community Development,* ISSN 2152-0801 (online only), is published quarterly (summer, fall, winter, spring) with occasional supplements by the Thomas A. Lyson Center for Civic Agriculture and Food Systems, a project of the Center for Transformative Action (a nonprofit affiliate of Cornell University). Editorial office: 45 School Street, Keene, New Hampshire 03431 USA. Administrative and financial office: Center for Transformative Action, P.O. Box 760, Ithaca, New York 14851 USA. The publisher assumes no responsibility for any statements of fact or opinion expressed in these published papers.

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Journal of Agriculture, Food Systems, and Community Development
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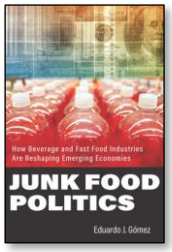
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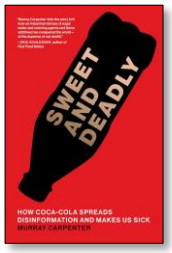
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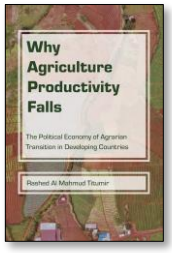
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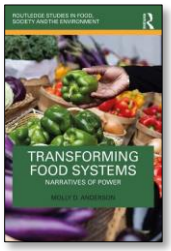
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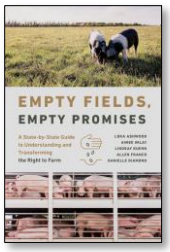
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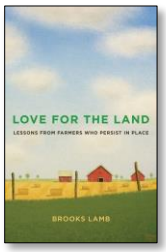
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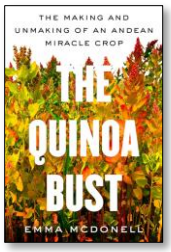
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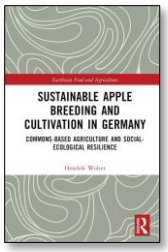
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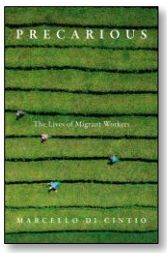
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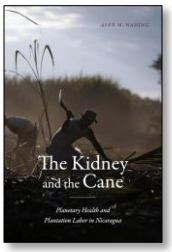
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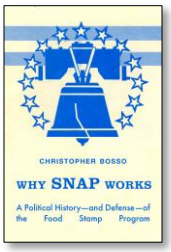
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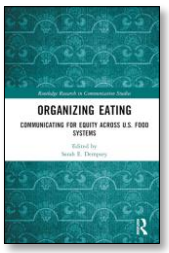
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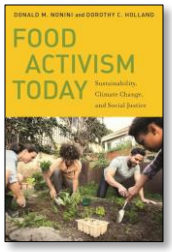
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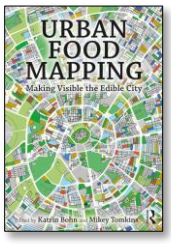
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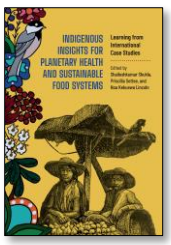
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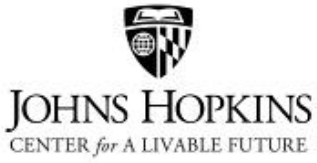
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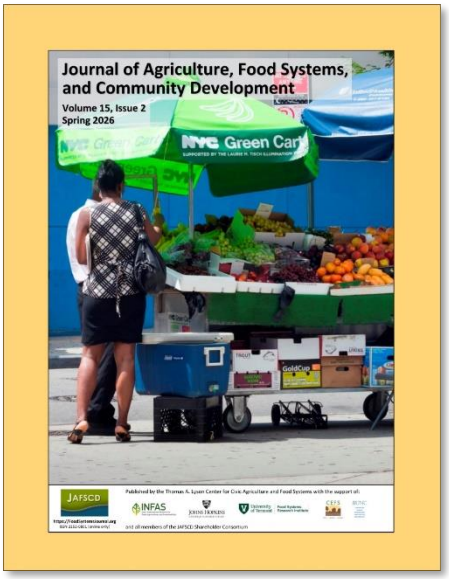
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Journal of Agriculture, Food Systems, and Community Development
ISSN: 2152-0801 online
https://foodsystemsjournal.org

IN THIS ISSUE
DUNCAN HILCHEY

Righting systemic food and farming inequalities



Published online April 7, 2026

Citation: Hilchey, D. (2025). In this issue: Righting systemic food and farming inequalities [Editorial]. *Journal of Agriculture, Food Systems, and Community Development*, *15*(2), 1–4. https://doi.org/10.5304/jafscd.2026.152.040

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The spring 2026 issue of the *Journal of Agriculture, Food Systems, and Community Development* brings together a set of contributions that, while they are open-call and not in response to a specific call for papers, collectively examine how food systems are governed, how access and equity are structured, how agroecological transitions unfold, and how knowledge systems and cultural values shape transformation. Across its entire content, the issue reflects a strong throughline of systems thinking, place-based analysis, and an expanding recognition of the wide range of ways of knowing and acting within food systems.

Conveying the issue's theme of righting food system inequalities, our cover photo is of a NYC Green Cart on a street in Jamaica, Queens, New York. Green Carts sell fresh fruits and vegetables to promote healthy eating in neighborhoods that have a lack of access to fresh fruit and vegetables. This convenient produce vending strategy was launched in 2008 through a public-private partnership and has stood the test of time as a good practice in urban food security. In their paper *Sustaining mobile produce vending in NYC: Evaluating the future of Green Carts*, **Katherine Tomaino Fraser, Rositsa T. Ilieva, Jacquelyn Sullivan, Julia Greene, Mukta Mohnani, Craig Willingham,** and **Nevin Cohen** provide an analysis of the successes and challenges of the NYC Green Carts program.

Duncan Hilchey, MRP, is editor-in-chief and publisher of the *Journal of Agriculture, Food Systems, and Community Development*, published by the Thomas A. Lyson Center for Civic Agriculture and Food Systems; duncan@lysoncenter.org; https://orcid.org/0000-0001-9465-6606

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On Our Cover
On our cover: A NYC Green Cart on a street in Jamaica, Queens, New York, on August 28, 2012. Green Carts sell fresh fruits and vegetables to promote healthy eating in neighborhoods that have a lack of access to fresh fruit and vegetables. See the article in this issue, Sustaining mobile produce vending in NYC: Evaluating the future of Green Carts, for an analysis of the successes and challenges of the NYC Green Carts program. Photo credit: © Littleny, ID 26656408 | Dreamstime.com

We are excited to open this issue with the inaugural value chain coordination column written by members of the JAFSCD Value Chain Coordination Editorial Circle. In *Turning supply chains into value chains*, Associate Editor **Anaya Hall** and colleagues introduce value chain coordination (VCC) as the relational "soft infrastructure"—networks, partnerships, and information flows—that enables values-based, place-based food supply chains to equitably support small and midsized producers while advancing environmental, economic, and social goals. The JAFSCD VCC Editorial Circle is also launching a practitioner-focused JAFSCD VCC brief series that synthesizes research and real-world practice, beginning with strategies to leverage institutional purchasing as a key market opportunity for regional and sustainable food systems. We are grateful for Anaya's leadership in establishing the VCC Editorial Circle and for the collaboration with USDA AMS and The Food Connection at the University of Kentucky in advancing this work.

Next, **John Ikerd** argues that incremental reform is insufficient to address structural failures in contemporary food systems; he calls instead for a fundamental reorientation toward ecological integrity and community resilience in his typically insightful Economic Pamphleteer column, *The need for radical changes in U.S. food policies*. **Zeynab Jouzi's** viewpoint, *Measuring change without seeing the system: A call for epistemic humility in intervention evaluation*, complements the Economic Pamphleteer by challenging dominant evaluation paradigms and advocating for more reflexive, context-aware approaches. This emphasis on evaluation and learning is extended in the commentary *Food and nutrition security support groups: A safety net strategy for sustaining gains from a livelihood program in Uganda*, in which **Moureen Mbeiza, Caroline Nambafu, David Banige, Samuel Ikendi, Dorothy Masinde, Lee Burras, Gideon Nadiope,** and **Francis Owusu** examine community-based mechanisms for sustaining the impacts of development interventions over time.

We then turn to the governance issues related to agricultural production, beginning with several studies that serve to contrast rural and urban agricultural production. **Jacob Miller-Klugesherz** offers two papers on his research in Kansas: in *Challenges to production agriculture in Pottawatomie County, Kansas, USA*, he analyzes structural pressures facing regional farming systems, and in *Cover crops, chemicals, and emissions in Pottawatomie County, Kansas, USA*, he examines the environmental implications of production practices. Extending production into urban contexts, *Scaling up urban agriculture in Tempe, Arizona: A participatory planning case for early urban food policy* by **Esteve Giraud, Elora Bevacqua, Madeline Mercer, Nicholas Benard, Priya Nayak, Tawsha Trahan,** and **Kathleen Merrigan** demonstrates how participatory planning and stakeholder alignment can enable the expansion of urban agriculture as a meaningful component of local production systems. Governance constraints within local food systems are further explored in **Sarah Hofmeyer's** *Permits and paperwork: Administrative burden in Kansas City's community food system*, which reveals how regulatory complexity can constrain small-scale producers. This emphasis on place-based dynamics is echoed in *Our Food Future: A regional food circularity case study from Canada* by **Haley Everitt** and **Kate Parizeau**, which, alongside the place-based studies in Kansas and Tempe, shows how important regional context is in shaping food system outcomes.

We continue the food production governance theme with a focus on the Global South. *Food supply improvement for planning to meet needs in Indonesia's New Capital City*, by **Adang Agustian, Ika Inayah, Benny Rachman, Rika Reviza Rachmawati, Chairul Muslim, Helena Juliani Purba, Alan Ray Farandy, Suharyon, Umi Karomah Yaumidin, Mewa Ariani, Sri Hastuti Suhartini, Sri Hery Susilowati, Ening Ariningsih, Irawan, Maino Dwi Hartono,** and **Ketut Kariyasa**, illustrates the importance of coordinated infrastructure and planning in shaping future food supply systems. And in *Beyond the shade: Family farmers' perceptions of silvopastoral systems in the Amazon*, **Elisangela Sodré, Alexandre de Azevedo Olival, Marla Weihs, David Rojas,** and **Carolyn Petersen** examine how farmers engage with integrated agroforestry–livestock systems. Attention to enabling conditions in the Global South continues in *The role of civil society networks in catalyzing agroecological transitions in Uganda*, where **Charles Tumuhe, Denis Katusiime, David Ssekamatte, Joshua Muloi, Keiron Audain, Hannah Kamau,** and **Ronald Byaruhanga** highlight the importance of networks and collective action in advancing agroecological change.

From the governance of production, the issue turns to how food circulates through markets and institutions, which can have social and environmental consequences. Looking in North America, *Using a screening*

survey to understand the appeal of poultry meat label attributes to support small-scale producers by **Chyi-lyi (Kathleen) Liang** and **Bryan Collins** examines how labeling influences consumer preferences and market access. And in *Virginia independent food retailer perceptions of their role in planetary health promotion,* **Maria DeNunzio, Bailey Houghtaling, Victor Olayemi, Elena Serrano, Maaz Gardezi, Vivica Kraak, Sam Hedges,** and **Sarah Misyak** find that profit and customer opinions matter most in the eyes of retailers. In the Global South, value chain innovation and coordination are explored in *Social innovation strategies to improve agroecological product marketing: A case study in rural Colombia*, where **Estíbaliz Aguilar-Galeano, Diana Marcela Diaz-Ariza,** and **Claudia Paola García-Castiblanco** examine the collective marketing approaches that strengthen agroecological systems. In contrast, **Segnide Guidimadjegbe** and **Laurence Becker** suggest that the potential for Gis to protect place-based foods and strengthen community food sovereignty is threatened by the reliance on herbicides due to labor constraints risks, thus undermining both agroecological transitions and the integrity of the GI product in the paper entitled *From geographical indication protection to food sovereignty: Cassava and Gari Sohoui in Savalou, Benin*.

Questions of access, nutrition, and equity bring the discussion to the lived experience of all who eat. In a particularly timely study entitled *Impact of conflict on Lebanon's food industry: Challenges, needs, and emergency response*, **Aline Issa, Samar Merhi, Jessy El Hayek Fares, Elie Bou Yazbeck,** and **Marc Bou Zeidan** shed light on how war in the Middle East, and Lebanon in particular, is exacerbating regional food insecurity. They call for immediate and lasting intervention to arrest the growing crisis. In *A community supported agriculture produce prescription pilot program in the Northern Black Hills*, **Gemma Bastian, Sarah Lane, Haley McMahon, Olivia Husmann,** and **Evangeline Schumacher** demonstrate how healthcare-linked interventions can improve access to fresh foods. The NYC Green Carts study, *Sustaining mobile produce vending in NYC: Evaluating the future of Green Carts*, by **Katherine Tomaino Fraser** and colleagues, further evaluates a mobile retail intervention. In *Culturally appropriate food in local food systems and associated health impacts among immigrants living in high-income countries: A scoping review*, **Luyue Zheng, Ge Ge, Shuhan Wen,** and **Analena Bruce** emphasize culturally responsive approaches to food access and well-being. Policy design also plays a central role in the article *SNAP's Restaurant Meals Program: Understanding drivers and constraints on state adoption and implementation*, in which **Vicky Vong, Cerra Antonacci, Audrey Thomas, Lisa Poirier, Megan Mueller, Julia Wolfson,** and **Yeeli Mui** analyze uneven adoption and the administrative and political dynamics shaping implementation.

At a deeper level, questions of knowledge, culture, and power are taken up in *Bridging Western and Indigenous epistemologies in an opaque world: Food security and food sovereignty as climate adaptation*, where **Garin Bulger, Will Butler, Tisha Holmes, Karen Lowrie,** and **Coreine Rainford** position food sovereignty as central to climate adaptation and resilience. Similarly, **Sara María Cano-Bedoya, Jennifer Marcela López-Ríos, Leisy Cruz-Rodríguez, Juan Camilo Calderón-Farfán,** and **Luz Nidia Finscue-Pete** center "good living" as a core concept of food sovereignty in their paper, *Community strategies for strengthening food autonomy and buen vivir in a Nasa Indigenous Reservation, Colombia: A community-based participatory research (CBPR) approach.* And, finally, in *Nourishing connections: An arts-informed approach to illuminating community food values* by **Rachel Zollinger** and **Gigi Owen**, uses creative methods to surface the cultural and relational dimensions of food systems. Together with the viewpoint *Measuring change without seeing the system* by **Zeynab Jouzi**, these contributions underscore the importance of how knowledge is framed, valued, and applied.

These themes are further extended through a rich collection of book reviews that examine food systems through the lenses of power, justice, labor, and transformation. **Zeynab Jouzi** reviews *Junk Food Politics: How Beverage and Fast-Food Industries Are Reshaping Emerging Economies* (by Eduardo Gómez), while **Andrea Cullers** takes up *Sweet and Deadly: How Coca-Cola Spreads Disinformation and Makes Us Sick* (by Murray Carpenter), together illuminating the outsized influence of corporate actors on diets and public health. These concerns are deepened by **Manoj Sharma's** review of *Why Agricultural Productivity Falls: The Political Economy of Agrarian Transition in Developing Countries* (by Rashed Al Mahmud Titumir) and **Carina Manitius's** review of *Transforming Food Systems: Narratives of Power* (by Molly Anderson), both of which interrogate how structural inequalities and dominant narratives shape agrarian change.

Attention then shifts from macro-level dynamics to the lived realities of land, production, and rural life. **Roland Ebel** reviews *Empty Fields, Empty Promises* (by Loka Ashwood, Aimee Imlay, Lindsay Kuehn, Allen Franco, and Danielle Diamond), and **Elisabeth Ramsey** reviews *Love for the Land: Lessons from Farmers Who Persist in Place* (by Brooks Lamb), offering grounded perspectives on persistence and dispossession. These themes extend globally through **Hans Goertz's** review of *The Quinoa Bust: The Making and Unmaking of an Andean Miracle Crop* (by Emma McDonell), while **Charles Tumuhe** examines alternatives in *Sustainable Apple Breeding and Cultivation in Germany: Commons-Based Agriculture and Social-Ecological Resilience* (by Hendrik Wolter), pointing toward commons-based approaches and resilience.

The focus on agrarian systems naturally leads to the conditions of labor that sustain them. **Jessica Garneau** reviews *Precarious: The Lives of Migrant Workers* (by Marcello Di Cintio), and **Donald Cole** reviews *The Kidney and the Cane* (by Alex Nading), both foregrounding the vulnerabilities and embodied costs experienced by workers in globalized food economies.

From labor, the discussion moves into questions of governance and the role of public policy in shaping food access and equity. **Lucy Srour's** review of *Why SNAP Works: A Political History—and Defense—of the Food Stamp Program* (by Christopher Bosso) provides a critical account of one of the United States' central food security programs, situating it within broader debates over welfare, rights, and state responsibility.

Building on these institutional perspectives, several reviews explore how change is pursued through activism, communication, and collective action. **Emily Talkow** reviews *Organizing Eating: Communicating for Equity Across U.S. Food Systems* (edited by Sarah Dempsey), and **Jason Wallace Triefenbach** reviews *Food Activism Today: Sustainability, Climate Change, and Social Justice* (by Donald Nonini and Dorothy Holland), both highlighting the strategies and narratives that underpin contemporary food movements.

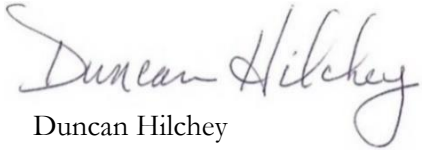
Questions of place and visibility come to the fore in **Hannah Dankbar's** review of *Urban Food Mapping: Making Visible the Edible City* (edited by Katrin Bohn and Mikey Tomkins), which examines how spatial tools and mapping practices reveal—and potentially reshape—urban food environments.

Finally, the collection turns to foundational questions of knowledge and epistemology. **Jill Fabricius Keith** reviews *Indigenous Insights for Planetary Health and Sustainable Food Systems* (by Shailesh Shukla, Priscilla Settee, and Noa Kekuewa Lincoln), bringing forward Indigenous perspectives that challenge dominant paradigms and point toward more relational, place-based approaches to sustainability.

In its totality, this issue reflects a field that is increasingly attentive to the interconnections between production, markets, access, knowledge, labor, and place—highlighting the limits of siloed approaches while advancing a vision of food systems that are more sustainable, equitable, and responsive to diverse contexts and communities.

Indeed, systems thinking and borderless approaches to addressing growing challenges across communities and transnationally may seem, at first, daunting and impractical. Yet in a world that is increasingly interconnected, such approaches may be the only realistic means of promoting resilient food systems for the future.





Duncan Hilchey
Publisher and editor-in-chief

PS. You may have noticed I declared using ChatGPT (see the note at the bottom of page 1) to thematically analyze the content of this issue. This was an honest attempt to experiment with the technology. It was not the time saver I expected it to be; I ended up rewriting and restructuring the narrative quite a bit. I am uncertain whether I would use it again. In the meantime, please let me know what you think about my use of AI in this case to organize the thematic content of the issue.

Journal of Agriculture, Food Systems, and Community Development
ISSN: 2152-0801 online
https://foodsystemsjournal.org

VALUE CHAIN COORDINATION COLUMN

Turning supply chains into value chains

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Published online April 7, 2026

Citation: Hall, A. L., Edwards-Orr, L., Carberry, A., & DeLuca, E. (2025). Turning supply chains into value chains. *Journal of Agriculture, Food Systems, and Community Development*, *15*(2), 5–9. https://doi.org/10.5304/jafscd.2026.152.039

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JAFSCD is delighted to share this **inaugural column** on the topic of value chain coordination. We define VCC as the development of relational infrastructure—networks, information channels, and partnerships—that support thriving and sustainable regional food economies. JAFSCD also announces a **new series of program, policy, and practice briefs** focused on value chain coordination This series aims to synthesize the current knowledge on coordinating values-based food supply chains into concise, high-impact, practitioner-focused briefs. The series and associated articles are being curated by a JAFSCD Value Chain Coordination Editorial Circle made up of the scholars and practitioners below, who will also jointly produce this quarterly column.

- Kathryn Barr, Associate, SupplyChange
- Patrick Baur, Associate Professor, University of Rhode Island
- Analena Bruce, Assistant Professor, University of New Hampshire
- Andrew Carberry, Project Manager, Wallace Center at Winrock International
- Eric DeLuca, Consultant, Food Finance Institute
- Laura Edwards-Orr, Senior Agricultural Marketing Specialist, USDA Agricultural Marketing Service, Local and Regional Food Division
- Anaya Hall, Postdoctoral Scholar, The Food Connection at the University of Kentucky
- Heather ("H") Nieto-Friga, CEO, SupplyChange
- Ashton Potter, Executive Director, The Food Connection at the University of Kentucky
- Elliott Smith, Consultant, Kitchen Sync Strategies
- Jodee Smith, Executive Director, FARMWISE Indiana
- Ye Su, Assistant Professor, Lincoln University of Missouri
- Dawn Thilmany, Professor, Colorado State University
- Kamran Zendehdel, Research Branch Chief, USDA Agricultural Marketing Service, Local and Regional Food Division

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* * *

At a moment when food systems stakeholders are navigating supply chain disruption, market consolidation, and increasing climate-driven risk, questions of how best to retain or expand benefits for small and midsize farms and food businesses are increasingly urgent. Across various geographies and markets, value chain coordination (VCC) has emerged as a critical lever for addressing these challenges. In this inaugural column, we introduce VCC—a concept that bridges many concerns of JAFSCD readers—and suggest a few topics the series may address. We also provide some context on the first brief, which focuses on how VCC offers a pathway to address challenges associated with institutional purchasing and harness this strategic opportunity to support regional and sustainable food producers.

In the context of a growing bifurcation in agri-food systems between large-scale commodity supply chains and direct marketing relationships, VCC represents a deliberate response—one that is focused on actively forging connections across stakeholders to strengthen and extend market opportunities for regional producers (De Master, 2018; Lyson et al., 2008). As these markets diverge, producers, intermediaries, and consumers committed to values such as environmental stewardship, regional economic development, and public health outcomes can all benefit from dedicated coordination capacity to establish purchasing mechanisms and relationships that prioritize shared values across the food supply chain.

On its own, a supply chain is the infrastructure, actors, and activities through which products move from production to consumption, often national or international in scope, with a focus on maximizing efficiency and minimizing cost (Diamond & Barham, 2011; Stevenson et al., 2011). A value chain, however, is often place-based and designed to reflect the priorities of the community they serve and share benefits fairly among partners. Common value chain priorities are farm or producer identity and financial viability, environmental sustainability, food access, worker well-being, animal welfare, and culturally or ecologically relevant products. Incorporating these values requires education, innovation, and long-term, relational approaches to marketing, all of which can be accomplished through VCC.

In practice, this work often includes sharing market information; facilitating connections and convenings; mobilizing resources; and translating the needs and constraints of different actors to balance economic viability with shared social, environmental, and place-based values. Such coordination depends on both hard and soft infrastructure: the facilities, equipment, and information systems that enable product movement, as well as the contracting practices and trusted relationships that sustain it (Bloom & Hinrichs, 2011). Effective coordination, in other words, is fundamentally relational and ongoing (Rocker & Smith, 2022).

When food systems stakeholders are navigating supply chain disruption, market consolidation, and increasing climate-driven risk, questions of how best to retain or expand benefits for small and midsize farms and food businesses are increasingly urgent.

Over the past two decades, a growing body of research has examined values-based supply chains as strategic alliances characterized by transparency, trust, shared ethics, and mutual benefit, in which producers are treated as partners rather than interchangeable inputs (see, for example, Stevenson et al., 2011). JAFSCD has played a foundational role in advancing this scholarship, including through a special issue published more than 15 years ago that helped establish values-based supply chains as a distinct area of inquiry within food systems research (Hilchey, 2011). This work has generated important insights into the mechanisms of coordination, including governance structures, the role of intermediaries, and tools for sharing benefits as well as risk equitably across the supply chain (Diamond & Barham, 2011; Horst et al., 2011; MacCallum et al., 2014).

The emergence of value chain coordination as a named role and field of practice grew out of two

key insights developed through local and regional food systems work. The first illuminated how values-based supply chains have distinct characteristics among supply chains: they add value to products across steps, share values across chain actors, and benefit enterprises while building rooted local and regional wealth (Diamond et al., 2014; Porter, 1985; Ratner & Markley, 2014; Stevenson et al., 2011; Stevenson & Pirog, 2008). The second elevated the importance of "soft infrastructure" in the effective functioning of value chains, identifying coordination roles that mitigate the financial risks associated with overcapitalizing hard assets and strengthen overall value chain capacity.

The coordination and sharing of the roles proved more crucial than one individual "doing it all" in a particular regional system.

This progression is also legible in federal farm policy. Twenty-first-century farm bills reflect a shift from early interest in direct-to-consumer markets, such as farmers markets, toward market diversification via local and regional enterprises. By 2012, the U.S. Department of Agriculture (USDA)'s working definition of a food hub had broadened to recognize more business models, specifying that food hubs "actively manage" value chain functions (Barham et al., 2012).

On the ground, this evolution was already underway. Hubs like Red Tomato had transitioned from brick-and-mortar operations to brokerage-based models, increasing financial sustainability and reducing burnout. In the early 2010s, Sarah Fritschner, coordinator of Louisville (Kentucky) Farm to Table, modeled a public-interest broker role that generated US$9.70 of farm income per US$1.00 invested by the Kentucky Agricultural Development Fund in a farm-to-institution market connection program (Davis et al., 2015). Such examples informed Elanor Starmer and Jim Barham's leadership in USDA in creating the 2016 Food LINC program, developed with philanthropic partners, which codified value chain coordination and centered the soft infrastructure—the relationships, trust, knowledge, and norms that scaffold market connections and undergird the efficient use of physical infrastructure (Rocker, 2019; USDA, 2016).

Prior conceptualizations of this function, notably, had used the term *facilitation* rather than *coordination*. Research on and evaluation of the Food LINC program revealed that no single coordinator performs all roles in a regional system. The coordination and sharing of the roles proved more crucial than one individual "doing it all" in a particular regional system. This work also suggested that future funding models for value chain coordination should encourage actors to share roles for resilience and efficiency across the regional system.

This literature has helped establish value chain coordination as a dynamic field shaped by deep collaboration between academics, practitioners, and public agencies. The new JAFSCD Program, Policy and Practice Briefs series focused on value chain coordination will follow and extend this collaborative tradition by highlighting on-the-ground value chain coordination practices to inform community development and food systems transformation. Some briefs will serve as accessible primers that introduce key concepts and frameworks, while others will offer deeper dives into specific programs, policies, or practices drawn from real-world experience. Together, they are intended to support learning across experience levels and organizational roles.

Brief Development and the Editorial Circle

As noted above, the VCC series is being led by an editorial circle of scholars, professionals, and practitioners from across the U.S. with deep expertise in both researching and actively coordinating value chains in many geographies and market contexts. Members of the editorial circle bring perspectives from academia, nonprofit and cooperative organizations, public agencies, and value chain intermediaries, many of whom are directly engaged in the daily work of coordination. The series is supported in part by funding from the USDA Agricultural Marketing Service.

Ahead of the series launch, the JAFSCD Editorial Circle curated a collection of topics of high importance and immediate impact, based on input

from a survey of JAFSCD readers and a series of key informant interviews, to identify pressing issues and emergent opportunities in value chain coordination. This first round of briefs will cover a range of critical topics, such as financing the hard and soft infrastructure of coordinated value chains, and market matchmaking strategies for connecting aligned supply chain stakeholders.

We recognize that the contexts in which value chains operate, as well as the policy, market, and environmental conditions that shape them, are constantly changing. As such, effective value chain coordination requires flexibility, experimentation, and a commitment to learning over time. This series is intended to offer lessons, rather than blueprints, for practitioners, policymakers, and researchers working to strengthen communities through food systems change. Each peer-reviewed brief will contain operationalized terminology, actionable recommendations, and links to resources for more information.

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The Inaugural Brief: Unlocking Institutional Food Purchasing: Contract Strategies for Values-Based Sourcing

A subgroup of the editorial circle, Katie Barr, H Nieto-Friga, Jodee Smith, Elliot Smith, and Ashton Potter—composed of practitioners actively working to create and coordinate value chains across the U.S.—has taken the lead in drafting the inaugural brief. This brief draws on their shared experience coordinating values-based institutional procurement, where scale, public accountability, and mission-driven goals often intersect.

The authors review the specific challenges of working with institutional purchasing systems, including a breakdown in plain language of the contractual design elements that limit market participation for small and mid-sized producers. They identify strategic leverage points to navigate the operational realities that govern institutional decision-making and facilitate viable market access that supports regional and sustainable producers.

We Want to Hear From You!

We invite input from practitioners, professionals, scholars, and policymakers engaged in this work. We see this series as a living body of knowledge, responsive to new evidence, evolving practice, and shifting conditions. Readers are encouraged to share feedback, suggest topics, and contribute insights from their own experiences in designing, practicing, and sustaining coordination in values-based supply chains.

If you have questions about or suggestions for the series, please be in touch with Associate Editor Anaya Hall, PhD, at anaya.hall@uky.edu. If you'd like to submit a topic for a brief, please follow this link: https://surveymonkey.com/r/jafscd-query



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Journal of Agriculture, Food Systems, and Community Development
ISSN: 2152-0801 online
https://foodsystemsjournal.org



THE ECONOMIC PAMPHLETEER
JOHN IKERD

The need for radical changes in U.S. food policies

Published online February 4, 2026

Citation: Ikerd, J. (2026). The Economic Pamphleteer: The need for radical changes in U.S. food policies. *Journal of Agriculture, Food Systems, and Community Development*, *15*(2), 11–16. https://doi.org/10.5304/jafscd.2026.152.001

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In my two previous Economic Pamphleteer columns, I have suggested that the current political turmoil in Washington, D.C., creates an environment conducive to radical change in government policies. Those columns focused on government policies affecting economic opportunities and access to farmland for sustainable farmers. I argued that U.S. farm policies should focus on long-run domestic food security, and that land use and production for exports or biofuels should be regulated as industrial, not agricultural. This column advocates policy changes to ensure that everyone has access not only to enough food but also to "good food," defined as wholesome, nutritious, culturally appropriate, and sustainably produced food. Changes in community development policies will be addressed in my next column.

Current farm and food policies are defended politically as providing food security by making food more affordable for more people. Current government programs absorb much of the economic risks for large-scale, specialized agri-food businesses, which are alleged to be more economically efficient. Without government price supports, subsidies, access to capital, and tax credits—and the lax regulation of food quality, worker safety,

John Ikerd is professor emeritus of agricultural economics, University of Missouri, Columbia. He was raised on a small farm and received his B.S., M.S., and Ph.D. degrees from the University of Missouri. He worked in the private industry prior to his 30-year academic career at North Carolina State University, Oklahoma State University, the University of Georgia, and the University of Missouri. Since retiring in 2000, he spends most of his time writing and speaking on issues of sustainability. Ikerd is author of six books and numerous professional papers, which are available at http://johnikerd.com and https://ikerdj.mufaculty.umsystem.edu.

Why an Economic Pamphleteer? In his historic pamphlet *Common Sense*, written in 1775–1776, Thomas Paine wrote of the necessity of people to form governments to moderate their individual self-interest. In our government today, the pursuit of economic self-interest reigns supreme. Rural America has been recolonized, economically, by corporate industrial agriculture. I hope my "pamphlets" will help awaken Americans to a new revolution—to create a sustainable agri-food economy, revitalize rural communities, and reclaim our democracy. The collected Economic Pamphleteer columns (2010–2017) are available at https://bit.ly/ikerd-collection

environmental protection, and antitrust violations—today's industrial food system would be too risky for economic feasibility. The implicit assumption is that the efficiencies of large, industrial operations will be passed on to consumers through lower food prices, making food more affordable. The incomes of those unable to buy enough food to meet their basic needs will be supplemented with government payments.

The U.S. Department of Agriculture (USDA) administers the government programs that provide supplemental food assistance. The USDA shares administration of programs in nutritional education, research, and monitoring; food safety, content, and labeling; and agri-food imports and exports with the Centers for Disease Control and Prevention (CDC) and the Food and Drug Administration (FDA) within the Department of Health and Human Services (HHS) (Nestle, 2019). The responsibility for maintaining competitive agri-food markets is shared among the USDA, the Department of Justice (DOJ), and the Federal Trade Commission (FTC).

These programs were successful, at least initially, in increasing food production and reducing the percentage of consumer incomes spent on food. The percent of consumers' disposable incomes spent on food dropped from 15% in 1964 to less than 10% in the late 1990s, but has remained around 10% during the 2000s (USDA Economic Research Service [USDA ERS], 2025a). Any further reductions in costs at the farm level have been more than offset by increases in the share of consumers' dollars going to food processors, distributors, and retailers.

The industrial food system has failed to provide food security for many. Five percent of U.S. households were classified with "very low" food security in 2023 (USDA ERS, 2025c). This was slightly higher than the first official estimate of food insecurity in 1995 (Nord & Andrews, 2022), and is the same as the unofficial estimate reported in the influential 1968 CBS documentary, "Hunger in America" (Carr & Davis, 1968). The number of households classified as "low" food security has ranged from 11% to 13% since 1995 (USDA ERS, 2025b).

Equally troubling, "cheap food" polices have created an additional kind of food insecurity. Obesity among adults has tripled since the early 1960s, from 13% to 40%, and childhood and adolescent obesity has quadrupled, reaching more than 20% (USA Facts, 2025). Obesity has been linked with diabetes, hypertension, heart disease, cancer, and other diet-related diseases (Ikerd, 2015). A 2012 global report by 500 scientists from 50 countries suggested that "obesity is a bigger health crisis than hunger" (Dellorto, 2012).

The Good Food Movement is a logical response to the failure of government farm and food policies to prioritize public over corporate interests.

The Good Food Movement is a logical response to the failure of government farm and food policies to prioritize public over corporate interests. It is not a single, well-defined movement but instead numerous initiatives focused on creating a more sustainable, equitable, and healthful food system. The movement encompasses farmers markets, community supported agriculture operations (CSAs), food hubs, and farm stops, all of which promote relocalization and transparency in food provision. And the good food process begins with organic, sustainable, regenerative, agroecological farming.

The Food as Medicine Coalition[1] and Bionutrient Food Association,[2] among other organizations, emphasize links between soil health and human health. Slow Food,[3] bioregionalism (Clancy & Ruhf, 2012), the HEAL Food Alliance,[4] and Indigenous food sovereignty (Antonio et al., 2025) advocate for locally adapted, traditional, culturally appropriate foods. Food justice and food sovereignty movements demand good food for all, regardless of their ability to pay (Merritt et al., 2024). These and numerous other related initiatives

[1] https://fimcoalition.org/
[2] https://bionutrient.net/site/home
[3] https://www.slowfood.com/
[4] https://healfoodalliance.org/

constitute the Good Food Movement.

Food sovereignty provides a conceptual umbrella for radical changes in government food policies by proclaiming,

> the right of peoples to healthy and culturally appropriate food produced through ecologically sound and sustainable methods, and their right to define their own food and agriculture systems. It puts those who produce, distribute, and consume food at the heart of food systems and policies rather than the demands of markets and corporations. (Nyéléni, 2007)

Good food policies must prioritize those who produce, distribute, and consume food over economic efficiency driven by the quest for profitability.

Good food policies must prioritize those who produce, distribute, and consume food over economic efficiency driven by the quest for profitability.

As I have explained in previous columns, market economies respond to scarcity rather than necessity, and they will never provide the economic incentives necessary to ensure enough *good food* for everyone (Ikerd, 2016b). It is more profitable to extract and exploit than to regenerate and empower. Sustaining the productive of natural and human resources requires long-term economic investments that cannot compete with short-run profit opportunities. Those who produce good food cannot compete economically with those who provide cheap food. In the absence of good food policies, those who cannot afford good food are forced to eat cheap food or go hungry. Those of future generations will be left without enough food because the resources upon which agricultural productivity depend will have been depleted.

It is more profitable to extract and exploit than to regenerate and empower.

Policymakers must recognize that the process of creating a *good food* system is fundamentally different from creating an *industrial* system. The industrial food system is driven and perpetuated by a single, generic indicator: economic efficiency. As a result, government policies that reduce costs of any sector of the industrial food chain—production, processing, or distribution—can lead to lower retail food costs. The process of industrializing the food system took place one vertical sector at a time: processing, wholesaling, retailing, animal feeding, and then farming, even though these sectors have since been vertically integrated.

Good food systems will be vertically integrated as well but must be developed very differently, as complete vertical food systems, from farmers to consumers: one complete food system, one food community, one bioregion at a time. It is impossible to have good food at the retail or consumer level unless good food is produced and retains its identity and quality as it moves through the vertical food chain from farmer to consumer. Farmers markets, CSAs, and farm stands are complete vertically integrated food systems, but more complex systems depend on cooperation, coordination, and commitment among all vertical levels. No sector can expand sufficiently to achieve sustainable levels of economic efficiency unless the other sectors expand simultaneously. Economies of scale in processing and distribution are typical bottlenecks in developing good food systems.

The Good Food Movement has been hindered by initiatives, programs, and policies that focus on single sectors of the food system: soil quality, pesticide use, farming, marketing, food waste, nutrition, or affordability. Such policies are destined to fail without adequate recognition that significant improvements in one vertical sector of a food system depend on complementary improvements in the others. Ecologically sustainable farmers have been unable to find economically viable markets. Socially responsible food hubs have not attracted enough ecologically sustainable

farmers or consumers. Advocates for food justice have had to rely on philanthropy, volunteers, and charity from farmers. Successful initiatives have been limited to those that have linked good food producers with consumers willing and able to pay the full economic costs of good food. Those relationships frequently lack the long-term commitment essential for sustainability.

Furthermore, every good food system is different from every other. Every community has unique food needs and preferences, and every agroecosystem or bioregion is different from others. Every food-sovereign community has the right and responsibility to determine its own food system. Every good food community must put "those who produce, distribute and consume food [including future generations] at the heart of food systems and policies rather than the demands of markets and corporations" (Nyéléni, 2007, para. 3).

One approach to removing obstacles to the Good Food Movement would be to provide local *public alternatives* to today's national and global *private* food systems, much as some states are now funding private alternatives to public school systems. Today's Supplemental Nutritional Assistance Program (SNAP) functions much like a school voucher program. Recipients receive debits to their electronic benefits transfer (EBT) cards, which they use to buy food at privately owned and operated markets, much like parents use vouchers to pay tuition for private schools. A public food option would function more like the school lunch program, except that local farmers, processors, and consumers would select *menus* that work for everyone. Perhaps public food options could be called Nutritional Security or NutriSec programs, since the priority would be on nutritional health and agrifood sustainability, or long-run food security. Community members would be free to choose between private and public options to meet their food needs.

One approach to removing obstacles to the Good Food Movement would be to provide local public alternatives to today's national and global private food systems.

Those eligible for current government food assistance programs could choose to participate in the public option by authorizing the government to transfer some portion of their food assistance funds to their local or regional good food system. Medicare Advantage programs involve a similar voluntary merging of public and private healthcare systems. In return, participants would receive the assurance of access to enough healthful, culturally appropriate, sustainably produced food to meet their basic nutritional needs. The public option probably should leave some portion of participants' food budgets for discretionary spending in the private sector.

Those who are ineligible or only eligible for limited government assistance could participate in the public option by contributing a portion of a typical local food budget. For example, if a typical local food budget is US$750 per month and the public option met 100% of food needs, those ineligible for government assistance would pay the full US$750 per month. Government payments for those eligible for partial benefits would be deducted from their US$750 monthly payment. There might be a further reduction for lower net incomes. If the public option only offset purchases for at-home consumption, the payment would be US$375 or one-half of the total. If some portion of the typical food budget were left for discretionary spending, the payments would be proportionately smaller. The local government would need to make up any budget deficits for the public option.

Food services of local schools, hospitals, assisted living facilities, and other institutions subject to government oversight could be required to participate in the public food system. The potential public health and environmental benefits would justify such requirements. Anyone eating in these facilities who objects to this requirement could be provided a voucher to spend in the private food system. Funds allocated to the public option from government food assistance programs and local institutions would provide a dependable economic foundation for local farms and food enterprises

that supply both the private and public systems.

The role of government should be limited to authorization, technical support, and verification that local and regional food systems are fulfilling their intended public purpose. Food-sovereign communities would be authorized to develop, monitor, and enforce their own food safety and nutrition standards, which would exceed those of state and federal governments. Government regulations of the public food system would be limited to periodic checks of food quality and inspection of facilities. Communities would also develop and enforce their own environmental standards to ensure ecological integrity. Continuous monitoring of air, water, and soil quality would replace government regulations of production practices. The role of government in environmental protection would be limited to periodic checks of monitoring equipment and records. Government research and education would be redirected to support the development and employment of site-specific, scale-appropriate technologies to improve the overall performance of community and bioregional food production, processing, and distribution systems.

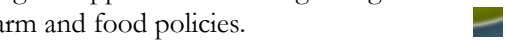
As with public schools, state and federal governments would need to allocate additional funds to offset any shortfall between the costs of operating the public food system and revenues collected from local participants. The allocation of government funding would be comparable to the way local property taxes are used to support public schools. Those who own property pay taxes to support public education in proportion to the value of their property. Those with more property pay more, those with less property pay less, and those without property pay nothing. This is similar to how the government funds public alternatives for healthcare, transportation, legal aid, and other essential services.

Publicly supported alternative local and regional food systems could be organized initially with a relatively small number of committed participants, particularly if local institutions are required to participate. As I suggested in a previous column proposing "food-based communities," the good food alternative might be economically feasible with 200 to 500 participating households, supporting 4 to 10 farm families (Ikerd, 2025). Systems of this size would also contribute to the economic viability of farm stops, food hubs, or other intermediaries that participate in the public systems. Local food systems would need to scale up to regional systems to increase their variety in food choices and increase efficiencies in processing and distribution. The organizational structure for the public alternative could be vertical cooperatives (Ikerd, 2012), community food utilities (Ikerd, 2016a), or some other democratic form of organization.

The necessary changes in food policy, locally and nationally, will depend on an understanding of the purely public, non-economic benefits of good foods.

A long-term government commitment would be essential in allowing farmers and provisioners time to adjust their production systems, and consumers to adjust their food selection, preparation, and eating habits. An emphasis on locally grown, raw and minimally processed foods would be essential for economic feasibility and nutritional healthfulness. This would likely require significant changes in the production and eating patterns of participating farmers and consumers. The success of the Good Food Movement ultimately depends on people recognizing the necessity of fundamental changes in the culture of food production and consumption.

As local and regional public food systems grow and connect to form good food networks, they will become more economically efficient and competitive with industrial food systems. However, without government programs that recognize and reward the non-market and non-economic benefits of good food, it will be difficult, if not impossible, for good food to compete with cheap food. The necessary changes in food policy, locally and nationally, will depend on an understanding of the purely public, non-economic benefits of good foods. People, as taxpayers and consumers, must be willing to support radical changes in government farm and food policies.



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Journal of Agriculture, Food Systems, and Community Development
ISSN: 2152-0801 online
https://foodsystemsjournal.org

VIEWPOINT

Measuring change without seeing the system: A call for epistemic humility in intervention evaluation

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Submitted January 13, 2026 / Accepted January 21, 2026 / Published online March 9, 2026

Citation: Jouzi, Z. (2026). Measuring change without seeing the system: A call for epistemic humility in intervention evaluation [Viewpoint]. *Journal of Agriculture, Food Systems, and Community Development*, *15*(2), 17–18. https://doi.org/10.5304/jafscd.2026.152.028

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In behavioral and applied food system research, intervention studies aimed at improving practices such as healthy eating are often evaluated as if the systems in which they operate are stable and closed. Success is usually measured through specific behavioral outcomes, based on the assumption that observed changes can be attributed primarily to the intervention itself. However, eating behaviors do not occur in isolation. They are shaped by income, housing conditions, time constraints, cultural norms, food environments, and policy contexts that extend far beyond any single program. Intervention design already includes assumptions about how the system works, and evaluation frameworks follow those assumptions. Therefore, what evaluation can observe, measure, and interpret is limited before the evaluation even begins.

This problem resonates with recent discussions in food systems scholarship about how a narrow focus on methodological rigor shapes what can be known in complex systems, including JAFSCD's winter 2025 introduction to a special section of articles on triple rigor (Budowle & Porter, 2025). The introduction highlights the limits of epistemological rigor alone and argues for making space for uncertainty as a condition for more humble and generative knowledge production in complex food systems. This commentary is informed by engagement with and review of intervention research in food systems, nutrition, and community development settings.

These epistemological limits become visible in evaluation practice. The assumptions embedded in intervention design influence not only what is measured, but also how results are interpreted. Measuring behavioral outcomes such as food consumption is not the problem in itself. The problem arises when these outcomes are treated as sufficient evidence of intervention effectiveness, without

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Conflict of Interest Disclosure
The author declares no conflict of interest.

accounting for how system level forces shape, sustain, or constrain those changes. Evaluation timelines and indicators often prioritize outcomes that fit program goals and funding expectations, while effects that appear slowly, differ across groups, or fall outside the immediate scope of the intervention are excluded. At multiple points in the evaluation process, results become biased toward showing success, not because of intentional misconduct, but because design and reporting choices favor internal coherence over interaction with broader social and economic conditions. Outcomes that do not align with expectations are often described as implementation problems or contextual noise, rather than as information about how the system responds to intervention.

To be clear, evaluation cannot and should not be expected to capture every dimension of a complex social system. Some degree of simplification is necessary to make analysis possible and to support meaningful interpretation of results. The concern raised here is not about the existence of boundaries, but about how rarely those boundaries are made explicit or examined. When the openness of social systems is treated as a methodological inconvenience rather than a defining feature of eating behavior, rigor becomes associated with control within artificial limits. This may strengthen internal validity, but it can weaken explanatory power. Precision in measurement is then mistaken for understanding of how and why change occurs.

This limitation becomes visible in common evaluation scenarios. For example, the study of an intervention may report increased consumption of fruits and vegetables during the program period. Evaluation records this as success. However, the analysis may not examine whether the change depended on temporary food subsidies, shifts in household stress, changes in work schedules, or reductions in other food expenditures. The measured outcome is real, but the conditions that produced and supported it remain unclear. Without attention to these conditions, it is difficult to know whether the intervention itself was effective, for whom it worked, or whether similar results would occur under different circumstances.

Some of the concerns raised here are already being discussed in fields such as systems-informed evaluation, realist evaluation, and implementation research. This commentary does not dismiss those efforts. Rather, it suggests that closed system assumptions remain common in practice, particularly in behavioral food system interventions where evaluation is closely tied to predefined program goals. Intervention design defines the system boundary, evaluation operates within that boundary, and institutional incentives often reward clear and positive findings. These levels are related but distinct, and each contributes to shaping what evaluation can see.

Taking a step back from individual outcomes helps clarify what is at stake. If evaluation only asks, "Did consumption change?", learning often stops there. The intervention is labeled effective or ineffective, and attention shifts to replication or scale. When evaluation instead asks, "Under what system conditions did consumption change, and for whom?", the focus moves from confirmation to understanding. This shift does not require abandoning behavioral interventions or evaluation as a practice. It requires greater humility about what evaluation findings can claim, given the assumptions built into intervention design.

Viewing food systems as open and adaptive does not weaken evidence. It reframes evidence as partial, context-dependent, and provisional. Without this reframing, evaluation risks confirming what intervention design has already assumed, rather than contributing to meaningful learning. Making space for uncertainty, uneven effects, and structural influences is not a failure of rigor. It is a necessary condition for producing more honest knowledge about how behavior change unfolds within real-world food systems.

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Journal of Agriculture, Food Systems, and Community Development
ISSN: 2152-0801 online
https://foodsystemsjournal.org

COMMENTARY

Food and nutrition security support groups: A safety net strategy for sustaining gains from a livelihood program in Uganda

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Submitted September 26, 2025 / Accepted December 15, 2025 / Published online March 3, 2026

Citation: Mbeiza, M., Nambafu, C., Banige, D., Ikendi, S., Masinde, D., Burras, L., Nadiope, G., & Owusu, F. (2026). Food and nutrition security support groups: A safety net strategy for sustaining gains from a livelihood program in Uganda [Commentary]. *Journal of Agriculture, Food Systems, and Community Development*, *15*(2), 19–28. https://doi.org/10.5304/jafscd.2026.152.029

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Introduction

In 2015, world leaders set the target to achieve zero hunger by 2030 through the launch and operationalization of the Sustainable Development Goals (United Nations, 2015). However, progress reports show that the world is still off track, with projections indicating persistent hunger and malnutrition (Food and Agriculture Organization [FAO] et al.,

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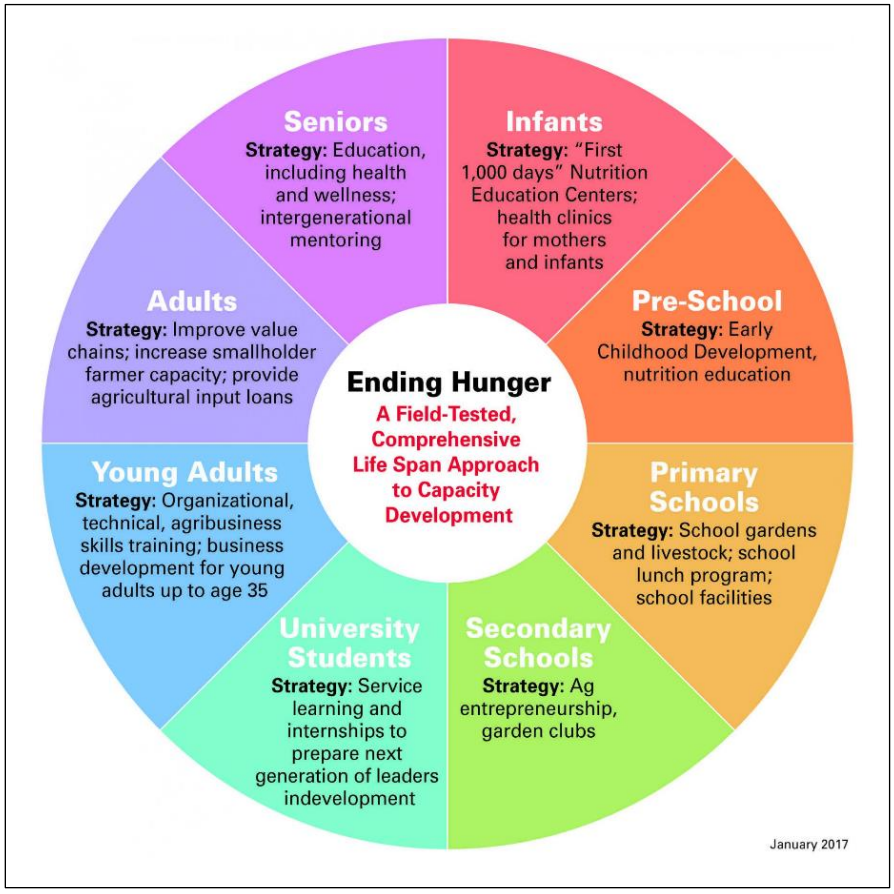
2024; 2025). These reports are synonymous with the global hunger index, which has consistently marked Uganda as *serious* in hunger severity (Scherer et al., 2025). Moreover, the 2024 national census also showed that 46% of Ugandans were experiencing food insecurity (Uganda Bureau of Statistics, 2024), and trend studies and models indicated increasing levels of food and nutrition insecurity in the country (Akumu et al., 2023; Maniragaba et al., 2023; Ogenrwoth et al., 2022).

The government of Uganda has directly invested in interventions to improve food and nutrition security (FAO, 2024, p. 180; Office of the President, 2025) and through public-private partnerships (Office of the Prime Minister, 2020) to ensure consistent food production to nourish the population and sustain the gains. These partnerships are consistent with the sustainable livelihood programs of our study between Uganda and the U.S. (Butler & Acker, 2015; Ikendi & Retallick, 2025; Ikendi, Mwenyi & Retallick, 2025; Thurow, 2024).

The Iowa State University Sustainable Livelihood Program in Uganda

In this commentary, we describe a U.S.-based sustainable livelihood program as a related public-private partnership between the Center for Sustainable Livelihoods (CSRL), based at Iowa State University (ISU), the ISU Uganda Program (ISU-UP), and Makerere University, located in Kampala, Uganda, that implements programs geared toward ending hunger in rural Uganda (Butler & Acker, 2015; Ikendi & Retallick, 2025; Ikendi, Mwenyi & Retallick, 2025; Thurow, 2024). The CSRL programs have focused on human capacity development (Figure 1) to foster food production and food access (Ikendi et al., 2023a; Ikendi, Owusu, Masinde, Bain, & Oberhauser, 2025) through research, teaching, and extension in soil improvements, crop production, agroforestry and orchard management, postharvest technologies, livestock management, nutrition and feeding, school gardens, income innovations, and youth entrepreneurship programs (Ikendi, Mwenyi & Retallick, 2025).

Figure 1. The CSRL/ISU-UP Human Capacity Development Model



The CSRL programs also emphasize nutrition security (Ikendi et al., 2023b; Masinde, McMillan et al., 2015; Masinde, Ikendi et al., 2025), through several livelihood education programs in water and public health, nutrition and infant feeding, and complementary services such as nutrient-dense therapeutic porridge through the nutrition education centers and school feeding programs (Ikendi, Mwenyi & Retallick, 2025).

Despite those livelihood

program efforts, food insecurity (Ikendi et al., 2023a; Sseguya et al., 2018), low dietary diversity and caloric intake (Ikendi, Owusu, Masinde, Bain, & Oberhauser, 2025) in communities, and nutrition insecurity in schools (Byaruhanga et al., 2017) and communities (Masinde, Ikendi et al., 2025) persist, but to a lower extent among program participants compared to non-program participants. Through programmatic restructuring, the food and nutrition security support groups were initiated in 2019 as safety nets to sustain the livelihood gains and foster further diversification of household livelihood strategies to support related programs such as mothers' craft programs operationalized in 2016 (Ikendi, Mwenyi & Retallick, 2025; Martin, 2018).

The Food and Nutrition Security Support Groups (FNSSGs)

The FNSSGs are groups of mainly women (men are welcome to join) of any age who come together to learn about and discuss issues of food and nutrition security that impact their households. The goal of FNSSGs is to improve food and nutrition security among households, especially nutrition education center (NEC) graduates (at-risk-for-malnutrition rehabilitated clients [Ikendi et al., 2023b; Masinde, Ikendi et al., 2025; Masinde, McMillan et al., 2015]), through the provision of technical support to help them initiate sustainable food production and income-generating activities. The identification, recruitment, training, and supervision of support group members are done by community-based FNSSGs Coordinators with additional support from other Extension and Outreach Assistants of the ISU-UP in Kamuli district, Uganda.

To foster effective operations, the FNSSGs form their committee, rules, policies, and procedures to follow under the guidance of the program Extension and Outreach Coordinator. This kind of organization and leadership supports the orderly operationalization of FNSSGs. Such procedures have been the backbone of food security group operations in the CSRL program under the earlier partnership with Volunteer Efforts for Development Concerns from 2004-2014 (Sseguya et al., 2015). Through the CSRL/ISU-UP partnership, from 2014 to present (Ikendi & Retallick, 2025), the conceptualization of the FNSSGs in 2019 under the management of a community-based coordinator was intentional. These coordinators have been trained by the program and are influential in their communities to cause behavioral changes towards food and nutrition practices, the essence of the theory of planned behavior in community development (Ajzen & Schmidt, 2020), as well as the technology transfer models (Rogers, 2003; Seevers & Graham, 2012).

Operationalization of the FNSSGs

The FNSSGs Coordinator supervises all support groups and their activities weekly. In the first three months, each group meets once a week to train and discuss progress; thereafter, the group meets twice a month. Each group chooses a chairperson to mobilize and oversee activities, and also serves as a mentor. Leaders use member-to-member support, a foundational extension model of the CSRL program (Masinde, Butler et al., 2015; Sseguya et al., 2015). The CSRL/ISU-UP uses a positive deviance approach to improve the food, nutrition, income, and health security in member households. This approach identifies members of a similar community struggling with similar issues, but can register more positive outcomes to overcome their challenges by deploying uncommon means. Therefore, their creativity places them at an advantage as influencers in the community (Baxter & Lawton, 2022; Natukunda et al., 2026).

Additionally, the FNSSGs involve male household heads as an important pillar in the support group activities. Involving fathers has had a positive impact on household food, nutrition, and welfare (Galvin et al., 2023; Ikendi, Owusu, Masinde, Bain, & Oberhauser, 2025; Ng et al., 2025; Orkaido et al., 2025). Group members meet in the homes of different members as they work with available materials to improve nutrition, hygiene/sanitation, income, livestock, and crop production. The CSRL/ISU-UP improves food security by distributing seeds such as soybean, amaranth, and millet for planting (Ikendi et al., 2024). Each group's clients specialize in one or two types of crops, and then barter trade (exchange of goods for goods) is promoted among members so that all members acquire the items they need, for instance, ingredi-

ents for the nutrient-dense therapeutic porridge (Ikendi et al., 2023b). In the groups, a percentage of the harvest and porridge flour made is sold, and a proportion of the sales revenue is put into the group's savings to support continuity of the project. Promoting the savings culture supports the development of financial independence among households and also reduces the burden of seeking financial support from financial institutions who may require substantial collateral security (Bagire & Namagembe, 2022).

Key FNSSGs Activities

Most of the FNSSGs' activities revolve around human capacity development to improve food security; fight illnesses, infections, and malnutrition; and improve household income and assets. Key activities include:

- **Technical support:** Extension visits at the group level; group leaders attend training at the NECs and train the group members
- **Sanitation and hygiene enforcement:** Encouraging and working together to support the construction and sustainable use of water resources and hygiene and sanitation facilities such as latrines, tip taps, plate stands, kitchens, rubbish pits, and bathrooms
- **Crop production:** Increasing household crop production as a way of improving food production and access to diversify diets and incomes through sales
- **Livestock production:** Improving livestock production for income and supporting the consumption of animal source proteins, and also benefiting from crop-livestock interaction, such as animal manure production and use
- **Table banking:** Enhancing income for group members through sales, promoting savings, and re-investing in income-generating activities
- **Nutrition and health counseling:** A priority target to keep families healthy at all times

Monitoring and Evaluation of Key FNSSGs Indicators

Activity monitoring is routinely conducted to assess members' progress and sustainability in key food and nutrition indicators. The indicators monitored include:

- Quantity of inputs and harvested produce
- Morbidity and mortality rates among families of group members
- Quantity of composite flour for therapeutic porridge produced in the homes of members
- Number of sanitation and hygiene facilities, such as latrines, and their cleanliness in the homes of members
- Amount of savings per member and per group
- Food security scores per household to assess levels of food security (Coates et al., 2007)
- Dietary diversity scores per household to assess levels of dietary diversity (Swindale & Bilinsky, 2006)
- Food consumption scores per household to assess levels of caloric intake (Swindale & Bilinsky, 2006)
- Anthropometric indices to assess the nutrition security of mothers for underweight and overweight, and children for underweight, stunting, and wasting (World Health Organization [WHO], 1995; WHO & Onis, 2007)

Achievements of the FNSSGs

In the first year of its launch in February 2019, the FNSSGs registered 14 groups with 300 clients (CSRL, 2020). After five years, the FNSSGs recorded a total of 60 groups with over 1000 members (CSRL, 2024). Capacity building through routine training has been the cornerstone of the FNSSGs in line with the CSRL/ISU-UP mission of using the power of education to uplift communities toward food and nutrition security (Ikendi & Retallick, 2025). Members are trained in several food security programs in soils, agronomy, postharvest, orchards, and agroforestry (Ikendi et al., 2024), based on research and experimental studies conducted in the communities in soil improvements (Akitwine et al., 2025; Wokibula et al., 2024; 2025), crop production (Kwikiiriza et al., 2026; Muyonga et al., 2010; Tusiime et al., 2019) and postharvest technologies (Asimo et al., 2024; Bbosa et al., 2017; Brumm et al., 2021; Mayanja et al., 2018; Tibagonzeka et al., 2018; Tumutegyereize et

al., 2022); and livestock management (Ikendi, Owusu, Masinde, Oberhauser, & Bain 2025; Masinde, McMillan et al., 2015), based on research and experimental studies conducted in the communities (Ampaire & Rothschild, 2010; Kugonza et al., 2014; Lubandi et al., 2019; Semahoro et al., 2018; Walugembe et al., 2014).

Similarly, FNSSGs receive routine training in nutrition security programs such as nutrition and infant feeding (Ikendi, Owusu, & Masinde, 2025), water and public health (Ikendi, Masinde, & Owusu, 2025), which are also based on studies in food safety (Nabwiire et al., 2023; Ssabika et al., 2024), public health (Buyinza et al., 2024; 2025), and other food stability programs such as income innovations (Ikendi, Mwenyi, & Retallick, 2025; Martin, 2018).

In addition to capacity building, the CSRL/ISU-UP supports the FNSSGs with quality seeds for multiplication, such as soybean, grain amaranths, sacks of orange-fleshed sweet potato vines, and provides fertilizers such as diammonium phosphate for group gardens (Ikendi et al., 2024). The groups have been able to grow other foods to diversify their diets, such as beans, sweet potatoes, cassava, vegetables, bananas, and maize, to ensure food security. Members established group activities like planting gardens together with different crops, making energy-saving stoves, plate stands, and compost pits. These activities have improved relationships in the community, a social capital strategy in food security programs (Craig et al., 2023; Campos & Campos, 2025; Sseguya et al., 2018; Wanyonyi et al., 2025).

To foster nutrition security, the groups have been able to grow nutritious porridge ingredients derived from crops such as millet, grain amaranths, and soybeans, both at the household and group level, to ensure they continue consuming porridge. The therapeutic porridge made from those ingredients is similar to what they were served during malnutrition rehabilitation (for mothers) at the NECs (Ikendi et al., 2023b; Masinde, McMillan et al., 2015). Members collect flour ingredients that they bulk, and the program supports them with silverfish to make a complete porridge flour composition.

The FNSSGs members also have savings and lending schemes, specifically table banking, a community-based financial system where members collect money from themselves, disburse it for their business, and are repaid with interest (Kathambi, 2023). The FNSSGs members collect money through table banking, from which they share weekly per member in terms of purchase of goats, pigs, chickens, and cows to increase income through production and sales, and improve nutrition through consumption of animal-source proteins. Also, from the amount saved, members share and buy household assets such as saucepans, plates, basins, and tarpaulins to improve the quality of dried grains. Some members buy goats and chickens for reproduction to multiply their stock. Table banking has had a positive multiplier in the economic and social empowerment of women (Akeju, 2024; Cherotich et al., 2022; Minja et al., 2023).

Facilitators of FNSSGs' Success

Many factors enabled the successful launch and operationalization of the FNSSGs, and these factors include:

- The groups operate in areas where NECs once operated; however were shifted to other communities where their demand was higher due to high malnutrition levels (Masinde, Ikendi et al., 2025).
- The target populations are mostly households that were once clients at the NECs, but graduated (malnutrition rehabilitated household [Ikendi et al., 2023b]). NEC clients who are members of other ISU-UP projects are also welcome to be part of the groups.
- The members should have some land to grow crops. The program recognizes the challenge of land shrinkage and supports production using land sparing techniques and micronutrient vegetable gardens, such as keyhole gardens and sack gardens (Ikendi et al., 2024). These techniques have been in use since the program's inception in 2004 (Masinde, Butler et al., 2015) and promoted in schools as part of the larger community food system ecology (Banige et al., 2026).

Conclusion

Food and nutrition security support groups (FNSSGs) are important safety net strategies of food and nutrition security interventions to manage relapses at the end of the intensive primary interventions. These groups can further be strengthened towards sustainability at the termination of the client–agent relationship to ensure communities move on their own after the interventions. In the diffusion of innovation (Rogers, 2003), this approach represents the last stage of adoption of innovations without the direct support of the agent, at the end of the intervention, and/or once the program funding sources dry up or cease. The FNSSGs demonstrate how community development can be fostered through public-private partnership, with communities taking ownership of their development efforts through a positive deviance approach (Baxter & Lawton, 2022; Natukunda et al., 2026), with support from development partners through teaching, research, and extension services. Similar studies, such as Tibagonzeka et al. (2025) also echo on a call for public-private collaborations in food and nutrition interventions in the regional district hit by high malnutrition like Buyende, in the neighborhood of Kamuli district. Also, the use of community-based trainers in the FNSSGs that members are familiar with in their training programs fosters adoption of innovations through influence, a key aspect in influencing behavioral change for community development (Ajzen & Schmidt, 2020).

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Journal of Agriculture, Food Systems, and Community Development
ISSN: 2152-0801 online
https://foodsystemsjournal.org

Challenges to production agriculture in Pottawatomie County, Kansas, USA

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Submitted December 13, 2024 / Revised February 26, May 23, 2025, August 21, November 4, 2025, and January 13, 2026 / Accepted January 14, 2026 / Published online March 24, 2026

Citation: Miller-Klugesherz, J. A. (2026). Challenges to production agriculture in Pottawatomie County, Kansas, USA. *Journal of Agriculture, Food Systems, and Community Development*, *15*(2), 29–52. https://doi.org/10.5304/jafscd.2026.152.027

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Abstract

Pottawatomie County, Kansas, features Flint Hills prairie, Oregon Trail history, lots of livestock, and commodity crop production. In 2023, it posted the highest population growth rate in Kansas, with high rates of community well-being and exurban and suburban sprawl. For farmers who have depended on maintaining and adding contiguous farmland to their operations, it has become increasingly difficult for them to compete with the prices that residential and business developers offer for farmland. Primary-occupation farmers also feel threatened by concentrated farm sales, redistricting, and an expanded county commission. I used Flora et al.'s (2016) community capital framework to assess rising tensions between and among stakeholders with interests in farming and nonfarm stakeholders with interests in development. Social capital—which includes social trust, networks, and shared values that people can cultivate and use to improve their livelihoods—was especially germane. To better understand the nature of social capital within and between the two stakeholder groups, I integrated the eco-social symbiotic spectrum (ranging from mutualism to competition) to perform a reflexive thematic analysis of 22 semi-structured interviews. Interviewees shared their experiences with, and perceptions of, the changing county dynamics, revealing how different symbiotic rela-

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Author Note and Conflict of Interest Disclosure

The author has lived in Pottawatomie County for two-thirds of his life, and the author's spouse is a member of the JAFSCD Editorial Board.

Funding Disclosure

This research was funded by the Agriculture and Food Research Initiative Competitive Grant No. 2021-68012-35923 from the U.S. Department of Agriculture, National Institute for Food and Agriculture. Any expressed opinions, findings, conclusions, or recommendations are those of the author and do not necessarily reflect the view of the U.S. Department of Agriculture.

tionships influenced social capital accrual. Interviewees' perceptions largely depended on their occupation. Primary-occupation farmers viewed their relationships with development stakeholders as parasitic, with the latter benefiting from the former, and their relationships with other farmers as competitive, undermining their social capital. Conversely, secondary-occupation farmers and community leaders expressed commensalism and mutualism with their networks. To ease tensions among stakeholder groups, the county and/or certain townships could implement property tax reforms —to reduce the degree to which farmland owners subsidize exurban and suburban expansion—and invest in more locally produced specialty crop infrastructure.

Keywords
community capitals framework, development, eco-social symbiosis, Pottawatomie County, Kansas, primary-occupation farmers, qualitative methods, social capital, well-being

Introduction

The expansion of exurban and suburban development into historically agricultural areas has emerged as a defining challenge for U.S. farmers and rural communities in the 21st century (Gazillo & Paterson, 2025; Meijerink & Roza, 2007; Satterthwaite et al., 2010). Nonfarmers and commercial and residential developers continually seek to purchase farmland (Halperin, 2023). Xie et al. (2023) projected that, by 2040, if "development continues at the same pace … this increase would collectively result in 18.2 million acres of agricultural land lost and fragmented" (p. 16).

Land use transitions can disrupt agricultural economies, erode farming communities' social cohesion, exacerbate rural-urban tensions, and shift local policy priorities away from land stewardship (Clark et al., 2014; Flora et al., 2016; Tickamyer, 2006). Commercial and residential development reshapes social, economic, and environmental conditions for farmers and nonfarmers alike (An et al., 2011; Inwood & Clark, 2013; Oberholtzer et al., 2010).

I investigated how these tensions manifested in one rapidly changing locale: Pottawatomie County (PT). In 2023, PT recorded the fastest population growth among all 105 Kansas counties (Self, 2023). PT's economic and social changes, driven in part by agricultural research and biosecurity investments, created the complex context for interactions between two groups: (1) stakeholders with interests in farming, and (2) nonfarm stakeholders with interests in development.

Given these tensions and dynamic social forces, I asked: *How have farming and development stakeholder groups perceived and experienced the emerging relationships between and among them*? To answer, I integrated the community capitals framework's (CCF) concept of social capital with the eco-social symbiosis spectrum to analyze the character of these stakeholder relationships.

By performing a reflexive thematic analysis of 22 semi-structured interviews, I studied how farmers' occupation type (primary versus secondary) influenced perceptions of stakeholder groups. This knowledge can give PT and other community leaders improved insights into their leadership situations and contexts, enabling them to more effectively balance the complex considerations for advancing mutualism and community well-being.

Theoretical Framework

The theoretical framework included the community capitals framework's social capital concept integrated with eco-social symbiosis.

Community Capitals Framework (CCF)

Communities can help steward Earth's working landscapes by harnessing various forms of 'capital,' or the resources people invest into communities to create more resources for the future (Emery & Flora, 2006). Flora et al.'s (2016) CCF incorporated the aims of a healthy ecosystem, vital community, and social well-being, and has been used to take stock of resources in counties experiencing economic and social changes. CCF was an appropriate theoretical framework for PT given that its residents experienced significant increases in housing stock and new business infrastructure, economic activity, population, and well-being, while being surrounded by agricultural farmland. According to the Pottawattamie County Economic Development

Corporation (PCEDC, 2022), 75% of PT's land was in farmland in 2022.

CCF is a functional framework with seven capitals (Table 1). I found it most suitable to analyze the dynamic relationships between agricultural production and commercial and residential development. CCF has been used in varied agricultural contexts, including sustainable agriculture (Butler & Flora, 2006; Flora, 1995, 2011; Warren et al., 2001), participatory agroecological and agri-environmental schemes (Arnott et al., 2021; Kansanga et al., 2020), community supported agriculture (Furness et al., 2022), and cooperative models (Hale & Carolan, 2018; Kustepeli et al., 2023; Mohammadi et al., 2022; Tuna & Karantininis, 2021).

Social Capital and Eco-Social Symbiosis

Although I initially considered all seven capitals when framing my research plan and questions, social capital (SC) emerged as the most applicable capital for analyzing the tensions among people in production agriculture and commercial and residential development. SC is at the heart of sustainable community development (Halstead et al., 2022; Mattessich, 2009), and includes social trust, networks, and shared values that people can cultivate and use to improve their livelihoods (Ostrom & Ahn, 2003; Putnam, 1995). SC networks can bond, bridge, or link (Cofré-Bravo et al., 2019), as explored in the following paragraphs.

Bonding SC involves closed, dense networks featuring strong ties within homogenous groups (Putnam, 2000). Relationships between farmers are considered bonding SC and tend to be based on shared experience, idea development, equipment sharing, and high-level knowledge exchange (Cofré-Bravo et al., 2019; Fisher, 2013). Bonding SC has been found to improve farmer well-being (Cavatassi et al., 2012) and shared trust exhibited an important influence on farmers' management decision-making (Fisher, 2013).

Bridging SC has been shown to bolster mutual relationships outside of homogenous groupings (Agnitsch et al., 2006; McDaniel et al., 2021). The formation of interconnected networks of related businesses and organizations ("clusters"), along with the expansion of agriculture-linked industries and increased employment and spending, can strengthen a community's SC (Adhikari et al., 2018). Because SC is a private and public good (Ibrahim et al., 2017), it serves as a conduit for communal activities (Future Farmers of America [FFA], county fairs, farmers markets) that bridge the divide between nonfarmers and farmers; for example, when nonfarmers reported positive direct relationships with farmers, their support for agriculture was stronger (Sharp & Smith, 2003). Of course, the strength of bridging SC depends on occupation type (Gómez-Limón et al., 2014).

Table 1. Definitions of Community Capitals

Capital	Definition
Natural	Resources such as air, land, water, minerals, oil, and the overall stability of ecosystems. Forms the basis for all other capitals.
Cultural	Language, symbols, mannerisms, attitudes, competencies, and orientations of local community members and groups.
Human	Knowledge, skills, health, and physical ability of community members.
Social	Social networks, associations, and the trust they generate among groups and individuals within the community.
Political	The ability to engage external entities in efforts to achieve goals and the ability and power to access and influence the distribution of resources.
Financial	Available financial savings, income, investments, and credit at the community-level that is instantly accessible.
Built	Buildings and infrastructure systems within a community.

Source: Flora et al., 2016, p. 13.

Among farmers, bridging SC helps them gain new kinds of information, build social cohesion, and engage in collective action (Fisher, 2013).

Linking SC refers to ties between individuals and groups in hierarchical relationships (Johnston & Mellor, 1961; Woolcock, 2001). The PT farm-land-development situation is embedded in and heavily influenced by the global agri-food system (Carolan, 2022), federal commodity subsidy programs (Bruckner, 2016), and crop insurance policies, all of which reward shape farming by rewarding productivity maximization (Yu et al., 2018).

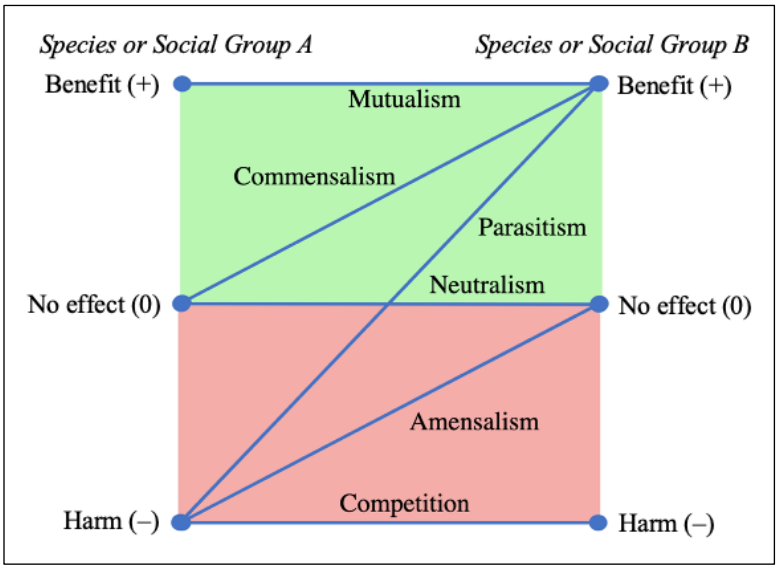
To best conceptualize the mechanisms that form SC in the context of natural agroecosystems, I incorporated the concept of 'eco-social symbiosis' to better understand the eco-social dynamics occurring between and within human networks and natural ecologies (Bao, 2023; Walton et al., 2024). Symbiosis originally referred to the long-term relationships between different species (Margulis & Lovelock, 1981), "is unavoidably cross-disciplinary" (Peacock, 2011, p. 224), and has been used to analyze relationships within species networks. Scholars have integrated SC frameworks with evolutionary theory to explore the complex inter- and intra-actions of matter, culture, and sociality (Hird, 2010). For instance, there have been at least 16 socio-ecological sustainability frameworks integrated with CCF (Panzarella et al., 2023), and scholars have called for more studies on socio-ecological ethics and policies (Elsen, 2018; Hirvilammi & Helne, 2014; Quilley, 2009). The six-pronged eco-social symbiosis spectrum ranges from mutualism to competition (Figure 1).

Background

Pottawatomie County (PT) is located northeastern Kansas and features native prairie and Flint Hills, products of the late Pleistocene. The Tuttle Creek reservoir forms its Western border while the Kansas River and Interstate 24 shape its southern border. Since early European settlement, alterations in the agrarian landscape have influenced transitions in the region's political economy (Middendorf et al., 2008). According to the KU Institute for Policy & Social Research (2023), in 2023, 26,382 people resided in PT, its largest recorded population. Compared to 2023 population trends for the other 104 Kansas counties, PT had the steepest annual increase at +17.3% (Self, 2023). Sanderson (2019) projected it to grow 59.2% by 2044. Most growth in PT occurred along the southern border. In 2011, 70.80% of PT residents lived in the four most populous townships—Blue, Wamego, Saint George, and Saint Mary's (U.S. Census Bureau, 2023)—but by 2023, 74.98% did (Table A1). When performing this study, I had lived in PT for two-thirds of my life and knew people practicing commodity and specialty agriculture.

For PT's rural residents and farmers,[1] the changes brought by population growth were simultaneously exciting and threatening. Growth brought new talents, ideas, economic opportunities, and ways of being, but "the influx of people and businesses [could] alter the style and pace of

Figure 1. Eco-social Symbiotic Relationship Spectrum



Source: Alexander, 2018; shared under CC-BY 4.0 license.

[1] I used "farmer/farming" terminology—rather than USDA's terminology of 'producer' or 'operator'—to convey the entangled identity and culture of the farm occupation and not limit farmers to the products they produce (Vayro et al., 2020).

life that originally made these areas appealing" (Brown & Swanson, 2003, p. 31). Growth in population accompanied growth in the annual earnings of nonfarmer residents, allowing them to offer higher bids for land.

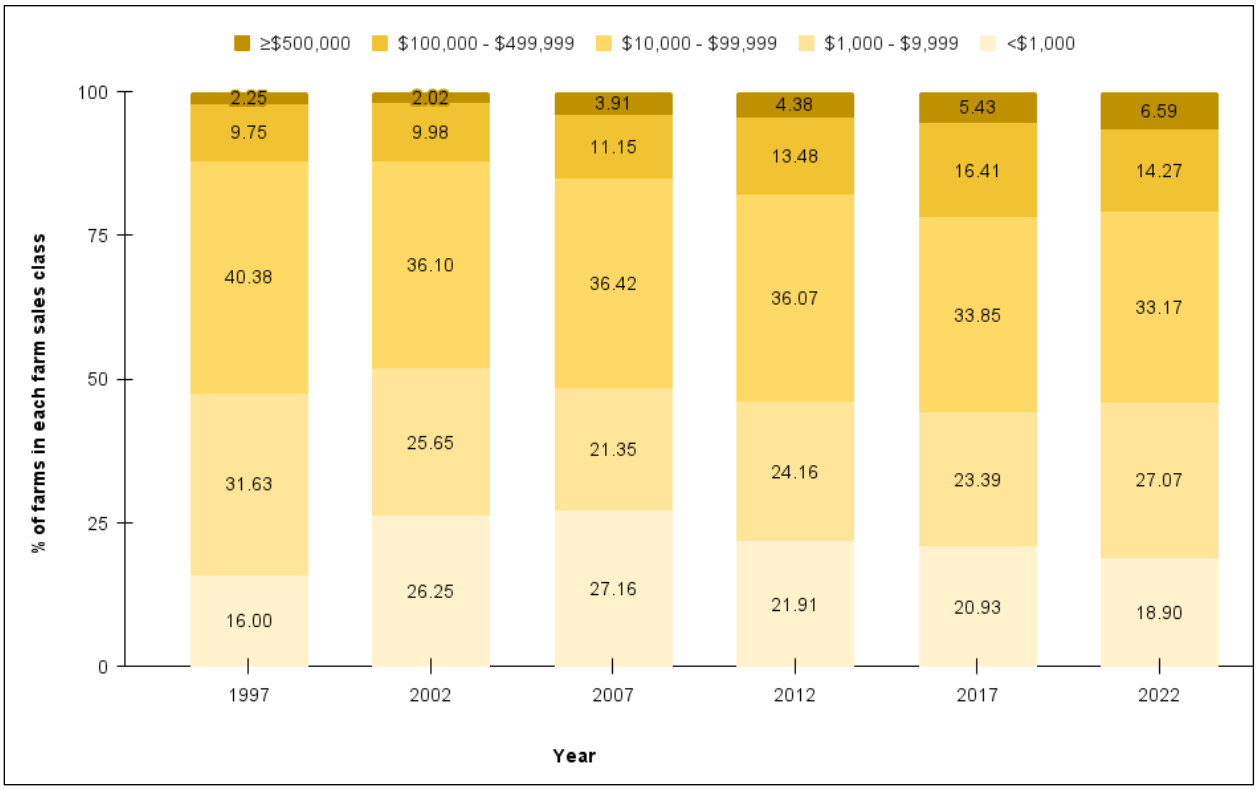
The PT Board of County Commissioners recognized and addressed these tensions in 2019 when they adopted Kendig Keast Collaborative's "Plan Pottawatomie County 2040," the county's first strategic plan since 1994. While its language was generally supportive of farmland preservation, the plan offered "potential revisions" to one of PT's zoning laws, the quarter-quarter rule. Moreover, the local newspaper asked 2024 county commission candidates, "What are your plans for preserving farm ground while also creating development opportunities and jobs throughout the county?" (Goodman, 2024).

I identified two potential reasons for the mounting tensions between stakeholder groups, which together provided an important background for understanding the situation in PT. First, larger socio-economic forces pressured primary-occupation farmers to expand their scale and intensify their production. Second, the Board of County Commissioners redistricted and added two commission seats in 2024, a change that effectively reduced farmers' representative power.

Gross Product Sales Concentration

While most PT residents experienced improved well-being, most PT farmers did not. From 1997 to 2022, the average inflation-adjusted sales per operation increased by $76,091.43.[2] However, much of that increase was in the largest farms. The rate of farms in the ≥$100,000 sales class range captured 20.86% of total market sales in 2022, up from 12.0% in 1997 (Figure 2). In terms of inflation-

Figure 2. Distribution of Pottawatomie County, Kansas, Farms by Sales Class, 1997–2022



Note: All currency is US$.
Data sources: USDA NASS, 1999, 2004, 2009, 2014, 2019, 2024.

[2] All currency in this article is in US$.

adjusted annual farm market sales as a percentage of total operations with sales, in 2022, the top market sales class of ≥$500,000 captured 75.61%, compared to 62.07% in 1997 (Figure 3). In other words, in 2022, just 54 of PT's 820 total producers (6.59%) captured more than three-quarters of all product sales.

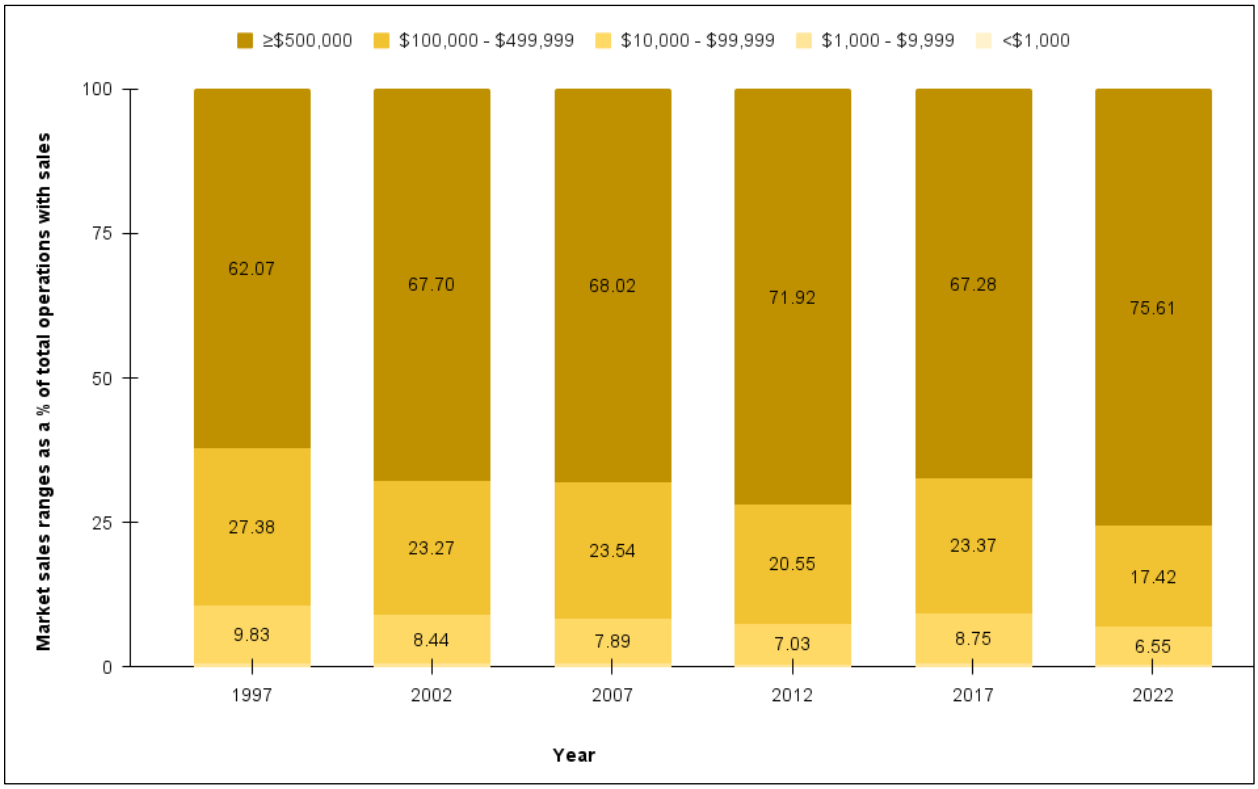
These trends were most likely driven by the larger socio-cultural conditions of both low per-unit returns and higher per-unit production costs. Low per-unit returns stemmed from overproduction and low prices, while higher per-unit production costs resulted from larger operators who received cheaper per-unit prices for many inputs (bulk orders), spread fixed equipment costs over larger acreages, and had higher labor efficiency (Cochrane, 1993; Duffy, 2009). These conditions may have pressured farmers to expand and/or intensify their operations (Crowley & Stainback, 2019; Farm Action, 2024).

Redistricting and County Commission Board Expansion

Kansas farmers have long been concerned about how non-farm development both threatens access to large enough tracts of contiguous farmland for efficient operations and increases the risks that those operations will cause conflicts with non-farming neighbors. Historically, state policies have ameliorated such concerns. Kansas was the first state to pass a 'right to farm' law in 1963, with the purpose "to provide agricultural activities conducted on farmland protection from nuisance lawsuits" (National Agricultural Law Center, 2022, p. 2; Kansas Protection of Farmland and Agricultural Activities, 1982/2024).

At the county level, the PT Board of County Commissioners can limit activities on the land and the sale of property for non-agricultural uses. PT has historically used the 'quarter-quarter rule' to preserve farmland from large residential developments by requiring new houses be sited in wooded

Figure 3. Distribution of Pottawatomie County, Kansas, Farm Sales Ranges by Operations with Sales (Inflation-Adjusted May 2024), 1997–2022



Data sources: USDA NASS, 1999, 2004, 2009, 2014, 2019, 2024.

areas or on less productive soils (though this rule could be revisited or amended). Articulated in the PT Office of Planning and Development's (2023) unified development plan, the quarter-quarter rule promotes "productive agricultural land" preservation and seeks to "lessen the conflict between urban development and agriculture."

While these longstanding policies have been advantageous for stakeholders with interests in farming, a 2022 resolution weakened their advantage. On December 12, 2022, PT's Board of County Commissioners (2022) passed Resolution No. 2022-70, which added two more county districts and commissioners to better reflect PT's changing population dynamics. The five-commission district map went into effect in November 2024. The 2024 redistricting and addition of two commission seats reduced the long-term representative power of farmers and farming stakeholders. It divided the county so that the six townships of Blue, St. George, Louisville, Wamego, Belvue, and St. Mary's—which collectively housed 80.1% of PT's total 2022 population—became represented by four district commissioners. The 17 remaining, northernmost townships—which made up 75% of the county's land mass but only 19.9% of the 2022 population—became solely represented by District 5, which contains a much larger share of farmland than the other four districts combined.

By adding two commissioners and realigning districts with township population trends, PT gave the average resident both more representation and more accurate representation. Because people rely on political connections with their commissioner to mobilize resources to augment their community's political capital (Flora, 2004), two more connections likely increased resource mobilization. At the same time, however, adding two new commissioners reduced the voting power of the District 5 commissioner from 1/3 to 1/5, a 40% decrease. Compared to pre-2024, redistricting gave greater representative power to people in exurban and suburban places than those living on the lion's share of PT farmland.

Given that representative shift, the strategic plan language suggesting quarter-quarter rule revisions, and the fact that 75% of PT's land was already in farmland (PCEDC, 2022), the county commission became less politically compelled to support policies favoring farmland preservation over development.

Methods

The methods used included participant interviews and a farmer survey, followed by a reflexive thematic analysis of those coded interviews.

Participant Interviews and Farmer Survey

Following institutional IRB procedures, I conducted semi-structured interviews with 22 PT participants from December 20, 2023, to May 19, 2024. My purpose was to understand how stakeholders with interests in farming and stakeholders with interests in development perceived and experienced the symbiotic relationships among them.

I used purposeful sampling (Campbell et al., 2020; Palinkas et al., 2015) and snowball sampling, whereby I asked participants to recommend others who might be willing to participate. Of the 22 interviewees, 14 were aware of my existence prior to initial contact. I sought potential participants who did not know who I was, but to little avail given timing issues or lack of interest in this project on their part. This made it difficult to gain perspectives outside of this networked sample and resulted in "inconvenience sampling" (Duneier, 2011, p. 9), which created the potential for bias, but also revealed social network patterns among participants (Noy, 2008).

My interviewees consisted of four nonfarmers and 18 farmers, 10 of whom also held leadership positions in agricultural and/or community organizations. Interviewees worked for a USDA conservation service office, county soil health agency, coop board, bank, feedlot, ag-tech company, agri-input company, and/or were members of the Farm Bureau, the National Farmers Union, churches, FFA, school boards, ad hoc community committees, and so forth.

A farmer's management practices can be influenced by the morals and mores of the groups to which they belong, including in Facebook groups, in coffee shops, on church committees, or at sporting events. The SC interview guide, adapted from Arnott et al. (2021), included the following ques-

tions: Which groups do you belong to? How often do you engage in them? With which groups are you most likely to discuss best farm management types and which groups do you learn from the most? With which groups do you most regularly share knowledge and resources? How do you perceive increased development in the county? How does it affect your operation and livelihood? How would you describe your relationships with other, similar farmers; do they tend to be more cooperative or competitive?

Of those 18 farmers, 16 responded to a short survey asking for basic information on their farm typology and characteristics. Among those, the average farm size was 1,182.75 acres (of which 435.4 were owned and 749.4 rented), which was 689.72 acres larger than PT's 2022 average farm size of 493.03 acres. Because I did not inquire about gross sales, I considered 'smaller' farms to be ≤493 acres and 'larger' farms to be >493 acres. On average, interviews lasted nearly two hours, and I talked 26% of the time versus 74% for interviewees, a 3:1 ratio. Participants were all non-Hispanic white and 72.3% male, with an average age of 55 years old and a range of 26 to 71.

Eight of those 16 farmers agreed that they would "be able to make it financially without farming," a secondary-occupation proxy. Countywide, the percent of primary-occupation farmers linearly declined (linear $r^2 = 0.462$) since 1997 (Figure 4), reaching 39.14% in 2022.

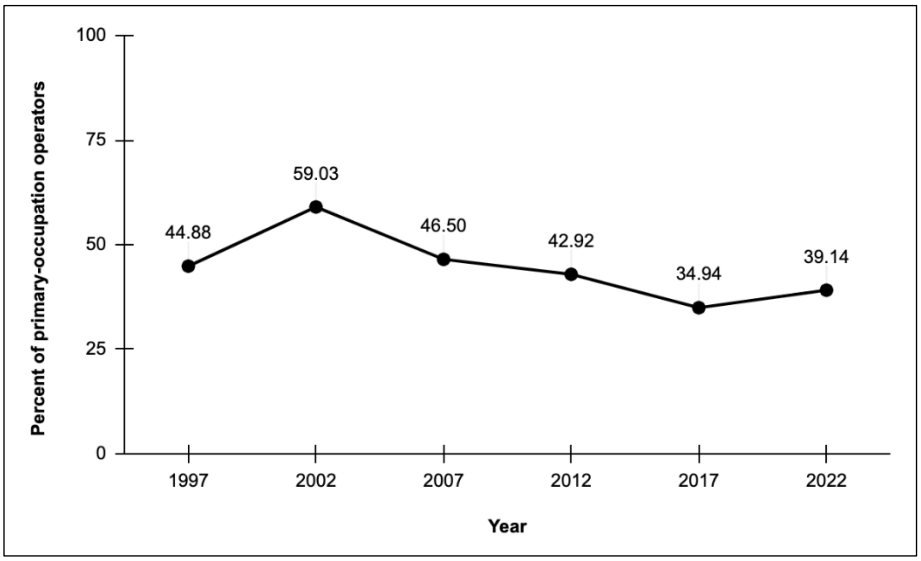
The average farm size of the eight interviewed primary-occupation farmers was 1,526 acres (29.02% larger than the interviewed sample average and 209.52% larger than the county average), illustrating the extent to which primary-occupation farmers were reliant on large acreages to make a living. This was intuitive. Principal operators self-report whether farming is their primary occupation (U.S. Department of Agriculture, Economic Research Service [USDA ERS], 2025), and if it is, then they are typically more dependent upon farm income—derived from larger acreages—for their livelihood than secondary-occupation farmers (Daloğlu et al., 2014).

Reflexive Thematic Analysis

I used My Voice Recorder to record, Otter.ai to transcribe, and Atlas.ti to store and code transcripts. To ensure that respondents remained anonymous, I assigned pseudonyms. I thematically analyzed qualitative portions of the interviews by following Braun and Clarke's (2006) six steps of reflexive thematic analysis: become familiar with the data, generate initial codes, search for emergent themes, review themes, define them, and name them.

Because coding was performed at the paragraph level, most paragraphs included more than one code. So, to get a better idea of how much aggregated time was spent discussing topics central to each capital, I meta-coded each paragraph. Meta codes provided a more holistic understanding of which capitals were most emphasized during over-

Figure 4. Percent of Pottawatomie County, Kansas, Primary-Occupation Operators, 1997–2022



Data sources: USDA NASS, 1999, 2004, 2009, 2014, 2019, 2024.

all conversations. I gave a paragraph one meta code if more than 50% of the paragraph's codes belonged to the same capital, or if there were two or more codes belonging to the same capital.

Findings

I analyzed interviewees' eco-social symbiotic experiences, followed by how those experiences shaped their social capital perceptions of the stakeholder groups.

Symbiotic Relationships Between Farming and Development

In its reports, the PCEDC has emphasized agriculture's myriad economic benefits (PCEDC 2022, 2023b) and couched development as a 'win-win' for all residents (see Giridharadas, 2019). That there were 150 more total producers in 2022 than in 2017 might serve as evidence for the mutualistic argument that the county has equally supported both stakeholder groups. But consider, as farmer and community leader Camden did, the scale at which those emerging producers operated:

> The increase in new farmers includes a lot of the more 'urban type' of farmers who may have a farm service agency account, but they might have a two-acre property, and they're going to install a high tunnel and do cut flowers or vegetables for the farmer's market. If anything, I'd say that farming operations are consolidating, they're clumping.

Under the USDA system, an operation with just over one-third of an acre of vegetables or five horses or ponies qualifies as a "point farm" worth at least $1,000 (O'Donoghue et al., 2009). Even though the number of PT producers increased, the total cropland acres has linearly declined since 1997 (Figure 5).

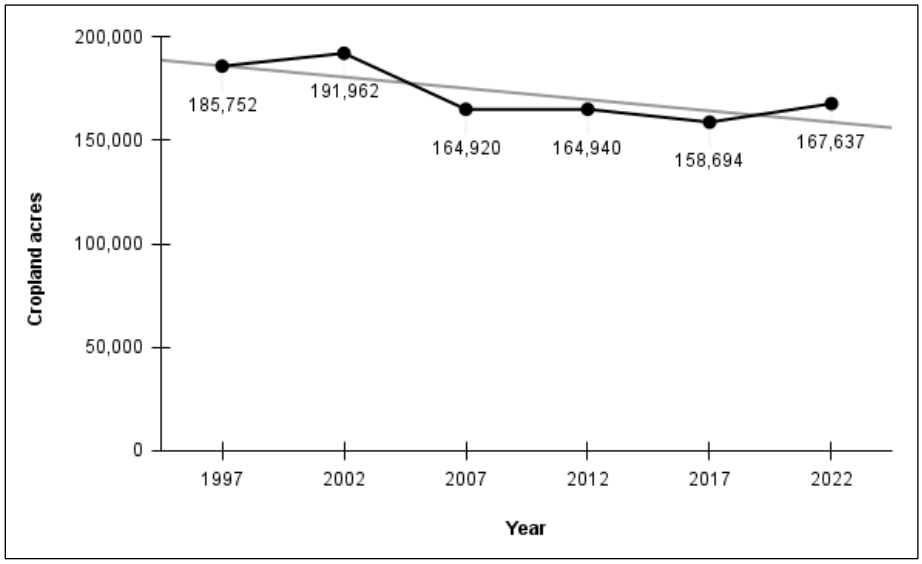
Primary-occupation farmers with larger-than-average operations stressed the necessity of consistently expanding their acreage to survive. Pete, a primary-occupation farmer with an operation much larger than the PT average, stated:

> There are no small farmers anymore, there's just no way for them to exist. … You got to constantly expand. They've told us that at K-State for the last 20 years, "If you don't double in size every five years, you're not going to be here much longer."

Pete elaborated that farmers with larger operations have the necessary capital to compete with private land sales, mostly from wealthier nonfarming families wanting to live a rural lifestyle:

> People are moving out of the city, coming here and buying the land. … We have more people around here, though they're not buying a huge amount of lots and then building a whole bunch of houses out here yet. But we're going to run out of land out here, and they're just gonna keep finding more land. Especially for the small-town farmer, it's hard to say 'no' with

Figure 5. Total Cropland Acres in Pottawatomie County, Kansas, 1997–2022



Data sources: USDA NASS, 1999, 2004, 2009, 2014, 2019, 2024.

> that amount of money on the line, especially now that all these small-time farmers are usually older farmers. If they have no one else in their who family wants a farm, why keep doing it? It's a lot of work, and when you're getting up there in age, you sometimes don't want to have to deal with farming.

There are several reasons why a farmer with a smaller operation might sell parcels to a nonfarmer, including retirement. Retiring farmers typically value family succession first, turning to leasing or selling as secondary options (Grubbström & Eriksson, 2018). The annual payments for mortgages on farmland may well exceed the returns, especially when land prices are high and returns on farming are low. Having larger operations allows the owner's farm debt payments to be distributed over larger acreages in production, especially if they own much of the land without debt. Mostly due to the widespread financialization of farmland (Gunnoe, 2014), owners of larger operations are better suited to take on more land—for example, Weber & Key (2014) found that farmers who incurred larger wealth gains from land appreciation bought more land than they would have otherwise compared to farmers with smaller gains.

Primary-occupation farmers were skeptical that commercial and residential development was the rising tide to lift all boats. Zach, a primary-occupation farmer whose operation was larger than the average county farm size in 2022, described a parasitic relationship:

> Agriculture can't compete with residential or commercial development, especially in the fastest growing county in the state. That's right in our back door. That's how it is, but probably not how it should be. Where the Scorpion project is going in, man, that was a prime 80-acre field. Maybe I wasn't on any kind of a list to rent or buy it in the future, but I could have been, so that affects me. Residential development can pay roughly three to four times the amount per acre that I can, so I'm basically doing whatever I can with politics to try to prevent more of it and just holding on to what I have. … The people who are doing the agriculture are not getting compensated enough for what they do, relative to the people who are reaping the benefits. And therefore, we're not competitive in the land market. And so, it's the demise of agriculture. If it was truly a free market, we would be adequately compensated for what we're doing. But the fact that agriculture is not competitive with other industries, that raises a red flag, doesn't it? At some point, it's going to, because people need to eat and if we don't have any land to raise food, then that at some point that will be an issue. … I don't see it turning around.

Nick, another primary-occupation farmer whose operation was larger than the county average, was concerned for the future of cropland farming given developmental pressures and the cultural transmission of values from those who come to own the land:

> Who cares what you were going to do with [the land], they'll pay more for it. I see that [sentiment] a lot out here, and it's getting closer to us. The money is the end all be all. But, if everybody built a house on five acres, what's left? That may be not in my lifetime, but I have grandkids, and it could be during their lifetimes. The land is getting passed on to people who don't have the same values, which is why we're having the housing development pressures. It's expensive to buy land around here because developers can obviously make it happen easier than I can. And it's tough because there's not enough responsibility or selflessness out there to question those younger people making the decisions. If you're in a subdivision deed and need five acres, why do you need to go spend thousands on a lawn mower so you can mow two hours once a week?

A central issue most interviewed, primary-occupation farmers had was not with population growth per se, but with nonfarmers buying more acres of former contiguous farmland than primary-occupation farmers deemed necessary. Earl, a primary-occupation farmer, called for sustainable development to reduce pressure on

the county's limited stretches of contiguous farmland:

> We'd be better served if the housing was more concentrated because you got to keep farms around, or eventually you're gonna get more competition between farmers. There's X amount of farm ground, and it's dwindling with the new houses and a little bit getting sold off here and there. It's not like the plumbing shop, where the town is growing and they're adding customers, so they're not necessarily stealing somebody else's customers. There's just a finite amount of land.

Farmers typically rely on stretches of contiguous farmland to yield enough to pay their operating notes. However, development can make farmland increasingly fragmented and unaffordable for farmers. When farmland parcels are sold to residential developers, farmers can come to operate smaller, oddly shaped plots of land; especially for farmers who own large equipment, this way of farming can be inefficient and challenging. Farming parcels of land that are long distances apart (even if all those parcels are rectangular and good-sized) can lead to inefficiencies and increased costs (Aslam & Fazal, 2025).

Secondary-occupation farmers mostly expressed relationships that ranged from commensalism to mutualism. Michael, a community leader and secondary-occupation farmer of a handful of acres, said there was a need to balance farming and sustainable development:

> It's a balancing act. I mean, it's progress. It's new money. It's great for the community, but I don't know about agriculture. … When farm ground comes available [to buy], it's mostly grassland north of St. Mary's where they're developing and building homes.

Nathan, a secondary-occupation organic farmer and community leader, said he hoped that several younger families interested in smaller-scale, subsistence, and specialty food production could pool their assets to make farmland purchases to then equally divide among them. In other words, the 'get big or get out' dictum need not be the default for successive generation's "future imaginaries" (Bazzani, 2023). Nathan imagined a more mutual model:

> Four cooperating families could do a good job farming these 400 acres, [and] they would probably have an opportunity to buy more than that. There are a lot of older people whose kids left for professional careers, and they don't need to sell the farm for money. They don't want to see it sold or have the uniqueness of that place obliterated, like bulldozing buildings and trees just for it to become a large tract of corn or soybeans. There are younger people who can look to develop that alternative land ownership model to the farmers who spent their lives assuming that they needed [their farms] to be large scale, and I think that was a mistake. They should be smaller scale and replicated.

Pete, a primary-occupation farmer with a larger-than-average operation, recalled the weekly in-person social events that used to take place in Westmoreland and Blaine in the 1940s and '50s:

> Social structure was so different back then. Saturday nights were the big thing—all these people would come in. Some would live as far as five or six miles out, but they got their horse and wagon and came into Blaine on Saturday night with some chickens, eggs, cream, or whatever they had to trade. And those vendors would be open on Saturday night in Blaine, and we had stores like the general store, the lumberyard, and two banks. There were several hundred people involved.

Due to decades of policies, social mores, and industrial capitalist penetration into agricultural ways of being (linking SC), farmers have felt pressured to expand and/or intensify commodity production to survive (Lobao & Meyer, 2001; Lobao & Stofferahn, 2008; Magdoff et al., 2000), and to compete with the higher land bids that developers typically offer.

Compounding farming and development

stakeholder tensions were PT's relatively low mill levy rates (tax rates applied to a property's assessed value to determine the amount of property tax owed), which attracted developers. In 2023, all Kansas counties had an average of $133,046 on each $1,000 valuation. In comparison, PT's average property levies of $96,885 were the second lowest, behind only Coffey County (Kansas Department of Revenue, 2021). Even so, in September 2024, PT lowered property taxes by 9.9% (Parker, 2024), meaning that PT residents saw a 2.856 mill levy decrease in the 2025 general fund (Wolfe, 2024).

Some farmers were frustrated by the extent to which they subsidized exurban and suburban development. For instance, Sam, a primary-occupation farmer, wanted to make non-agricultural-use properties pay more in property taxes:

> I tried to talk to our county commissioners about Pottawatomie adopting a different tax mill levy for lands not used for agriculture.

Sam's request was not unrealistic, given there was already a wide discrepancy between average urban (129.213) and rural (88.915) county-wide mill levy rates (Kansas Department of Revenue, 2021). Moreover, some PT townships had much lower-than-average rates than others; for example, certain 2021 tax codes for St. Mary's and Belvue Townships posted sub-80 rates.

Historically, farm, ranch, and forest landowners have paid far more for government services than they have received. American Farmland Trust's (AFT) 2002 meta-analysis of 83 'cost of community services' studies in 19 states found that those landowners paid more than they received in public services, with a median cost of community services, per dollar of revenue raised, of $0.36 per tax dollar versus $1.15 for residential (Freedgood et al., 2002). Moreover, AFT's 2005 analysis of 18,261 acres of farm, forest, and open land found that their landowners created an average surplus of $8.03 per acre for town services.

Property tax assessments can be great unifiers or dividers. For PT residents, especially those residing in the more remote rural townships, lower property taxes resulted in fewer county resources and their equitable deployment. For instance, when I spoke with Sam, he was frustrated that not enough county snowplows were deployed to the more remote rural pockets. He had just spent much of the week using his own tractor, diesel fuel, and time "plowing snow off county roads" and towing snowdrift-stuck vehicles so that his neighbors could access essential services from Blue Township. Indeed, the degree of social and political capital accrual can depend on the degree of township rurality (McCall et al., 2021). If rural PT township leaders increased their mill levy rates for nonfarm properties, they could perhaps influence county commissioners to do the same, disincentivizing nonfarmer purchases of previously contiguous farmland. If this change ever occurs, primary-occupation farmers may come to view their relationships with nonfarm stakeholders as less parasitic.

In sum, interviewed, primary-occupation farmers primarily couched agriculture versus development in competitive (lose-lose) and parasitic terms (win-lose), whereas secondary occupation producers and community leaders perceived relationships ranging from commensalism to mutualism. As I explored in the next subsection, interviewed primary-occupation farmers' competitive and/or parasitic perceptions of, and relationships with, nonfarmers and developers also typified their relationships with other primary-occupation farmers in their social networks.

Competitive Primary-Occupation Farmer Social Networks

Primary-occupation PT farmers reported (in interviews) deriving their success from 'winning' land from other farmers. Raymond, a primary-occupation farmer of an operation much larger than the county average, used the phrase "vulture culture" to describe his perception of, and nature of engagement in, competitive conventional agriculture social networks:

> I've seen where a farmer dies, and the family get tons of phone calls the next day before the funeral. I've never done it before, but they'll beat on the door to ask to farm the ground—it's the vulture culture. … I've never cut anybody's throat, but that's the culture of every-

> body around here. To be successful, to a certain degree you have to learn how to manipulate or cut someone else out, like a small producer. That's the problem with agriculture now, you do anything and everything to get ahead. Like say some [farmer] neighbor is going to retire; you have to make relations with that person before they retire, and even then, you still might only have a 50/50 chance to get their land. Even though you've helped that neighbor, a whole other third party might come in and get it. There are a lot of mind games. There is a lot more to farming than just 'go farm ground.'

Of course, local agriculture is affected by the larger social context of political polarization and media factions (Archer et al., 2008), and aggressiveness may influence financial success and social status.

When families go through farm transitions, they usually sell or lease, and each option has its own considerations, advantages, and disadvantages (Moore, 2025). Family farm ownership engenders socio-ecological resilience (Darnhofer et al., 2016), but in cases where there is not a clear family farm transition in place, competition heightens for owned or rented ground. A farmer operating more land would likely be able to offer or pay higher rent prices, at least in the short term, than would a farmer of a smaller operation. There were, of course, renter-lessee relationships in PT characterized by commensalism (0, +) or mutualism (+, +). However, the primary-occupation farmers of larger operations couched their relationships toward other primary-occupation farmers as competitive, meaning that there was negative harm for both social groups. However, there were times when their espoused relationships with other farmers were more parasitic (+, –) than competitive (–, –); i.e., they perceived owning or renting more land as benefitting them while doing financial and social harm to other farmers who also wanted the land but lost out.

Competitive, parasitic, and cooperative aspects to farming have always existed, but how did they change in rate and extent over time? The consensus among interviewees was that social symbiotic relationships surrounding land transition have emerged as increasingly competitive since the 1980s farm crisis (Meyer & Lobao, 2003). Development was a reason for increased competition, but certainly not the only reason. Earl farmed before the farm crisis, and experienced farmer competition grow fiercer since, especially when it came to renting farmland. He told a story of his time in seed sales to exemplify the competitive tensions that have persisted among those in his social networks:

> I don't think farming is cooperative anywhere [in the county]. Here's an example. When I was selling seed, the district rep came around, and we had a couple of dinners together. All my customers came in, we fed them and went through different plots. The rep down on the east side of Wamego had several big customers, but he took each one of his clients out separately, because none of them could get along because they had all poached ground from each other. It was so competitive, and people just did not like each other.

Vanessa, a secondary-occupation organic farmer with an operation size near the county average, did not want to be around the aggressive self-interest that she viewed as permeating the social engagements of conventional farmers. So, she pursued networks with other organic farmers:

> Conventional farmers are far too interested in, 'what's in it for me?' It's a narrow, short-term interest. … I think a lot of it is peer pressure—'what are your neighbors doing?' … We've done it differently than the big industrial approach to agriculture, the 'I'm going to buy out my neighbor and lease ground out from under you' mentality. I was going to do it differently, so I had to find people. Not in the county, because there's just a few organic farmers in the northern part, but I fled to find those people who were going to farm the way I wanted to farm.

Vanessa argued that farmers in alternative agriculture networks (such as organic or regenerative)

were keener to share knowledge and help neighbors due to their transformed worldview, a finding revealed elsewhere (Ohlson, 2014; Page & Witt, 2022; Snorek et al., 2024).

Adam, a primary-occupation farmer who rented an amount of farmland smaller than the county average, believed farming did not used to be so competitive, and wished neighboring farmers could return their more mutualistic roots:

> I felt like our area was a community 30 years ago. We went away from that type of culture, and it has become more selfish. It is sad to say, but I think everybody's in it for themselves. I don't like that. I feel like we can get kind of back to something like that culture, where it feels almost like a second family where if you ever need any help, don't be afraid to call. I saw that a lot growing up. If someone called you for help, you would say, 'yeah, I'll be right there.' And I want to get back to that.

Cameron, a conservationist and secondary-occupation farmer of just a few acres, also argued that farmers should not view their successes as competitively derived:

> Success is not a pie. Your success does not have to take away from mine or be deleterious toward me.

While Adam and Cameron espoused commensalism and emphasized the importance of cooperative farmer-to-farmer relationships, most primary-occupation farmers perceived success as a limited 'pie.' They stated or implied that they defined 'success' by their ability to acquire more affordable land or maximize yield per acre, a common way that conventional agriculture has measured success (Stone, 2022). For a few interviewees, success was not a 'pie' because they expanded their boundary of consideration beyond yield to encompass the larger goals of operation solvency (e.g., net income maximization) and community coherence.

Discussion and Conclusion

I analyzed how PT farmers, farm experts, and community leaders perceived and experienced eco-social symbiotic relationships between and among stakeholders with interests in farming and stakeholders with interests in development. This study was the first using eco-social symbiosis in tandem with social capital. By uniting Flora et al.'s (2016) CCF conceptualization of SC with the eco-social symbiosis spectrum concept, I showed how within-county forces helped to create the social conditions for rising tensions between these stakeholder groups. Due to larger, systemic socio-economic factors driving concentrated farm sales ('linking' SC), primary-occupation farmers felt pressured to expand or intensify production. Moreover, the board of county commissioners' 2024 decision to redistrict and add two commission seats shifted more representative power from farmers to nonfarmers.

Performing a thematic analysis of participant interviews ($N = 22$) allowed me to reveal the ways in which county development influenced how interviewed, primary-occupation farmers of larger operations perceived their relationships with development stakeholders as parasitic, and with other primary-occupation farmers as competitive, in turn undermining their bonding and bridging SC. Interviewed, primary-occupation farmers felt the pressure to intensify and/or expand production because they could not compete with the prices offered for land by commercial or residential developers and in-migrating millionaires "who [could] buy 80 acres and build a house" (Nick). The proportion of farmers whose primary occupation is farming may shrink as a result of pressures from population growth and development (that are unlikely to abate), and may also increase the scale of surviving farms owned by primary-occupation farmers. Conversely, interviewed, secondary-occupation farmers and community leaders espoused commensalism and mutualism with developers and other farmers.

For struggling commodity farmers wanting to transition to more alternative principles and practices requiring fewer acres, there are several 'how-to' guides (Butterfield et al., 2019; Masters, 2019; Perkins, 2019). PT has lacked sufficient infrastructure for processing, storing, and selling locally grown, specialty produce outside of the growing season. Recognizing this issue, the board of county

commissioners adopted a strategic plan in 2019 (Kendig Keast Collaborative, 2019) that included language calling for greater investment in aggregation spaces, cold refrigeration, local purchasing initiatives, and specialty markets (Ray & Schaffer, 2008).

Together, these efforts may help improve social capital stocks among stakeholders in agriculture and development and enhance the flourishing of all people who call Pottawatomie County home.

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Appendix. Supplementary Findings and Discussion

According to the Pottawatomie County Economic Development Corporation (PCEDC, 2023a), Pottawatomie County's (PT's) surrounding regional economy was more than 50% dependent on facilities and resources provided by federal government expenditures, especially Fort Riley and Kansas State University (KSU). Located at the Western edge of the Kansas-Missouri "animal health corridor" is the USDA's National Bio and Agro-Defense Facility (NBAF), the first USA facility with level-4 containment space to study zoonotic diseases affecting large livestock (USDA NBAF Office of Communications, 2023a, 2023b). Largely due to NBAF's presence, in April 2022, the City of Manhattan, State of Kansas, PT, KSU, and the Manhattan Area Chamber of Commerce passed an economic development package to fund construction of the $650 million Scorpion Biological Services facility in Blue Township, within the City of Manhattan's (2025) proposed East Manhattan Gateway Area (Figure A1). Verdict Media Limited (2022) projected that Scorpion would add 500 well-paying jobs to the area from 2022-2029.

In part thanks to PT's rapid population and economic growth, nearly every human well-being measure increased since 1997 (Table A1).[3] In 2023 Pottawatomie County ranked as the second healthiest of all 105 counties (CHR&R, 2023). Population increases have concentrated in the Blue (District 1) and Saint George (District 4) townships (Table A2).

Table A1. Human Well-being Variables, Percent Change (%Δ), 2010–2024

Variable	% Δ[a]	Years[b]	Linear r^2
Low birthweight[1]	-21.21	2010-2024	0.235
Poor or fair health[2]	13.16	2010-2024	0.437
Adult obesity[2]	32.97	2010-2024	0.572
Uninsured[3]	-30.58	2010-2024	0.346
Unemployed[4]	-24.38	2010-2024	0.257
Child poverty[5, 6]	-25.45	2010-2024	0.301
High school graduation, including equivalency[5]	-12.42	2015-2022	0.811
Some college (no degree) or associate's degree[5]	-2.96	2015-2022	0.578
Bachelor's degree or higher[5]	16.38	2015-2022	0.871
Graduate or professional degree[5]	24.56	2015-2022	0.798
Median household income (June 2024 inflation-adjusted)[5, 6]	9.48	2010-2024	0.590
Population[6]	22.12	2010-2023	0.695

[a] For variables 'low birthweight' through 'child poverty,' negative %Δ indicate improved well-being. Conversely, for variables 'HS graduation' through 'median household income,' negative %Δ indicate worsened well-being.
[b] Using the Community Health Rankings and Roadmaps datasets, I compiled all available data within these ranges. Using the coefficient of determination for the linear regressions (r^2) – a goodness-of-fit indicator – I assessed variance across ranges.
Data sources: [1] National Center for Health Statistics' National Vital Statistics System – Natality Files; [2] Center for Disease Control's Behavioral Risk Factor Surveillance System; [3] Small Area Health Insurance Estimates; [4] U.S. Department of Labor's Bureau of Labor Statistics; [5] U.S. Census Bureau's Small Area Income and Poverty Estimates; and [6] U.S. Census Bureau's American Community Survey Five-Year Estimates.

[3] These metrics did not show wealth distributions or any changes in the gaps between the poorest and wealthiest residents.

Table A2. Township Populations as a Percent of Pottawatomie County, Kansas's, Total Population,[a] 2010–2023

Township [b]	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Wamego [2]	24.39	24.61	24.45	24.39	24.25	24.16	24.13	24.01	23.88	23.81	22.37	22.55	22.35	22.19
Blue [1]	14.20	13.76	14.00	14.15	14.23	14.30	14.34	15.11	15.18	15.23	19.43	19.07	19.33	19.55
Saint George [4]	15.91	15.75	15.89	15.95	16.13	16.38	16.50	16.82	17.15	17.34	17.73	17.82	17.96	18.11
Saint Mary's [3]	16.92	16.68	16.74	16.69	16.59	16.51	16.33	16.09	15.93	15.78	15.12	15.38	15.26	15.13
Louisville [3]	3.74	3.93	3.82	3.84	3.52	3.74	4.63	4.49	4.86	5.27	3.96	3.69	4.04	3.89
Mill Creek [5]	4.71	5.26	4.99	4.71	5.31	4.88	5.00	5.49	5.04	4.45	3.78	3.75	3.43	3.56
Emmett [5]	1.99	2.66	2.28	2.27	1.62	1.16	1.33	1.39	1.61	1.63	1.78	3.41	3.14	2.99
Rock Creek [5]	3.45	2.74	2.76	2.96	2.78	2.75	2.50	2.26	2.12	2.71	2.73	2.16	2.18	2.27
Pottawatomie [5]	2.80	3.13	3.34	3.78	3.81	3.87	3.83	3.25	3.10	3.06	2.71	2.43	2.13	2.08
Grant [5]	1.25	1.25	1.34	1.26	1.21	1.40	1.47	1.09	1.04	0.96	0.93	0.98	1.40	1.65
Blue Valley [5]	1.60	1.91	1.74	1.78	1.53	1.62	1.50	1.51	1.38	1.59	1.50	1.58	1.36	1.69
Belvue [3]	1.71	1.44	1.56	1.49	1.54	1.82	1.96	2.35	2.70	1.99	1.55	0.99	1.16	0.95
Lone Tree [5]	1.01	1.83	1.48	1.34	1.55	1.46	0.96	0.81	0.81	0.83	0.90	0.71	1.08	1.13
Shannon [5]	1.26	1.10	1.53	1.19	1.37	1.12	1.08	0.89	0.85	0.97	1.01	1.20	1.00	1.13
Union [5]	1.04	0.80	0.98	0.82	0.86	0.94	0.66	0.55	0.76	0.98	0.94	1.38	0.93	0.98
Green [5]	0.86	0.44	0.48	0.64	0.60	0.53	0.79	0.67	0.76	0.81	0.84	0.65	0.93	0.66
Sherman [5]	0.55	0.75	0.46	0.68	0.65	0.68	0.60	0.69	0.36	0.29	0.50	0.63	0.71	0.77
Clear Creek [5]	0.65	0.43	0.49	0.44	0.76	0.89	0.73	0.84	1.02	0.64	0.59	0.45	0.47	0.20
Lincoln [5]	0.55	0.44	0.46	0.43	0.44	0.42	0.44	0.47	0.43	0.47	0.37	0.24	0.36	0.35
Saint Clere [5]	0.34	0.12	0.00	0.00	0.03	0.03	0.07	0.05	0.06	0.04	0.19	0.15	0.13	0.11
Center [5]	0.49	0.35	0.62	0.53	0.70	0.63	0.41	0.38	0.39	0.52	0.54	0.45	0.33	0.38
Vienna [5]	0.40	0.46	0.45	0.53	0.41	0.55	0.61	0.64	0.43	0.42	0.32	0.16	0.16	0.10
Spring Creek [5]	0.18	0.17	0.15	0.13	0.09	0.16	0.13	0.15	0.16	0.22	0.22	0.16	0.15	0.13

Data source: U.S. Census Bureau (2024).

[a] Cells shaded in green indicate the year with the largest % of the total PT population, whereas red shaded cells indicate the year with the smallest %.

[b] County commission Districts 1 through 5.

Blue Township leaders and residents (me included) have long discussed forming their own city but have yet to do so. They should accelerate their timeline, because within the decade, the City of Manhattan, Kansas (2025) will attempt to annex Blue Township, largely because its residents have received several city services but do not pay city taxes. The city of Manhattan established an East Manhattan gateway plan area that proposed their annexation of 13 square miles from Tuttle Creek Boulevard to Hopkins Creek Road (Figure A1). If the gateway becomes annexed, it would be a boon to the Manhattan economy and increase property values on new and existing housing and rental stocks. However, it could also threaten farmers currently operating within the plan area. The PT commission rezoned 70 acres just east of the gateway—from agricultural to intermediate-density residential—to pave the way for more subdivision development (Peoples, 2025). So, pressures will continue to mount on Blue Township leaders to incorporate.

Figure A1. East Manhattan, Kansas, Gateway Plan Area



Image source: City of Manhattan, Kansas (2025).

Journal of Agriculture, Food Systems, and Community Development
ISSN: 2152-0801 online
https://foodsystemsjournal.org

Cover crops, chemicals, and emissions in Pottawatomie County, Kansas, USA

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Submitted December 13, 2024 / Revised April 15, June 22, September 9, and October 7, 2025 / Accepted October 8, 2025 / Published online February 4, 2026

Citation: Miller-Klugesherz, J. A. (2026). Cover crops, chemicals, and emissions in Pottawatomie County, Kansas, USA. *Journal of Agriculture, Food Systems, and Community Development*, *15*(2), 53–79. https://doi.org/10.5304/jafscd.2026.152.002

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Abstract

Cover crops have numerous benefits, including enhanced erosion control, forage biomass, nitrogen fixation, nutrient recycling, weed suppression, water management, temperature moderation, and carbon sequestration. Still, the adoption of cover crops by farmers is significantly influenced by their individual goals and preferences, their specific agroecological contexts, and larger agro-industrial structures and systems. Farmers in Pottawatomie County, Kansas, planted cover crops on 8.2% of the county's cropland in 2022 (nearly twice the national average). This study sought to understand what these farmers were looking for in cover crops by specifically choosing to interview them. Utilizing information gleaned from interviews with 22 farmers and/or cover crop experts, I was able to thematically analyze the resulting data. Coding revealed that many interviewees were on the "chemical herbicide treadmill" for cover crop suppression and/or termination. I used this information as a theoretical framework to inform descriptive analyses of farm characteristics, crop types, farmland use, and emissions. After comparing trends and themes, I found that interviewees looked for cover crops to be affordable if not profitable, suitable for use as a supplement forage bio-

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Author Note

This article is based on a chapter in the author's doctoral dissertation (expected publication in May 2026; Miller-Klugesherz, in press).

Funding Disclosure

This research was funded by the Agriculture and Food Research Initiative Competitive Grant No. 2021-68012-35923 from the U.S. Department of Agriculture, National Institute for Food and Agriculture. Any expressed opinions, findings, conclusions, or recommendations are those of the author and do not necessarily reflect the view of the U.S. Department of Agriculture.

Conflict of Interest Disclosure

The author has lived in Pottawatomie County for two-thirds of his life, and the author's spouse is a JAFSCD Editorial Board member.

mass/nutrition for cattle, and ideally subsidized by cost-share programs (~US$50/acre). Weather and labor availability and labor cost were also key influences. When grazing or crimping cover crops was not an option for their suppression or termination, interviewees preferred using herbicides over minimum tillage. This preference was reflected in the 1997–2022 county-level trends of increased herbicide application rates and expenses, notable changes in the primary cropland type from hay(lage) to corn and soybeans, and accelerated leaching emissions. Finally, I discussed implications for adopting soil health principles that trended more organic than regenerative, and offered resources for cover crop education, outreach, and cost share.

Keywords
chemical herbicide treadmill, climate change, conservation agriculture, cover crop suppression and termination, herbicides, Pottawatomie County, Kansas, soil health principles

Introduction

Communities in the U.S. must adapt to the triple planetary crises of climate change, pollution, and biodiversity loss (Hellweg et al., 2023). Adaptation includes favoring policies that better align with United Nations sustainable development goals (Guterres, 2021; Ibrahim & Ahmed, 2022) and the Intergovernmental Panel on Climate Change's (IPCC, 2021) land degradation targets. In the U.S., the Biden Administration's Partnerships for Climate-Smart Commodities allocated US$3.1 billion to hundreds of agriculture organizations, corporations, universities, and nonprofits for "climate-smart" projects (Graddy, 2023; U.S. Department of Agriculture, Natural Resources Conservation Service [USDA NRCS], 2023). The intention of this funding was to "pass most of the money on to tens of thousands of farmers, ranchers, and forest owners" (Popkin, 2023, p. 1). Continuous government funding for these projects, however, is unreliable, and adoption of climate-smart projects is ultimately up to farmers and communities themselves and the demands of their places (Lloyd & Chalabi, 2021; van der Ploeg, 1994, 2022). To better understand how these practices are implemented on the ground, it was crucial to investigate how farmers in one community utilized, perceived, and valued one specific climate-smart agricultural practice: cover crops (CCs).

Although CCs are "no silver bullet" (Environmental Defense Fund [EDF], 2022, p. 28; Lamichhane & Alletto, 2022), there are several reasons to plant CCs before, after, or in companion with corn and soybeans (USDA NRCS, 2019a, 2019b). These include enhanced erosion control, soil organic matter, forage biomass, nitrogen fixation, nutrient recycling, weed suppression, water management, temperature moderation, and carbon sequestration (Green Cover, 2024; Kranz, n.d.; USDA NIFA SARE, 2024). Among other options, farmers can seed CCs with shorter season genetics into commodity crop systems, or no-till a cash crop into a living, green cover (Correira et al., 2023; Practical Farmers of Iowa [PFI], 2023a). In the past 15 years, CC implementation in the U.S. has surged (Plastina et al., 2024). This trend has been true in my lifelong community of Pottawatomie County, Kansas (PT), which features highly erodible, native Flint Hills prairie.

From 2012 to 2022, the number of PT cropland acres planted to a CC—excluding Conservation Reserve Program (CRP) acres—surged from 3,894 to 13,660 acres (1,576 to 5,528 ha), and, among farms with CCs, their average CC acreage nearly doubled, from 105 in 2017 to 201 in 2022 (USDA National Agricultural Statistics Service [NASS], 2019, p. 713; USDA NASS, 2024, p. 684).[1] In 2017, 4.3% of total PT cropland acres (excluding CRP) were planted to CCs; by 2022, 8.2% were, which exceeded the contiguous U.S. CC average of 4.7% in 2022 (Bowman & Morales, 2024). Therefore, in this study I explored the following three-pronged question: Why did such a rapid increase in CC adoption occur in PT, what were the primary individual and structural factors driving enhanced adoption, and what were PT farmers looking for in CCs?

[1] The NASS Agriculture Census's wording on the CC question means that a CC could be planted after a crop is harvested or be the only use of land during the census year (Zulauf et al., 2024).

The answers and findings made novel additions to the robust CC management and adoption literature for larger-than-average operations ($\bar{x}$ = 1,183 acres or 479 hectares) and offered implications on how the chemical herbicide treadmill influenced PT farmers' uses of and beliefs in CC suppression/termination.

Review of Extant Literature

Since antiquity, farmers in ancient China, Greece, and Rome have used CCs, otherwise known as "green manure" (Magdoff & Van Es, 2021). A proven ecological management practice (USDA NRCS, n.d.-c), CCs have several beneficial agri-ecological functions for the ecosphere's four spheres (Figure 1).

CCs can enhance soil cover, increase plant and animal biodiversity, and improve the presence of living roots, which altogether total more than half of the generally agreed-upon soil health principles (Brown, 2018; Groundswell Agriculture, 2019; USDA NRCS, n.d.-a). CCs have also been shown to decrease a soil's susceptibility to compaction, temperature, and erosion (Adetunji et al., 2020; Huang et al., 2025), while simultaneously increasing soil aggregate stability, nitrogen (*N*) concentration, and soil water content (Blanco-Canqui et al., 2011, 2012).

Despite the multiple benefits of CCs, the adoption rate of U.S. acreage for CCs has remained in the low single digits (Zhou et al., 2022), indicating that CCs can present more challenges than benefits for most farmers. CCs can be complex to manage and may require new knowledge and specialized equipment (Acharya et al., 2019; Koehler-Cole et al., 2023; Kreitzman et al., 2022). The advantages of CC benefits can take years to accrue. In the meantime, farmers can incur extra costs and reduced yields (Deines et al., 2023), which is one reason why farmers have called for greater CC economic incentives and more diverse crop and livestock markets (Bergtold et al., 2017; Roesch-McNally et al., 2018).

Understanding the holistic impact of CCs requires examining farmers' considerations and perceptions of CCs while also considering their personal and agronomic goals, as well as commodity and CC types (Basche et al., 2014; Mwangi et al., 2015; Van Eerd et al., 2023). Therefore, the purposes of this research were to (1) analyze PT farmers' treatment, management, and implementation of CCs, and (2) consider agroecological, climatological, and socio-cultural influences on PT farmers' CC adoption.

Figure 1. Cover Crop Benefits for the Ecosphere's Spheres

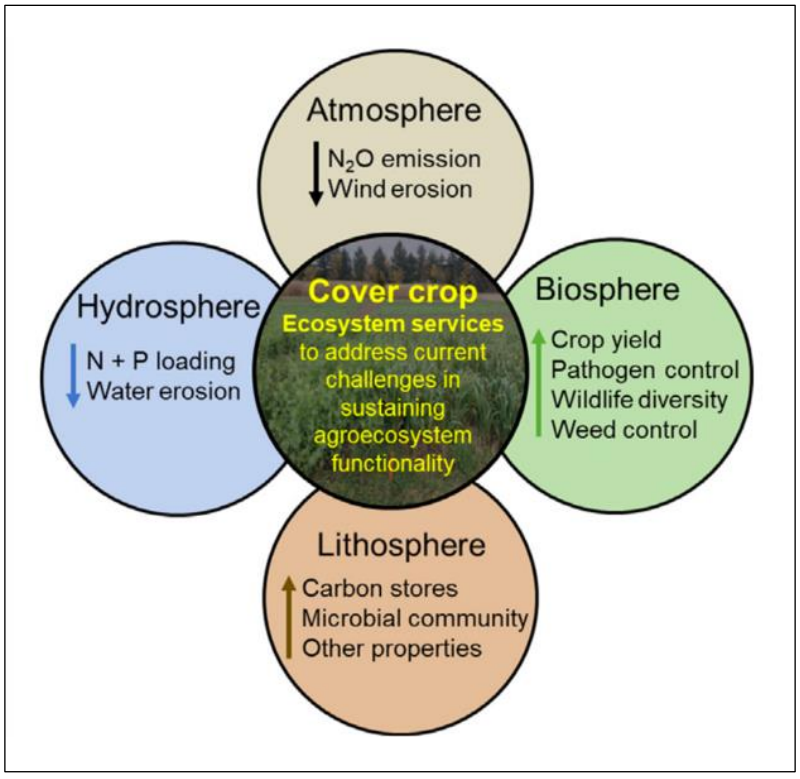


Image source: Van Eerd et al., 2023, p. 1; shared under CC-BY-4.0 license.

Methods

Methods proceeded in three steps. First, I thematically analyzed participant interview transcripts and a 23-item survey of their CC beliefs (Appendix, Table A1). Second, while coding certain themes, the "chemical herbicide treadmill" emerged as a guiding theoretical framework. Finally, I reported descriptive variable trends—

measuring farm characteristics, crop types, farmland use, and emissions—to contextualize the thematic analysis.

Table 1. Descriptives of Interviewed Farmers

Item	*n* responses	Mean
Total acres operated	16	1,183 acres / 479 hectares
Substantial off-farm income[a]	17	53%
Use cover crops?	16	81%
Integrate livestock?	16	94%

[a] Defined as "being able to make it financially without farming."

Thematic Analysis

Following institutional IRB procedures, I conducted semi-structured interviews with 22 participants from December 20, 2023, to May 19, 2024, using both purposeful (Campbell et al., 2020; Palinkas et al., 2015) and snowball (Noy, 2008) sampling techniques. I primarily interviewed farmers, but also included CC experts in extension, federal conservation, agronomy, input sales, and crop insurance. At the end of the interviews, I asked for recommendations of other potential interviewees. Five of the participating interviewees were individuals I had previously known, which introduced minimal purposeful sampling bias and constituted a limitation.

There were 18 farmers and four non-farmers, with 10 of the 18 farmers holding leadership positions in agricultural and/or community organizations. We conversed in vehicle cabs, barns, pastures, and during chore time. On average, interviews lasted nearly two hours. Participants were 100% non-Hispanic white and 72.3% male, with an average age of 55 (range = 26–71). With an average of 1,183 operated acres (479 ha) (Table 1), the sample more than doubled PT's 2022 average farm size of 493 acres (200 ha) (USDA NASS, 2024, p. 245). To ensure anonymity, I assigned pseudonyms to respondents.

As detailed below, I followed the six steps of reflexive thematic analysis (Braun & Clarke, 2006; Byrne, 2022; Knott et al., 2022; Naeem et al., 2023; Vanover et al., 2021).

1. **Become familiar with the data**. I initially used Otter.ai to transcribe the interviews, then checked its transcriptions against the recordings for accuracy and edited the former as needed. While doing so, I became more familiar with the data.

2. **Generate initial codes.** Going through the transcripts a second time, I used inductive coding to search for key words and phrases and generated initial codes (Bingham, 2023) while simultaneously searching for complete sentences or thoughts and entire paragraphs (meta codes). This ensured thorough, inclusive, and comprehensive coding (Braun & Clarke, 2006). I also used Atlas.ti's AI code suggestion feature to generate a separate list of codes.

3. **Search for emergent themes.** While searching for emergent themes, I compared my initial codes against those generated by Atlas.ti's AI code suggestion feature and the paragraph-level 'meta' codes. I revised, combined, and eliminated codes, checking them against one each other as well as the original data; in this way, themes iteratively evolved.

4. **Review themes.** I reviewed themes to ensure they were internally coherent, consistent, and distinctive. I compared data points and codes, and then condensed these codes into categories, categories into themes, and themes into findings (Charmaz, 2024).

5. **Define themes.** Defining entailed assigning a code name label, arriving at a full definition based on inclusion and exclusion criteria, and highlighting exemplary quotations (DeCuir-Gunby et al., 2011).

6. **Name themes.** For the last step, I named the finalized codes. To ensure that naming codes did not stem from my prejudices and prior experiences, I explicitly recognized my presuppositions, set them aside, and incorporated rival positions (Bailey, 2008).

During steps four and five of thematic analysis, I struggled to explain why many participants chose herbicide applications for CC suppression or termination by default, with no unprompted explanation of why that was their go-to method. CC and herbicide rates increased over 25 years (1997-2022), even though CCs were supposed to reduce the extent to which farmers applied herbicides to manage weeds (Giuliano et al., 2021). To make sense of the simultaneous increase in CCs and herbicides, one theoretical explanation emerged as most salient: the "chemical herbicide treadmill."

Theoretical Framework: Chemical Herbicide Treadmill

Chemical herbicide treadmill is a combinatory concept that is derived from several sources (e.g., Aronov, 2020; Haggblade et al., 2017; Howard, 2016; Merrill, 1976; Mortensen et al., 2024; J. I. Rodale, 1954). Although chemical herbicides can reduce labor and tillage costs, their widespread and repeated use exerts strong selection pressure on weed populations, and resistance evolves and spreads (Bharadia, 2025). To "fix" this problem, farmers add new herbicides, adjust formulations, utilize higher rates, and/or switch to crops that are tolerant to multiple herbicides, which can once again accelerate selection for multi-resistant weeds and increase costs and continue this cycle or "treadmill" (Peterson et al., 2025).

Powerful agro-industrial actors sell chemicals meant to be used with crops genetically geared to their use, forcing farmers onto the chemical herbicide treadmill. By continuously marketing and selling these new-and-improved "fixes" to farmers, consolidated and concentrated agro-industries handsomely profit (Carolan, 2022). There are other socio-cultural forces shaping herbicide hegemony and adding a faster "spin" to the chemical herbicide treadmill.

For instance, public dollars—which are allocated via direct payments to farmers (disproportionally to farmers of larger operations who sell commodity crops)—indirectly subsidize farmers' herbicide expenses. Also, land-grant extension agents offer farmers technical assistance including long lists of pre- and post-herbicide blends considered optimal for CC species suppression/termination (Grint et al., 2022; Hill & Sprague, 2024; Palhano et al., 2018). However, the primary purpose of these herbicide formulations is to minimize CC competition with cash crops to maximize yield per acre, which remains the culturally-touted metric of a "good" productivist farmer (Burton, 2004).

The chemical herbicide treadmill is a byproduct of the agricultural treadmill of production (Cochrane, 1993, 2003; Curran, 2017; Levins & Cochrane, 1996; Lynch, 2017; Sanderson & Hughes, 2019). Technological advances, production scales, and government subsidies encourage farmers to continually expand production and capital investment to maintain the pace or else leave, which in turn depresses commodity prices and creates additional scaling pressures. For example, farmers' widespread adoption of herbicide-tolerant crops can contribute to reduced labor, enabled larger fields and simplified rotations, exacerbated farm consolidations, and reinforced production incentives. Meanwhile, the intensive and repetitive use of herbicides selected for resistant weeds has forced farmers to consider additional herbicide options and new genetically modified traits that are tolerant to other herbicides. This example explains the mechanistic similarities between the treadmill of production (scale, subsidies) and chemical herbicide treadmill (herbicide overuse, weed resistance).

Descriptive Analysis

After performing a thematic analysis and establishing a theoretical framework, I compared interviewee data to county-level descriptive data measuring farm characteristics, crop types, farmland use, and emissions (Bingham, 2023). I then analyzed these data points in a comparative, integrated, and systematic approach (National Institute of Health Office of Behavioral and Social Sciences, 2018). County-level descriptive analyses also served as important validity and reliability checks on interviewee data (Guest et al., 2012).

I sourced most variables from USDA NASS (2004, 2009, 2012, 2019, 2024) and Conservation Technology Information Center (CTIC), Regrow Ag, Inc., et al. (2023). The latter developed a remote-sensing algorithm using earth-observing satellite data to document the adoption of soil health practices and greenhouse gas emissions at

high spatial-temporal resolutions (Hagen et al., 2020). These are available through the Operation Tillage Information System (OpTIS) 2.0 database (TNC et al., 2023). Regrow Ag, Inc., then utilized the Denitrification–Decomposition 11.0 model to estimate greenhouse gas emissions for nitrous oxide (N_2O), nitrate (NO_3^-), and soil organic carbon (SOC) (Gilhespy et al., 2014). I reported OpTIS and Denitrification Decomposition (DNDC) descriptive statistics to compare 2005–2019 trends in residue cover and leaching of soil organic *C* and *N*-based gases with 2002–2022 trends in harvested cropland types.

Findings and Discussion

The primary findings were grouped in three sections: (1) interviewees' CC beliefs, practices, and peer information networks; (2) county-level changes in leading crop types (less perennials, more corn and soybeans) and emissions over time; and (3) interviewees' preferences for "spray over spade" to control CCs; that is, automatically deferring to herbicide applications rather than minimum tillage to suppress and/or terminate CCs.

Beliefs, Practices, and Peer Information Networks

At first glance, using the chemical herbicide treadmill as a theoretical framework may not seem appropriate to analyze farmers' CC beliefs and practices. However, the chemical herbicide treadmill's socio-cultural hegemony shapes farmers' beliefs and practices regarding CCs. The treadmill fuels lock-ins and path dependence, fails to support the internalization of supposed 'externalities,' and creates arms-race dynamics that demand stronger chemicals, making it difficult to adopt alternatives (such as front-mount roller crimping, which requires neither spraying nor spading certain CCs, like rye) (Green, 2018; Green & Owen, 2011).

Interviewees believed in the union of no-till and CCs. In 2022, 49.5% of PT farmland was no-till. An extension agent and farmer named Tammy remarked, "With cover crops, you don't have to have all the different tillage equipment." There are other mutualistic reasons for the union of no-till and CCs. Farmer Tom said, "no-till and cover crops go together," commenting on their ability to improve moisture retention and regenerate "poorer ground":

> I did not see any yield drag at all except one field on one farm. Instead, the yields increased, especially on poorer ground. You're going to see more of an increase in yield with no-till and cover crops with your poor ground. Your poor ground is going to be a little wetter ground, you're going to have problems getting into it in the spring. … Have the patience to wait to have that ground dried out, and your cover crop will help get that moisture down deeper, just like money in the bank. … The soil is not going to have as much compaction, so when your seeds sprout, the roots of the new seed are not fighting all that hard against wet, tight, and compacted ground. … Walk into that field, and it's good ground. Good corn has a lot of trash [corn stover or crop residue].

Although Tom did not experience overall yield drag from CC, that can be the case. For instance, the first large-scale, field-level analysis of observed yield impacts from cover cropping implemented across the U.S. Corn Belt found there was an average corn yield loss of 5.5% (Deines et al., 2023). For soybeans, there was an additional 3.5% yield loss on fields where CCs were used for three or more years, compared to fields that did not adopt CCs (Deines et al., 2023).

To address Tom's other points, integrating CCs into no-till acreage can improve the soil's physical properties and decrease its compaction and temperature (Blanco-Canqui et al., 2011, 2012). Western corn belt producers have previously perceived diverse cropping rotations as an adaptive strategy to cope with marginal lands (Wang et al., 2021), and among U.S. soybean farmers, CC adoption has been positively correlated with crop diversification and no-till adoption (Lee & McCann, 2019). Interviewed farmers believed that CCs enhanced crucial agri-ecological services. Based on a 23-item survey of their CC beliefs, they most strongly agreed that CCs decrease natural resource degradation and soil erosion (see Appendix, Table A1). For instance, Tom regularly plants CCs after harvest to stymie soil erosion:

> One year I got the crops off way too late to plant any covers. So, I thought, "Well, I've been doing this for six years, I can skip a year." And I skipped that year, but it was amazing how many ditches I had out there. I mean, it was something you could just visually see, you didn't need to bring somebody in to point it out. And so, [ever since] I've been continuous cover cropping no matter what. I'm right behind the combine with the drill.

Despite CC's benefits, there can be drawbacks. For instance, Camden, a federal conservationist and farmer, cautioned farmers not to be complacent with initial CC success:

> Cover crops make weeds manageable, but they are not a cure-all. There's no one thing that works every year [because] every year is different. That is probably the biggest thing I would tell you—if you think you got it figured out, you better not pat yourself on the back too hard because next year's going to be different.

CCs can be sunk costs if a farmer chooses expensive mixes. Camden remarked:

> You got to have these very specific mixes, and they get expensive, especially if people don't have the capability to graze them because they don't have fence, water, etc. Even if the government pays me US$45 an acre, it still may not pencil out because I got to buy this crazy expensive seed just to terminate it.

Tammy also addressed concerns about CC seed costs, stating that cost share programs can sometimes require multispecies CC seed blends, which are more expensive to plant:

> Sometimes those cost share program rules say that you must use species from each different class, you must have brassicas, grasses, and legumes. Very commonly, one or two species out of a mix is going to dominate.

In 2019, Myers et al. identified some specific situations that can accelerate farmers' CC profitability. Their study contextualized responses from interviewed farmers who wanted CCs to be affordable, if not profitable. By utilizing CCs to increase their soil organic matter ratio to help improve future yields (Jacobs et al., 2022), the opportunity to potentially sell CCs on a secondary market can be considered. Increases in CC adoption have previously shown a high correlation with funding from federal and state conservation programs (Zhou et al., 2022), and farmers are eager to receive federal risk protections and incentives (Sawadgo et al., 2021; Wallander et al., 2021). For example, in the Southern Great Plains, producers expressed moderate willingness to accept CCs if they were paid US$26.38/acre (Johnson et al., 2024). In our study, a farmer interviewee named Hank confirmed that he would plant more CCs if the government subsidized seed costs to the tune of US$50/acre:

> The problem with cover crops is they may not always be the way. Right now, the seed is expensive. I mean, it costs you quite a bit per acre to put cover crops on…I'd rather do it for 50 bucks. But if the cost of the seed was regulated or somehow moderated or supplied by the government that would kind of make a difference too. Think back when the government did the soil belt programs, they supplied clover seed.

While much smaller than USDA Environmental Quality Incentive Program (EQUIP) CC payments of US$40–50 per acre (Myers & Wilson, 2023, p. 6), the 2022 USDA Risk Management Agency's (RMA's) (2022) Pandemic Cover Crop Program offered a US$5/acre premium discount to producers who planted qualifying CCs and were enrolled in eligible crop insurance policies.[2] Curtis, a farmer and crop insurance agent, remarked,

[2] H.R.8527 (2023) would have extended this program by providing a US$5/acre crop insurance discount (Casten, 2023), but it died in subcommittee.

> They're good for me, they're throwing me an extra five bucks an acre, and that makes a little bit of a difference. It might not pay for a chemical application throughout the spring or pay for seed costs, but it will make a little bit of a dent. … The option to graze them has become popular, because until just two years ago, [RMA] wouldn't allow you to graze or hay your cover crops. … Opening that up … really helped because farmers don't have to let acres sit idle for that long, and they can bring additional value back into their operations.

In Curtis' last point, he was referring to USDA RMA's (2021) decision that producers with crop insurance could hay, graze, or chop CCs for silage, haylage, or baleage at any time and still receive 100% of the prevented planting payment. Previously, farmers could only hay, graze, or chop CCs after November 1; otherwise, their prevented planting payment was reduced by 65%. Crop insurance also benefits from the USDA RMA's decision. Won et al. (2023), for instance, found that counties with higher CC adoption rates had lower levels of crop insurance losses caused by prevented planting.

When livestock graze CCs, they recycle manure back into the agroecosystem (Groff, 2015; USDA NIFA SARE, 2024). CC systems integrating livestock can be more profitable than those livestock systems without, because the value of CC forage is greater than its costs (Bowman et al., 2024). One interviewee, Martin—a farmer and employee working in the animal health industry—used wheat as a CC for soybeans, with one option for his end use goal of the wheat being cattle feed:

> We'll use wheat as a buffer between soy rotations. We will plant corn this year on everything down there, then turn around after corn harvest is done and plant wheat to help with erosion and to keep that ground covered until we plant soybeans in the spring. We will do one of three things—either spray the wheat, harvest it and take it to market, or cut and bale it up for cattle feed.

Tom preferred to graze his livestock on CCs for the quality protein it provided them:

> As a normal practice, I'll plant covers right after silage and I'll get a foot to eighteen inches of grazing off it. It's top nutrition, high [quality] protein. The cows will just get fatter than fat off it and do really well. … Because I run livestock, this here was chopped for corn silage and put in the silo, then I went in and planted turnip, radishes, and triticale. … As soon as it warms up, they will take off. That's what I like to see.

Edwin would plant late-summer cover mixes into wheat stubble, and then sell the silage to his neighbor to feed cattle:

> I've got a window of time in late summer after I harvest wheat to plant cover crops. I drill them into the wheat stubble. I've got a neighbor who we sell our cows to, and they want to buy chuck silage and put it in the silo for feed for their calves in the winter. We've worked with them where we can take that planter corn and bean—we have a rotation—and we can take that silage off, usually in early August, and that allows me to go in there and drill cover crops and turnips all in the same blend.

There's more to CCs than simply harvesting or grazing them. CCs require practice, patience, adaptation, long-term planning, and the ability to learn new management practices. To assist with the adoption of CCs, there are several resources available that consider species type and plant characteristics that best align with each farmer's goals (e.g., Community Alliance with Family Farmers [CAFF] & The Freshwater Trust, 2023; Hamilton et al., 2017; USDA NRCS, n.d.-b). Integrating CCs means learning new management skills. Luckily, there are several CC education and outreach resources in PT and the surrounding region: Pottawatomie County Conservation District (KACD, n.d.) (in Westmoreland); Kansas State University Research and Extension's (n.d.) Northeast Regional Office and Department of Agronomy (n.d.) (in Manhattan); the Kansas Soil Health Alliance (n.d.) (in Esbon); Kansas Farmers Union

(n.d.) (in McPherson); Kansas' USDA NRCS (n.d.) office (in Salina); Rodale Institute Regional Resource Center at Kansas Wesleyan University (in Salina); and the Kansas Alliance for Wetlands & Streams (n.d.) (in Newton). Finally, Kientzy et al. (2023) provided a summary of CC seeding machinery, equipment costs, coverage rates, seeding quality, seed size, and consistency.

Interviewees also emphasized that growing a successful CC stand "is more of a timing thing" (farmer Earl). "Timing" meant different things to different farmers. It meant receiving timely moisture after seeding CCs to ensure successful germination (farmer Michael), planting CCs before a freeze (farmer Zach), or terminating CCs before they "go to seed" (farmer Tammy). Farmer Sam lamented that lack of time and affordable labor prevented him from consistently planting CCs:

> I don't always get cover crops planted everywhere. I'd like to, but I don't always have time. The last several years I planted cover crops, and they didn't come up until the spring because it was too dry, so that didn't really help much. In fact, [planting] covers was more problematic than helpful. And so, this year, it was just too dry, and so I just didn't plant them. … I don't really see anything wrong with that.

Nick commented on the trade-offs of not tilling (but increasing his herbicide application rates for CC suppression/termination), and the time-intensive nature of CC management. He said,

> We use less fuel than we used to because we're not out there ripping the guts out of a tractor tilling. But we're also doing our own spraying, and so that kind of offsets that benefit. … Since I've gotten more into the cover crops, I have one guy who now works full-time for us on them.

Farmer peer information networks also influenced interviewees' CC decision-making. Geraldine noted,

> Cover crops are big talk at the coffee shop because people want to try it. They want to know their neighbor is doing them and when they can see the results, then they're going to try to plant them.

Farmers who use CCs are more likely to bond with other farmers who use CCs (PFI, 2023b), primarily for knowledge exchange. As Curtis explained,

> The guys that have done covers in the past are the first ones to tell you what has worked, what blend that they've used, or stuff that may not have worked as good for their operation.

Virtual mediums (online forums and Facebook groups), in-person events (e.g., No-Till on the Plains conferences), and everyday interactions with neighbors and community members spur knowledge exchange and bonding (Riley & Robertson, 2022). Trust and reciprocity norms emerge from regular and repeated interactions within a community (Bridger & Alter, 2006). Camden noted that the "farmer see, farmer do" mentality has even helped sway CC-skeptical farmers:

> I've heard conversations at many of the talks I've been to, like "just see what crazy Jim is doing, he's putting cover crops down!" They might talk about each another behind their backs a little bit but [then say], "he's been doing it for five years now, so he must be doing it for a reason."

Fewer Perennials, More Corn and Soybeans, and Accelerated Emissions

To better understand why CCs increased, it is necessary to examine an overview of county-level changes in leading crop types. From 2002 to 2012, PT farmers harvested more acres of hay(lage) than corn and soybeans. By 2017, the combined harvested acreage of soybeans and corn for grain or silage overtook hay(lage) acreage, and by 2022, soybean acres were the most prevalent crop (Figure 2).

Camden questioned the economic rationale of farmers who converted hilly hay fields to cropland:

> You get guys who will try and farm the top [ground], and it makes me shake my head. What are you gonna get? You got to plow it up and lose that grass. Prairie soils are highly erodible, so you have to put structural conservation on the ground—terraces, waterways—and then by the time you do that, now you have marginal farmland. How you gonna make that pencil out?

From 2005 through 2019, the PT cover crop rate increased, as well as crop residue rates of 51–100%. Meanwhile, conventional tillage and reduced tillage, low-residue cover crop rates decreased (Appendix, Table A2). Over that same timeframe, all leaching emissions increased (Table 2 and Figure 3).

In sum, CC rates increased in the county, but so did all emission types. This was especially sur-

Figure 2. Pottawatomie County, Kansas (PT), Harvested Cropland Acres by Select Crop Types, 2002–2022

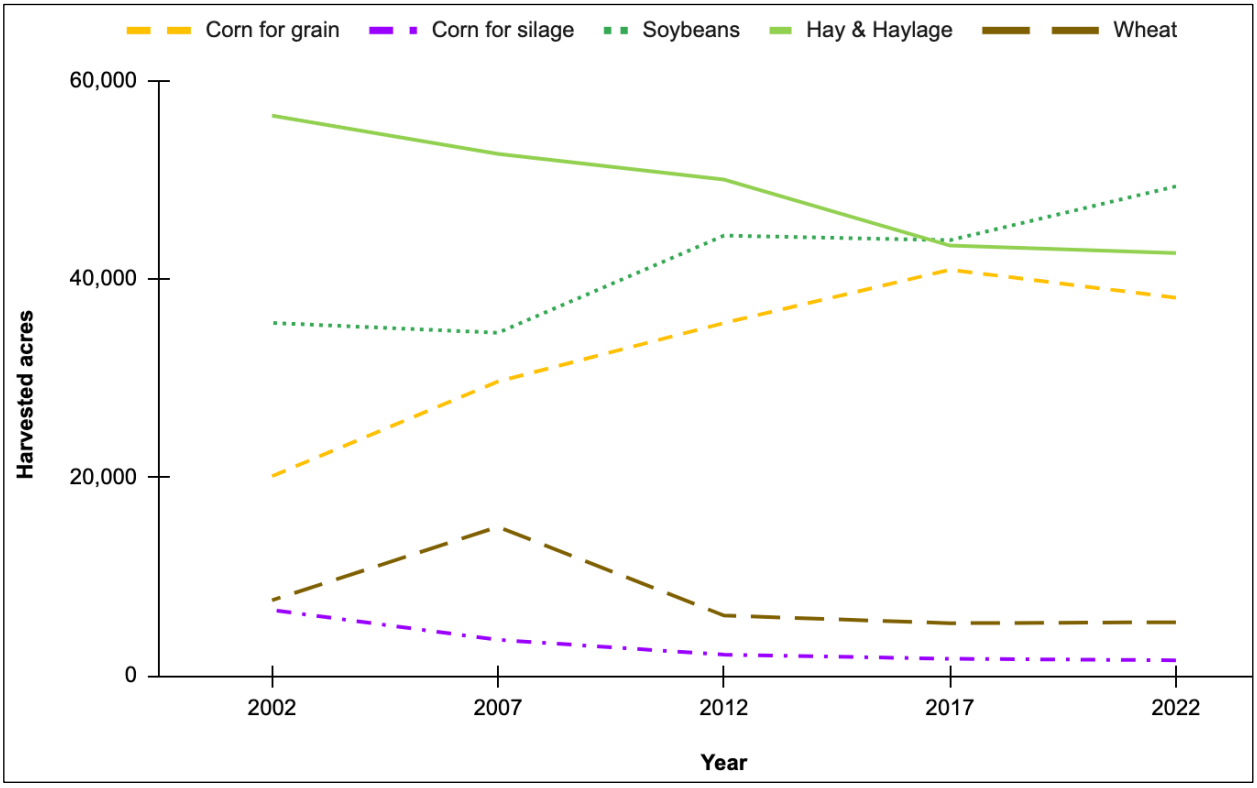


Figure by Jacob Miller-Klugesherz, © 2026; shareable under a CC-BY 4.0 license.
Data sources: USDA NASS 2004 (pp. 212, 226); 2009 (pp. 259, 268); 2014 (pp. 237, 251); 2019 (pp. 244, 271); 2024 (pp. 538, 554, 577).

Table 2. Denitrification Decomposition (DNDC) Emission Trends for Farmland Acres in Pottawatomie County, Kansas

Annual leaching emissions	% Δ (2005 to 2019)	Linear r^2	Min. (yr.)–Max. (yr.)	CSB 2019 Rank %
Nitrous oxide (kgN_2O/ha-yr)	53.19	0.432	0.778 ('08)–1.649 ('18)	73.73
Nitrate ($kgNO_3^-$/ha-yr)	93.41	0.524	22.69 ('06)–60.32 ('19)	64.1
Daily soil organic carbon global warming potential (kgC/ha/yr)	103.3	0.383	–0.306 ('16)–0.01 ('19)	70.01
Daily global warming potential, total atmospheric emissions ($kgCO_2$-eq/ha/yr)	370.8	0.523	–0.113 ('05)–0.306 ('19)	75.52

Data source: The Nature Conservancy [TNC] et al., 2023.

prising for nitrate emissions because Nouri et al.'s (2022) global meta-analysis found that, across different soil types and agronomic systems, cover crops reduced nitrate leaching by 69% compared with fallow. There was a sizeable discrepancy, in directionality and magnitude, between the emissions data I expected and those I observed.

One possible explanation for this discrepancy was that the acreage ratio of perennials, alfalfa, and woodlands all decreased, while corn and soybean acreage and productive intensification increased over the same time. The percentage of acres planted to herbaceous perennials was >11% in 2005–2007, but in 2009, it dropped to 4.41% and remained <5% through 2019 (Hagen et al., 2020). Acres of harvested alfalfa declined since 1997 (10,163 acres), reaching its lowest point in 2022 at 6,077 acres (USDA NASS, 2019, 2024). This could have collectively skewed C-N ratios below the ideal 24:1 thresholds (e.g., alfalfa fields exhibit a 25:1 C-N ratio) (Gullickson, 2015). Moreover, although CCs can supplement inorganic fertilizers by fixing more N_2 (Blanco-Canqui et al., 2012), in certain conditions—especially in drier fields fertilized with inorganic N—decomposing, leguminous CC residues can consume soil O_2 and lead to N_2O emissions via respiration-induced anoxia (Lussich et al., 2024). As Basche et al. (2014, p. 471) concluded, "cover crops do not always reduce direct N_2O emissions from the soil surface in the short term."

Organic farmer Vanessa explained why increased CC attention can distract from understanding the broader impacts of farmland use patterns:

> I've seen some pretty bad examples of no-till. How is there still a lot of sediment in the ditches and in the reservoirs if we're doing such a good job with [no-till]? So now they implement more cover crops and chemicals in

Figure 3. Annual Average Daily Global Warming Potential of Total Atmospheric Emissions on Pottawatomie County, Kansas (PT), Cropland Acres by Year, 2005–2019
Negative values equal net sequestration and positive values represent net emissions.

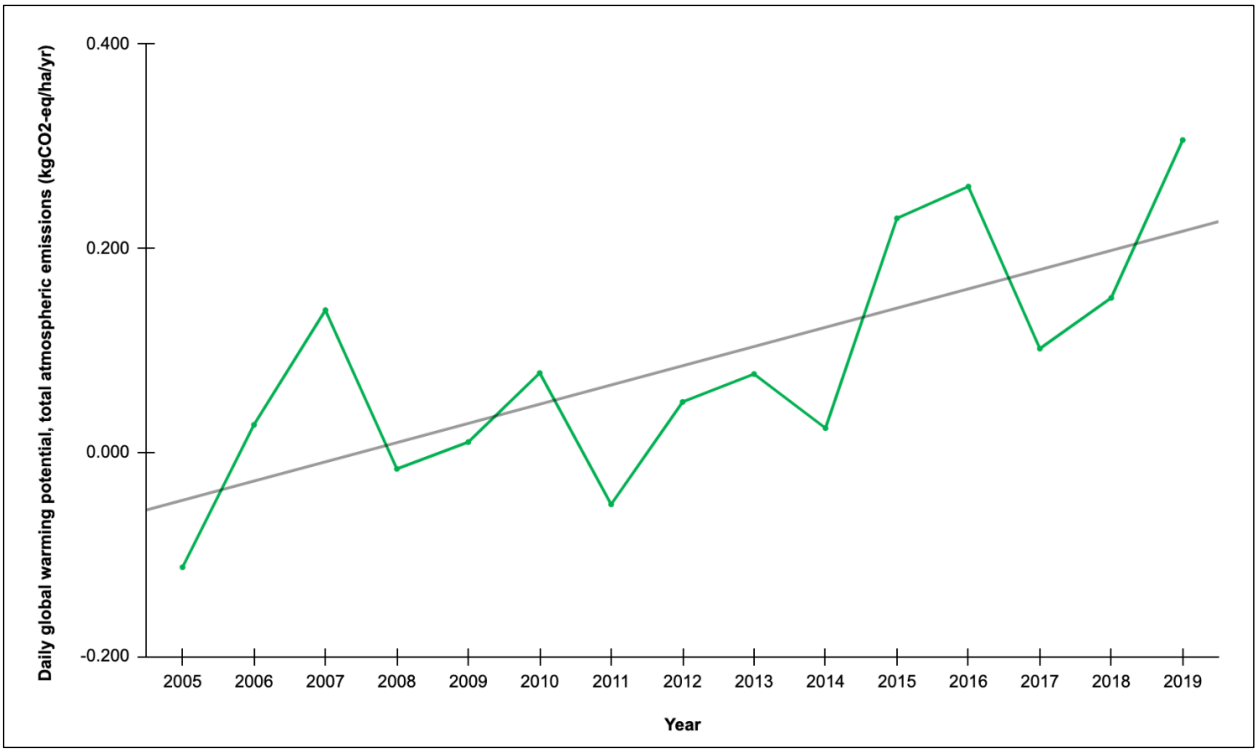


Figure by Jacob Miller-Klugesherz, © 2026; shareable under a CC-BY 4.0 license.
Data source: Hagen et al., 2020, p. 16.

> corn and soybean rotations. But that's not enough diversity. We are not going to solve the problems of water quality and soil health until we recognize and solve the problem of size and scale. I see the bulldozing going on, and they're constantly pushing the borders of the fields. They're filling in the little low places and farming the riparian and brushy areas. They're taking all that out so to do monocultured corn and soybeans. And then they say, "Oh, I'm environmental because I've thrown in some rye cover crop or a mix. And you know, I graze our cattle out there, so those are good things." But for the big picture, we're not going to solve the bigger problems this way.

Vanessa's perspective was holistic. Similarly, Nathan recognized the importance of public dollar investment in CC payments, but experienced a situation when a government program incentivized farmers to convert native prairie to CC-planted cropland:

> [I was on a] project where farmers tore out a whole bunch of native prairie to put it in cropland. They had a proposal that would pay them to implement cover crops on this land they had taken out of native grass. I was adamantly opposed and said, "we are just rewarding bad behavior. We should not be supporting it." But man, there were people on that committee who said, "but it will do good going forward." It passed and … it's still paying them for something that they should not have done.

There was another potential explanation for increased emissions: excessive herbicide application can result in NO_2 and NO_3^- leaching, which occurs when an herbicide is dissolved in water, moves down through the soil profile, and is carried away from crop and weed germination zones (Giuliano et al., 2021; Nogueira Bandeira et al., 2022). From 1997 through 2017, the percent of total PT cropland acres applied with herbicides more than doubled (USDA NASS, 2004, p. 563; 2014, p. 610; 2024, p. 670), and from 1997 through 2022, chemical expenses per operation (in June 2024 inflation-adjusted US$) more than tripled (USDA NASS, 2004, p. 268; 2014, p. 293; 2024, p. 309).

"Spray or Spade": The Rigid Dualism Dictating Cover Crop Suppression/Termination

Choosing the correct CC suppression or termination method depends on farmers' goals, equipment availability, cost, and management preferences. These options include mowing, disking, roller crimping, grazing, and herbicides (Adetunji et al., 2020; Anderson, 2023; Hill & Sprague, 2024). Ideally, cover crops' weed suppression should reduce the herbicide costs farmers pay for weed suppression. Tammy explained:

> Weed suppression is becoming more of a cover crop benefit that producers are focused on. They like the idea that they could use less expensive herbicide options, because the days of glyphosate working perfectly and never having to apply anything else are long gone. …They can help farmers use less costly herbicides, and potentially they might be able to use Roundup only for their burn-down.

The evidence that CCs can reduce herbicide costs is mixed. CTIC et al. (2025) have conducted nationwide surveys of CC users. In their 2023 survey, 55% of respondents saw no change in herbicide costs in corn following CCs, while 42% noted that they saved money on corn herbicides after CCs (CTIC, USDA SARE et al., 2023, p. 74).

Eight PT interviewees (36.36%) said that every year they must make the choice between minimum tillage or herbicides for cover suppression/termination. For their operational contexts, crimping or grazing were not options. They perceived "spray versus spade" to be a necessary choice for ensuring a harvestable and marketable cash crop. Earl argued,

> Either you spray, or you use a spade. I don't know how you could do it otherwise. … Cover crops can eliminate one trip across spraying for weeds, and that helps. And a lot of the chemical stuff has gotten high enough that this year, I think you could run over ground a couple

> times with a disk and a field cultivator for way less than the burndown cost. … I hired my chemical application done because I don't really want to be around the stuff. And they [coop] have better spray equipment with better filters on the cabs. If I were to go organic, that would make a pretty big change.

Curtis echoed Earl's rigid belief about the necessity of spray or spade:

> From an on-farm perspective, there are two ways to control weeds: with iron, whether that be a disc, moldboard, plow … or with a chemical application, [especially] when the weeds become so bad. … If you go through with a cultivator, you're only killing what's in between the rows. I think that's why some guys have gone back to a more of a minimum till instead of a no-till, because of the mis-management of the chemical that they had to begin with.

Some farmers were not concerned about the negative impacts of chemical herbicides, partly due to the implied trust that considers salespersons as the experts. As Pete explained,

> I don't see any other way to do it. … My grandfather came here from Germany in the late 1920s, and they farmed with a hoe. Back then you could round up a few kids to help weed. Now you can't do that or find anybody who would even consider doing that kind of work. … I go to farm meetings all the time, and with those farmers I talk to, all of us have used Roundup since it was initially invented. It's a very useful herbicide.

Hank, a noncertified organic farmer, said neighboring farmers used herbicides to terminate both annual CCs and emerging weeds around the planted-green cash crop:

> A lot of the no-tillers now are going in and are no-till planting the cash crop into that cover crop and then trying to come in later and spray it to kill the cover crop. So, they're kind of doing two things at once: they're killing the cover crop plus killing the new weeds coming in around the cash crop.

However, herbicides used to control weeds in a cash crop stand can affect CC planting schedules. This effect is called residual "carryover" (Corteva, 2022; Maia et al., 2024; Paris et al., 2024). Tammy explained the carryover:

> One of the other challenges to cover crop adoption is going to be the herbicides used on the cash crop. Some [herbicides] are going to kill some of the cash crops because of their perennial natures and the time between planting and harvest. When trying to get that cover crop established, not all of them are going to survive. And so sometimes the choices that you make in the cash crop will dictate what you can do with covers, or if you can grow anything after. A lot of our most effective weed control herbicides have some residuals, and there hasn't been testing done on every single cover crop known to man, and so you just try to find something close or look at the longest one. A lot of times, the longest [residuals] may be 15 months, but you don't have 15 months between the application and the need to plant a cover crop. So, there are some substantial limitations in terms of herbicide technologies and some testing that probably should be done on particular cover crop species and whether they can be established after using those herbicides.

Unless they did custom spraying themselves, most interviewed farmers distanced themselves from spraying and depersonalized its effects. They acknowledged certain risks but downplayed them to emphasize the necessity of spraying. For instance, Michael said,

> These airplanes, you gotta be careful. … Herbicides will kill people's gardens, flowers, and trees. … There aren't very many neighbors who don't get along, but that'd sure be a way to piss off your neighbor and have them not

talk to you—scorch their gardens.

"Kill." "Piss off." "Scorch." Such terms of death can reflect farmers' attitudes toward themselves, others, and their operations (Brown, 2020). Herbicides can be lethal for humans, as Hank attested:

> I quit using chemicals. … I can't make myself spray anymore. Dad came down with Alzheimer's [disease] when he was 60, and he just loved to spray. He'd come in soaking wet with chemicals. I think maybe that's what ended up doing him in. It got so bad he put a raincoat on me when I sprayed with a tractor, because it gets sprayed up. That was Agent Orange, you know?

Five PT interviewees displayed cognitive dissonance about using more herbicides for weed and CC suppression/termination. However, they all ultimately justified their intensified use of herbicides as being necessary to "feed the world," which is a powerful cultural and social "script," or a "commonly used line of argument that is widely invoked in response to a particular issue or situation" (Vanclay & Enticott, 2011, p. 256). Marvin followed this script thusly:

> There's always a balance. You either take the risk of death by cancer or death by starvation. The main goal that farmers are trying to tackle is just feeding the world. It's why you see the need for improved technologies. Bigger populations require more people to be fed. It's an interesting social dilemma.

Barbara admitted that her farming practices were heavily dependent upon herbicides and that they have negative impacts on human health (see Ahuja et al., 2024). However, Barabara justified her use of them:

> We are afraid of people starving, that we won't be able to produce enough to feed the world. We've already got people in the world starving.

Tammy believed there was no viable way to "feed the world" with organic production:

> The Certified Organic Program is perfectly acceptable if honesty is shared about what that actually means, which sometimes it's not. … But the reality is that if every producer adopted only those practices and went through that [organic certification], we would have trouble feeding the world for sure.

Stewardship and business are two social roles that often represent competing moral imperatives (Bell, 2018, 2004). To reduce the tension between them, Iowa farmers portrayed themselves as a "hero feeding the world," a third social role with more positive moral overtones (Comito et al., 2013, p. 283). The "feed the world" justification for herbicide (over)use has been refuted (Stone, 2022). Scaled organic production can feed the world just as viably as conventional production (Badgley et al., 2007). As Lappé (2010) argued, creating a food system that encourages "low-input local production, with organic practices where viable, will not only help address the climate crisis but also help redress one of the most painful facts of the modern world: hunger amid plenty" (p. 172). Nevertheless, these interviewed farmers followed the "feed the world" script to justify their chemical herbicide suppression/termination of CCs.

From an agroecological perspective, the ideal management type is regenerative organic (Rodale Institute, n.d.),[3] which has been codified by the Regenerative Organic Alliance's (n.d.) Regenerative Organic Certified™ program. This certification indicates that both no spray *and* no spade is achievable, although PT interviewees perceived it as impractical. Given that many of these PT farmers will not stop using herbicides any time soon, a practical way that farmers can reduce usage rates is to consult and consider the best on-farm management practices (Prokopy et al., 2008, 2019). One option to consider is the 4R method, which

[3] The "original regenerative principles" (pluralism, protection, purity, permanence, peace, potential, and progress) did not specifically omit herbicides or tillage (Rodale Institute, 2019), although their exclusion was implied.

involves applying the right source at the right rate, time, and place (Rogers, 2019; TNC, n.d.). Jones (2009, p. 5) argued that if one had to pick between herbicides and minimum tillage, the latter would be best, because in most situations, herbicides cause greater loss of soil aggregation and structure than tillage. To minimize erosion and leaching, Jones continued, one should consider planting CCs immediately following a tillage event to incorporate some kind of living root back into the turned soil.

Conclusion

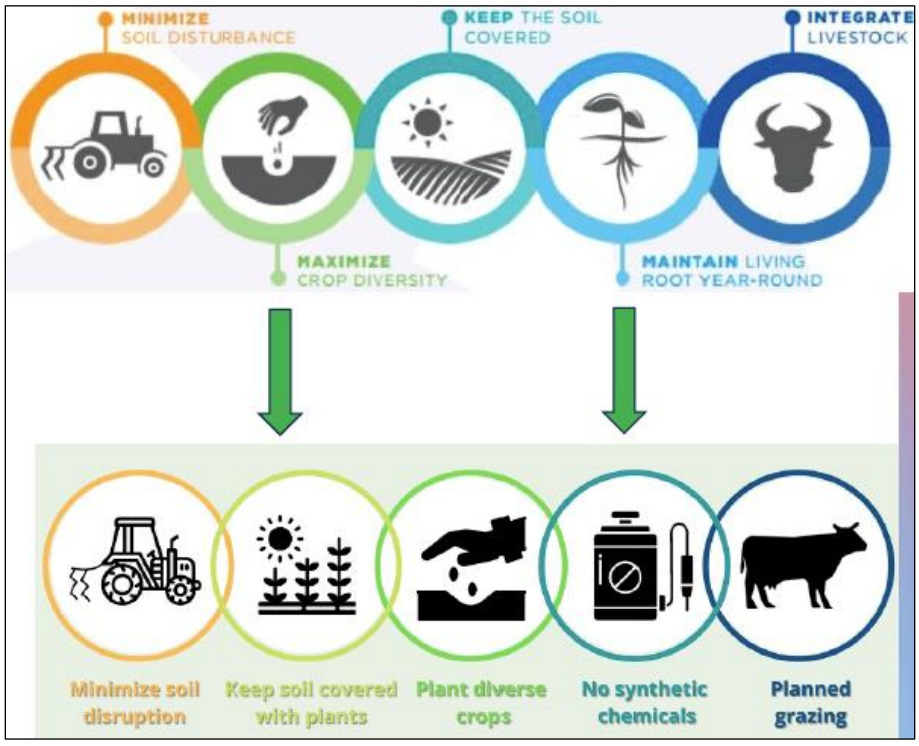
This study analyzed the CC beliefs and practices of Pottawatomie County (KS) farmers and CC experts on large corn and soybean operations ($\bar{x}$ = 1,183 acres or 479 ha), as well as structural factors influencing their CC perceptions, decision-making, and adoption. Interviewees foremost looked for CCs to be affordable, if not profitable, and subsidized by public dollars via cost-shares. PT farmers planted CCs to supplement forage biomass for cattle, and grazed cattle on CC residues, mostly corn stover. They learned about CCs from their neighbors and emphasized the importance of timing related to weather and available labor. They treated CCs as another tool in the conservation toolbox, not a silver bullet. One explanation for the increased adoption of CCs was that farmers converted more cropland acres from perennial crops to corn and soybeans from 1997 to 2022. During that same 25-year timespan, other concerning trends increased: acres applied with herbicides, total chemical expenses, and leaching emissions. These trends were associated, related, and likely correlative, although I did not empirically demonstrate correlation in this study.

When CC suppression and/or termination by crimping or grazing was not an option for farmers, they more frequently deferred to herbicides (spray) instead of minimum tillage (spade). While generalizations were limited to the study context, this finding raises implications for the tradeoff between herbicides versus minimum tillage under certain agricultural conditions and contexts (Dentzman, 2018).

Moving forward, PT farmers and agriculture-adjacent people could consider soil health principles that trend more organic than regenerative (Figure 4).

Starting from the five principles used by Jay Fuhrer (Groundswell Agriculture, 2019) and Gabe Brown (2018), replace the "maintain living roots year-round" principle with the "no synthetic chemicals" principle. The "maintaining living roots year-round" principle can be

Figure 4. Pottawatomie County, Kansas, Farmers' Potential Shift in Soil Health Principles: From Reducing Synthetic Agrochemicals (above) to Eliminating Them (below)



Sources of images: LandscapeDNA (n.d.) (above) and Health Care Without Harm (2025) (below); shared under CC-BY 4.0 licenses.

considered implicit to the "keep the soil covered" principle, and omitting the former allows for shallow, minimum tillage practices when and where appropriate. Front-mount roller crimping does not use herbicides or disrupt soil aggregate formation through tillage (Gailans & Bakehouse, 2022; USDA SARE & Clark, 2007, p. 115) and could therefore be considered as a suitable suppression/termination tool (Alonso-Ayuso et al., 2020). Of course, "regenerative" and/or "organic" labels are most useful when contextualized with ongoing, on-ground farm management practices, farmer experiences, and certification requirements (Staton et al., 2024).

Adopting healthier agricultural practices is at once difficult and necessary, yet ultimately dependent upon farmers' preferences, beliefs, and contexts. CCs are not a one-size-fits-all solution. When implemented and managed correctly, however, CCs can help root and spread the soil health revolution (Montgomery, 2018). They are a small but essential part of helping communities adapt to the triple planetary crises of climate change, pollution, and biodiversity loss.

Acknowledgment

I sincerely appreciate the late Dr. Cornelia B. Flora for her advisement.

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Appendix. Supplementary Findings and Discussion

I asked interviewed farmers to provide their level of agreement with 23 statements related to CC benefits and influences on their decision-making (Table A1).

Table A1. Interviewed Farmer Beliefs About Cover Crops (CCs)

#	Statement	*n*	$\bar{x}$
1	I believe that cover crops decrease the degradation of natural resources (soil organic matter, fertility, water retention, etc.).	14	4.50
2	Cover crops reduce the risk of commodity crop failure.	14	3.14
3*	Cover crops don't reduce dependence on pesticides and herbicides.	13	3.00
4	In general, planting cover crops is better than conventional (monoculture) methods.	13	3.92
5	Cover crops will reduce long-term dependency on external fertilizer inputs.	13	3.23
6	Conservation agriculture allows for optimized and sustainable yields.	13	4.00
7	Cover crops are a win-win for farmers and their agroecosystems.	14	3.93
8*	Cover crops do not help in adequately distributing nutrients in the soil profile.	14	2.36
9	I recommend other farmers in my area adopt cover cropping.	13	3.69
10*	Cover cropping is not applicable to my fields.	13	2.23
11	I believe cover cropping improves production efficiency.	14	3.93
12	Cover cropping requires new management skills.	13	4.31
13	Cover crops balance the soil ecosystem by carefully managing residue and waste.	13	4.15
14	To de-risk cover crop adoption, appropriate technical packages and training programs are needed.	13	3.69
15	Diversity in cover crops can reduce the occurrence of pests and diseases.	13	3.62
16*	Cover crops are ineffective for weed control.	13	2.23
17	Cover crops reduce climate risk.	13	3.54
18	Cover crops reduce soil erosion.	14	4.25
19	I am more likely to plant cover crops if government payments for them are *comparable to* payments for commodity crops.	13	3.62
20	I am more likely to plant cover crops if government payments for them are *more than* payments for commodity crops.	13	3.85
21	Current political and economic structures incentivize farmers to adopt cover crops.	13	3.00
22	I would be willing to try to incorporate groundcover into my cropping systems sometime before 2026.	11	3.91
23	Groundcover seems advantageous to cover crops that need terminated.	12	3.50

Note: Items source from Maria et al.'s (2023, p. 120) reliable "conservation agriculture" scale; s*trongly agree* (5), *agree* (4), *undecided* (3), *disagree* (2), strongly *disagree* (1).
* Reverse coded to ensure respondents paid attention to the directionality of all the questions.

To contextualize and compare interview data, I consulted county-level longitudinal (1997–2023) and cross-sectional (2017, 2022) variables (Miller-Klugesherz, 2025), and rank-compared them to the same variables from the other 859 NOAA NCEI–designated (2024) U.S. Corn-Soybean Belt (CSB) counties (Miller-Klugesherz & Flora, 2025). Table A2 details the residue cover crop ranges from 2005 to 2019.

Table A2. Pottawatomie County, Kansas, Residue Cover Ranges, 2005–2019

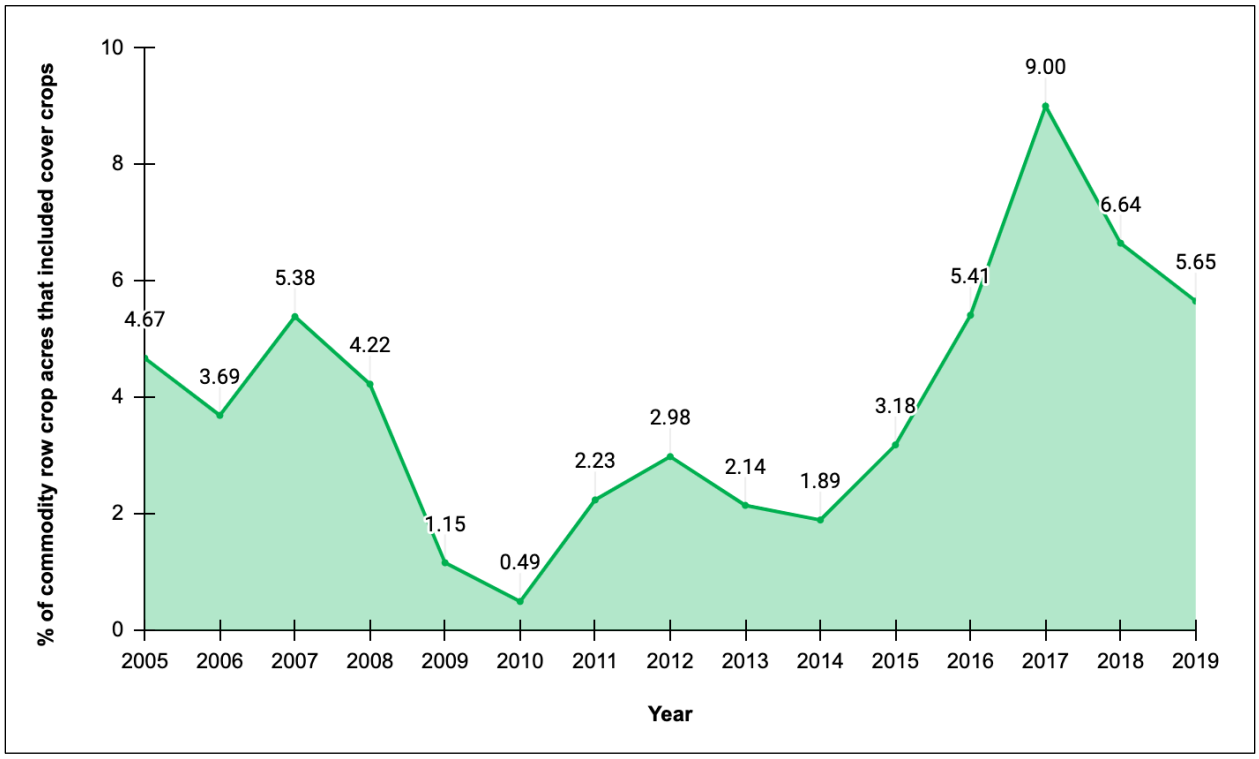
Percent of total acres[a] with …	% residue cover range[b]	% Δ, '05-'19	r^2	Min. (yr.)–Max. (yr.)	CSB '19 Rank %
… conventional tillage, very low residue cover level.	0–15	–27.95	0.217	8.93 ('13)–26.65 ('05)	58.46
… reduced tillage, low residue cover.	16–30	–8.17	0.083	32.75 ('16)–53.74 ('07)	66.57
… reduced tillage, moderate residue cover (all previous year's crops *except corn*).*	31–50	–10.64	0.217	20.81 ('16)–49.02 ('13)	37.96
… reduced tillage, moderate residue cover (*only corn* was the previous year's crop).*	31–50	–28.16	0.019	28.39 ('13)–59.39 ('05)	65.20
… significantly reduced tillage, high residue cover.	51–100	0.91	0.011	15.89 ('06)–26.73 ('10)	51.31
… significantly reduced tillage to no tillage, high residue cover.	51–100	11.10	0.072	3.56 ('15)–19.54 ('08)	27.37
… cover crops.		20.99	0.156	0.49 ('10)–9.00 ('17)	72.90
… winter commodity crops.		–80.44	0.654	2.04 ('17)–18.12 ('05)	70.56
… perennial crops, such as hay(lage) or pasture.		–72.63	0.531	2.73 ('11)–15.37 ('05)	82.81

[a] Total acres were calculated by summing "acres with CCs" and "acres without CCs," and included all previous year crop types (except for asterisked variables).
[b] Residue cover ranges 30% were considered "conservation tillage," whereas ranges ≤30% were considered "conventional tillage."

I used Hagen et al.'s (2020) OpTIS 2.0 data—that was collected via remote sensing and validated with field-level verification data—to determine that the percent of PT acres with CCs peaked at 9% in 2017 (Figure A1), which well above the national or regional average at that time.[4] There was a positive percent change of commodity row crop acres containing CCs from 2005 to 2019 (% Δ = 20.99), although there was a sustained dip below 5% from 2008 to 2016.

[4] There are differences in how USDA NASS and OpTIS measure and calculate of the percent of farmland with cover crops. The former relies on survey responses to the Ag Census, and the latter measures the ratio using remote sensing and ground-truthing. The latter is collected every year, and the former every five years. Therefore, although the ratios are not the same every year, the general direction and degree of the linear trends mirror one another.

Figure A1. Percent of Commodity Row Crop Acres with Cover Crops, 2005–2019



Data source: Hagen et al., 2020.

Journal of Agriculture, Food Systems, and Community Development
ISSN: 2152-0801 online
https://foodsystemsjournal.org

Scaling up urban agriculture in Tempe, Arizona: A participatory planning case for early urban food policy

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Submitted August 24, 2025 / Revised November 1, 2025, and January 5, 2026 / Accepted January 13, 2026 / Published online March 23, 2026

Citation: Giraud, E. G., Bevacqua, E., Mercer, M., Benard, N., Nayak, P., Trahan, T., & Merrigan, K. A. (2026). Scaling up urban agriculture in Tempe, Arizona: A participatory planning case for early urban food policy. *Journal of Agriculture, Food Systems, and Community Development*, *15*(2), 81–124. https://doi.org/10.5304/jafscd.2026.152.026

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Abstract

This paper documents an early-stage participatory planning process to scale up urban agriculture in Tempe, Arizona, an arid, land-constrained city that in four contiguous neighborhoods faces high rates of food insecurity and vulnerability. Using a Participatory Action Research (PAR) approach, a transdisciplinary team of researchers, city staff, and community-based organizations collaborated with neighborhood residents to assess the state of urban agriculture, identify local priorities, and co-develop ten policy recommendations. The process included 86 food access surveys, mapping, practitioner interviews in Tempe and with representatives from six

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other cities, and community workshops. Residents emphasized the need for urban agriculture spaces that support food production, education, workforce development, and community building. Key barriers included limited funding, volunteer instability, and poor communication of existing resources. Despite water scarcity and land pressures, the study highlights how urban agriculture when water-smart and strategically located can serve as resilience infrastructure and address intersecting civic, environmental, and social goals. The case contributes to growing evidence that participatory planning supported by trusted intermediaries can shape agendas before formal food policy structures exist, and foster civic engagement, social connections, and institutional learning essential for food systems transformation. It serves as an example of pro-connection public engagement that addresses the loneliness epidemic, and proposes recommendations for transitioning from fragmented grassroots efforts to a coordinated, equity-centered urban agriculture system in Tempe. The findings offer insights for other cities exploring participatory food planning in the absence of formal food policy structures.

Keywords
participatory planning, urban agriculture, urban food policy, food governance, equity, civic health

Introduction and Literature Review

Cities play an increasingly important role in food systems governance, and their role in creating sustainable and resilient food systems is recognized by the United Nations Sustainable Development Goals (United Nations Department of Economic and Social Affairs, 2015). Although food and agriculture have been traditionally excluded from urban planning for the best part of the 20th century, especially in the Global North (Pothukuchi & Kaufman, 2000), the turn of the 2000s saw an increase in urban agriculture policy instruments in the U.S. (Halvey et al., 2021). Urban agriculture (UA), described by the U.S. Department of Agriculture as including "backyard, roof-top and balcony gardening, community gardening in vacant lots and parks, roadside urban fringe agriculture and livestock grazing in open space" (USDA Climate Hubs, 2020), is often advanced as a solution to increase local resilience and sustainability because of its potential to reduce food transportation emissions, strengthen the local economy, and provide an array of environmental and social benefits for urban communities (Hebinck et al., 2021; Lal, 2020; Mok et al., 2014; Nogeire-McRae et al., 2018; Siegner et al., 2018; Vermeulen et al., 2018). In fact, 15% of U.S. farms are now located in the 50 most populated cities (Hinds, 2023) and many municipalities have expressed intentions to scale up urban agriculture by "increasing the number and diversity and boosting size, productivity and capacities of urban agriculture operations" (Qiu et al., 2024, p. 84). More than 300 local governments around the U.S have been engaging recently in food systems planning and policy to various degrees (Halvey et al., 2021; Raja, 2024), most of which include participation planning (Beckie et al., 2013, Berke et al., 2006, p. 293; Freedgood & Fydenkevez, 2017; Karetny et al, 2021; Raja et al., 2018; Sloane et al., 2019). Indeed, participatory planning, which necessitates citizen participation and community engagement to produce policy in collaboration with government (Caldeira & Holston, 2015; Smith, 1973), is crucial to successful, viable, and equitable UA public policy planning (American Planning Association, 2025; Cassatella et al., 2022; Diekmann & Ostrom, 2020; Poulsen et al., 2014). While equity is often stated to be a core goal of food planning, detailed documentation of the specific steps taken to involve residents from traditionally underserved groups in early municipal food and UA planning remains limited—especially before initiating formal food policy councils or food action plans.

Disclosure
This study was conducted according to the guidelines of the Declaration of Helsinki and considered exempt by the Institutional Review Board of Arizona State University pursuant to Federal Regulations 45CFR46 (STUDY00016641).

Funding Disclosure
This material is based upon work supported by the USDA, under agreement NR223A750001G014. Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the authors(s) and do not necessarily reflect the views of the USDA.

In Arizona, although 36% of the land area is used for agricultural purposes and 14.1% of the population is food insecure (including 20% of the Latino population), only a few local governments are engaged in food and urban agriculture planning (Feeding America, 2023; University of Arizona Cooperative Extension, 2022). The City of Phoenix is the only local government to have formally adopted an urban food action plan at the time of this research (City of Phoenix, 2020), in spite of multiple participatory efforts led by community groups such as the Pima County Food Alliance and the Arizona Food Systems Network (Arizona Food Systems Network, 2022; Bhakta et al., 2024) and ongoing work initiated by the City of Flagstaff (City of Flagstaff, 2025). Although these efforts all seek equitable community engagement to inform food planning efforts, the extent to which food insecure residents are able to actively propose, design, engage with and comment on the cities' initiatives to develop food and UA policies often remains unclear, making it difficult to assess the scope and depth of participatory efforts. This article contributes to that gap by detailing the formative phase of participatory UA planning in Tempe, a mid-sized and resource-constrained Arizonan city seeking to build equitable food governance from the ground up.

Urban agriculture planning and governance processes have been criticized for reproducing the overall food system's prevailing socio-economic inequalities (Alkon & Agyeman, 2011; McClintock, 2014; Raja 2024). Collaboration in urban food systems policy-making is often limited to the actors who can more easily understand and access the cogs of governance and power networks, with leadership roles often occupied by white middle-class residents (Hoover, 2013; Maurer, 2021). Even when diverse actors engage in UA planning and governance, such as farmers, food businesses, and food policy councils, it is not always clear who does and does not benefit from the process (Carrad et al., 2022; Moragues-Faus & Battersby, 2021). People who experience food insecurity are rarely actively engaged in food policy making and governance although they are often the direct target (Anderson, 1990; Raja, 2024). This merits attention because inequitable UA leadership produces unequal distribution of impacts, which can undercut its potential benefits (Sbicca, 2019). Early stages of UA planning present the opportunity to lay down structures and processes that will support long-term collaboration of policymakers with diverse groups, especially those who are traditionally less represented, less familiar with local policymaking processes, and/or experience food insecurity. For meaningful transformation of policy making and governance, local governments should explicitly plan for inclusive processes (Clark et al, 2017). By presenting the participatory efforts of the City of Tempe, this work aims to serve as a blueprint for practitioners and researchers seeking to initiate urban agriculture planning efforts that aim to engage residents from traditionally underserved neighborhoods.

Until the mid-20th century, Tempe was basically a small farm community, 13 miles from Phoenix, the state capital. Today home to over 189,000 inhabitants, Tempe has been engulfed by the urban sprawl of the Phoenix metropolitan area. Housing and commercial development overtook most of its arable land (Shrestha et al., 2012), and urban agriculture initiatives today are scarce and fragmented. Over the last decade, the City of Tempe government has gradually shown interest in UA, as it aligns with the government's sustainability and resilience strategy (Kay et al., 2022; Withycombe Keeler et al., 2019). Both the Tempe 2040 and 2050 General Plans also explicitly set objectives to support and develop UA initiatives (City of Tempe, 2013, Land Use and Development Chapter, p. 13; 2023a, pp. 247–248). However, Tempe urban agriculture aspirations are constrained by its relatively high population density, limited space, development pressures for housing and businesses, socio-economic disparities, and the U.S. Southwest Megadrought (Williams et al., 2022). The combination of these factors is pushing many local actors to encourage housing development over agriculture, and the new "Ag to Urban" bipartisan program aims to save nearly 10 million acre-feet of water through the sale of Arizona farmlands to housing developers (Office of the Governor Katie Hobbs, 2025; Porter & Sorensen, 2023).

Conscious of these challenges, our project team partnered to develop a two-year planning

grant proposal to scale up UA and leverage its benefits for economically vulnerable populations. Initiated by the USDA Office of Urban Agriculture and Innovative Production (OUAIP) in 2022, the project specifically focused on engaging low-income populations with low access to food (LI/LA) in participatory planning to initiate UA efforts, especially with the University Heights, Escalante, Victory Acres, and Alegre Community neighborhoods, which constitute Tempe's very high-equity priority zones (Appendix A). Our participatory action research focuses on the early stages of food and urban agriculture planning and seeks to better understand how to effectively engage LI/LA neighborhoods to transition from fragmented grassroots UA initiatives into a "scaled-up" and integrated system with institutional support and community value. To guide this work, we asked: Which programs and policies can help scale up urban agriculture in Tempe to respond to the needs of residents experiencing food insecurity while aligning with the city's agenda for sustainability and resilience? Recent research by Qiu et al. (2024) proposes a conceptual framework that identifies pathways through which scaling up UA can occur, distinguishing three phases in a "triple S" growth curve that describes the pathways for scaling up UA. Each phase is characterized by its respective accelerator: individual accelerator (Phase I), institutional accelerator (Phase II), and economic accelerator (Phase III). A series of transformative changes are needed in each phase for UA to continue growing, scaling up, and progressing towards desirable pathways (Figure 1). Without such changes, the efforts risk declining and leading to undesirable outcomes. The purpose of this participatory and transdisciplinary research is to (1) pinpoint which phase currently characterizes the state of Tempe urban agriculture, and identify policies and programs to support current actors and propel the city into further phases, (2) provide a documented case of early urban food planning, and (3) offer insights for other cities exploring participatory planning to create or develop urban food policy.

Methods

We used Participatory Action Research methods (Bradbury, 2015; Cohen & Reynolds, 2014) to identify the core issue (i.e., how to scale up urban agriculture in Tempe to align with the City's goals for sustainability and resilience, and respond to the needs of residents experiencing food insecurity) and design the research (i.e., conduct a baseline assessment, review existing UA initiatives in other U.S. cities, and develop policy recommendations for Tempe) (Figure 2).

The project team (PT) included city staff from Tempe's Office of Sustainability, local community organizations (one focused on building community leadership, education and health in the Phoenix metropolitan area, one promoting the development of food forests in Arizona, and one promoting school gardens) and the research team (RT) was composed of researchers from different disciplines working to support Arizona food systems. Together, they co-defined, co-designed, and co-implemented the research project, and most project team members are co-authors of this paper. Additional participants—primarily Tempe residents—engaged throughout the project through consultation, cooperation, decision-making, and providing information, as defined by Karl (2002).

To address the core issue, the project team developed two sub-research questions: RQ1 – What is the state of urban agriculture in Tempe? and RQ2 – Which practices from other cities can best inform scaling up urban agriculture in Tempe? The research questions and design initially stemmed from the UA planning grant proposal, co-developed by the project team partners through a series of meetings in 2021. They were further refined throughout the two years of the project across team meetings and participants' engagement, which was anchored in the project design. The project team also identified four core priorities for the project: food security, education, workforce development, and water security (definitions in Appendix B), which reflected priorities from the participating community organizations and Tempe's Climate Action Plan.

Baseline Assessment

To answer RQ1, the project team conducted a baseline assessment between fall 2022 and spring 2023 of existing urban agriculture initiatives in Tempe, that included four elements:

(1) The research team reviewed the City Council Strategic Priorities, the Tempe Climate Action Plan, the Urban Forestry Master Plan, and the AZ Indigenous Foodways Yearbook (City of Tempe, 2017; City of Tempe Strategic Management and Innovation Office, 2022; Kay et al., 2022; Zah, 2020) to identify Tempe's existing goals and plans relevant to urban agriculture.

(2) The research team conducted ten semi-directed interviews of UA practitioners in different Tempe sites. While this number may appear limited, it reflects the relatively small number of active UA sites in the city. The sample included four community gardens (the only ones known by the City of Tempe at the onset of the project), one urban farm (the only registered farm in the city during the project), four school gardens (among the six most active known to the project team at the time), and a student-run homestead garden. These sites were selected from the sites listed on public records or known to the project team, and selection was based on the availability of the growers in charge of each site, their work with LI/LA populations, and their work towards the project team's priorities (food security, workforce development, education and

Figure 1. Developmental Pathways for Scaling Up Urban Agriculture Over Time

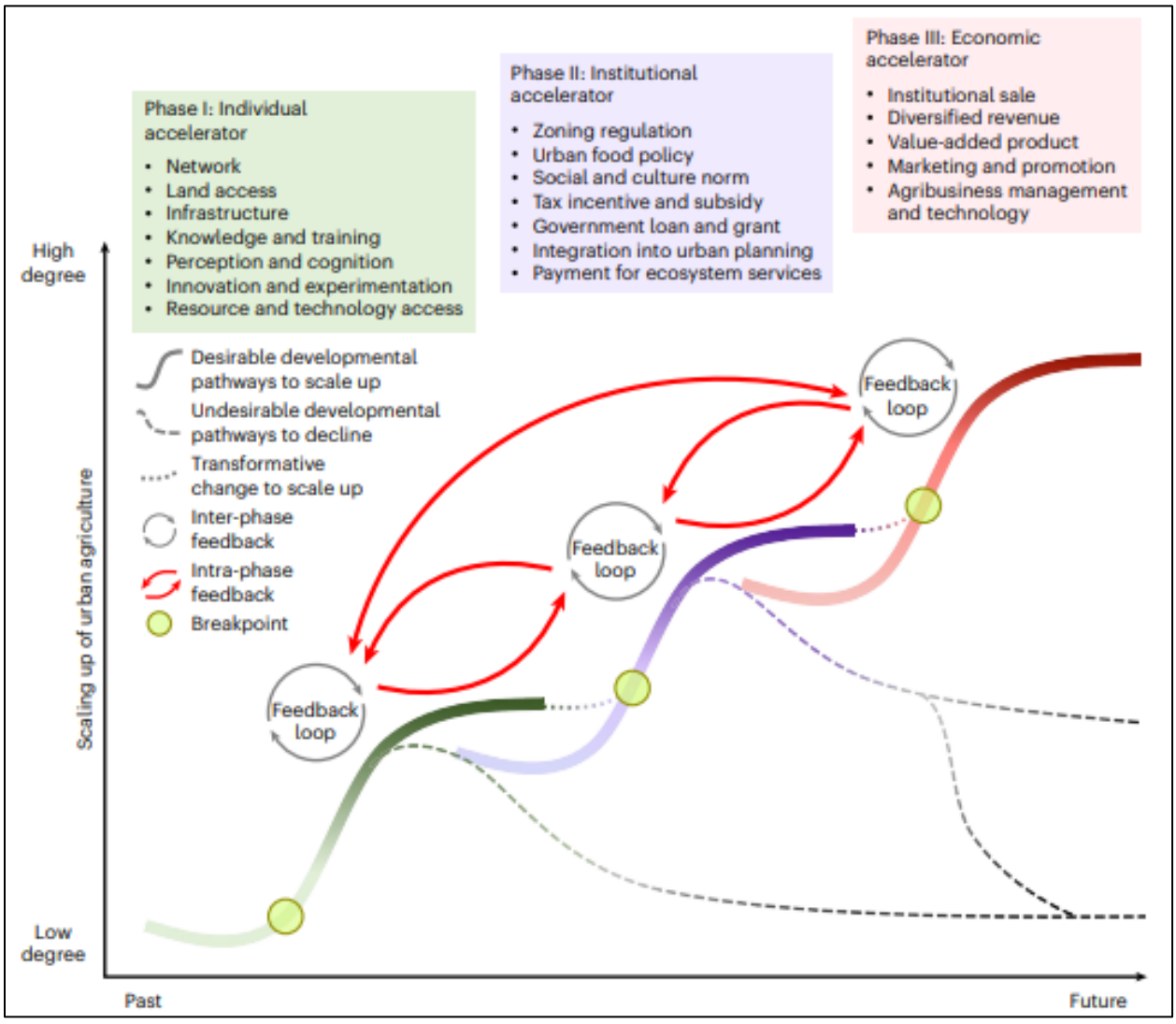
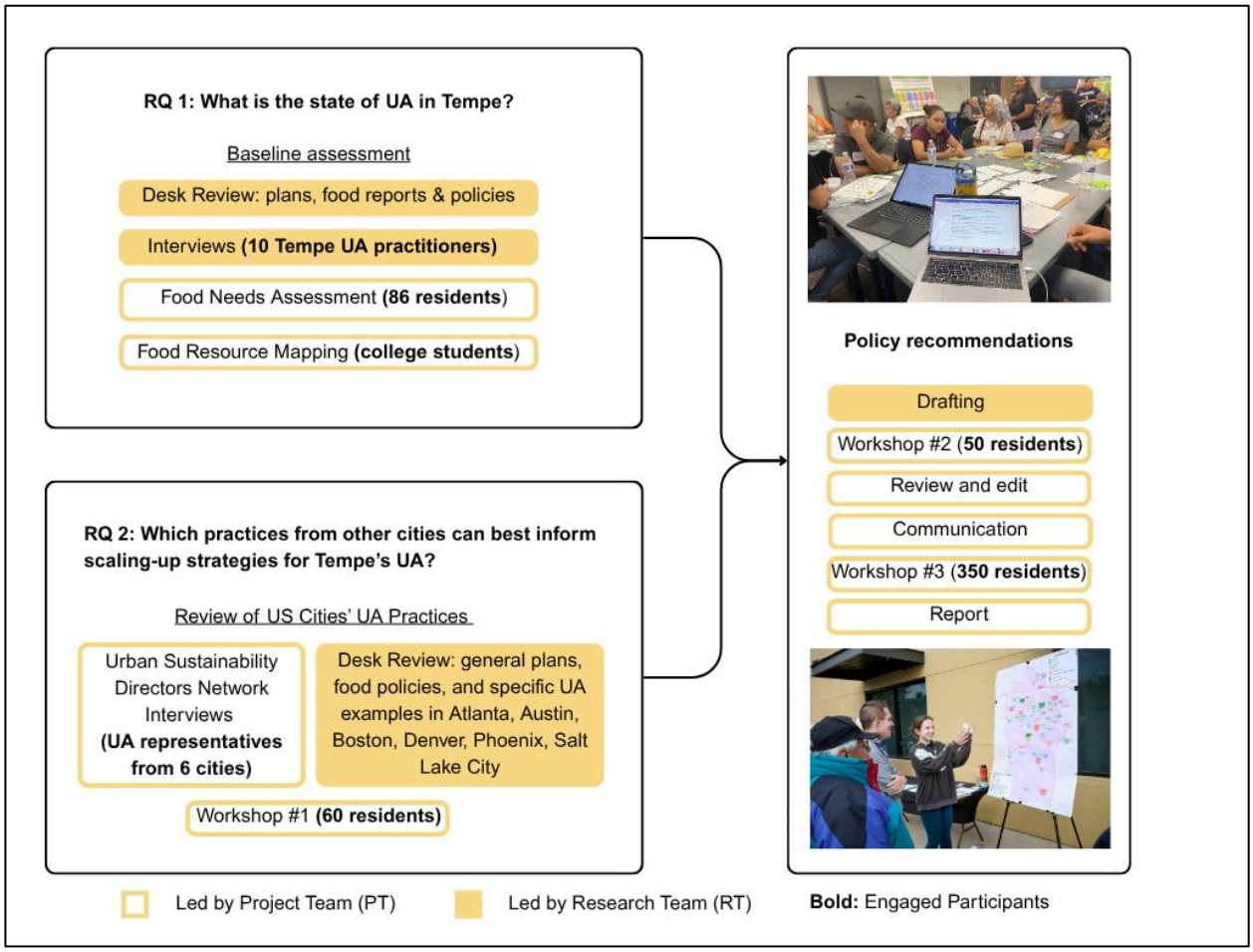


Figure reproduced with permission from Qiu et al. (2024, p. 87).

water security). Although they constitute the largest number of UA sites in Tempe, individual home gardens constitute the least represented category in the sample because there is no record of these sites and building a representative sample would have gone beyond the project's capacity, and because these sites are not as accessible to the public as the other sites. The only home garden included in the sample was student-run, located in a low-income apartment community, and visible and accessible from the street, which best aligns with the project priorities of supporting food security, workforce development, and education. We used Applied Thematic Analysis (ATA) to define and analyze themes emerging from the interview transcripts (Guest et al., 2012). The analysis served to identify current successes and barriers experienced by UA practitioners, the perceived role of UA for the project's four priorities, and to highlight potential solutions to scale up UA in the city (Appendix C).

(3) Community health workers from the project team surveyed 86 community members (60% Hispanic: Appendix D) in the Escalante, Victory Acres, and Alegre Community neighborhoods, which have a high concentration of Hispanic residents (more than ten points above the city average of 22%). One-on-one surveys were conducted at a variety of locations, including the Escalante community garden, the local food bank, Iglesia de Dios Pentecostal church, the Escalante community center, and through door-to-door canvassing efforts in Alegre, Escalante, and La Victoria/Victory Acres. Although the sample is not statistically representative of the neighborhood population, as it includes a higher proportion of Hispanic and female

Figure 2. Participatory Action Research: Project Design



respondents, the recruitment strategy—centered on community hubs such as gardens, food banks, and churches—captured perspectives from residents most connected to local food access efforts, which are central to the study's aims. The questionnaire (Appendix E) pertained to food access, food security, nutrition and education, and asked which UA initiatives they would like to see in their neighborhoods. The purpose of this needs assessment was to understand the food environment of these residents, to provide opportunity for residents to suggest paths to improve UA in their neighborhoods, and to determine their priorities in scaling up UA in the city. Residents were able to give feedback on the results of the need assessment during workshop #2.

(4) The mapping exercise allowed the project team to review and categorize the existing sites that form the fabric of UA in Tempe, identify the spatial trends, and create a visual baseline of sites to share with the public. The project team used the results of the interviews (2) and surveys (3) and worked with a group of college students to identify the sites that support UA and provide support to people experiencing food insecurity, review their activity, and generate a publicly accessible map using ArcGIS.

Review of Urban Agriculture Practices in Selected U.S. Cities

To answer RQ2, the review was conducted in three steps:

(5) The project team reached out to the Urban Sustainability Directors Network (2025) with a request to interview urban agriculture representatives. USDN partners from Atlanta, Austin, Boston, Denver, Phoenix, and Salt Lake City offered to share their insights. After a preliminary desk review of the cities' activities, we conducted semi-structured interviews in December 2022 and January 2023 led by the City of Tempe staff (questionnaire example in Appendix F). These were not recorded or transcribed but were the subject of extensive notetaking by two to four members of the project team. The purpose was to discuss the funding and governance structure of their UA initiatives, and their unique successes and challenges. To analyze the content of the interviews, the project team members compared notes, held meetings with the partnering organizations on the project, and identified some activities and strategies that could be applicable to Tempe.

(6) After the interviews, the research team compiled a list of initiatives in the cities through in-depth desk reviews of their food plans, policies, and programs, and created six city profiles of UA best practices that were returned to each interviewee for validation.

(7) The project team selected eight initiatives that best aligned with the project team's priorities and results from the baseline assessment, and submitted them for residents' feedback. The initiatives were presented on thematic posters during community workshop #1 and used to collect residents' thoughts and priorities (Appendix G). This workshop took place during an Escalante outdoor festival organized by Parks and Recreation that attracted 150 participants thanks to multiple communication channels (e.g., email, community centers, posters, and social media). During the festival, participants walked around and interacted with different community booths. Sixty Tempe residents directly engaged with the posters presented by our research team, placing stickers to vote for the initiatives they liked, and sharing comments on how they saw these initiatives contributing to their vision for UA in their city (Appendix H).

Policy Recommendations

Following workshop #1, the research team used participant feedback and preferred initiatives to draft ten policy recommendations that aligned with the project team's priorities and the results from the baseline assessment. These recommendations were initially reviewed by other members of the project team, who provided details on how to weave them into existing local programs, then shared the recommendations with 50 adult community members (75% Spanish speakers) during an evening workshop (workshop #2) held in the Escalante neighborhood (see Appendix I for agenda and facilitation guide). Participants were

recruited by partner community organizations using existing contacts and mailing lists and by placing posters at the community center. Many residents attended with their children, and food, childcare, and a free bag of local produce were provided on site. Residents formed into groups, with members of the project team—a facilitator, a notetaker, and a Spanish-English translator—presenting drafts of the recommendations using images (Appendix J). Participants could express their thoughts verbally, through drawings, sticky notes, and confidentially, using an envelope system (Appendix K). Throughout the conversations, the participants decided on their preferred recommendations to guide the city's future AU work. After the discussions, the workshop also included a cooking demonstration with tasting, which further elicited comments and thoughts from the participants (Appendix L). Following the workshop, the project team integrated the feedback to finalize the policy recommendations shared with the residents and the City of Tempe via a digital report, and during a public workshop held in the Alegre Community (workshop #3) with over 350 Tempe residents. During this workshop, interested participants engaged with the map and the recommendations, and received complimentary seedlings, soil, and local produce on a first-come, first-served basis thanks to a partnership with local farmers (see Appendix M for more details).

Reflexivity and Evaluation

After each workshop, the project team members gathered to discuss the event and reflect on their own engagement with community members. They asked themselves: What went well? What did not? Did we miss opportunities to better listen? Were we able to effectively engage all participants? These one-to-two-hour debriefing sessions encouraged us to continuously improve our community engagement and trust-building efforts (Clark et al., 2017). Consistent with Participatory Action Research principles, the project team informally evaluated engagement effectiveness through workshop attendance tracking, demographic diversity, and participant feedback forms (whenever possible), and post-event debriefs with facilitators. Indicators of success included recurring and multilingual participation, and visible integration of residents' priorities into the policy recommendations.

Results

The baseline assessment, review of best practices from other cities, and regular resident engagement informed the development of policy and program recommendations.

RQ1: State of Urban Agriculture in Tempe

Weaving perspectives from Tempe UA practitioners with those from the project's neighborhoods, the project team identified existing challenges and opportunities for Tempe UA.

Food Insecurity and Need for More Healthy Food Options

The residents confirmed their interest in UA initiatives, in part motivated by their experience with food insecurity. The overwhelming majority (94%) purchased their food at the grocery store, but 53% of them worried about running out of money, and 48% expressed not having enough money to buy the food they need, which confirmed the high proportion of individuals experiencing food insecurity in our sample. Less than half were satisfied with their options to purchase healthy food. They viewed UA as a means to increase food access and to learn to grow their own food. All UA practitioners reported that their gardens/farms increased personal and community food access. Many residents also noted time constraints and indicated preference for community orchards and gardens with shared plots so that they could collaborate on production efforts and build a sense of community.

Need for Resources and Coordination

All Tempe UA practitioners expressed needing more resources, especially funds and manpower, which are vulnerable to fluctuations over time. They asked for funds in the form of grants and rebates on supplies, and for existing grants to be more accessible as the application process can be daunting. One gardener interviewee said, "Trying to find funding for the garden specifically is really difficult because we don't generate any kind of income. It's hard to create any kind of pool for funding for things. It's part of trying to look for

grants, and it all takes a lot of time to try to get donations or grants or things like that." Labor was also a leading concern, as most sites to run their activities heavily rely on volunteers, who take time to train and can be unpredictable. Volunteering can provide a path to workforce development, but it also requires capacity and adaptability from the hosting organization. A community garden leader mentioned the lasting effect of COVID: "a lot of volunteers have spread away, it's kind of like we are starting over again." As a result, more than half the practitioners would like to receive support from the city in attracting a flow of volunteers. A school garden coordinator asked for a "team of volunteers that would come out and help the school build it" because "teachers are really overworked." The flow of volunteers appeared to be even harder to manage in low-income neighborhoods: "In this neighborhood, you're not going to get parents that come on weekends and volunteer for gardens. They're working. They're hard-working families, and they just don't have the time to come and just play in the garden. And we had, we'd have a parent-garden day, and I have maybe five parents show up." Even when there are enough volunteers, training them takes significant resources from the site coordinators, who need to plan garden activities around their involvement, availability, and preferences. While three practitioners have many years of experience in managing volunteers, others could benefit from their expertise. One of them said: "I would love to be learning from someone who knows more than me. A lot of times I'm kind of like the end-all person in the garden, and I feel like I know so little."

Residents and practitioners alike asked for better communication on the existing resources and initiatives to support urban food production. For example, a school garden coordinator pointed out that it was not widely known that the city offers small grants for school gardens, so many schools do not apply for them. Residents reported not knowing where to find healthy food options. A majority of them (52.3%) did not know about the Escalante community garden and its CSA box options, although most of them live less than a mile away from the garden. Out of 10 interviewees, four UA practitioners asked for a point person at the City of Tempe government to coordinate UA initiatives, serve as a knowledge source for the community, communicate existing resources, and support networking among growers.

Despite the southwest Megadrought, water security did not appear to be an immediate concern for any of the practitioners, possibly because none were in charge of the water budget for their garden, which was handled by either the city, a school district, an administrative department, or a Homeowner Association. However, all practitioners noted that they use drip irrigation and desert-adapted plants as much as possible.

Integrating Agriculture in Public Spaces

The interviews and surveys revealed a strong interest in weaving food growing spaces into public and community spaces, mostly parks and schools but also parking lots and apartment buildings. These spaces would increase food security through improved food access, and offer education and workforce development opportunities. Residents and practitioners believed that gardens should be included in regular planning for city development and maintenance of public areas: "When the City is redoing a park, it could include a garden in their plans, you know, just like they include a basketball court, a playground, a dog run, whatever it is." One practitioner expressed that existing community gardens located on community center grounds could become food hubs and serve as a model for other Tempe parks in: "I would have loved to see this kind of CSA distribution at parks throughout Tempe so that people could just walk one day a week and pick up fresh local produce from farms and also be invited to get involved in other garden activities if it interests them." In fact, about 83% of surveyed residents believed that only building recreation sites should be second to building food production sites. According to practitioners and residents, these hubs should include community gardens, subscription CSA boxes with food from the gardens and from local farmers, nutrition education, cooking and gardening classes, and even food entrepreneurship incubators. Practitioners stressed that local farmers should play a key role in those hubs. They should be paid to educate the community on local food systems, and could also

support training the city landscapers so that food growing spaces coexist with traditional landscapes in city parks.

Parking lots offer an unusual but promising growing site for Tempe. Parking spaces constitute 10% of the Phoenix region (Hoehne et al., 2019); according to city code, a minimum of 12% of the surface area of all parking lots should be landscaped with shade trees, shrubs, and ground cover plants (City of Tempe, 2025a). One practitioner led a local non-profit with a unique garden initiative on a Tempe parking lot, growing watermelon, eggplant, okra, basil, and more, all freely accessible for people to take: "We are flourishing over here. If you need it, take it." The organization also uses the garden space to offer classes on nutrition and well-being and provides employment and training opportunities to residents in transitional housing. They are ready to collaborate with the City to reproduce their model, and believe there could be an opportunity to integrate food gardens as landscaping for new housing developments: "Okay, build apartments, but the people that live in those apartments should have no landscaping but gardens."

Schools also offered an important opportunity to grow food in Tempe. The map revealed 23 sites in Tempe with some form of school garden (City of Tempe, 2024b). Some of these were no longer operating and/or were very limited in scope (e.g., consisting of one raised bed) but all revealed interest from some school members at some point, which could be leveraged with proper support. Considering that the Tempe school districts are some of the largest landowners in Tempe, and that the schools are spread out across town, they could provide food and educational opportunities for most city neighborhoods. The interviewed school garden coordinators appreciated the support they received from the City of Tempe and wished for a better coordinated effort at the district level to support their gardens. Just as schools include sport facilities, they could dedicate some of their space for food production education. Although the city does not have control over the district, it could encourage the district to support school UA and also serve as a model by growing food in parks to create a blueprint of what it takes to develop and maintain publicly owned and operated UA sites: "We can grow so much in the desert…The City could model as a system for a school district…Like really create a roadmap of some kind for what that looks like."

The baseline assessment confirmed that Tempe UA was largely supported by individual-level and grassroots efforts, with minimal institutional support and market opportunities. According to Qiu et al. (2024), this would indicate that Tempe was in Phase I. The purpose of RQ2 was to identify the policies and programs that would help propel the city toward Phase II, where individual efforts are supported and driven by coherent institutional support and planning, and toward Phase III, where market-based economic factors and profitability support the upscaling of urban agriculture.

RQ2: Selected Practices from Other U.S. Cities to Inform Scaling Up UA in Tempe

Atlanta, Austin, Boston, Denver, Phoenix and Salt Lake City have had noteworthy successes with UA initiatives and programs, of which many can provide inspiration for comparable and aspirational cities. The City of Atlanta invested significant resources to grow and coordinate UA. It launched AgLanta, the city's initiative for UA and local food businesses with the goal of 100% of Atlanta residents living within a half-mile of affordable fresh food (AgLanta, n.d.). The initiative also provides the option for residents to convert vacant lots into community gardens. AgLanta was selected by the project team to inform scaling up urban agriculture in Tempe, for its coherent and ambitious vision and planning to increase food access. The City of Austin introduced the Healthy Corner Stores initiative in 2015, helping bring fresh and local produce from City-approved farms to convenience stores in neighborhoods with high rates of food insecurity (Janda & van den Berg, 2020). This initiative was selected by the project team for its focus on food insecurity reduction. The City of Boston Office of Urban Agriculture, "GrowBoston," hosts a community garden and urban directory, which counts 112 community gardens and 18 urban farms across the city's neighborhoods in 2025 (City of Boston, 2025). One urban farm, Eastie Farm, operates sev-

eral community gardens, partners with local schools to provide infrastructure for school gardens and educational programs for students, and serves as a community space where residents can gather (Eastie Farm, 2025). It was selected by the project team to inform Tempe's future planning for its focus on community development and garden education. Huerta Urbana was a Denver-based initiative selected by the project team for its impacts on workforce development. Created in 2020, the agricultural social enterprise trains families in local food production and distribution, supports them with a stipend, and provides a Colorado State University Beginner Market Farmer Training Certificate (Focus Points Family Resource Center, 2025). In Salt Lake City, the SLC Share program was selected to inform Tempe's planning because of the many fruit trees in the city that remain unpicked (especially citruses), and because of the program's focus on food security and workforce development. SLC FruitShare allows residents to register their fruit trees to receive maintenance support; the fruits are picked by volunteers and shared between the tree owner, the volunteers, and community food banks (slcGreen Blog, 2019).

Additional UA initiatives were selected in Phoenix because Tempe is part of its metropolitan area, and the adoption of similar municipal initiatives through tailored governance strategies could increase the initiatives' impact (Liu, 2025). First, the Phoenix backyard gardening project, an American Rescue Plan Act-funded initiative, allows LI/LA populations to apply for free installation of a backyard gardening system with educational support over the course of a year (City of Phoenix, n.d.). The team also selected Garfield's Garden on the Corner (GGC), a school garden at an elementary school that provides education on health, gardening, cooking and nutrition, and offers food bags to families (Edible Schoolyard Project, 2025). Both the backyard gardening program and the GCC were selected for their impact on food security and education. The gardening programs of the TigerMountain Foundation were the third initiative selected in Phoenix, for their focus on food security and workforce development. They work in challenged communities experiencing high rates of food insecurity and incarceration to provide garden work through shared use of community gardens, incubator farms, and other landscaping initiatives.

In total, eight initiatives from other cities were selected by the project team based on alignment with the results of the baseline assessment and the project team's initial priorities for food security, workforce development, and education (Appendix H). Two members of our research team presented the initiatives during workshop #1. Sixty participants interacted with the posters and voted for their preferred initiatives. The initiative that garnered the most votes was the Phoenix Backyard Garden, likely due to preexisting knowledge of the program, which many participants mentioned to the research team. The second most popular initiative, SLC Fruit Share, got interest due to the high number of established citrus trees that often remain unpicked around Tempe neighborhoods. Participants were excited about the idea of saving the fruit from waste, reducing backyard pests attracted to the unpicked fruit, and allocating it to those in need.

Policy Recommendations

The project team and Tempe residents who participated in the community survey and workshops cooperated to create 10 recommendations to inform future UA and food planning for the City of Tempe. Their recommendations directly align with priorities from Tempe's plans for sustainability and resilience. If implemented, each recommendation would contribute to scaling up UA in Tempe by enhancing individual, institutional, and economic drivers (Phases I, II, and III) (Table 1).

Discussion

This paper presents the detailed process through which city government staff, researchers, local organizations, UA practitioners, and residents from Tempe high-priority equity zones cooperated to identify strategies to scale up urban agriculture. We detailed the specific steps taken to involve residents, especially those from LI/LA populations. These residents informed our baseline assessment evaluating the current state of UA in Tempe and were decision makers in designing the policy and program recommendations to support the growth, diversity, productivity and capacity of existing

Table 1. Pathways to Scale Up Urban Agriculture in Tempe, Arizona, Through 10 Policy and Program Recommendations

Phase I: Individual Drivers	Phase II: Institutional Drivers	Phase III: Economic Drivers
Recommendation #1: Create a Tempe Food Action Plan rooted in community outreach and engagement.		
Residents gather and reflect on their vision for local food and propose goals to work towards. They gain knowledge about city governance.	The City initiates accelerators in alignment with residents' goals and priorities: zoning regulations, urban food policy, tax incentives, subsidies, etc.	The Food Action Plan may include goals supporting growth of local food markets; e.g., through public procurement or by incentivizing residents and local businesses to buy local food.
Recommendation #2: Increase urban agriculture visibility by growing in public spaces.		
Individual stakeholders learn about local foods and participate in public urban agriculture projects.	The City experiments with integrating food production spaces in public spaces and catalyzes future efforts. It helps transform social norms around where food can and should be grown. Zoning regulations become more inclusive of urban agriculture.	The visibility of urban agriculture projects serves as marketing and promotion opportunities for local farms and food businesses.
Recommendation #3: Collaborate with neighboring cities to expand some of their successful programs.		
Rather than being city- specific, resources, infrastructures, knowledge, and training opportunities are scaled across the region.	Partnership between cities allows for larger funding applications and more impactful projects. County- level urban planning guidelines help implement coordinated food strategies.	County-level guidelines and infrastructures facilitate growth opportunities and markets for urban food businesses.
Recommendation #4: Support gardeners and urban farmers through extension services and technical assistance to educate and to build networks.		
The City community liaison serves as a resource for individuals and facilitates their learning, experimenting, and networking opportunities.	The City community liaison facilitates social and culture norm shifting towards greater acceptance of food production experimentation.	Urban farming is valued as entrepreneurship, and urban farmers get opportunities to sell their produce in their neighborhoods and to local businesses.
Recommendation #5: Implement a fruit-sharing program.		
Participants improve their knowledge of fruit tree production cycles, maintenance, irrigation, pruning, and picking techniques. Tree owners are recognized for their participation in producing ecosystem services and supporting food security.	A plan to plant, maintain, and harvest fruit trees in public areas is created and integrated into urban planning.	New food business ventures are created to make use of fruit surplus.
Recommendation #6: Create viable workforce development options.		
Urban agriculture training is available from K-12 to college, for career change, and for seniors.	Local urban agriculture degrees provide a pathway to work with city park services, and urban agriculture careers are increasingly perceived as viable career paths.	Local growers have access to more professional training and are involved in training new urban growers, which helps diversify their revenues and provides opportunities for marketing and promotion.
Recommendation #7: Work closely with the Tempe school districts to promote school gardens and cooking.		
Empty school grounds are made available as arable land to create school gardens that serve as educational opportunities for students, their families, teachers, and staff.	The City works with residents and school districts to develop and implement roadmaps for specific schools, and provides dedicated funding and resources for school gardens.	Schools partner with local farms to offer CSA to families, teachers, and school staff.

Table 1, continued.

Table 1, continued.

Phase I: Individual Drivers	Phase II: Institutional Drivers	Phase III: Economic Drivers
Recommendation #8: Expand existing grants to have food-specific options.		
Residents' knowledge of existing grants improves, along with their grant application literacy, and the number of food-related applications increases.	Funding available for local urban agriculture and food projects is increased.	Funding dedicated to local food and agriculture entrepreneurship supports the growth of the sector.
Recommendation #9: Support rainwater harvesting and expand rebates for smart irrigation.		
Smart irrigation and water harvesting knowledge increases, helping to control the use of flood irrigation and water waste due to poor maintenance of irrigation systems, and helping to promote safe water harvesting.	The City provides discounts on water used for food production that is targeted for personal consumption and local markets.	Special water pricing for urban agriculture helps businesses become profitable faster. The use of smart irrigation techniques encourages them to grow native crops that thrive locally, and to develop new markets.
Recommendation #10: Center equity and uphold Indigenous Peoples and knowledge.		
Access to knowledge of native crops and usages allows individuals to adjust their personal consumption and production choices, and to create new networks to communicate these transformations.	Urban food policy centers equity and indigenous knowledge as fundamental norms for local food planning and activities. Indigenous plant names are integrated into public areas.	Local indigenous farmers and chefs are integrated into the City's food procurement plan.

operations by strengthening institutional support and economic opportunities. In focusing on equitable engagement, our work echoes previous recommendations by researchers and practitioners urging those involved in food planning to design inclusive processes (Clark et al., 2017; Raja et al., 2018; Sloane et al., 2019). At the onset of the project, the grant proposal was co-developed by the project team, which included researchers, city governance staff, and local community organizations with strong ties to the traditionally underserved neighborhoods involved. We worked together to frame the project with community members, many of whom spoke English as a second language and had limited experience in policy making, to assess the current situation, envision where the community would like to be, identify opportunities to improve the current situation, and propose recommendations to scale up urban agriculture in Tempe.

Although we did not formally conduct evaluation of the community engagement process, multiple indicators—recurring resident participation (from the baseline assessment activities to the last workshop), iterative refining of recommendations through feedback, and increasing solicitation of the City for food-related projects—suggested that the participatory process was effective in shaping outcomes and building a sense of community ownership. The research team attributes this success primarily to the work of local community organizations, especially to the community health workers (CHWs) trained in community-building leadership, education, and health promotion. CHWs' core competences, including communication, relationship building, and outreach (Unlimited Potential, 2025), facilitated meaningful connections with the participants, and fostered the project's genuine aspiration to what has been called "authentic participation" (Sloane et al., 2019, p. 206). We believe that this project initiated a political space of public exchange around the municipal food system, that holds the potential to increase feelings of political efficacy over time (Levkoe, 2011; McIvor & Hale, 2015). To optimize participation, we encourage other city staff and researchers to work with organizations that have meaningful connections and regularly work with the communities they seek to engage, and to ensure they have leadership in project design, participant recruitment, and data collection and analysis as we strived to do in this work. Continuous reflective engagement and debriefing sessions after each workshop also facilitated collaboration, alignment, and learning for all project team members. One such learning included

the recognition that the neighborhoods involved in this research are at a high risk of "green gentrification" due to their strategic location in Tempe. As cities seek to engage LI/LA neighborhoods residents in food policy planning, they need to guarantee that residents will be able to afford to continue living in the spaces they are helping transform (Anguelovski et al, 2022; Oscilowicz et al., 2021).

In addition to nurturing relationships and reflexivity, communication and logistics are essential to the success of participatory planning workshops. Before and between events, maintaining open lines of multi-media communication (social media, phone, email, flyers, canvassing, etc.) helps engage the residents where they are at. For the events, providing clear instructions on running the show, hosting planning meetings with all facilitators, co-developing agendas, and creating facilitation guides help to manage expectations for all facilitators and adjust to the inevitable unexpected. Providing translators, childcare, and food and refreshments on site are assets, and, along with previous researchers, we recommend using multiple tools to engage participants and collect their opinions and feedback, such as written text, pictures, stickers, drawings, color pencils and markers, charts, posters, envelopes, sticky notes, and produce and plants (Freedgood & Fydenkevez, 2017). Having some produce and a few local plants available can be particularly helpful when people are familiar with them but don't know their names or how to cook them.

Because several project limitations emerged, improvements could be made to strengthen community ownership over the research question, design, and analysis. First, although the grant proposal was designed through a partnership between city staff, researchers, and community organizations, investing in listening sessions and resident surveys prior to proposal design would help better tailor the project to residents' aspirations; for example, by involving college students perhaps as part of capstone research work. Second, although we did validate emerging themes with the community members, the data analysis process for RQ1 could have benefited from more community involvement, by hosting collaborative analysis workshops to make sense of the interview and survey data, and building capacity for analysis through mini-training to enhance reciprocal learning (Cargo & Mercer, 2008; Pain & Francis, 2003). As food policy can be intimidating, we recommend partnering with organizations that provide policy literacy training to obtain more sustainable results. The trainings could be easily included in the planning workshops, thus helping to democratize the food policy process and to lead to more resilient and desirable systems.

For the City of Tempe, the project participatory planning process helped secure another source of funding from USDA (the Local Food Promotion Program) that provided free commercial kitchen space in the Escalante neighborhood and bilingual business development training to Tempe residents. The project team also continues looking for more sources of funding to implement the recommendations, but challenges remain to better align the existing municipal plans, and the various but specific needs expressed by the residents. Tempe has set objectives to support and expand UA in its land use and community design goals (City of Tempe, 2013), but none of the current city council strategic priorities or performance measures explicitly include food policy. As such, there is a gap between the City's plans and the indicators it uses to track its progress. As of December 2025, the City Council has prioritized homelessness, feeling of safety in parks and neighborhoods, and tree and shade canopy (City of Tempe, 2025b), most of which could be supported by well-designed UA initiatives (Gibbins, 2019; Gorham et al., 2009; Hale et al., 2011; Mok et al., 2014; Siegner et al., 2018). Consistent with the literature and with our recommendation #1, we reiterate the importance for cities which seek to scale up UA to integrate food into their strategic priorities, with clearly articulated goals, and implementation metrics appropriate to their performance measures (Freudenberg et al., 2018; Hodgson et al., 2011).

For Arizona cities, however, as land pressure and water scarcity intensify, making such a commitment to UA is not evident, especially in light of recent municipal budget cuts (Shappell, 2024). Urban agriculture can be water-efficient, especially when it incorporates drip irrigation, rainwater harvesting, and desert-adapted crops

(Dhakal et al., 2015; Nabhan et al., 2020; Rufí-Salís et al., 2020), as many Tempe sites are already doing. Moreover, unlike conventional landscaping, which provides limited public benefit, food-producing landscapes can have many benefits, such as nutrition, education, climate mitigation, and community well-being. In our research, social cohesion and community emerged as core themes of the baseline assessment, consistent with the literature (Kirby et al., 2021; Petit-Boix & Apul, 2018; Veen et al., 2016). Residents recurrently talked about the opportunity to open public spaces where they could grow food, access fresh produce, learn from each other, engage, build relationships, volunteer, and share the workload. This translated into several recommendations: #2 (growing in public spaces), #4 (hiring a community liaison to help connect existing initiatives and residents to resources and to one another), #5 (creating a fruit-sharing program), and #7 (expanding school gardening programs).

The need for community reflects a larger loneliness concern in Arizona, ranked the ninth most isolated state in the country (Sepulveda & Barraza, 2024) and where participation in actions that build community and social cohesion is traditionally very low (Adams et al., 2016; Center for the future of Arizona, 2023). We can envision that further investments in community gardens, urban farms, and school gardens would foster networks, create a community of practice (Lave & Wenger, 1991), and strengthen connectivity, all contributing to civic health, social resilience, and a culture of care (Curry, 2002; Giraud, 2021; Hodbod et al., 2024; Joshi & Wende, 2022; Williams & Sharp, 2022). For Arizona cities, scaling up UA by prioritizing community food access and production could help increase trust in municipal institutions and serve as an example of pro-connection public policy in response to the country's loneliness epidemic (Office of the Surgeon General, 2023).

Conclusion

This research set out to explore how early-stage participatory planning can support the development of urban agriculture in Tempe, Arizona. Through a Participatory Action Research approach, we engaged residents from neighborhoods experiencing high food insecurity alongside local practitioners, students, and city officials to assess the current state of UA, document barriers and opportunities, and co-develop ten policy recommendations for scaling up UA in alignment with community needs and the City's sustainability and resilience goals. Our findings confirm that Tempe UA remains at an early stage, with dispersed grassroots efforts and limited institutional coordination, Phase I of a scaling up framework (Qiu et al., 2024). Nevertheless, research participants emphasized the transformative potential of UA to improve food security, support education and workforce development, and foster a stronger sense of community. By grounding planning in the voices of underrepresented residents, the project helped to bridge a critical gap between Tempe's sustainability ambitions and its current lack of food-related policy mechanisms.

The study underscores that equitable UA planning depends not only on participatory engagement but also on the cultivation of long-term relationships between residents and city institutions. Community health workers and local organizations were instrumental in building trust and facilitating authentic participation among residents, suggesting that similar partnerships are essential for other municipalities pursuing equity-centered food governance. This work details practices to make participatory urban food planning workshops engaging (e.g., providing childcare, food, and adjusting to different communication styles) and yielding sustainable results (e.g., providing training in local policy), which can serve practitioners and scholars who wish to engage in participatory planning for early-stage urban food policy. Ultimately, this participatory process represents an important step toward democratizing food policy, strengthening local capacity for collective action, and fostering a culture of connection.

As Arizona cities face growing pressures from land conversion and water scarcity, water-smart UA offers an opportunity to reimagine public spaces as productive, educational, and socially connective environments offering cross-cutting benefits such as heat mitigation, biodiversity support, crime reduction, and public

trust. In a time marked by rising isolation, ecological stress, and civic distrust, urban agriculture offers more than food—it offers infrastructure for belonging and care. 

Acknowledgments

The authors acknowledge all participants who attended the workshops for their valuable inputs, comments, thematic validation, and shaping of this research. We also express our gratitude to the interviewees who took time to answer our questions and revised our drafts: Kelly Hedberg, Will and Ashley, Juliann Vitulo, Ken Singh, Elizabeth Ferguson, JoAnna Sanchez, Nesha Higgins, Kathryn Blaha, Mary Bosen, Erin Kirkpatrick, Joseph Rossell, Dan Goldhamer, j. olu baiyewu, Elizabeth Beak, Justin Nickelson, John R. Seydel, Shani Fletcher, Laine Cidlowski, Elizabeth Babcock, and Marty Edwin.

Last but not least, we address our special thanks to the JAFSCD reviewers for their careful engagement and valuable feedback, along with Jone-Benito Rosales Chavez, Braden Kay, Brianne Fisher (City of Tempe), Helene Tack, Emma Viera, Ana Karen Anaya, Aidee Covarrubias, Samantha Esparza, Juana Silva, Minerva Velarde, Araceli Montero, Margarita Ramirez, Julia Rodriguez, Nancy Sandoval, Briseida Santos, Brianne Fisher (USDN), Gabriel Sheppard, Colleen Hanley, Sara El-Sayed, Eric Fries, Jt Yeyna, Jonathan Gelen, Sofia Lomeli, Karli Barrett, Andrea Rissing, Courtney Buzzard, and Jane Coghlan.

The authors used ChatGPT to assist with revising the manuscript's phrasing and clarity. All content, analysis, and interpretation are the authors' own, and the final text was reviewed and edited entirely by the research team.

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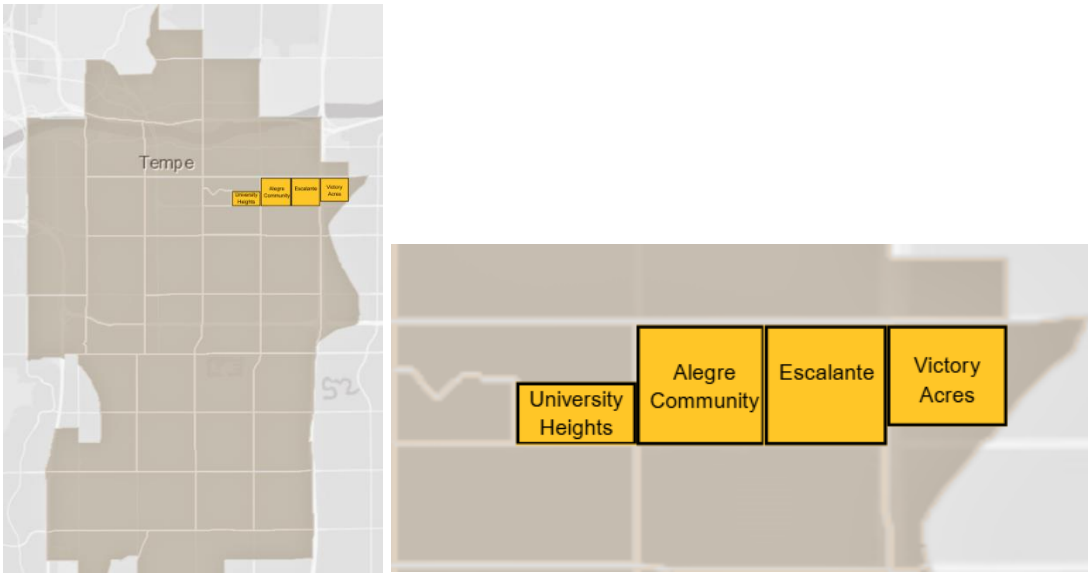
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Appendix A. Project neighborhoods: University Heights, Alegre Community, Escalante, and Victory Acres



These four neighborhoods are part of three census tracts: 3191.03 (University Heights), 3192.01 (Alegre Community and Escalante), and 3193 (Victory Acres). They are classified as Equity Zones, which are areas of the City of Tempe identified as having above-average crime concentrations and socioeconomic inequities and public health concerns (indicators include CDC vulnerability index, crime concentration, rate of rental tenure over 50%, mental health distress, low rate of physical activity, asthma prevalence, and informal housing encampment). These low-income tracts also have a significant share of residents more than ½ mile from the nearest supermarket, according to the USDA Food Access Research Atlas (USDA ERS, 2025a). University Heights, Alegre Community and Escalante are the highest priority zones in the city (City of Tempe, 2023b).

	Census Tract 3191.03	Census Tract 3192.01	Census Tract 3193
Population	4,800	7,309	2,977
Household median income	$49,795	$54,366	$51,977
Percent of population below 150% poverty level	56%	52.7%	51%
Minority rate	64%	67%	55%
Percent of population over 18 with no high school diploma	8%	31%	28%
Percent of population over 18 with no vehicle	26%	13%	14%

Sources: American Community Survey (2019–2023), CDC 2020 Social Vulnerability Index (AZGeo Open Data, n.d.; City of Tempe, 2025c)

Appendix B. Definitions of Project Core Priorities

Core priorities	Definition	References
Food security	According to the USDA, food security is a household-level economic and social condition of limited or uncertain access to adequate food. Additionally, the USDA distinguishes ranges of food security: high food security, marginal food security, low food security, and very low food security.	(USDA ERS, 2025b)
Education	Education is the continuous process of developing knowledge, abilities, morals, and attitudes through learning. It takes place in settings both traditional (schools, universities, vocational training) and non-traditional (workplaces, personal research, lived experiences), and promotes personal and societal growth through the practices of analysis, creativity, and continuous learning.	(Jackson, 2011; Schuller et al., 2004)
Workforce development	Workforce development prepares individuals for employment by providing opportunities to learn and practice the skills necessary for success in the job market. It aims to enhance the skills and employability of workers. It is implemented through practical application through programs such as vocational training, education, and career counseling.	(Goldsmith & Coleman, 2022; Schrock, 2013)
Water security	Water security is the capacity to sustainably manage and govern water resources in a way that ensures reliable access to clean, affordable water, supports ecological health, and protects against emerging threats such as climate change, infrastructure failure, and environmental degradation.	(Cook & Bakker, 2012; Hoekstra & Mekonnen, 2012; UN-Water Task Force on Water Security, 2013)

Appendix C. Tempe Urban Agriculture Practitioner Interview Questionnaire

1 – Can you share your experience farming/growing food in the City of Tempe? What do/did you grow? What do/did you raise?

2 – What is/were your relationships with the city?

3 – What is/was the scale and acreage?

4 – Do you market/sell your production? Describe

5 – Do you use some for your own consumption?

6 – What are the main challenges you face? What are some of the challenges/barriers that you have faced and how did you overcome them?

7 – Which kind of support could you benefit from (especially from the City of Tempe)?

8 – How do you get your water? How does the current water situation impact your long-term water security?

9 – Do you use any low-water consumption growing technique? What's your average water bill?

10 – How is your operation zoned?

11 – Are there any zoning ordinances going in the way of growing or marketing your products?

Appendix D. Food Need Assessment Questionnaire

1) In general, where do you purchase or obtain most of your food? Choose the 3 most frequent places that you visit.
   - Food Bank / Soup Kitchen
   - Farmers Market
   - Convenience Store (like QuickTrip)
   - Drug Store / Pharmacy (like CVS)
   - Online (Amazon / Meal Delivery Service)
   - Community Garden
   - I grow my own food
   - Butcher Shop / Carnicerias
   - Ethnic Markets (such as Asian, Kosher Markets…)
   - Food Trucks
   - Grocery Store (like Walmart, Fry's, Food City, Costco, Sprouts, etc.)

2) What kind of things are important to you when you shop for food?
   - Location (the food is near my home/convenient)
   - Cost (the food is affordable)
   - Quality (the food is fresh and tastes good)
   - Cultural Availability (I can find what I need/want)

3) How satisfied are you with your options to find healthy food?
   - Satisfied
   - Neutral
   - Unsatisfied

4) What type of barriers or challenges do you have when it comes to finding healthy food? Select all that apply.
   - It is too expensive for my budget
   - I don't know how to cook or eat it
   - I don’t have time to cook or prepare it
   - I don't know where to find it
   - I lack access to basic kitchen equipment (tools needed to prepare meals)
   - Physical conditions/limitations at a personal level
   - No Barriers
   - Not a priority - other priorities, such as:

5) What other considerations are important to you when it comes to food?
   - Cultural traditions
   - Health-related dietary needs (such as pre-diabetes)
   - Alignment with personal beliefs
   - Plant-based
   - Comfort
   - None of the above

6) I know how to find:
   - Traditional foods that matter to me and my culture
   - Community garden near me
   - Community orchard near me
   - Another place to find healthy food near me

6) Do you grow any of your own food?
   - Yes - at home
   - Yes - at a community garden

Yes - at another location:

No

7) If you do grow some of your own food, what do you grow?

Vegetables

Fruits

Herbs

Edible desert plants / desert-adapted plants

I don't grow any of my own food

8) Do you cook at home?

Yes

No

9) Do you or any members of your household work in a food business?

Yes

No

10) Which types of urban agriculture would you like to see in your neighborhood? Select up to 3 types that you think would be the most beneficial.

Community garden

Community orchard / food forest

School garden

Edible landscapes - in public places, like parks

Edible landscapes - where I live (yards, common spaces in apartment complexes)

Urban farms

Farmers market

11) If you think it would be beneficial to have more urban agriculture in the city, what might be some of the reasons? Select all that apply.

Improving local food access

Growing food for personal use

Growing food for sale

Donating food for community needs

Teaching gardening skills

Meeting new people

Building a feeling of community

Fun and relaxation

Beautifying the neighborhood

Environmental benefits, like promoting pollinator habitats

Creating new places to pick food or forage

Building gardening or farming skills

Preventing food waste

Overall well-being (physical, spiritual, social, etc.)

12) Did you know there is a community garden at Escalante?

Yes

No

13) If there was an urban agriculture site established near you, would you be interested in any of the following activities? Select all that apply.

Growing food for sale / starting your own food business

Composting food scraps

Helping to design the site

Donating supplies or money to the site

Helping to set up the site (e.g., creating garden beds)
Teaching a cooking class / attending a cooking class
Teaching a garden class / attending a garden class
Volunteering to maintain the site
Share with the community (grow and give)
Other:

14) If there is open/vacant space in the city, how do you think it should be used? What would you like to find there?
Food / Urban Agriculture
Recreation
Other:

15) How beneficial do you think nutrition and cooking classes are in shared spaces?
Not at all beneficial
Not really beneficial
Mostly beneficial
Beneficial
Very beneficial

16) What do you want to know about food?
Cooking / recipes
Fiber
Medicine
Edible native desert plants and desert-adapted plants
Eating seasonally
Food entrepreneurship / food business
Health/nutrition
Food waste diversion / composting
Other:

17) What is your vision for your neighborhood related to food?
To explore new ideas about food
To have the ability to support each other
To have the ability to be more self-sufficient
To learn new things about growing food
To get to know my neighbors
To explore new cultural ideas and/or foods
I don't know / I don't relate to my neighborhood
Other:

18) "We worried whether our food would run out before we got money to buy more." Please respond whether the statement was often true, sometimes true, or never true for you in the last 12 months.
Often true
Sometimes true
Never true, in the last 12 months
I don't know

19) "The food we bought just didn't last, and we didn't have money to get more." Please respond whether the statement was often true, sometimes true, or never true for you in the last 12 months.
Often true
Sometimes true
Never true, in the last 12 months
I don't know

20) Language Preference

Spanish
English
Other:

21) Age Group
Less than 18 years old
18–25
26–35
36–45
Prefer not to respond

22) Race/Ethnicity
White
Black or African American
American Indian or Alaskan Native
Asian
Native Hawaiian or Other Pacific Islander
Hispanic
Other:
Prefer not to respond

23) Gender Identity
Woman
Man
Transgender
Non-binary / non-conforming
Other:
Prefer not to respond

24) Neighborhood of Residence
Escalante
Alegre
La Victoria
Other:

Appendix E. Food Needs Assessment Demographics

Food Needs Assessment (N = 86)

	Number	Percent
Language Preference		
Spanish	41	48%
English	44	51%
Other:	0	0%
Prefer not to respond	1	1%
Age group		
Less than 18 years old	2	2%
18–25	10	12%
26–35	19	22%
36–45	17	20%
46–55	16	19%
56–65	11	13%
66 years old or older	11	13%
Prefer not to respond	0	0%
Race / Ethnicity		
White	20	23%
Black or African American	5	6%
American Indian or Alaskan Native	5	6%
Asian	7	8%
Native Hawaiian or Other Pacific Islander	2	2%
Hispanic	52	60%
Other:	0	0%
Prefer not to respond	1	1%
Gender Identity		
Woman	63	73%
Man	21	24%
Transgender	0	0%
Non-binary / non-conforming	0	0%
Other:	0	0%
Prefer not to respond	2	2%
Neighborhood of Residence		
Escalante	40	47%
Alegre	8	9%
La Victoria	18	21%
N/A	20	23%

Appendix F. Salt Lake City Interview Questions

1. In reviewing Salt Lake City's Comprehensive Master Plan, *Plan Salt Lake*, and comparing it to each community's master plan, we saw a varying focus on urban agriculture across the different community plans. We are curious about the challenges and achievements you've faced in your journey to become a model city for urban agriculture and food systems. In particular, how do you find the individual communities—each with their own unique master plan—incorporate the larger vision of *Plan Salt Lake* into their own community? What are the steps and stages a city like Tempe can look towards as we seek to support our local food system and local food production? What were the community engagement strategies used during these steps? Did you find that there was existing community buy-in, or did you find that people needed to be convinced of the benefits of urban agriculture? How about internally—do you feel that other departments recognize the value of urban agriculture and are willing to partner on these initiatives?
2. Of the different cities we're interviewing, Salt Lake City's Green City Growers has taken a unique step by partnering with an outside company, Wasatch Community Gardens. How did this relationship come about? Are there any aspects of this partnership that you find especially helpful for meeting the city's urban agriculture goals? Are there any issues that you had to work through in implementing this partnership?
3. Wasatch Community Gardens organic standards are also a unique requirement of urban agriculture initiatives. How has it been to get the community on-board with utilizing organic practices? Did you find you needed to do community outreach or educational seminars to highlight what makes organic gardening different from conventional gardening? Does the community see added value in these organic practices?
4. The City of Tempe is particularly interested in integration of urban agriculture as we do not have a lot of vacant land like our neighbor Phoenix. This would likely involve integration of urban agriculture into landscaping/parks, schools, residential yards, and institutional sites, like community resilience hubs. Several of Salt Lake City's Community Master Plans have addressed this issue, such as Sugar House purchasing interior block areas for urban agriculture, or East Bench looking to use school grounds as public open spaces. Do you know of any programs/ initiatives/ projects in these communities that Tempe could look towards as an example of urban agriculture success, especially with our focus of integrating urban agriculture into public, institutional and residential spaces? Are there any communities and/or projects that stand out to you as exemplary? How might we get more information on these communities and work being done at the neighborhood level?
5. Westside's community master plan takes specific aim at increasing the quantity of fruits and vegetables consumed in the community, as well as addressing the issue of food deserts. Can you talk about this initiative? Is urban agriculture helping to address this issue? What strategies have you used to address food insecurity beyond urban agriculture? Have you done anything related to workforce development, food entrepreneurship training, or food business incubation? If so, what strategies have you used to ensure that you're reaching those who are most impacted by food insecurity?
6. This summer Utah's Governor noted that 100% of the state was facing drought conditions, putting it in a similar position as Arizona. As both Tempe and Salt Lake City share water conservation concerns, what might Tempe learn from Salt Lake City relating to water incentive programs in urban agriculture policies and programs? Does Salt Lake City subsidize water costs used for food production at all? Are there any pilots looking towards stormwater use?
7. Ag-tech is another focus of the City of Tempe, especially indoor agriculture due to the low availability of land in Tempe. I am curious if Salt Lake City has any glowing examples of indoor agriculture programs, projects, policies, or other ag-tech ventures Tempe can learn from?

Appendix G. Making Space Festival (Workshop #1), Spring 2023 (City of Tempe, 2024a)

An estimated 150 residents attended the festival, of whom about 60 interacted with the food posters. No demographic information was collected.

Event picture



Example of thematic poster presented to participants



Appendix H. Selected UA Initiatives: Alignment with the Project and Residents' Votes

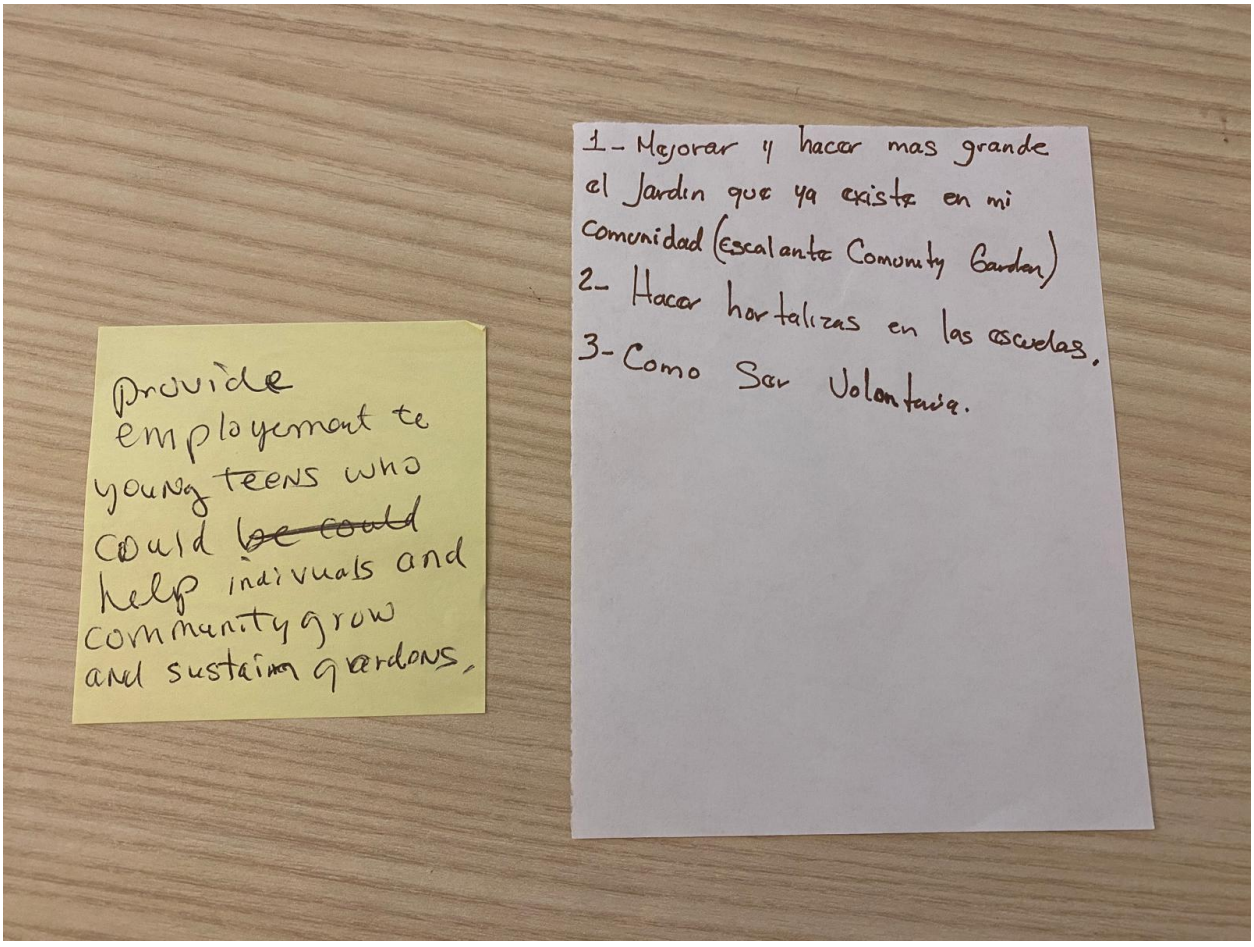
City	Name of initiative	Baseline assessment alignment	Project team priorities alignment	Number of votes
Atlanta	AgLanta	- Provides a coordinated plan	food security, education, workforce development	19
Austin	Healthy Corner Stores	- Increases options to access healthy food	food security	16
Boston	Eastie Farm	- Increases options to access healthy food - Operates community gardens - Supports school gardens and food education - Serves as a space for community learning and exchange	food security, workforce development, education	20
Denver	Huerta Urbana	- Increases options to access healthy food - Offers options for participants to grow and sell food	workforce development, education, food security	20
Phoenix	Phoenix Backyard Program	- Increases options to access healthy food - Offers options for participants to grow food	food security, education	28
	Garfield's Garden on the Corner	- Increases options to access healthy food - Offers food, health, and food systems education - Serves as a space for community learning and exchange	food security, education	21
	TigerMountain Foundation	- Increases options to access healthy food - Operates a community garden - Serves as a space for community learning and exchange	food security, workforce development	21
Salt Lake City	SLC FruitShare program	- Increases options to access healthy food - Creates opportunities for community learning and exchange	food security, workforce development	25

Appendix I. Image and Text Used to Discuss with Participants in Workshop #2 the Recommendation for Growing Food in Public Spaces



Illustration by Vidhya Nagarajan, published in *Chicago Magazine*, April 2, 2018 (Wetli, 2018).

Appendix J. Examples of Notes Left by Workshop #2 Participants in the Envelopes



The yellow Post-It:

provide employment to young teens who could help individuals and community grow and sustain gardens

The white paper (in Spanish):

1- Improve and increase the size of the garden that already exists in my community (Escalante Community Garden)
2- Create gardens in schools
3- How to volunteer

Appendix K. Workshop #2 Agenda and Workshop Facilitation Guide

Community Workshop June 22, 2023 | 5:30–6:30 PM | Escalante Community Center

Event Agenda

Day-of-Event Prep:

1. Facilitators Arrive (4:40–4:45 PM)
    A. Facilitators arrive at the Bro/Bravo at the Escalante Community Center. Facilitators will park in the ___ lot.
2. Facilitator Briefing & Introductions (4:45–4:55 PM)
    A. Facilitators will do introductions, recap table assignments, and review the final run-of-show.
3. **Workshop Set-up** (4:55–5:15 PM)
    A. Facilitators set up materials at tables, arrange the "gallery" of Resident Food Needs Assessment posters, and set up any required technical equipment (set up slide deck, etc.).

Participant Overview:

4. Workshop Participants Arrive (5:15–5:30 PM)
    A. Participants arrive at the Brio/Bravo room at the Escalante Community Center. Participants will park in the South lot.
    B. After participants sign in, they will be asked to review the Resident Food Needs Assessment posters and provide feedback on the identified findings.
        2. If participants don't get a chance to review the posters at this time, there will be additional opportunities throughout the event.
5. Workshop Welcome (5:30–5:35 PM)
    A. Team to welcome participants and provide an overview of the goals and key parts of the project.
    B. Group level setting – share definitions of key terms and the goals of the workshop with the participants.
    C. Discuss general housekeeping rules for the workshop.
6. Ice Breaker (5:35–5:40 PM)
    A. Facilitate ice breaker activity with participants within their small groups. Ask the following questions:
        i. Name
        ii. General location where they live in Tempe
        iii. One thing they love about where they live
        iv. A food they love

7. Food Needs Assessment Overview (5:40–5:45 PM)
    A. Provide an overview of the purpose, process, and key findings of the Resident Food Needs Assessment.
    B. Reference the "gallery" of findings, and encourage participants to denote their feedback / interest on the posters during a break or after the workshop portion of the event.
8. Introduce Policy Recommendations Activity (5:45–5:50 PM)
    A. Describe the purpose of the drafted policy recommendations, how they were created, and the role that they play in the project.
    B. Introduce the activity.
        i. [Think about the framing + instructions].
9. Policy Recommendations Activity (5:50–6:55 PM)
    A. Show picture to participants, present the idea of the recommendation, make time for translation
    B. Encourage participants to ask questions, provide feedback, share reflections. Give them different options to participate (speaking, envelope, post-it, drawing, etc.)
10. Wrap-Up and Next Steps (6:55–7:00 PM)
    A. Thank participants for their time and provide an overview of the next steps in the process
    B. Highlight post-workshop activities and resources (e.g., food + food demonstration, TCAA, Farm Express Bus giveaway)
    C. Remind participants to give feedback on the food needs assessment and to sign up to receive project updates/become involved in the next steps of the project.
11. Post-Workshop Activities (7:00–7: 30 PM)
    A. Food and cooking demonstration.
    B. TCAA resource table.
    C. Sun Produce Cooperative farm bag giveaway.

Workshop Facilitation Guide

Project Overview (Goals & Milestones)

- The project aims to expand food access, economic opportunity, and community well-being through the expansion of urban agriculture in Tempe.
- The project will 1) assess the current state of the Tempe food system, 2) identify residents' needs and goals relating to food, and 3) develop strategies to expand urban agriculture.
- The strategies to expand urban agriculture will be co-developed with Tempe community members, and community workshops will be used to get deeper feedback from community members on draft recommendations

Policy Recommendation Activity

Activity Overview (What's happening?)

Materials (What will we need?)

Guiding Questions (What are we asking?)

Recommendations 1 and 10

- Why do you think it would be valuable to have a food plan for the City of Tempe?
    - [Follow-Up Question]:
- Do you think that a food plan could be helpful in supporting Indigenous producers and farmers in the City of Tempe?
    - [Follow-up Question]:

Recommendations 7 and 3

- Do you think the City of Tempe should help schools to grow food?
    - [Follow-up Question]:
- What would it take for you to participate in a backyard gardening program?
    - [Follow-Up Question]:

Recommendations 4 and 5

- Would you be more willing to grow food if you had access to resources like technical support, workshop, and connections to other people growing food in Tempe?
    - [Follow-Up Question]:
- Explain what fruit share programs are, including what roles people fill in them: What would influence your decision to be a part of a fruit tree harvesting program?
    - [Follow-up Question]:

Recommendations 2 and 6

- Would you be interested in volunteering in or eating food from public food gardens? Why or why not? [Follow-Up Question]:
- If the City of Tempe provided free/low-cost cooking classes (including cooking with novel food items such as mesquite pods, prickly pear, and other native plants) what would influence your decision to participate in them?
    - [Follow-up Question]

Recommendations 8 and 9

- Do you have any concerns about the future of Arizona's water?
    - [Follow-up Question]
- Would grants that fund food growing and food business initiatives help you participate more in growing food activities?
    - Follow-up Question: Would you consider applying for such a grant yourself? Why/why not?

Materials Needed:

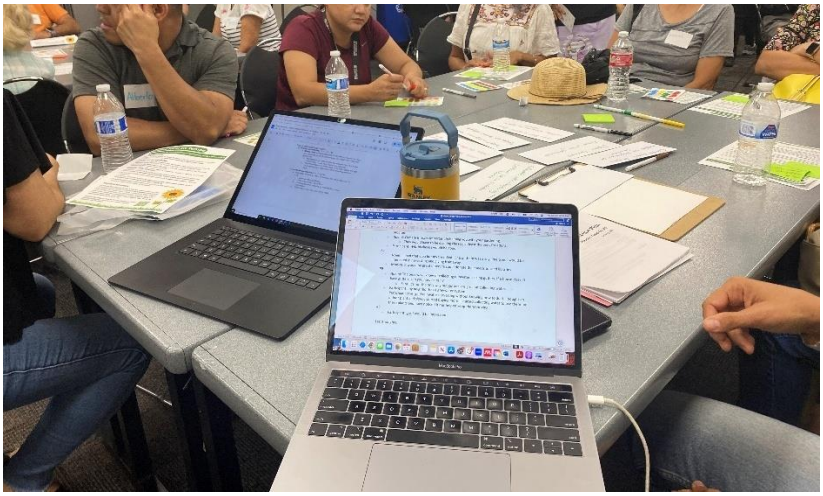
- ✓ Table materials (Boxes/Plastic containers for each table with post-it notes and markers)
- ✓ Stands for policy recommendations/tape
- ✓ Sign-in sheet with name/contact information/Photo release form/Several options/copies
- ✓ Roster for facilitators/note takers/ clarify data collection for each table (taking photos/computer notes/clip boards, collect sticky notes, etc., reporting expectations for UP)
- ✓ Agenda + Facilitator Guide (who is responsible for what section, table questions, a brief description of policy recommendations /simplified version)
- ✓ Resident Food Needs Posters (large format)
- ✓ Easels to display posters
- ✓ Resident food needs assessment findings handout
- ✓ Groceries + compostable plates/utensils

Appendix L. Workshop #2 Pictures

Beginning of the workshop, participants joining different tables



Policy recommendation activity



While dinner is served, a cooking demonstration takes place to elevate ingredients produced in the backyard of one of the moderators.



Appendix M. Workshop #3

Day-of Event logistics email

Thank you for participating in the **Community Food Showcase**, which will take place on **Saturday, January 20th** from **10–12 PM.** Below is some information about day-of-event logistics:

- **Event Time:** 10 AM – 12 PM
    - **Set-up:** Please plan to arrive between **8:00–8:30 AM** to help set up for the event.
    - **Check-in:** At **9:00 AM**, we will have a short group meeting for everyone on the event team to introduce themselves. We will have 30+ people facilitating activities and staffing the event, including City staff and community partners.
    - **Run time:** The event will run from 10 AM to 12 PM.
    - **Break down:** We will clean up from the event from **12–1:30 PM**.
- **Location:** EnVision Center (1310 E. Apache Blvd.)
    - **Parking:** Parking for event staff and attendees will be available in the former Park and Ride lot on the **southwest corner of Lemon St. & Dorsey Ln.** SRO will place signage to indicate the parking area, and Eric will help to direct traffic.
    - **Site Map:** Linked here **is the site map** for the event, which indicates the parking area and location of participants' booths.
        - One note – the event will be indoor/outdoor, with some tables set up on the south/east sides of the building and other tables set up inside. As of right now, it looks like the weather will be cloudy, with a low of 51 degrees (during set-up) and a high of 67 (at 12pm). Please note whether your activity is inside or outside and dress appropriately.
- **Materials:**
    - **Table/chairs:** SRO ordered tables/chairs from the Phoenix ToolBank. **Please see the attached attendee list** for the total table/chair count – we ordered 30 tables and 52 chairs. There are also some additional chairs/tables onsite if we end up needing any extra.
    - **Tablecloths:** If you have one, please bring an organization-specific tablecloth. If you don't have one, we can provide you with a plain black tablecloth. We have 30 plain black tablecloths to borrow for the event.
    - **Tabling supplies:** Please review your list of materials to bring, linked here.
- **Day-of-Event Contact Information:**
    - If you need anything from me leading up to the event, please contact me at XXX-XXX-XXXX or via email at XXXXX@tempe.gov.
    - To reach me on the day of the event, please call/text my cell number – XXX-XXX-XXXX

Please let me know if you have any questions about the above information— I'm happy to hop on a call to clarify things or answer any questions. Thanks again for being part of this event!

Participants were recruited by Tempe's office of sustainability, partner community organizations, and members of the research team via emails, community centers, event flyers (see below) and social media posts.



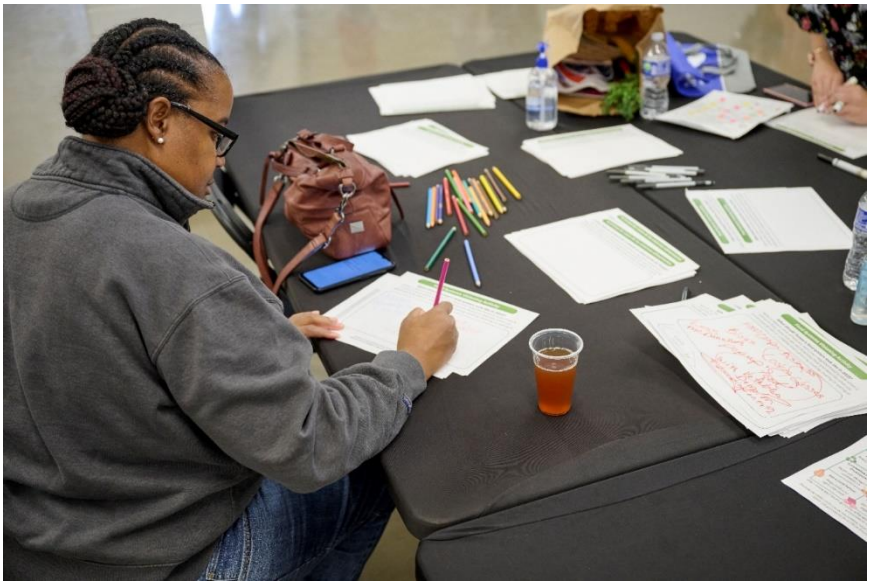
Workshop participants queue to receive their free bag of produce



Participants walk through the activity booths



Food system visioning activity: drawing activity in which people draw the future of what the city would look like once some of the recommendations are implemented



Tempe food asset map activity: interactive activity presenting resources on existing food initiatives



Guiding Questions:

- Have you been to any of the locations on the map? / ¿Ha estado en alguno de los lugares del mapa?
- Is anything missing from this map? / ¿Le falta algo a este mapa?
- What are some important places where you interact with food? These are places where you might grow, connect with, eat, buy, grow, cook, and share food. This could be anything from a favorite restaurant to your neighbor's garden!) / ¿Cuáles son algunos de los lugares importantes en los que encuentra alimentos? Estos son lugares donde usted puede crecer,comer, comprar, cultivar, cocinar y compartir alimenticios. Pueden ser desde su restaurante favorito hasta el jardín de su vecino).
- Did you learn about any new food assets by looking at the map? / ¿Ha descubierto nuevos recursos alimenticios al observar el mapa?

Map Key:

- Tempe City Boundary / Límite municipal de Tempe
- Compost Site / Lugar de compostaje
- School Gardens / Huertos escolares
- Community Gardens / Huertos comunitarios
- Seed Libraries / Almacenes de semillas
- Produce Bag Pick-Up Locations / Lugares de entrega de bolsas con fruta y verdura
- Farm Express Bus Stops / Lugares de parada del autobús "Farm Express"
- Food Pantry & Emergency Food Access Locations / Lugares de entrega de despensas de alimentos incluyendo de emergencia

Journal of Agriculture, Food Systems, and Community Development
ISSN: 2152-0801 online
https://foodsystemsjournal.org

Permits and paperwork: Administrative burden in Kansas City's community food system

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Submitted June 26, 2025 / Revised August 27 and October 20, 2025 / Accepted October 22, 2025 / Published online February 5, 2026

Citation: Hofmeyer, S. L. (2026). Permits and paperwork: Administrative burden in Kansas City's community food system. *Journal of Agriculture, Food Systems, and Community Development*, *15*(2), 125–141. https://doi.org/10.5304/jafscd.2026.152.005

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Abstract

Local food producers and organization leaders often encounter unclear regulations, complex permitting processes, and frustration as they ensure that their food is grown legally. The administrative burden framework offers a valuable lens to identify these costs and potential interventions to support the long-term success of community food system efforts. This research uses a qualitative case study of the Kansas City metropolitan region to identify the learning, compliance, and psychological costs these actors face when encountering local government. I analyze survey and interview data to explore how administrative burdens manifest in local policy through zoning, use definitions, and permitting processes. Findings reveal that vague

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Declaration of Conflicting Interest
The author declares that there is no conflict of interest regarding the publication of this article.

Funding Statement
This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

Ethical Approval and Informed Consent Statements
This study was reviewed and approved by the University of Kansas IRB. The IRB ID is STUDY00149442. All participants provided informed consent in accordance with ethical guidelines.

Data Availability Statement
The data that support the findings of this study are available from the corresponding author upon request.

Acknowledgments
This article is based on the author's dissertation research (Hofmeyer, 2024).The author would like to acknowledge the advisory support of Dr. Rachel Krause during the completion of this research. They would also like to acknowledge the advisory support of Drs. Dorothy Daley, Bonnie Johnson, Ward Lyles, and Paul Stock.

policy language and permitting requirements impose steep administrative costs. These barriers are not only technical but psychological, particularly for producers who perceive local food as marginalized, who face structural disadvantages such as insecure land tenure, or have limited familiarity with bureaucratic systems. Encounters with administrators often shape whether burdens are alleviated or intensified. Importantly, both informal peer networks and formal organizations—such as nonprofits—function as navigators, reducing costs and filling institutional gaps. Practical recommendations include clarifying local policies, conducting policy audits, and providing administrator training. This study underscores the need to address administrative costs that hamper investments in community food system initiatives.

Keywords
qualitative research, community food systems, administrative burden, local food, small-scale producers, municipal policy, land use, zoning, grant-seeking, psychological costs

Introduction

In the United States, "local food" represents alternative agriculture movements, community-oriented food economies, and sustainable, biodiverse agricultural production. The concept of local food is defined in numerous ways, reflecting its multifaceted nature (Allen, 2010; Low et al., 2015; Maretzki & Tuckermanty, 2007). The government typically defines local food based on factors such as the distance it travels to point of sale, the marketing outlets used, its perceived attributes, and its potential to address food deserts, as outlined by the U.S. Department of Agriculture (USDA) (Johnson et al., 2020). Although not all local food is inherently sustainable or equitable (Enthoven & van Den Broeck, 2021; Stein & Santini, 2022), research highlights key benefits of local foods. Multifunctional agriculture offers biodiversity, and in urban settings it provides microclimate control, heat island reduction, recreation, and public spaces (Lovell, 2010); reduced stress, increased physical exercise (Brown & Jameton, 2000); and increased community awareness and efficacy around food and the environment (Reynolds, 2015).

Local governments regulate food and agriculture through land use zoning and ordinances. For example, cities may designate areas for urban agriculture or permit community gardens. They also regulate the steps producers must follow to obtain legal approval for their objectives if not allowed by right with set parameters. For instance, backyard chicken-keeping may require a special-use permit that entails a public hearing, an application fee, and, in many cases, an annual renewal fee that varies widely, ranging from under US$100 to beyond US$1,000. Previous research has mapped many municipal policies (Halvey et al., 2021; Meenar et al., 2017). Yet few studies link these to administrative burden, which has been more often studied in food assistance programs like the Supplemental Nutrition Assistance Program (SNAP) (Barnes et al., 2023; Negoita et al., 2024), Special Supplemental Nutrition Program for Women, Infants, and Children (WIC), and the Commodity Supplemental Food Program (Cochran, 2023). We know far less about how local food producers experience administrative burden in navigating local government policy.

Using the case of the Kansas City regional food system, this study examines how producers and food system stakeholders encounter government policy through the lens of administrative burden—a concept describing how an individual perceives and experiences the learning, compliance, and psychological costs of policy implementation given that individual's resources, capabilities, and personal context (Chudnovsky & Peeters, 2021; Heinrich, 2016; Masood & Azfar Nisar, 2021; Moynihan et al., 2015). Community food system producers and advocates encounter government at the local, state, and federal levels through regulatory compliance and efforts to seek financial support in the form of grants. This study centers on one such level: local government. Drawing on surveys with small-scale agricultural producers and interviews with stakeholders such as nonprofit leaders and food program administrators, this qualitative study explores their experiences. Rather than cataloging complaints, this research applies the administrative burden framework to better under-

stand how community food advocates experience local government influence. My core research question is: *How do community food system advocates experience administrative burden at the local level?*

The goal is to empower stakeholders by identifying how administrative complexity affects their work and advocacy, identifying points of potential intervention. This descriptive and exploratory analysis contributes in three ways. First, it evaluates the learning, psychological, and compliance costs at the local level. Second, it highlights a lesser-studied area of administrative burden with practical implications for local policy reform. Third, it provides an empirical foundation for evaluating administrative burden in local food systems, pointing to the role of social networks and power dynamics in shaping how administrative costs are experienced. Ultimately, I offer insights for practitioners and researchers seeking to improve the investments of local food system stakeholders like producers and nonprofit leaders.

Applying Administrative Burden to Local Food Systems

Administrative burden—the learning, compliance, and psychological costs individuals experience during government encounters—shapes participation in public programs (Moynihan et al., 2015). Learning costs refer to the time and effort invested in understanding eligibility requirements, completing applications, and remaining informed about shifting policy (Moynihan et al., 2015). For example, lacking the technical knowledge required to navigate complex federal grant program applications such as the Farmers Market and Local Food Promotion Program (USDA Agricultural Marketing Service [USDA AMS], 2023). Historical disparities intensify these barriers; Black farmers, for instance, have long faced exclusion from USDA programs due to limited access and discretionary implementation (Cowan & Feder, 2008; *Pigford v. Glickman*, 1999; Russell et al., 2021). Compliance costs refer to the documentation requirements, financial obligations, and other mandates that may disproportionately affect individuals with limited administrative capacity. City and county land use regulations impose use restrictions or permit requirements that create compliance costs such as fees, time spent in meetings, or required paperwork for urban and peri-urban food production (Halvey et al., 2021; Meenar et al., 2017).

Finally, psychological costs capture the stress, frustration, and stigmas perceived during government encounters. Baekgaard and Tankink (2022) expertly describe the power of psychological costs in shaping an individual's perception of encountering policy implementation: "a feeling of emptiness or meaninglessness that individuals might experience when dealing with burdensome rules or procedures where they do not understand the origin or need" (p. 18). Psychological barriers are pronounced when program participants sense a misalignment in a policy or program's purported mission and its actual impact through bureaucratic hurdles. They also manifest where a program is tied to stigmas like deservingness or political ideologies (Baekgaard & Tankink, 2022). This raises concerns about policy design that ostensibly promotes agriculture while creating administrative obstacles. Such obstacles can shape attitudes toward government; for example, one study found that farmers participating in direct-payment programs and associated inspections exhibited administrative burden, which influenced their view of the direct payment system negatively (Ritzel et al., 2020). The consequences of administrative burdens are substantial. Policy choices and government encounters ultimately influence social capital, civic engagement, government trust, political efficacy, and participation (Herd et. al, 2013; Moynihan, 2022). Thus, administrative activities do much more than provide services or set policy; they influence the relationship between citizens and their government in a democracy. The result is an explicit link to policy feedback, wherein an experience with the state affects attitudes, beliefs, and negative emotions toward the state (Hattke et al., 2020; Mack et al., 2021; Soss, 1999).

Third-party actors—nonprofits, peer networks, and extension services—help reduce perceived burden by guiding individuals through complex systems. These navigators offer technical support and reassurance (Sternesky, 2023). For example, agricultural extension services and community food

nonprofits support farmers navigating federal and community grant-seeking or understanding local regulatory frameworks. Trusted community organizations and peer networks, forms of social capital, provide reassurance and advocacy, counteracting feelings of alienation and distrust toward government institutions (Masood & Azfar Nisar, 2021). Studies on administrative burden in housing assistance indicate that navigators improve application success rates and reduce dropout rates due to psychological deterrence (Sternesky, 2023).

Local Government Policy and Local Food

Local governments shape the regulatory landscape in which agriculturalists operate. Food and agriculture intersect directly with local police powers overseeing health, safety, and welfare—codified in a municipal code of ordinances (Witt, 2013). This code governs zoning, building standards, and business operations through rules that define where land uses can occur (zoning), what may occur in those zones (use restrictions), and how to seek exceptions (permitting, variances, rezoning). Some cities offer clear pathways; others impose barriers through restrictive or ambiguous rules. This variation across municipalities leads to uneven costs for producers in a given region.

Zoning, which separates land based on permitted uses, is a key source of administrative burden. It aims to protect health and guide development (Reece, 2018) but has also historically reinforced racial and rural-urban divides (Pendall, 2000; Rothstein, 2017). Zoning codes define agricultural use—such as crop farming or animal husbandry—based on location, lot size, number of users, traffic, and commercial activity (McClintock et al., 2012). Some codes prohibit agriculture outright; others are silent, causing urban agriculture to "fall through the cracks" (Pawlowski, 2018, p. 6) when uses are not explicitly addressed.

Producers engage in a range of activities, such as growing, processing or adding value, sales, beekeeping, aquaculture, and more. Where limited agricultural definitions or use restrictions related to processing, adding value, or sales exist, diverse agricultural objectives are impeded (Horst & Gaolach, 2015). Residents may become confused about local government's goals when policies enacted under the banner of promoting local agriculture are challenging to understand or comply with. Such was the case when the City of Oakland, California, implemented mixed zoning with conditional uses in its city code. Although the intent was to facilitate urban agriculture, it resulted in conditional use applications with fees and required justification that an operation's location, size, design, and operating characteristics would not affect the "residential character" of a neighborhood. Residents, unsure of whether their activities were considered "gardening" (an accessory use allowed by-right on one's property) or "agriculture" (a potentially commercial use if it attracts traffic or sales) in code, walked a thin line determining whether transforming a vacant lot into a garden was allowed at all, and how to meet conditional use permit requirements (Witt, 2013). Agricultural definitions, use restrictions, and permitting process requirements are the root of this example's administrative costs (Halvey et al., 2021; Meenar et al., 2017). Conditional or special use permits often entail extensive, expensive, or confusing administrative processes, including paperwork, fees, and weeks of time. Producers may struggle to determine how their objectives, like building fencing or engaging in sales onsite, fit in with existing municipal policy when it is vague or silent regarding agricultural and/or food uses. Administrative burden provides a useful lens to understanding this complexity that can lead to a "daunting and fruitless endeavor . . . either discouraging individuals from engaging in the process or causing them to unintentionally violate local ordinances and face penalties" (Pawlowski, 2018, p. 7). Pawlowski (2018) further notes that the complications in fitting with policy also relate to the intersection of planning, building, and fire codes, as municipal codes of ordinances set requirements for building height, building code, setbacks, lot size, accessory structures, fencing, and other components of urban agricultural activity.

Some municipalities reduce burden through more supportive frameworks. For instance, Waterloo, Canada, adopted open zoning to allow cooperative wholesale produce sales, improving community food system outcomes (Desjardins et

al., 2011). This contrast demonstrates how use definitions and permit processes—like conditional versus open use—shape land access, direct-to-consumer sales, and farm viability. Halvey et al. (2021) found differences in the actors implementing policy, the tools used (e.g., regulation, programs, recommendations), and the issues addressed. These policies may originate from governments, quasigovernmental entities, or public–private partnerships. Regulations typically govern zoning, land tenure, and animal husbandry; notably, the Midwest had the second highest number of urban agriculture ordinances in one study, demonstrating regional variation in policy, potential burden, and a useful case to investigate (Meenar et al., 2017).

Applied Research Methods

I leverage a qualitative case study to examine administrative burden in the Kansas City regional food system, selected for its diverse agricultural policies, varied production types, and research accessibility. I draw on two data sources: a regional survey of agricultural producers and semi-structured interviews with producers and stakeholders (e.g., program managers, nonprofit leaders). The University of Kansas Institutional Review Board approved the methodology, ensuring compliance with ethical standards.

First, an online survey gathered responses from agricultural producers in the region between June and October 2023 using Qualtrics software. It included questions about producers' experiences with regulations, government's role in the food system, and farm characteristics. The survey design was informed by prior research on administrative burden and balanced to respect producers' time. I identified participants through farm listings (e.g., farmers markets listings, Kansas City Healthy Kids, Local Harvest, Missouri Grown) and included urban, peri-urban, and rural growers in a roughly 60-mile (97-km) radius of Kansas City. In-person outreach to invited participants and recruitment of any producers not found online occurred at Kansas City and Olathe farmers markets, with some completing the survey on-site. I also offered an hour of my volunteer labor to respondents opting in. Three reminders to participate were sent via email.

The final survey sample consisted of 39 respondents (for a 40% response rate). Producers were reluctant to disclose certain information, with many declining to share income or education data, instead focusing on questions directly related to their experiences. Thus, the survey data provide qualitative insights and descriptive statistics but are not suited for quantitative analysis. I analyzed the responses using summary statistics to describe interactions with local policy and perceived administrative costs (learning, compliance, and psychological) as they relate to governance.

I conducted semi-structured interviews with two groups: agricultural producers and key stakeholders, who had experience in food policy councils, nonprofits, extension services, and grant-funded program administration. The stakeholder group was identified via online searches and social media, prioritizing those with cross-sector experience (e.g., farming and policy). Of 12 invited, six food system stakeholders completed interviews via Zoom (in spring and summer 2023), each about one hour long. These discussions explored policy implementation, structural barriers, and administrative burden in food system governance. The producer group was largely recruited through the survey's final question ("Do you or someone you know have a particularly noteworthy experience (positive or negative) with the government you would be willing to share in a short interview?"), while others began through conversations at farmers markets. Producers who opted into my volunteering an hour of time at their operation typically discussed their experiences during my site visit. Ten in-person interviews with producers took place between June and October 2023. These interviews averaged 1.5 hours. Although they were audio-recorded, some were difficult to transcribe due to outdoor conditions, so detailed field notes were used. Conversations focused on local permitting, grant access, compliance burden at various levels of government, and key actors shaping producers' perceptions.

Data coding was systematic and iterative, facilitated by NVivo software (2022). I leveraged inductive reasoning to allow themes to emerge from content, and deductive reasoning to structure cod-

ing using the existing administrative burden framework (Moynihan et al., 2015). These approaches were combined by first coding content with the existing conceptual framework while tagging content for emergent themes. An iteration of coding was then applied to track those emergent themes. Concepts from administrative burden and the costs framework are found in Table 1, outlining this alignment. Survey and interview findings were triangulated to assess how burdens appear, accumulate, and where opportunities for intervention may lie, as discussed below.

Results and Discussion

This section presents two sets of findings. First, I examine the learning, compliance, and psychological costs experienced when engaging with local policy, along with opportunities to reduce burden. Second, I highlight how the actions of individuals, especially administrators, social networks, and professional connections, can exacerbate or alleviate perceived burden.

Finding 1: Local Government: Administrative Costs and Opportunities

Municipal codes of ordinances and county policy produce memorable administrative costs for producers, revealed in both survey and interview data. These are discussed under three themes: learning, compliance, and psychological costs.

Learning Costs

Understanding how a producer's operation aligns with local land use codes is a persistent challenge. Participants described difficulty deciphering vague wording and inconsistent regulations, often worsened by unclear or contradictory guidance from administrators. For example, some cities clearly define and allow urban agriculture, while others leave its legal status ambiguous. In the region, only Kansas City, Missouri, explicitly defines "urban agriculture" in its code. Producers also cited uncertainty around constructing temporary structures or if they could sell products on-site as a home-based business. One producer, Taylor,[1] described the burden of learning how to go about building a demonstration farm on county-owned land in city limits:

> I have to say, working with the zoning and code people was kind of a nightmare. [Because] the county is the owner it became a commercial structure. If I had been trying to build the same structures in my backyard, it would have been easier. However, because they became commercial structures, we had to go through a complete permitting process, which I thought could seem relatively straightforward, but they wanted engineered drawings for the structures.

Table 1. Administrative Burden: Learning, Psychological, and Compliance Cost Measurements

Administrative cost	Description of code
Learning costs	L1: Extent of difficulty finding information about a policy, generally
	L2 Extent of difficulty learning terminology or what the other side "wants" based on their verbiage
	L3: Extent of difficulty learning required processes, paperwork, etc.
Psychological costs	P1: Impact on one's personal stress level
	P2: Impact on one's perception of their own efficacy or autonomy
	P3: Impact on one's sense of stigmatization
Compliance costs	C1: Complying with paperwork requirements
	C2: Complying with requirements such as visits with administrators or public meetings
	C3: Complying with financial requirements like application or annual renewal fees

Sources: Jilke et al., 2024; Moynihan et al., 2015

[1] All producers' names are pseudonyms to provide anonymity.

Season extension structures like hoop houses, essential for profitability, are a central point of confusion. These unheated greenhouse-like structures may be considered permanent or semi-permanent depending on locality, but are rarely named in code. Whether they require permits or are allowed by-right is often unclear, imposing learning costs. Seeking clarification from administrators does not always help. One producer, Rod, shared their first foray with county government to learn regulations on constructing a hoop house that was meant to happen quickly.

> I tried to be a good citizen [and ask], "Well, do I need a construction permit?" [The county said] "No, you really can't get started because you're in a floodplain, you can't do it. You can't get insurance. Well, [unless] is it a permanent structure? Or is a semi-permanent structure? If it is movable, you can. …"
>
> We come back and forth, and we got frustrated. I don't need insurance. I try to make it permanent, so the wind doesn't blow it away, but I call it movable. Finally, I got the state representative involved. Two months later, staff came down to the farm and we got this corrected. They [the county] had questions I thought were legitimate, but meanwhile if I build again, I'm not going to ask anything or raise my hand. … I try not to take it personally, but I felt that they [the county] were fairly aggressive. I don't know everything about the fine print in government and what we can or can't do, … but it flies in the face of what we need to accomplish.

This illustrates a mismatch between floodplain building limitations and unique agricultural structures, since hoop houses technically can be moved and do not require insurance, whereas these are not considerations for a structure that people inhabit. In this scenario, seeking information from a local administrator did not result in reduced learning costs, more accessible information, or help navigating complex administrative processes. Rather, getting assistance from a state representative solved the problem. The outcome was ultimately remembered for the administrator's attitude, which also shaped the perspective of a future "ask for forgiveness" approach. When administrative requirements are incongruent and demand considerable time to learn and comply with, the resulting frustration compounds, intensifying psychological stress and creating a greater cumulative burden. This frustration deepens when producers perceive that administrators are more responsive to the influence of other actors in determining how an agricultural use is recognized, or whether exceptions are granted.

On the other hand, reaching a helpful administrator might not matter if the information provided is outdated, inaccurate, or if the administrator is unsure of how to apply policy to an agricultural objective. Inaccurate information inadvertently results in learning costs and increases the perception of burden as time and energy are spent to engage with administrators. One interviewee describes special use permits required when agriculture is not allowed by-right, including the unique cost faced by refugees with English as a second language: "that special use permit process. … it's almost like they're seeing different directions on the website than they're hearing from … city staff that they're working with and it's just a very confusing and complicated process [to learn]." This showcases administrators' role and potential importance for individual producers as they cope with learning costs.

Compliance Ccosts

Assuming that one is able to learn how policy applies to an agricultural objective, producers face financial and technical demands complying with requirements. In this region, of cities that allow agriculture in residential areas, 60% (n = 9) require special or conditional use permits for common practices like hoop houses, deer fencing, on-site sales, or signage. These intersect directly with producers' core objectives. Special use permits come with time costs and can be financially constraining as described by a survey respondent:

> Not all municipalities allow goat grazing (no willingness to issue permits), so there are many places I cannot operate. I've also offered services in some areas that will allow grazing with a permit; however, the cost of that permit makes it prohibitive for the customer … often adding 25% or so to the total cost of their project.

The scale of agricultural objectives can also increase the cost to comply. Taylor returns to describe complying with the special use permit requirement of submitting architect renderings, which they found challenging due to their project's scale. Although time- and cost-intensive, these renderings were not approved because they crossed state lines:

> Getting those drawings done was basically a small enough job that I couldn't get any engineering firms to call me back. I couldn't make any progress. Really, I was kind of stuck, and I didn't know how to proceed. … Then, thankfully, one of our master gardeners who lived nearby … trains architects and just volunteered to help us out of their good, good hearts. And as soon as they got involved … I don't know, the issues just went away. Watching the email correspondence, they were saying the exact same things [to code/enforcement representatives] that I said. But somehow, they convinced them that the ones I submitted would work.

This quote illustrates two points. First, social connections can mitigate compliance burdens, in this case, access to a knowledgeable and trusted community member. Second, an architect's formal credentials appeased the administrator's concerns rather than a producer who relayed the same information, reminiscent of Rod's experience upon involving a state representative. Survey respondents mentioned special use permits and on-site sales restrictions the most. Of the 18 producers who responded to questions about local policy interaction, 56% encountered a special use permit (n = 10), 44% encountered on-site sales restrictions (n = 8), and 33% encountered on-site signage restrictions (n = 6). Survey results indicate broad adoption of accessory and season-extension structures and fencing. Accordingly, vague or inflexible rules governing these uses produce equally broad consequences (see Table 2). These costs accumulate through learning how municipal code applies to an objective, complying with engineering drawings, public meetings, fees, and coping with the process. Each requirement represents a point where compliance can become a deterrent to agricultural objectives, build a greater cumulative burden, and affect this group's view of local government.

Interview participants detailed the requirements for getting these permits and permissions—lengthy meetings, engineering renderings, fees—which seemed disproportionate to the size of their operation and more geared toward large development projects. This incongruence fosters frustration and perceived unfairness, producing psychological costs alongside the compliance costs of time, money, and energy. One stakeholder contrasted the experience of small producers with city support for developers in a dubious tone:

> There are a number of graduates from the [New Roots for Refugees] program who have wanted to keep chickens, and basically, any number of them need a special use permit to do that. The process to get a special use permit is the same for around 20 chickens as it is for a massive building. So, a huge amount of paperwork, going to public meetings, and community meetings. Apparently one of the farmers had to stay at a meeting until midnight to get his special use permanent for his handful of chickens.

Table 2. Agricultural Uses Reported by Survey Respondents

Which of the following are used in your operation?		
Agricultural use	**Count**	**Proportion**
Accessory structure	25	76%
Fencing	22	67%
Season extension structure	16	48%

Psychological Costs

The psychological cost of advocating for agricultural objectives when administrators seem unreceptive has been described. Producers also express psychological costs tied to land tenure uncertainty and the emotional toll of navigating a system with little consideration of their objectives. Precarity in land access is an important contextual feature of how burden is perceived in the local policy environment. One nonprofit organization's community farm, led by Sam, encapsulates this challenge. Their organization farmed on a 25-year leased property through a development firm, which owned the land. This community farm was an integral part of the initial developer acquisition. However, the developer was seeking an amendment to terminate the lease early and build apartments, which required city approval. This threat to stability made investment by the nonprofit feel risky and emotionally exhausting. For many urban producers working on leased land, public lots, or temporary contracts, land access seems to shape how burden is felt. Sam describes the arduous process of finding out they will likely lose the land they have invested in to try and benefit their community:

> We have to work with developers because they are our landlords … and we need them to honor their agreement to at least help pay for relocation costs. We were part of the vision that was sold to the community for the developers to be able to purchase the site [originally] and now this situation … We don't totally know how much we're going to put into fighting to stay on that land or not. So, I think about other urban farmers that … will find themselves in similar situations as the city continues to develop.

Producers also described the frustration and mental fatigue of operating in the larger corporate-dominated food system given their stewardship values and volunteering time in local food policy councils. Several individuals' reflections reveal a sense of weariness and inequity, sentiments that shape how administrative burdens are experienced:

> I'm tired of near starving and juggling pennies all while being a responsible steward of the land.

> An interesting observation is the number of farmers who have quit the local food policy council in frustration of being on a committee with salaried, government/nonprofit members.

> What we are trying to do is feed people and mitigate losses from the environment, and it flies in the face of what we need to accomplish when you have government bumping heads.

> All of this local and regional food is part of a larger system and how we have structured our dominant … food system. In a lot of ways, it dictates how things go with local and regional food. Like profitability, which is partly a challenge because of how we subsidize and externalize costs in our dominant food system—there are certain costs associated with the dominant system that are externalized to society that are not externalized in local regional food systems. So, to some degree, it's not fair, you know. There's not fairness across the board between the two systems.

These statements reflect more than policy frustration; they reveal how structural inequities, perceived marginalization, and value-incongruence in the larger food system impose psychological weight. For small-scale, locally oriented producers, the cost of trying to "do good" often includes emotional exhaustion and sense of exclusion, sharp psychological costs not always captured in administrative terms.

In sum, learning, compliance, and psychological costs seem to interact and compound into a substantial cumulative burden for producers. For example, learning how an operation's objective fits into vague municipal policy takes more time than when policy is clear, adding stress in certain cases. Similarly, undergoing special use permit fees, public meetings, and other process requirements contributes to a sense of stress. When logistic stress meets the weight of land precarity or incongruence with

one's values, administrative costs are deeply felt. These candid offerings speak to the intensity and impact of administrative costs for this social group seeking to advance community food system efforts.

How Can Local Governments Apply These Insights?
Local governments can reduce administrative burden for producers, especially in urban areas, by revising policies for clarity and inclusivity. Revising local policy with an eye toward enabling agriculture in a thoughtful and clear manner versus permitting on a case-by-case basis is a meaningful lever to influence local food production. A planning and policy audit using the administrative burden framework can track both policy substance and potential costs, helping local governments avoid policies that superficially support agriculture but create hidden barriers (Witt, 2013). It also identifies opportunities to reduce unnecessary complexity where permitting requirements are utilized. A comprehensive policy audit and revision workshop would:

- Include formal collaboration with local food nonprofits, producers, and policy councils to bridge gaps in knowledge and social networks. Such collaboration brings practical insight and attends to important local context. Where producers' ideas are integrated and valued, collaboration can rebuild trust in local government intentions.

- Interrogate existing definitions of agriculture and urban agriculture for inclusivity of peri-urban and urban use. Does the code reflect modern practices (e.g., chickens, bees, value-added processing), or only traditional row-crop farming? Many cities lack a definition of urban agriculture entirely.

- Review allowable uses, restrictions, and process requirements from a producer perspective. This includes season extension structures, taller-than-average fencing, on-site sales, and signage. If these uses are allowed, to what extent, and in what form: hobby, backyard garden, or home business? A lack of clarity adds burden for both producers and administrators. For example, Kansas City, Missouri, divides urban agriculture into home gardens, community gardens, and community supported agriculture operations with clear limits on what can be grown and sold in each.

- Streamline permitting processes where possible. Assess whether requirements are tailored to small-scale agriculture or modeled on large-scale development. Simplify language, reduce fees, and make materials accessible. Consider whether certain agricultural activities could be allowed by-right or granted exemptions if they operate below a determined scale. This step, in collaboration with food system stakeholders, can prevent unintended consequences of allowing all agricultural activities by-right while considering common agricultural objectives, their scale, and fit with local government goals. For example, policy could specify the number of backyard chickens allowed by-right or allow permitting through a simplified process that relies on a single form with lower fees and no meeting requirements. These reform efforts should remain attentive to the scale at which allowances create public health concerns or become incompatible with neighborhood factors like space, density, and character.

- Coordinate across jurisdictions. Regional working sessions between counties and municipalities can resolve conflicting rules where jurisdictions overlap, reduce learning costs between governments. This also lowers transaction costs for both producers and governments.

Finding 2: Individual Influence in Administrative Burdens

Producers' encounters with policy demands are shaped by others: administrators, peers, nonprofits, and professional networks. These actors can either heighten or reduce learning, compliance, and psychological costs. By influencing how producers interpret policy, meet requirements, and manage stress, these individuals represent an important lever for positive change. For instance, some non-

profit leaders leaned on colleagues' successful grant applications as templates. One producer described a peer-driven mindset around grant-seeking: rather than viewing grants as competitive and scarce, they emphasize the need to "evangelize" about available competitive grants and teach others "how to speak USDA and speak bureaucracy." This perspective highlights how individual and collective efforts in networks can shape access to funding opportunities and reduce costs to apply for funds enabling community food system programs.

In cases where producers could not persuade administrators, professional contacts often provided the support needed to gain approval or exemption. Recalling an earlier example, Taylor resolved an issue with architectural renderings for a demonstration farm with help from a connected neighbor. This support reduced administrative burden and underscored how professional connections can function as a critical resource when administrators place more weight on professional authority than a farmers' own knowledge or advocacy. This dynamic was also at play in Rod's case, whose hoop house was ultimately approved once a state government representative advocated on his behalf—what they described as "utilizing leverage and other government agencies to get things moving." Survey results reinforce this theme. Over 40% of respondents identified professional connections as instrumental in their success (Table 3). One's personal social circle also proved useful, with 42% of respondents citing them as helpful in addressing administrative burdens.

While producers identified personal networks, professional associations, and cooperative extension services as the most helpful, formal governmental institutions like city planners and managers were perceived as less helpful. Overall, experiences with administrators were described as inconsistent. One survey respondent summarized it as a "mixed bag":

> Our farm has interacted with various government departments and agencies, national and local. Some have been great, and some have been frustrating. Local planning and zoning [is] down the middle and doing their bureaucratic job okay; it really depends on the municipality and person you talk to. City health department [is] totally hit or miss, depending on the individual you talk to. NRCS local offices? Okay, if underfunded and short-staffed. It's really a mixed bag. We are lucky enough to have some familiarity with bureaucratic processes. Sometimes having mentors to "translate" bureaucracy helps.

This "mixed bag" is further illustrated by the goat-grazing example from a survey respondent, who describes how their learning and compliance costs directly relate to who is in charge:

Table 3. Groups Helpful and Not Helpful in Navigating Administrative Costs

Group	Helpful	Not Helpful
Your personal social circle	46%	3%
Professional connections	38%	8%
Extension offices	33%	0%
Social media groups	18%	8%
Another city or county representative	18%	10%
University connections	15%	0%
City planner(s)	13%	5%
Nonprofit(s) (please list)	10%	5%
City manager's office	8%	0%
Food policy council	8%	0%

> Some cities are easy to work with—they understand that targeted grazing is not "farming in the city" and are happy to let me operate with basic communication. Others require multiple steps, fail to respond or communicate at all, contradict themselves, and are a major time sink. Depends on the city in question. Lenexa, Platte City, Independence: communicative, helpful. Blue Springs: moderately communicative, willing to be flexible. Liberty, Smithville, Plattsburg, Parkville: communicative, not always flexible. KCMO: noncommunicative, inflexible. At these different spots I've spoken to city managers or administrators, zoning, business, codes enforcement, animal control, and others—all depends on who they decided was in charge.

Stakeholders encounter administrators regularly, making their role consequential. This is supported by interview data, where Taylor encountering an administrator was described as "very confusing and complicated" or "kind of a nightmare … working with the zoning and codes people." Another producer, Lee, adds to this evidence. They described receiving a citation for rank weeds over a certain height due to a neighbor's complaint. They attributed the complaint and subsequent citation for code violation to "a lack of understanding and familiarity with what native, edible, landscaping looks like, or what is a farm." They further describe challenges attempting to comply as they "called the Codes inspector on the letter 10 times and never heard back. Then it kind of went away, so I don't know [what happened]." Lee's attempts to comply or share knowledge about native landscaping were stymied by unresponsiveness—an example of psychological and time costs amplified by ineffective communication.

The inconsistency of administrator helpfulness reflected in survey responses and interviews demonstrates a feasible opportunity to improve administrative encounters with short-term results. These patterns also illustrate that administrative burden is not only structural but also relational. Administrators, along with other individual actors, whether supportive or obstructive, can profoundly shape producers' engagement with local government. They represent a practical lever to reduce burden.

Applying Insights Around Individual Influence

Individuals—administrators, peers, and professional network connections—influence how producers perceive and navigate administrative requirements. Government representatives such as city and county planners, zoning officials, health departments, and more all produce one side of an administrative encounter that can greatly shape how administrative costs are perceived. They directly impact the ease of achieving an objective through learning and complying with requirements. Their tone, clarity, and responsiveness shape whether producers feel supported or discouraged. Positive interactions can encourage engagement with complex systems. Negative interactions may lead to future avoidance and a higher perceived burden through stress or the sense that local government lacks understanding. Because administrators were more often associated with negative experiences, such as unclear guidance, unreturned communication, or seemingly adversarial encounters, they represent a key source of unintentional, informal administrative burden. Overall, the evidence suggests that increased responsiveness and constructive use of discretion could shift administrative encounters toward being supportive rather obstructive, easing unintended burdens.

Producers with access to peer support, nonprofits, or extension services reported lower learning and compliance costs. This emphasizes the importance of social capital in mitigating administrative costs, underscoring the "community" in community food systems for essential support. However, not all producers have equal access to these connections, highlighting potential gaps in knowledge-sharing and support.

The following interventions are possible methods to address these gaps and lower the costs of administrative burden:

- Clear, written standards should precede and anchor training. Training should address administrative behavior by promoting plain

communication and supportive responses to producers across planners, zoning officials, and other staff. This is especially relevant where decisions are now governed by discretionary judgment due to absent or vague policy. However, because personnel changes routinely produce variation in interpretation, education is a second-best, partial remedy; codifying rules in policy is necessary to minimize inconsistency and address structural gaps affecting agricultural goals.

- Strengthen informal peer networks to build encouragement and policy knowledge through the exchange of real-world experiences of policy interpretation, regulatory compliance, and efforts to seek financial support. Identify existing networks, resources, and "champions" in the food system to reinforce these efforts. Target outreach to producers with limited social capital, including immigrants, refugees, and beginning farmers. Involve governmental and nongovernmental organizations to host outreach events, establish producer-to-producer mentorship programs, and provide funding to sustain them.

- Invest in formal organizations (governmental or nongovernmental) who serve as navigators offering regular, essential technical assistance in grant-seeking and local policy interpretation. Investments in structured mentorship, policy trainings, and skill development programs can formalize the support currently accessible to producers with greater social capital. Organizations like New Roots for Refugees demonstrate how nonprofits can act as navigators for producers unfamiliar with regulatory systems. Extension services likewise provide valuable assistance.

- Prioritize collaboration among producer networks, food policy councils, nonprofit organizations, and local government bodies to strengthen relationships and establish regular channels of communication. This approach fosters ongoing shared understanding and strengthens relationships between government and food system stakeholders. Such relationships provide the foundation for informed use of discretion, for example, in decisions about the permanence of hoop houses, challenges related to project size, and other cases that require clearer communication to determine fit with existing policy.

Conclusion

This study leverages the administrative burden costs framework to examine the learning, compliance, and psychological costs faced by agricultural producers and community food stakeholders in the Kansas City region (Moynihan et al., 2015). Findings demonstrate that vague local policies and complex permitting systems create substantial burdens, while social and professional relationships can ease the experience of administrative burden. Producers face psychological costs rooted in land insecurity and in operating in a dominant food system that undervalues the environmental and community-oriented principles guiding their approach to agriculture.

Third-party intermediaries—nonprofits, peer networks, and professional connections—are key navigators of local rules and processes. They translate zoning and permitting requirements, broker communication with administrators, support grant preparation, and buffer the psychological strain of compliance. By filling gaps, especially when government communication is limited or adversarial, they reduce administrative burden. Yet access to these resources partly hinges on social capital, raising equity concerns about who receives help. Expanding formal navigators' technical assistance while strengthening peer networks can address this concern. Future research should clarify how these supports complement or substitute for improved government responsiveness and clarity.

Practically, these findings point to a need for clearer, more inclusive policy language, especially around permitting, use definitions, and use restrictions (e.g., season extension structures, sales). Local governments must examine how discretion is exercised, particularly by administrators who unintentionally produce burden through misinformation, poor communication, or procedural opac-

ity. Administrative training, partnerships with food policy councils, and intentional collaboration with producers could improve encounters and reduce friction. One avenue to reducing learning costs is ensuring that information on ordinances, how to interpret code, and contact information with administrators is clearly accessible online. Digital tools are another avenue to reduce burden: web forms containing plain language might start the permitting process for particular objectives (i.e., deer fencing) or uses below a certain scale.

Limitations of this study are three-fold. First, it presents one regional case, Kansas City, limiting its generalizability. While Kansas City offers a valuable lens to examine administrative burden in community food systems, future research should test if patterns identified here hold across other Midwestern contexts and the greater United States. Comparative research would clarify to what extent the findings are context-specific. The degree of coordination between government entities and the strength of nonprofit and extension networks are unique to this region and may shape how burdens are mitigated or amplified. Future research should explore how various metropolitan governance arrangements (e.g., consolidated city-county governments, regional councils, or government-integrated food policy councils) alter the extent to which producers experience learning, compliance, or psychological costs. For example, consolidated city-county governments may feature less variation in policy, reducing learning costs, even if permitting processes are still required.

Second, although this study's sample size is sufficient to capture recurring themes, it does not capture the full range of experiences among producers and food system stakeholders. Larger samples, whether gathered through expanded survey data or additional qualitative interviews, would allow for greater statistical power and a more nuanced understanding of variation in burden across subgroups. Third, this study relies on self-reported perceptions of administrative burden. Accounts do not fully capture the institutional perspective or document-based measures of burden. Future research could complement these perspectives with administrator interviews or policy document analysis for a more comprehensive view.

Beyond logistics, this study highlights two takeaways for administrative burden research. First, administrative costs are not experienced in isolation but accumulate to create a heightened sense of cumulative burden. Repetitive learning demands—such as deciphering policy language, determining required compliance steps, or identifying the appropriate administrator for guidance—compound over time and intensify psychological stress. These stressors stem not only from the complexity of the requirements, but through repeated encounters with administrators regarding the same issue. Streamlined processes and clear policy language could alleviate this cumulative burden, in part. Similarly, compliance obligations often appear disproportionate to the scale or nature of agriculture and food production, contributing directly to perceptions of administrative burden.

Second, small-scale producers bear a distinct psychological burden when engaging with government systems. They perceive a misalignment between their agricultural objectives and the policies they encounter, often interpreting this as evidence that local governments lack knowledge or consideration of agricultural objectives. This psychological impact is heightened by their commitment to environmental stewardship and community food connections—values they invest in financially, materially, and socially—which remain largely incongruent with the priorities of the dominant food system. Psychological costs therefore extend beyond stress with government policy misalignment. They reflect both the structural position of community food advocates and their perception of whether government recognizes and supports these guiding values.

Cumulative administrative burden and psychological costs are further shaped by land insecurity, language fluency, and cultural familiarity with government processes. Producers who speak English as a second language, are recent immigrants or refugees, or do not identify with dominant cultural or professional norms may experience elevated psychological burden due to feelings of exclusion, intimidation, or mistrust. This underscores how administrative costs may be distributed unequally

or amplify pre-existing differences in a community's food system, an interesting area for future research. Establishing these differences would provide evidence of a differential impact of burden (Heinrich, 2016) and its disparate consequences in this empirical setting (Jilke et al., 2024).

The long-term impact of securing land, seeking financial solvency, and encountering government in the process is not simple. Stakeholders frequently frame their orientation toward agriculture and food as rooted in stewardship, environmental protection, and community engagement, yet they perceive themselves as working against a powerful current. These perceptions may compound and shape views of government, suggesting a pathway for future research. It is uncertain how far such disillusionment extends, whether encounters with local policies or administrators shape broader attitudes toward government, and how state and federal interactions contribute. Here, qualitative research indicates a strong descriptive relationship between psychological costs and sentiment toward local government, making causal analysis an important next step for research.

In sum, local governments should take seriously the cumulative burden community food advocates face. While social ties, professional networks, and formal organizations provide essential navigation, they can be unevenly distributed in filling institutional gaps. Scholars and practitioners alike should explore how to scale such supports and reform policy to ensure clarity and inclusion of agricultural objectives. Addressing these challenges directly supports community food initiatives and the investments that advocates make in their communities.

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Journal of Agriculture, Food Systems, and Community Development
ISSN: 2152-0801 online
https://foodsystemsjournal.org

Our Food Future: A regional food circularity case study from Canada

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Submitted July 31, 2025 / Revised November 13, 2025, and January 7, 2026 /
Accepted January 12, 2026 / Published online March 27, 2026

Citation: Everitt, H., & Parizeau, K. (2026). Our Food Future: A regional food circularity case study from Canada. *Journal of Agriculture, Food Systems, and Community Development*, *15*(2), 143–158. https://doi.org/10.5304/jafscd.2026.152.024

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Abstract

In response to the socio-economic and environmental limitations of contemporary food systems, a multistakeholder group of community changemakers came together to create Our Food Future, an ambitious effort that aimed to develop a regional circular food system in the Guelph-Wellington region of Ontario, Canada. This study involved interviews with individuals (N = 35) who contributed to the development and/or implementation of Our Food Future's programming and projects in order to identify lessons learned from this municipally led circular economy initiative. In this article, we argue that the proponents of Our Food Future worked to leverage circular economy and municipal innovation discourses and practices to catalyze a sustainability transformation based in the local food system. Perceived enablers to success include the centrality of relationships and partnerships to the project design, collaborations across traditional city/county divides, the diversity of thought embodied by the workstream model, the focus on food as a locally relevant issue, and the municipal scale of intervention into policy and practice. We also observed that the municipal governance model operationalized in the project was itself an innovation. Our analysis indicates that Our Food Future represented systemic and enabling approaches to sustainability transformations, and that structural transformation will require ongoing efforts to fundamentally change the socio-ecological context of contemporary food systems. This study functions

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Disclosures

Kate Parizeau was a community-engaged researcher who participated in some of the initiatives described in this article.

Funding Disclosure

We acknowledge the support of the Natural Sciences and Engineering Research Council of Canada (NSERC). Nous remercions le Conseil de recherches en sciences naturelles et en génie du Canada (CRSNG) de son soutien.

as an early case study of regional food circularity initiatives, with the goal of enabling the project's lessons to be applied to other locales in Canada and abroad.

Keywords
circular economy, food, food waste, municipal innovation, sustainability transformations, Smart Cities

Introduction and Conceptual Framework

Food systems around the world are riddled with inefficiencies and inequities that result in enormous quantities of wasted food and the perpetuation of food insecurity (Parizeau & von Massow, 2022). Municipalities are increasingly positioned as the appropriate scale of intervention in food systems issues, and circular economies are becoming a prominent framing for such interventions (e.g., see Federation of Canadian Municipalities, 2022). The present study investigates Our Food Future, an initiative led by a multistakeholder group of community changemakers that aimed to develop a regional circular food system in Guelph-Wellington, Ontario, Canada. The initiative was primarily funded through a CA$10 million grant awarded by Infrastructure Canada's inaugural Smart Cities Challenge in 2019. This federal grant competition encouraged communities to improve the lives of Canadians using data and connected technology (Government of Canada, 2019). This funding served as a catalyst for future grants and in-kind funding. In total, Our Food Future leveraged CA$23,545,257 in new funding throughout its duration from multiple sources (City of Guelph & Wellington County, 2023a).

Employing a triple bottom line approach to simultaneously achieve social, environmental, and economic outcomes, Our Food Future's "50x50x50" objectives included: (1) a 50% increase to affordable and nutritious food access, (2) the creation of 50 new circular businesses and/or collaborations, and (3) a 50% increase in circular economy revenue achieved through food waste reduction (City of Guelph & Wellington County, 2019a). To achieve these objectives, a multistakeholder group of community changemakers, led by the City of Guelph and Wellington County, collaborated to develop and implement regional programming and food-based initiatives. Their efforts were organized into workstreams focused on each of the 50x50x50 objectives: Affordable, Nutritious Foods workstream; Waste as a Resource workstream; and Circular Businesses and Collaborations workstream. A Smart Cities Office was established in each of the City of Guelph and Wellington County to provide central municipal project oversight. More than 1,000 stakeholders from municipal and provincial governments, postsecondary institutions, nonprofit organizations, social enterprises, and local businesses contributed to Our Food Future from its conception in 2018 to its conclusion in 2023 (City of Guelph & Wellington County, 2023a).

The aim of this research article is to identify the lessons that can be learned from Our Food Future's work to build a circular food economy in Guelph-Wellington through a series of interviews with key actors in this initiative. The research questions explored in this study include:

(1) What did the project accomplish, and what factors led to the successes and challenges experienced across Our Food Future's diverse initiatives?
(2) How did the "circular economy" framing of the project shape the goals and outcomes of Our Food Future?
(3) What can be learned from the municipal governance model chosen for the project?
(4) How did Our Food Future contribute to sustainability transformations in Guelph-Wellington?

Our Food Future is situated within the topical intersections of circular economies, municipal innovation and institutionalization, and sustainability transformations. As such, literature from each of these fields informed the study design. In this article, we argue that the proponents of Our Food Future worked to leverage circular economy and municipal innovation discourses to catalyze a sustainability transformation based in the local food system. Following is an overview of the conceptual framework that guided this research project.

Conceptual Framework: Circular Economies

The circular economy is often positioned against the 'linear economy' that currently dominates global production and consumption processes with its unsustainable 'take-make-waste' approach. 'Circular economy' definitions are plentiful in academic and grey literature (Kirchherr et al., 2017). These descriptions have been criticized for being deliberately vague, deeply normative, unachievable, and impractical (Corvellec et al., 2022; Friant et al., 2020; Gregson et al., 2015; Kirchherr & van Santen, 2019). Kirchherr et al. (2017)—who completed an analysis of 114 circular economy definitions—describe circular economy as a construct "developed through a multi-stakeholder discourse" (p. 224) and offer the following definition:

> A circular economy describes an economic system that is based on business models which replace the 'end-of-life' concept with reducing, alternatively reusing, recycling and recovering materials in production/distribution and consumption processes, thus operating at the micro level (products, companies, consumers), meso level (eco-industrial parks) and macro level (city, region, nation and beyond), with the aim to accomplish sustainable development, which implies environmental quality, economic prosperity and social equity, to the benefit of current and future generations. (pp. 224–225)

Despite the environmental potential for waste reduction through a circular economy, the environmental and social implications resulting from circular models in practice remain questionable. Considering waste to be a resource may lead to its commodification (Greer et al., 2021), which works against the waste hierarchy and directly competes with waste reduction efforts. The possible and problematic shift toward commodifying waste is noticeable within circular economy discourses. Of the '4 Rs' (i.e., reduce, reuse, recycle, recover), 'recycle' appears most often in circular economy definitions, with some scholars subverting the concept by suggesting that circular economies are merely models for recycling (Kirchherr et al., 2017). Determining the environmental benefits of circular economies are also muddied by the application (or lack thereof) of the laws of thermodynamics (Friant et al., 2020), the possibility of increasing bio-accumulative toxicants in our biological systems (Isenhour et al., 2021), and a failure to recognize that the indefinite circulation of many materials is currently not possible (Friant et al., 2020). Similarly, circular economies generally neglect social considerations (Corvellec et al., 2022; Friant et al., 2020; Kirchherr et al., 2017), and as such, it has been challenging to identify which societal benefits circular approaches may offer. Some recent efforts to implement circular economy models have responded to these critiques at the design stages.

Our Food Future thus presents an interesting case study, given its explicit focus on addressing social equity concerns through a circular economy framework. As described below, this initiative grappled with the critiques of circular economy models throughout its operations, resulting in the emergence of a place-based definition for the term that proponents worked to operationalize: "Circular economies—which minimize waste by recycling and reusing resources instead of throwing them away—have the potential to address environmental challenges and decrease social inequities while creating business opportunities" (Federation of Canadian Municipalities, 2022. p. 4). We analyze this definition further below.

Municipal Innovation and Institutionalization

Innovation can be understood as a gradual or long-term transformative process that disrupts existing procedures to enhance institutional practices (Robinson & Biggar, 2022). In Canada, there have recently been increased efforts to innovate at the municipal level of governance (P. A. Johnson et al., 2020). Innovation in the public sector can be described as "intentional effort to design, realize, and diffuse new public policies, services, organizations, and procedures that disrupt established practices and conventional thinking" (Sørensen & Torfing, 2016, p. 828). Municipalities are increasingly attempting to innovate under the umbrella of the 'smart city' concept. A smart city refers to a municipality that uses technologies to optimize the delivery of public services, advance sustainability, and improve the well-being and quality of life of

residents (Zwick & Spicer, 2024). While technology is often centered within smart city narratives, many academics and practitioners agree that smart city initiatives must extend beyond digital infrastructure to also incorporate social innovation and participatory governance models (Spicer et al., 2023; Zwick & Spicer, 2024). Smart city projects have been criticized for being profit-driven and dominated by corporate, rather than public, interests (Goodman et al., 2020). For example, several multinational companies, like Uber and Airbnb, have used vendor-driven smart city models to deploy technologies at the city-scale around the globe. However, it appears that there may be a potential rise in government-centered smart city efforts that prioritize the public good over profit maximization (Robinson & Biggar, 2022).

Institutionalizing innovation involves "a transformational process that shifts innovations out of the experimental phase … by diffusing innovations among a wider array of adopters and integrating them into emerging or existing regimes. This process enhances the legitimacy, coherence, and stability of the innovations through the diverse interactions and actions of various actors" (St-Laurent et al., 2025, "Conceptual Background," para. 3). The institutionalization of innovation may therefore be a key component to long-term, sustained transformations in our communities. Yet, achieving such institutionalization is not without challenges. There is limited knowledge on how to operationalize municipal innovation (Robinson & Biggar, 2022; Zwick & Spicer, 2024). Institutionalization efforts in Canada can be complicated by governance mismatches, such as the division of authority (e.g., data privacy) and the perception of responsibility (e.g., waste management) between federal, provincial, and municipal governments (Spicer & Zwick, 2021). Institutional silos can also impede municipal innovation. With its focus on government-led approaches, Infrastructure Canada's Smart Cities Challenge provided an opportunity to further our understanding of institutionalizing innovations at the municipal level. The municipal innovation focus of Our Food Future's primary funding source therefore influenced our choice of analytical frameworks.

Sustainability Transformations

'Sustainability transformations' can be defined as fundamental, long-term, and multidimensional shifts in socio-technical-ecological systems that reshape structural, functional, relational, and cognitive components to enhance well-being, promote environmental protection, and support sustainable production and consumption (Daedlow et al., 2016; Markard et al., 2012; Patterson et al., 2017). Within the context of this study, Our Food Future aimed to transform Guelph-Wellington's food systems. Food system transformations involve fundamental 'farm to fork' changes within and between the structure, systems, and functions of a given food system. The concept of 'sustainability transformations' first emerged in 1990's sustainability literature (Markard et al., 2012) and became further popularized through the United Nations' launch of the Sustainable Development Goals in 2015. Three approaches to sustainability transformations elaborated by Scoones et al. (2020)—structural, systemic, and enabling—have gained recent recognition. Structural approaches involve the fundamental rethinking of entire social systems by changing core political, economic, and societal foundations. Systemic approaches target and aim to change individual system features, such as institutions, technologies, and stakeholders. Enabling approaches build social capacities and agency that empower individuals and communities to take meaningful action on their own. Coupled with these approaches, Scoones et al. (2020) outline three principles to consider when facilitating transformative change: (1) engage with diverse knowledges to create hybrid—rather than homogenous—knowledge systems, (2) explore a plurality of pathways toward sustainability, and (3) recognize the deeply influential role of politics in transformation.

Transformations are rarely straightforward, often contested, and do not occur in a "political or cultural vacuum" (Hebinck et al., 2018, p. 2). Rather, transformations are inherently political and have the potential to be deeply influential within policy and governance (Blythe et al., 2018; Hebinck et al., 2018; Patterson et al., 2017; Scoones et al., 2020). It is critical to recognize the role of political systems and processes in sustainability transformations as they inevitably lead to shifts in power

and changes to who and what experiences benefits and drawbacks (Blythe et al., 2018; Hebinck et al., 2018). Failure to critically consider power dynamics and the role of politics within transformations can have considerable implications. For example, Blythe et al. (2018) argue that "by shifting the burden of response to global environmental change from those who have caused it to those who are most effected, transformation discourse may serve to disempower and further marginalise vulnerable groups" (p. 1212). Our Food Future presents a case study for strengthening our understandings of how these theoretical considerations manifest in practice, due to its local governance model which aimed to induce sustainability transformations while maintaining a commitment to social equity considerations.

Applied Research Methods

This study involved interviewing individuals who contributed to the development and/or implementation of Our Food Future's programming and initiatives. A review of publicly accessible project resources[1] was undertaken to inform the study design, research questions, and interview guide. Interviewees included 35 former Our Food Future staff members and collaborators. Most participants (n = 24) had been involved with Our Food Future since its inception and prior to it being awarded CA$10 million through Infrastructure Canada's Smart Cities Challenge in 2019 (Government of Canada, 2019). Eighteen participants contributed to Our Food Future as municipal or provincial government employees, 13 contributed from nonprofit organizations or social enterprises, and four contributed from postsecondary institutions. Of the 35 interviewees, 12 participants primarily worked within the Affordable, Nutritious Foods workstream; 10 mainly contributed to the Waste as a Resource workstream; and six were mostly involved with the Circular Businesses and Collaborations workstream. Of the remaining participants, four were members of the overarching leadership team who contributed to Our Food Future more broadly and three provided guidance and shared their expertise through adjacent roles.

Participants were recruited through email, LinkedIn messaging, and snowball sampling (Henry, 2009). Participants were sent a letter of information and, if they were interested in participating, a one-hour virtual interview was scheduled. An interview guide was emailed to participants prior to their interview. Semi-structured interviews were conducted by author Everitt between November 2024 and January 2025 via Microsoft Teams. Because Our Food Future concluded in December 2023, the results of this study may be limited by recall bias. Verbal consent was obtained from all participants at the beginning of each interview. During the interviews, video, audio, and Microsoft Teams–generated transcriptions were recorded. Transcriptions were manually revised and verified for accuracy.

The two authors collaboratively coded the interview transcripts in NVivo using a thematic coding approach. Themes identified for the preliminary codebook were based on the research questions, interview guide, and field notes written by Everitt. As per Richards & Hemphill (2018), the preliminary codebook was independently pilot-tested by each author against three uncoded transcripts. The authors then met to discuss and revise the codebook where appropriate. The authors wrote analytic memos (Saldaña, 2013) and continued to meet regularly over a period of six weeks to share coded excerpts, discuss emergent themes, and resolve disagreements through compromise. A structured member checking approach (McKim, 2023) was followed to establish validity and gather feedback from participants. All participants (N = 35) were given the opportunity to choose their own identifiers for this research and to review a draft of this article, including a preliminary review of the direct quotations that we anticipated using in the study results.

Parizeau is a community-engaged researcher who participated in the development and operation of Our Food Future between 2018 and 2023. She was invited by Our Food Future leadership to participate in the Waste as a Resource workstream, attend meetings of the Program Delivery Team and the Community Steering Table, and provide feed-

[1] Available at https://foodfuture.ca

back on policy and programming associated with the project. She also led research assessing the outcomes of initiatives associated with Our Food Future. Parizeau's participation in Our Food Future influenced the research questions and design of this study, and provided a first-hand perspective on the operations of the project. This model of community-engaged scholarship has been described as collaborative public-sector innovation and is considered appropriate for municipal policy research because of shared commitments to community-informed solutions, the development of mutually meaningful goals, and shared aspirations for more equitable societies (Levac & Chan, 2025). Community-engaged researchers must navigate multiple dimensions of their insider-outsider identities with respect to their research communities, and reflexivity is a key strategy for ethical engagement in this type of research (L. R. Johnson, 2017). Parizeau practiced self-reflexivity at all stages of the research project through a series of field notes, where she considering her intentions and interests in participating in Our Food Future as well as her assumptions and beliefs about the project. This research study is the result of multiple initial conversations with proponents of Our Food Future, who encouraged the research team to document the process of forming this initiative. As a result, the research design of this project was collaboratively conceived with the aim of building reciprocal research relationships with community (L. R. Johnson, 2017).

Results and Discussion

In the following sections, we describe the accomplishments of Our Food Future, report on its impacts and the factors enabling its success, analyze the municipal leadership model deployed in this initiative, and describe the challenges and lessons learned by project participants. We close the discussion with an analysis of the discursive shifts and transformations associated with building Our Food Future.

Our Food Future Accomplishments

Between 2020 and 2023, it was estimated that Our Food Future led to the creation of 287 circular jobs; funding for 93 community food projects; increased access to affordable nutritious foods for 20,572 individuals; the diversion, upcycling, or recycling of 84,860 tonnes of food waste; 320 acres of land piloting regenerative agricultural practices; and the prevention of 168,788 tonnes of greenhouse gas emissions (City of Guelph & Wellington County, 2023a). We highlight some of the projects commonly discussed by interviewees below. Additional information about the many other innovative projects housed under this initiative can be found online.[2]

To further progress toward achieving a 50% increase in affordable and nutritious food access (one of the 50x50x50 goals), Our Food Future partnered with the Guelph Community Health Centre and other stakeholders to implement a variety of food security initiatives. A social enterprise leader (P31) described the community impacts of these initiatives:

> I would say the biggest change was on the ground. We distributed a lot of food and worked with a lot of people who are experiencing food insecurity, and those people had a lot of say in how that happened and had a real voice in that. And so, there was a lot more people getting good food and more people being involved and being asked to be involved.

This approach resonates with Varney and Soma's (2024) identification of the need to develop an equity-oriented approach to prioritizing dignified food access within circular food economies. Some initiatives may rely on a short-sighted approach of redirecting wasted food to food insecure individuals in a nontransformative practice that cannot address the root issues of income insecurity and inequality (Soma, 2024). Our Food Future proponents actively worked to provide food security with dignity through the Affordable, Nutritious Foods workstream initiatives. One example of these initiatives is 'groceries from the SEED,[3] the first sliding-scale online grocery store in Canada (City of Guelph & Wellington County, 2023a). In its first year of the project, the SEED

[2] https://foodfuture.ca

[3] https://www.theseedguelph.ca

made over 10,000 grocery deliveries, of which 80% were made to households experiencing food insecurity, saving pay-what-you-choose customers over CA$500,000 (Wellington Dufferin-Guelph Public Health, 2022). Groceries from the SEED continued to operate beyond the conclusion of Our Food Future, contributing to increased food access in the Guelph-Wellington region.

Working toward the creation of 50 new circular businesses and/or collaborations (another of the of the 50x50x50 goals), the Smart Cities Office at the City of Guelph initiated the Circular Opportunity Innovation Launchpad (COIL) in 2021. COIL provided for-profit businesses and nonprofit organizations with access to knowledge, tools, resources, and supports to embed circularity into their principles and practices (City of Guelph & Wellington County, 2023a). A leader in the Smart Cities Office (P11) described how COIL mobilized circular economy knowledge within the corporate world:

> In the business and the startup space, we worked with tons and tons of startups who had not necessarily heard of 'circular economy.' They may have been doing some things in that space, but the framing, the thinking, the linking it to climate, all that stuff I think was really valuable.

One example of a COIL success story is Friendlier,[4] a reusable container company that received support from COIL during its incubation phase. It is now the fastest growing business of its kind in Canada (City of Guelph & Wellington County, 2023b). Throughout COIL's time under the Our Food Future banner, the launchpad supported over 160 organizations across 42 cities in southern Ontario—expanding Our Food Future's reach outside the Guelph-Wellington region (City of Guelph & Wellington County, 2023a). With support from COIL, over 80 new products and services were developed and a total of CA$1,075,000 in corporate funding was leveraged to advance circular innovations (City of Guelph & Wellington County, 2023a). Following the conclusion of Our Food Future, COIL is now housed within the Circular Innovation Council,[5] a nonprofit organization that aims to advance the circular economy in communities across Canada.

Toward the goal of achieving a 50% increase in circular economy revenue through food waste reduction efforts (one of the of the 50x50x50 goals), Our Food Future partnered with the Circular Innovation Council to pilot a food recovery and rescue business model for industrial, commercial, and institutional (IC&I) sectors in the Guelph-Wellington region. In the first year of the pilot project, 53 participating businesses recovered and donated the equivalent of 39,447 meals (valued at CA$131,803.76) and diverted 230,637 kilograms (508,468 lbs.) of food and organic waste from landfill (Alexander et al., 2023). Environmentally, this resulted in the mitigation of approximately 2,542 tonnes of greenhouse gas emissions (Alexander et al., 2023). Following the conclusion of Our Food Future and building on the project's success in the Guelph-Wellington region, Circular Innovation Council expanded the pilot in 2024 to the Town of Westlock and Strathcona County in Alberta, as well as the Waterloo Region in Ontario.

Impacts of Our Food Future and Factors Enabling Success

In discussing the overarching impacts of Our Food Future, a circular economy manager at a municipality (P21) said:

> It showed the art of the possible, and I think that even though the Smart Cities Office [at the City of Guelph] has shuttered its doors, I still think the spirit of Our Food Future lives on, and it wasn't just a flash in the pan. It really spurred a lot of creativity and inspiration and work that now continues on.

Participants identified multiple factors that enabled success and contributed to Our Food Future's positive impacts. Many participants perceived value in the new and enhanced relationships created as a result of the initiative's highly collaborative approach. An academic at a local university

[4] https://www.friendlier.com

[5] https://www.circularinnovation.ca

(P34) reflected on the unprecedented community collaboration that took place: "I've been in Guelph for almost 15 years, and it was the first, arguably the only, time that there's been serious collaboration between members of civil society and the City and the university all trying to articulate a common vision." Some participants, such as a leader in the charitable healthcare sector (P12), recognized that inclusion and diversity contributed to the project's successes: "Having so many people at the table, it was a bit of a double-edged sword, but it worked well because we had lots of diversity of thought and opportunities that presented themselves." This finding aligns with Scoones et al.'s (2020) transformative change principles that encourage serious consideration and appreciation for diverse knowledges.

Our Food Future's focus on food systems as focal points for transformation likely enabled success as well. A manager at a community-based organization (P6) described the impact of the project's focus on food:

> I think food is something that people understand. People have different relationships with food, but we also understand that food does more than just nourish bodies. It's a place. It's something that people connect over. It's something that people have moments of joy over. … I think another resource may not have garnered the level of excitement and attention because it just doesn't impact people in so many varied ways.

The involvement of the City of Guelph and Wellington County in this highly collaborative model was also described as an enabler of success, as some participants recognized the role municipalities have (or should have) in food system transformations. For example:

> We do see municipalities at the forefront of addressing climate, addressing affordability, and circular economy approaches are so supportive of some of those challenges, but they can't be undertaken in silos and so that ability to work cross-functionally was meaningful. (P29, Circular project manager)

We argue that the achievements of Our Food Future position this initiative as an example of a community-based circular food system. Alonso Martínez et al. (2025) articulate a vision for community-based circular food systems:

> … which can be defined as local and regional food systems that reduce waste and regenerate eco-systems through practices grounded in participation, equity, and the local context. … Their emphasis extends beyond material flows to encompass relational dynamics, participatory governance, and holistic well-being. (p. 2)

The inclusion of equity-oriented goals and the participatory ethos of the project were closely connected to the multistakeholder collaborative model at the heart of the project's design. The local and regional scale of the food system was considered to be both meaningful to participants as well as appropriately matched to the governance context where relevant policy decisions could be taken (Spicer & Zwick, 2021).

Municipal Institutionalization and Innovation

The municipal leadership model developed for Our Food Future positioned municipal staff at the hub of a burgeoning circular food system network. A Smart Cities Office was established at each of the City of Guelph and Wellington County to provide central, municipal project oversight. While housed within municipalities, one participant described the City of Guelph's office as being "slightly removed from the City, but still within the confines of the municipal machine" (P10, Project coordinator at a municipality).

In alignment with Our Food Future's overarching sustainability objectives, programs and their corresponding stakeholders were grouped into three thematic workstreams: (1) Affordable, Nutritious Foods; (2) Circular Businesses and Collaborations; and (3) Waste as a Resource (City of Guelph & Wellington County, 2019b). Smart Cities Office staff also worked on a fourth theme of Systems Change, which provided logistical support, project management, and policy guidance to the project. Municipal staff from both the County and the City participated in all workstreams, and were

joined by relevant representatives from community organizations, local businesses and business accelerator programs, postsecondary institutions, public health, and others according to the workstream mandates. A circular economy leader (P5) described their experience with these workstreams as follows: "My experience was that that [format] was great because it became the way that the project was more led by community leaders and the participants in the workstreams than it was by the centre."

While the workstream format enabled shared leadership of Our Food Future's projects and goals, the core of the municipal governance structure provided operational stability and the perception of legitimacy in some spheres. Municipal employees assigned to the project supported the innovation work of community organizations and businesses by disbursing funding, supporting communications, and coordinating actors across sectors. Drawing on the definition of institutionalization as the embedding and diffusion of innovations by building their legitimacy, coherence, and stability (St-Laurent et al., 2025), municipal actors were positioned as important prospective agents for institutionalizing the innovations associated with Our Food Future. For example, interviewees commented on the need for municipal policy change to support Our Food Future's transformational work:

> The City's in charge of a lot of things that matter to us every day, and how cool if they also thought thinking about food and food access is a piece of it. I think that's why I find that more exciting than maybe if a university took it up or a not-for-profit, because I think the impact for policy change is just higher. (P13, Faculty member at the local university)

Interviewees noted that there can be strong capacity for effecting transformative change at the municipal scale when it is resourced appropriately. The municipal sphere was repeatedly discussed as an appropriate scale for sustainability governance and interventions:

> I think from the municipal perspective … we are the ones typically that are closest to the need, especially in this area of food and waste. We're the ones that are most attuned into what people are needing and are looking for. (P19, Supervisor in waste management)

> There's been a lot of discussion about how cities can drive circular economy, more so than even provincial or federal governments. Or they have their own unique role to play, and I just think that this project really demonstrated that cities do have a role to play. (P10, Project coordinator at a municipality)

The municipal scale can therefore be the appropriate scale for community-centred sustainability transformations. However, municipal governments in Canada tend to be chronically underfunded and stretched thin with increasing service responsibilities. A number of interviewees noted that the development of Our Food Future created a space for municipal innovation in a context where municipalities often cannot afford to experiment. One interviewee commented on the distinctiveness of the municipal governance approach undertaken through Our Food Future:

> Not only did this project exceed expectations, but this experience also presented significant learning opportunities, including the role a municipality can play as a community convener and mobilizer, diverging from the usual operations of a municipality. (P2, Manager at a municipality)

The municipal governance model associated with the Our Food Future project positioned city and county representatives as the 'hub' that connected 'spoke' projects located across the community. This format of municipal leadership can be understood as a form of innovation, in that it represented a purposeful attempt to "disrupt established practices and conventional thinking" (Sørensen & Torfing, 2016, p. 828) about how to catalyze sustainability transformations at the municipal scale. However, the meaningful institutionalization of this model of governance and other workstream outcomes has proven challenging in the winddown of the project.

Challenges and Lessons Learned

Interviewees described a number of challenges that they experienced through the design and implementation stages of Our Food Future. While some of these issues presented barriers to success, many of the challenges identified were also framed as opportunities. For example, multiple interviewees alluded to the ambitious scale and complexity of Our Food Future as a source of operational challenges, while some also named this ambition as a factor that contributed to the diverse successes associated with the project. Relatedly, the time and effort required to build the partnerships at the heart of this ambitious project were described by interviewees as both a challenge, and a prerequisite for success:

> And I think that what I always tell people about having been through this project is that you really can only move at the speed of trust. You can't do it without partnerships and partnerships work on trust and that takes time. (P1, Member of the project's leadership team)

The COVID-19 pandemic was described as very disruptive to the project, especially given the planned involvement of public health staff in the Affordable, Nutritious Foods workstream. Our Food Future was designed to support local food businesses that were subsequently severely impacted by COVID-19 closures and regulations. However, interviewees also framed the COVID-19 pandemic as an opportunity to rethink some of the premises of Our Food Future and to reprioritize the social equity goals of the project in the local context of intersecting inequalities that had been exacerbated by the pandemic (Pin et al., 2021). The project's short-term pivot to creating a Grow Back Better plan to guide community and business initiatives in the wake of the pandemic led to Our Food Future being named a top recovery project by Future of Good (a federally funded news aggregator focused on amplifying community impact; City of Guelph & Wellington County, 2023a).

Some interviewees also spoke to the challenges of working across urban and rural divides, acknowledging historic disconnects and tensions between the City of Guelph and Wellington County. They noted that project responsibilities and resources were not always evenly distributed between the city and the county, and that the application of circularity appeared to prioritize urban rather than rural spaces. Spicer et al. (2021) discuss the urban focus in most smart cities research, noting that a major limitation to creating smart rural communities is a lack of internet access. Even though this barrier was also mentioned by Our Food Future participants, some interviewees also noted that Our Food Future served to create a more effective working relationship between the city and the county through close collaboration on a number of initiatives.

Some respondents raised challenges around financial issues (including the prioritization of funding for chosen aspects of the project), silos between the work completed by different workstreams, competing project goals, and interpersonal frictions. Many of these issues are common in large-scale, multistakeholder projects. Interviewees also mentioned technical difficulties, including the challenge of measuring progress. Despite the achievements of Our Food Future, some participants perceived a lack of awareness of the project and its outcomes among the public.

Interviewees also mentioned tensions between the approaches preferred by different stakeholders in the project. For example, a contrast was drawn between some proponents' entrepreneurial 'move fast and break things' worldview versus nonprofit organizations' approach of slow, relational advocacy to effect structural change. Some interviewees' commitment to effecting structural changes in the food system informed how they interpreted the final outcomes of the Our Food Future initiative:

> Whether or not there's any lasting effect on the social inequality side of things, I think would be pretty debatable. In fact, things are worse now than they were when the project started. But again, I think that goes to show the scale of the issue is greater than a municipality alone can tackle. I think it's more provincial and federal level funding and attention that needs to happen. (P4, Manager at a nonprofit organization)

> There needs to be a home for food in all levels of government and until there is, this will be hard. (P26, Community connector within a nonprofit)

These quotations speak to the intractability of some of the issues that the Our Food Future initiative set out to address, including food insecurity and food access. Other researchers have commented on the difficulties of addressing trenchant social inequalities through circular economy interventions (Corvellec et al., 2022; Friant et al., 2020; Kirchherr et al., 2017). Notably, Varney and Soma (2024) argue for "systemic solutions that address the root causes of food insecurity and food waste to ensure the implementation of a circular food system that promotes equity and prosperity for current and future generations" (p. 16).

In addition to the intractability of some of the issues at the core of the Our Food Future initiative (such as food insecurity and widespread food waste generation), the goal of institutionalizing sustainability transformations proved somewhat elusive. With the end of the federal funding for the project, Our Food Future and the City of Guelph's Smart Cities Office shut down at the end of 2023. Some of the workstream activities had been successfully mainstreamed into municipal operations by this point. For example, the City of Guelph's Solid Waste Master Plan update and Wellington County's introduction of organic waste diversion services represent the long-term institutionalization of sustainability practices and policies that had been developed through Our Food Future (City of Guelph & Wellington County, 2023a). The Smart Cities Office in Wellington County has continued to operate beyond the end of the federal funding for the project, and the manager in that office has maintained the legacy of Our Food Future's aims on a reduced budget. However, other initiatives ended abruptly, to the dismay of some interviewees. While many respondents were disappointed by the lack of continuity for Our Food Future's initiatives, some noted that this outcome is status quo in sectors that rely on noncontinuous funding sources:

> One major lesson learned is—and this is a problem with many government-led initiatives—there's no forethought around legacy and continuation of initiatives that have been launched. Often times they're one-offs and I suspect the government's just hoping, somehow miraculously, someone will figure out how to continue the work. But more often than not, additional funding of large scale is hard to come by, and therefore these really fruitful initiatives get launched, executed, grow, then all of a sudden they shut down at their peak when they're starting to make a benefit. (P3, Academic researcher)

The deep desire for continuity of the Our Food Future initiatives could be interpreted as a commentary on the value of the network that was formed and the unrealized potential that many participants perceived in these collaborations. Such sentiments also speak to the need for legacy planning in order to ensure the sustainability of ambitious projects like Our Food Future.

An Analysis of the Discursive Shifts and Transformations Associated with Building Our Food Future

Our Food Future aimed to transform not just the social and material flows of food in Guelph-Wellington, but also the discursive framing of these dynamics through "articulat[ing] a shared vision of a regional circular food system" (City of Guelph & Wellington County, 2023a, p. 2). Interviewees noted that 'circular economy' became a more legible concept over the tenure of the project, especially in conversations with local decision-makers:

> I think a significant accomplishment was getting elected officials talking circular economy languages both at the City and the County. You had City councillors, County councillors who know a lot more about the circular economy than they did before Our Food Future. And so I think that's an achievement in itself, because [elected officials] are important stakeholders as we look to move to a more circular society. (P27, Manager at a local municipality)

> I think part of the legacy was the way that people across sectors started to work together and also started to think about circularity just as an important concept within the regular day-to-day work that they were participating in or doing. (P5, Circular economy leader)

Despite its increased use in municipal governance and organizational contexts, some respondents noted that it was not clear whether the term 'circular economy' had gained increased resonance with the public over time. Interviewees also noted that different definitions of circular economy had been invoked in different contexts throughout the project to speak to diverse priorities across the workstreams.

Respondents had disparate perspectives on the transformational impacts of Our Food Future. Many pointed to the successes of individual initiatives as transformational, particularly mentioning the expansion or development of specific organizations and businesses that were enabled through Our Food Future funding and mentorship. Others spoke to the ongoing relationships and cross-sectoral partnerships fostered through Our Food Future, which they believed would change the status quo for collaborations in Guelph-Wellington. These types of changes typify what Scoones et al. (2020) describe as systemic approaches (e.g., changing institutions, technologies, and stakeholders) and enabling approaches (e.g., empowering individuals and communities) to sustainability transformations. Structural approaches that fundamentally transform social systems remain more elusive, according to some interviewees:

> But unfortunately, it's going to fade from our collective conscience, I think. That's not Our Food Future specific. I've been working in this world for a long time. That is unfortunately the way it is with these types of initiatives unless they are heavily resourced for a really long time to do the slow, methodical, strategic work to spread the impact, to get it into people's minds and brains, and that sometimes is about changing curriculum in school so the next generation is thinking about these things differently. (P6, Manager at a community-based organization)

Structural transformation is an ambitious expectation for a project of this scope and scale. As Alonso Martínez et al. (2025) observe, community-based circular food system initiatives:

> are often resource-constrained and highly localized, which can make them vulnerable to systemic shocks and very much reliant on community buy-in for long-term viability. This can result in organizational challenges to scale impact, secure long-term financing, and navigate regulatory constraints (p. 2).

The challenges faced by Our Food Future, including the closure of one of its municipal offices and program discontinuations, are therefore consistent with the experiences of other community-based circular food systems. An interviewee recommended that the vision of a circular food economy for Guelph-Wellington should be understood as:

> a generational goal. Something that … takes a lot of time to implement. … It's really a fundamental changing and re-ordering of not only the economy, but society in a lot of ways. (P27, Manager at a local municipality)

True transformation is a long-term project that must be pluralistic and differentiated to challenge the root causes of unsustainable practices and systems (Blythe et al., 2018). Shifts of this magnitude can be supported by community-based circular food systems initiatives like Our Food Future, but such projects cannot be expected to effect a structural sustainability transformation on their own. They require institutionalization across multiple sectors and multiple scales of governance in order to lead to long-term sustainability transformations.

Conclusions

Our Food Future experienced many successes, including fostering the development of multiple new or expanded businesses and nonprofit interventions seeking to disrupt traditional food system dynamics, as well as policy changes to support local waste reduction and diversion. Many of these initiatives focused on triple bottom line goals and were supported through multistakeholder collaborations

across different sectors. By the end of its tenure, the final project was stated to have met or exceeded its 50x50x50 goals of (1) a 50% increase to affordable and nutritious food access, (2) the creation of 50 new circular businesses and/or collaborations, and (3) a 50% increase in circular economy revenue achieved through food waste reduction (City of Guelph & Wellington County, 2023a).

Success factors identified by interviewees included the centrality of relationships and partnerships to the project design, collaborations across traditional city/county divides, the diversity of thought embodied by the workstream model, the focus on food as a locally relevant issue, and the municipal scale of intervention into policy and practice. Ultimately, it was the capacity of the project proponents to successfully fundraise for the project that enabled subsequent accomplishments. The discursive framing of a circular food economy for Guelph-Wellington as both a smart city initiative and an opportunity to locally effect socio-environmental transformations were central to these fundraising efforts.

The challenges discussed by respondents included project logistics, workstream silos, concerns about the continuity of the initiatives, urban-rural divides, COVID-19 interruptions, and interpersonal issues. Factors influencing these challenges included the ambition and complexity of the project goals, the scale of the project and its many participants, and the transient and disjointed nature of funding for municipal innovation in Canada. Another major constraining factor was the trenchant nature of the root issues that Our Food Future sought to address through the creation of a circular food economy. In particular, food insecurity (which is caused primarily by income insecurity; Idzerda et al., 2024) and food waste are deep, structural, systemic challenges that are embedded across multiple scales and sectors of the food system in Canada. Addressing such issues is truly a generational project.

We observed that the municipal governance model operationalized in the project was itself an innovation. The long-term institutionalization of the achievements of Our Food Future was partial, although the progress that was made in embedding the practices and discourses developed through this project was likely a result of the municipal governance model that brought diverse stakeholders together in a series of topically organized workstreams. The focus on food was perceived to be appropriately matched to the municipal scale, although interviewees also noted that institutionalization of policy changes to the food system would also require buy-in from the provincial and federal scales in Canada. We therefore advise that future attempts to build circular food systems in Canada will require buy-in and support from all levels of government to ensure their sustainability and their meaningful institutionalization. We also recommend that extended public and private funding for such initiatives would enable the goal of structurally transforming the food system. In the absence of long-term funding, we recommend that planning and resources should be dedicated to the end-stages of time-limited investments in local circular economies to enable legacy planning and the continuity of programming, where possible.

In this article, we have argued that the proponents of Our Food Future worked to leverage circular economy and municipal innovation discourses to catalyze a sustainability transformation based in the local food system. Over the course of the project, Our Food Future's multistakeholder discourse led to the creation of a locally relevant and socially oriented definition of the term: "Circular economies—which minimize waste by recycling and reusing resources instead of throwing them away—have the potential to address environmental challenges and decrease social inequities while creating business opportunities" (Federation of Canadian Municipalities, 2022, p. 4). This definition rationalizes the approach to transformation undertaken throughout the project, while also recognizing the intractability of some of the underlying social and environmental issues that such interventions seek to address. This definition does not speak to structural change, but rather to practice-oriented interventions that can be effected at a municipal scale. The discursive framing of a 'circular economy' for Guelph-Wellington shaped the workstream model of the project as well as the articulation of the 50x50x50 goals of the project, and so was central to its conceptualization and

operations. The successful funding and traction provided by this focus has launched Guelph-Wellington onto the world stage, receiving recognition from the Ellen McArthur Foundation, the World Economic Forum, and the Milan Urban Food Policy Pact.[6]

In summary, this article provides an overview and analysis of a community-based circular food system innovation (Alonso Martínez et al., 2025) in the Guelph-Wellington region of Canada. While many circular economy studies are situated within manufacturing sectors (Kirchherr & van Santen, 2019), this article explores a multifaceted circular economy initiative spanning agriculture, retail, hospitality, residential, waste management, and manufacturing sectors. In alignment with Kirchherr & van Santen's (2019) observation that there is a lack of empirical work on circular economy, this article also strengthens our understanding of how circularity functions in the 'real world' and provides concrete evidence to complement an existing body of literature focused on theoretical advances and conceptual work. We posit that Our Food Future represents an example of how community-based circular food systems can represent systemic and enabling approaches to sustainability transformations, and that the successes of this type of multistakeholder collaborative initiative can provide inspiration to move toward deeper structural changes.

Acknowledgments

We thank the staff and community partners who brought Our Food Future to life. We greatly appreciate the expertise and insights shared by those who took part in interviews for this study.

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Journal of Agriculture, Food Systems, and Community Development
ISSN: 2152-0801 online
https://foodsystemsjournal.org

Food supply improvement for planning to meet needs in Indonesia's New Capital City

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Submitted July 9, 2024 / Revised August 23, September 22, October 6, and October 26, 2025 / Accepted October 27, 2025 / Published online February 4, 2026

Citation: Agustian, A., Inayah, K., Rachman, B., Rachmawati, R. R., Muslim, C., Purba, H. J., Farandy, A. R., Suharyon, Yaumidin, U. K., Ariani, M., Suhartini, S. H., Susilowati, S. H., Ariningsih, E., Irawan, Hartono, M. D., & Kariyasa, K. (2026). Food supply improvement for planning to meet needs in Indonesia's New Capital City. *Journal of Agriculture, Food Systems, and Community Development*, *15*(2), 159–181. https://doi.org/10.5304/jafscd.2026.152.007

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Abstract

The Republic of Indonesia is relocating its national capital to a new city (NCCI) in East Kalimantan Province (EKP). This future megacity will require a resilient and adequate food supply. This study provides critical evidence base for food supply planning by analyzing the balance of food production and needs, mapping supply chains, and formulating strategies to enhance food supply from buffer zones to the NCCI. Conducted in EKP and its key buffer provinces, the research employs a mixed-methods approach, combining quantitative food balance analysis with qualitative insights from stakeholder focus groups. Key findings reveal that in 2023, EKP faced significant deficits in rice and

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layer eggs, achieved self-sufficiency in broiler meat, and showed a surplus in beef. This dependency on external food supplies necessitates a complex multi-province buffer system, primarily involving South Kalimantan, East Java, South Sulawesi, East Nusa Tenggara, and West Sulawesi. The study concludes that securing NCCI's food supply requires an integrated strategy: boosting local production through land optimization and technology, strengthening core logistics infrastructure (including warehousing and maritime transport), and formalizing intergovernmental and public-private partnerships. These strategies provide a transferable framework for food security in large cities globally.

Keywords
food security, New Capital City, food balance, food supply, Indonesia, food system planning

Introduction

Food is a fundamental human right, recognized in Indonesia's 1945 Constitution (Republic of Indonesia, 1945) and international frameworks, such as the 1996 Rome Declaration (Food and Agriculture Organization of the United Nations [FAO], 1996). This principle is central to national law (Law No. 18 of 2012 on Food) and is critically important for sustaining Indonesia's large population (Chaireni et al., 2020). The strategic challenge of ensuring food security is now being redefined by a historic national initiative: the relocation of the capital from Jakarta to a newly developed area in East Kalimantan, enacted through Law No. 3 of 2022 on State Capital. This move addresses severe pressures in Java and aims to spur equitable development

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Funding Disclosure
This research was funded by the National Research and Innovation Agency (BRIN) of the Republic of Indonesia under the *Rumah Program* scheme (Decree No. 6/III.12/HK/2024), administered by BRIN's Research Organization for Governance, Economy, and Community Welfare. The research project, titled "Strategies for Enhancing Food Supply (Distribution) and Price Stabilization from Buffer Regions to the National Capital and Major Cities," was conducted in collaboration with the National Food Agency.

Conflict of Interest Disclosure
The authors declare no conflicts of interest.

(Herdiana, 2022; Rachman, 2019; Sulaiman et al., 2017). The relocation seeks to create a sustainable region as a development model, ensure equitable growth, and promote urban farming for food security (Brinkley et al., 2013; Rosmiati et al., 2023). The creation of the New Capital City of Indonesia (NCCI), Nusantara, presents a unique and unprecedented challenge: building a resilient food system from the ground up for a planned urban center whose population and infrastructure are in their initial stages.

As a new urban entity, the NCCI lacks an established agricultural base and must rely on a regional food system from its inception, drawing supplies from East Kalimantan Province (EKP) and surrounding buffer provinces. This creates an immediate vulnerability, as such systems are universally pressured by agricultural land conversion and rising demand for development (Ikerd, 2013; Kusumastuti, 2014). In Indonesia, these pressures are compounded by systemic weaknesses, including inefficient supply chains, poorly mapped food reserves, and fragmented institutional coordination (Rachman, 2019; Sulaiman et al., 2017). For the NCCI, these issues are paramount and manifest as three core problems: (1) projecting and meeting escalating food demand in a context of rapid population growth; (2) designing efficient supply chains and logistics where infrastructure is still developing; and (3) ensuring reliable flows from external buffer zones. However, a critical research gap exists in providing the integrated data and analysis necessary to strategically plan and secure the food supply for a new capital city from its inception, particularly mechanisms for integrating it with regional buffer zones that quantify both production deficits and logistical bottlenecks.

This study addresses this gap by introducing a novel, dual-scale analysis that systematically links the micro-level food balance of the NCCI's immediate regencies with the macro-level dynamics of interprovincial supply chains. This approach is crucial because it reveals not only the volume of deficits but also the specific geographic and logistical vulnerabilities of the entire system, a perspective absent from prior planning documents. The research is urgent for four reasons. First, it will identify the projected mismatch between future demand and existing production capacity, quantifying the NCCI's dependency on interprovincial flows (Blay-Palmer et al., 2018; Food and Agriculture Organization of the United Nations [FAO], 2018). Second, it will formulate strategies to enhance local production within EKP and strengthen critical partnerships across the supply chain. Third, it contributes to the discourse on building resilient food systems for new cities. Finally, it provides a valuable case study for other nations contemplating new capital cities. This study aims to (1) assess the current food production in the NCCI and EKP, (2) analyze the balance between production and need, (3) map food supply sources and chains, and (4) formulate strategic recommendations to secure the food supply for the NCCI.

Literature Review

Effective planning for the NCCI's food system requires robust data on food sources, distribution networks, and production volumes to meet the needs of a rapidly growing population. The food balance sheet is a critical tool in this planning, providing a quantitative estimate of staple food supply and demand that serves as an early warning system for potential shortages and informs regional food policy (Food Security Agency, 2016; P4W IPB University, 2021).

A primary challenge is that urban growth often occurs at the expense of agricultural land, as fixed land areas are converted to support housing and infrastructure (Chatterjee et al., 2016). This conversion directly threatens local food availability. Consequently, major cities frequently become food-deficient centers, dependent on external supplies, and experience higher and more volatile staple food prices (Ommani, 2011; Rachman, 2019). This reflects a well-documented urban phenomenon where cities are inherently dependent on food trade, with their security shaped by external demand and supply forces (Likoko, 2013; Omondi et al., 2017).

This dependency creates vulnerability, as long supply chains are susceptible to price shocks and disruptions (Hellegers, 2022; Singh-Peterson et al., 2013). In response, integrating urban agriculture and local food production has been widely advocated as a key strategy for enhancing urban

resilience and food security (Brinkley et al., 2013; Rosmiati et al., 2023), a principle central to the NCCI's planning vision. This paradigm holds for the NCCI, which is initially expected to rely heavily on interregional food flows, as current domestic production in East Kalimantan is insufficient (Mulyono et al., 2025; Silalahi & Silalahi, 2024).

Addressing urban food dependency requires a dual strategy. First, initiatives to boost local production, such as the provincial government's one-million-hectare agricultural program, are crucial for long-term self-sufficiency (Media Pusaran, 2024). Research indicates that food security depends on three key elements: sufficient agricultural land, productivity-enhancing technologies, and strong distribution partnerships (Azzurri et al., 2024; Puspitoarum, 2017). Second, and equally important, is strengthening the distribution infrastructure. Efficient transportation and logistics are fundamental to facilitating the flow of goods from production centers to the capital (Mulyono et al., 2025). Furthermore, strategic partnerships between East Kalimantan's governments and external food-producing provinces are essential to streamline this supply chain and ensure a reliable food system for the NCCI.

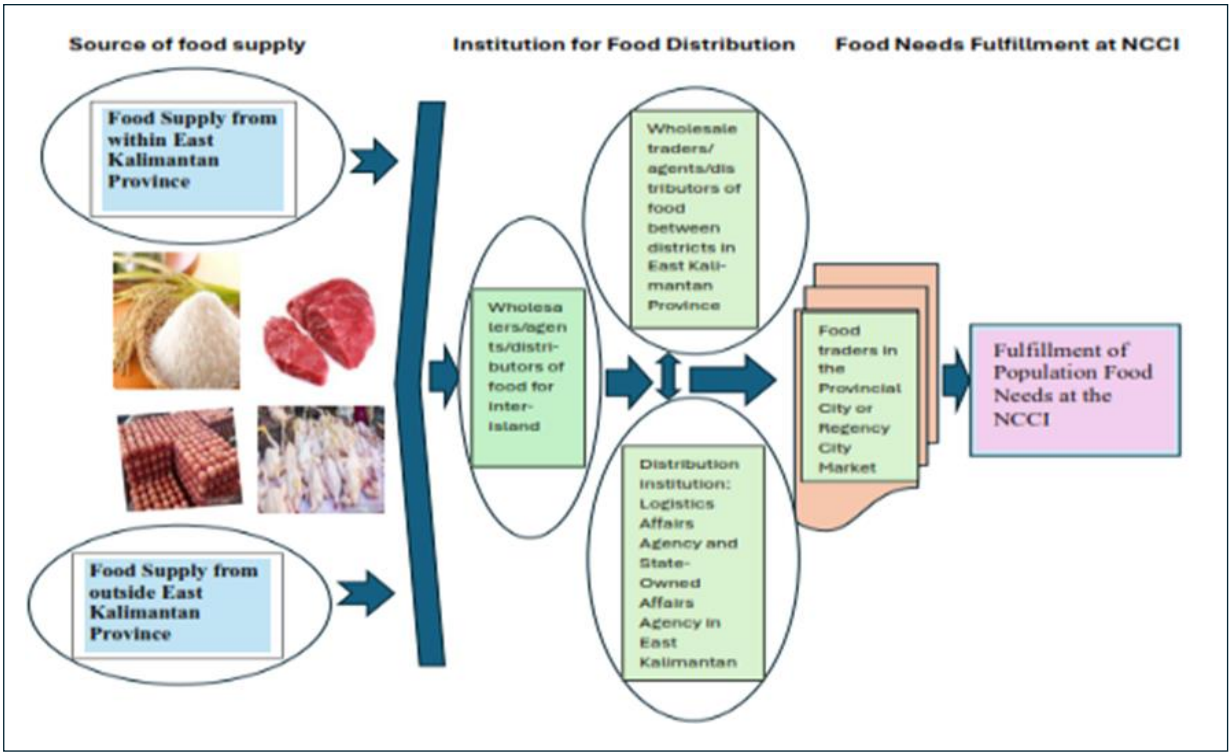
Methodology

This study employs a mixed-methods approach, combining quantitative analysis of food balances with qualitative insights from stakeholders to assess the NCCI's food supply system. The research was conducted in EKP and its key food buffer provinces. The following sections detail the research framework, locations, data collection, and analytical methods.

Research Framework and Commodity Selection

This study's framework addresses the challenge of planning a resilient food system for the NCCI, guided by Law Number 3 of 2022 (Ibu Kota Nusantara [IKN], 2022). The conceptual model, illustrated in Figure 1, provides a structured framework for planning and analyzing the NCCI's food supply, positing that it is a function of two interconnected subsystems, to ensure availability and access as key pillars of food security (Syathori, 2018).

Figure 1. Conceptual Framework on the New Capital City of Indonesia (NCCI) Food Supply System



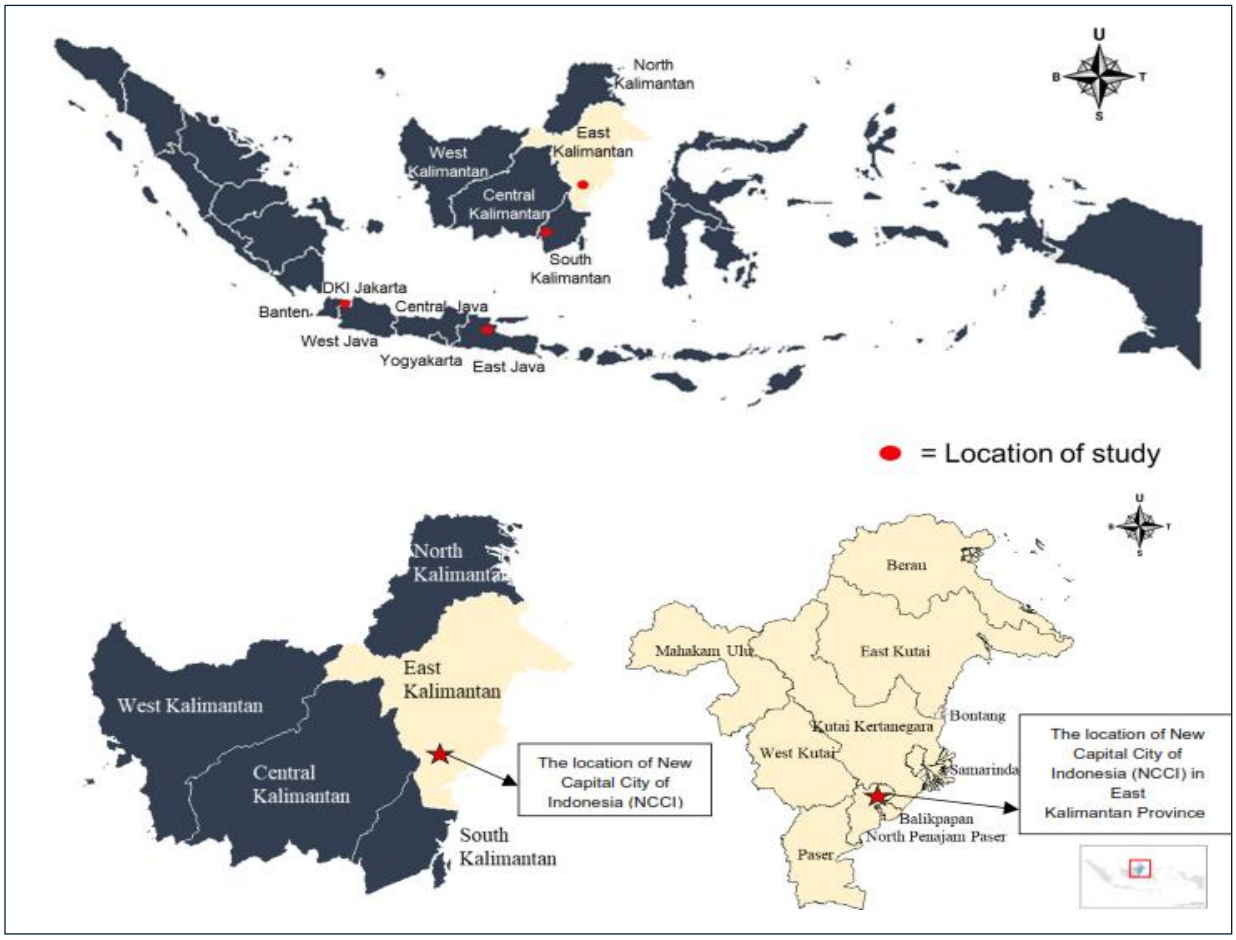
The first is the local production system within EKP, centered on the NCCI's regencies of North Penajam Paser and Kutai Kartanegara. Its capacity is determined by land availability (e.g., rice field area), agricultural technology, and local policies, which directly influence productivity and harvested area (Santosa & Sudrajat, 2017). The second is the regional buffer system, which supplies the NCCI through interregional flows. This system's efficiency, dependent on distribution infrastructure and market linkages, functions by aligning distribution flows with regional needs and surplus production (Zhou & Benton, 2007).

The framework traces commodity flows from these two systems through supply chain institutions to the NCCI. This enables a holistic analysis of production-consumption gaps and supply chain bottlenecks, as effective food planning requires integrated information on production centers, distribution institutions, and collaborative strategies (Sulaiman et al., 2017; Widodo et al., 2013). The analysis focuses on four strategic commodities mandated by Presidential Regulation number 125 of 2022 on the Administration of Government Food Reserves: rice, beef, layer eggs, and broiler meat. These were selected for their critical role in food security, their high urban consumption, and their representation of both plant- and animal-based food sources.

Study Area

The core study area is the NCCI, a designated special capital region whose territory spans parts of two regencies within EKP: North Penajam Paser and Kutai Kartanegara (Figure 2). This empirical setting frames the analysis, with the "NCCI area" referring specifically to these two regencies in all subsequent results and tables. To capture the

Figure 2. Location of the New Capital City of Indonesia (NCCI) in East Kalimantan Province (EKP), 2025



whole food supply chain, the research scope was expanded to include the broader EKP and key external food buffer provinces.

The selection of buffer provinces was based on data from the EKP Food, Food Crops, and Horticulture Office, the BPS-Statistics East Kalimantan Province (BPS-Statistics EKP), and a prior study by the Indonesian Center for Agricultural Socio-Economic and Policy Studies (ICASEPS). South Kalimantan and East Java were chosen as representative samples due to their established role as major suppliers of food commodities to the EKP region.

Data Collection

The analysis integrated primary data from focus group discussions (FGDs) with secondary data. This secondary data consisted of quantitative figures on food production, total utilization, and food imports for the period 2021–2023, obtained from official publications of the BPS-Statistics EKP (2024), and from the EKP Food, Food Crops, and Horticulture Office (2024). It is worth noting that no official data were available for food exports originating from East Kalimantan.

Primary data were collected through FGDs with purposively selected respondents from across the food system. A total of 150 participants were engaged in 34 FGDs (typically 4−5 participants per session), ensuring triangulation between different government tiers and key private-sector supply chain actors. The distribution of FGDs, which included officials from relevant agencies and traders of the four key commodities (rice, beef, layer eggs, and broiler meat), is summarized in Table 1.

Analytical Methods

This study employed a mixed-methods approach, integrating quantitative and qualitative analyses to provide a comprehensive understanding of NCCI's food system. Quantitative analysis was conducted in three key areas: (1) trend analysis: examining production developments from 2021 to 2023; (2) food balance analysis: calculating the surplus or deficit for each commodity by comparing total domestic supply and total utilization; and (3) supply chain analysis: determining the percentage share of different sources in the food supply to the NCCI.

The food balance analysis adapted the standard model (Food Security Agency, 2021; ICASEPS, 2023; Santosa & Sudrajat, 2017) to the data constraints and future-oriented policy goal of food self-sufficiency for EKP. The standard food balance equation is

Table 1. Distribution of Focus Group Discussions (FGDs)

Location	Stakeholder Groups	Number of FGDs
Central Government, Jakarta	• National Food Agency • Directorate General of Food Crops • Directorate General of Livestock and Animal Health	4
East Kalimantan Province	• Food, Food Crops, and Horticulture Office • Livestock and Animal Health Office • Logistics Affairs Agency • Traders (rice, beef, layer eggs, broiler meat)	14
South Kalimantan Province	• Agriculture and Food Security Office • Plantation and Livestock Office • Logistics Affairs Agency • Traders (rice, beef, layer eggs, broiler meat)	8
East Java Province	• Agriculture and Food Security Office • Livestock Office • Logistics Affairs Agency • Traders (rice, beef, layer eggs, broiler meat)	8
Total		**34**

$$Pd = Pr + Mi - Xi - (Fd + Sd + In + Wa + Uo)$$

where *Pd* is food available for consumption, *Pr* is production, *Mi* is import, *Xi* is export, *Fd* is feed, *Sd* is seed, *In* is industrial use, *Wa* is waste, and *Uo* is other uses. Due to the lack of data on food exports (*Xi*) from East Kalimantan, the food balance was calculated using a simplified and policy-relevant approach:

$$Balance = Pr - TU$$

where *TU* represents the total domestic food needed, encompassing food consumption, feed, seed, industrial use, waste, and other uses ($TU = Fd + Sd + In + Wa + Pd + Uo$). Therefore, a surplus occurs when $Pr > TU$, and a deficit occurs when $Pr < TU$. This method effectively calculates the province's net dependency, as a deficit indicates the minimum volume that must be supplied from external sources to meet internal demand. This approach aligns with the provincial government's aspiration for self-sufficiency by directly contrasting local production capacity (*Pr*) with total domestic needs (*TU*).

Complementing the quantitative analysis, a qualitative thematic analysis of FGD transcripts identified key challenges, policy responses, and stakeholder perspectives. These insights were used to explain quantitative trends, triangulate findings, and provide contextual depth, resulting in a more complete and reliable understanding of the food system.

Results and Discussion

This section presents the results and discussion through a sequence of four analyses that systematically address NCCI's food security challenges. It begins by analyzing production trends to establish a baseline of local capacity, then quantifies the regional food balance to identify specific commodity deficits and surpluses. Next, it maps supply chains from buffer provinces to reveal the NCCI's external dependencies. Finally, the findings are integrated with stakeholder perspectives to formulate strategic recommendations.

Food Production Trends in EKP

This section analyzes EKP's capacity to build a foundational food supply for the NCCI by integrating quantitative production data with qualitative insights from stakeholders. The analysis reveals a precarious and divergent trajectory, consistent with the known challenges that urban food security faces, including pressures from decreasing agricultural land and rising population demands (Ikerd, 2013; Kusumastuti, 2014). This trajectory is characterized by a structurally declining staple crop sector alongside a rapidly growing, yet strategically concentrated, livestock sector.

Government ambitions for food sovereignty in EKP are articulated through development roadmaps that focus on land diversification and productivity enhancement (Antara National News Agency, 2023; EKP Food, Food Crops, and Horticulture Office, 2024). A key challenge in this endeavor is significant land-use competition from mining, plantations, and housing. In direct response, authorities are actively identifying idle land for potential agricultural development. A concrete step in this direction is the plan to prepare 1,890 hectares (4,670 acres) for a new rice field program in 2024/2025 (Presisi, 2025). However, evidence from stakeholder discussions, summarized in Table 2, reveals a consistent gap between these plans and on-ground realities.

The FGDs crystallized the core challenges facing production growth. Officials from both the central government and EKP specifically identified the suboptimal utilization of agricultural land, with EKP officials detailing the difficulties of cultivating dry and former mining lands, as well as the uneven distribution of cultivation technology, as direct constraints (Table 2). Notably, stakeholders across all regions, from central to buffer province governments, converged on expanding pump irrigation systems as a critical policy response to these water-related challenges. These stakeholder-identified issues provide the causal link explaining the quantitative trends of low production, confirming earlier studies (Adi et al., 2021) with current, on-the-ground evidence.

A critical insight from the FGDs is that EKP's challenges are part of a broader, fragile system. Perspectives from buffer province officials revealed that the NCCI's food security depends on regions confronting distinct and severe threats to their own

production capacity. Officials in South Kalimantan directly reported a three-year decline in rice production due to climate change–induced drought. At the same time, those in East Java identified large-scale land conversion as their primary challenge. This lack of a uniform, secure external supply creates a compound risk for the NCCI, as a climate shock in one buffer zone cannot be easily compensated by another that is simultaneously losing productive capacity, a vulnerability underscored in broader food security literature (Kovács & Sigala, 2021).

The statistical data from 2021 to 2023 provide stark evidence of these systemic issues. As shown in Table 3, provincial rice production declined at an annual rate of 6.37%, falling from 142,321 tons to 125,228 tons. This significant decline is the quantitative manifestation of the qualitative challenges reported by stakeholders, underscoring the urgent need for the massive production increases advocated to meet regional food needs (Andoko & Doretha, 2019).

A critical nuance is that the decline was nearly universal, except in the NCCI's core regencies of North Penajam Paser and Kutai Kartanegara. This suggests that the presence of the capital project is already creating a stabilizing or positive influence on agricultural production in its immediate vicinity. This aligns with the qualitative data from EKP officials, who highlighted active beef cattle programs in Sepaku Subdistrict and initiatives to optimize rice fields. However, this localized stability is insufficient and highlights a risk of a core-periphery disparity emerging within EKP's agricultural sector, where the capital's development inadvertently benefits its immediate hinterland at the expense of wider provincial production.

In contrast to the declining staple crop sector, the livestock sector in EKP presents a more complex and promising picture, yet one that is strategically imbalanced. A sequential analysis of beef, layer eggs, and broiler meat reveals a sector marked

Table 2. Stakeholder Perspectives on Food Production Challenges and Policy Responses

Stakeholder	Key challenges	Policy response
Central Government, Jakarta.	• Suboptimal utilization of agricultural land. • Uneven and limited distribution of cultivation technology (mechanization, superior seeds). • Limited development in cattle and poultry businesses.	• Promoting intensification and extensification programs. • Land optimization, rice field development, and the expansion of pump irrigation systems to increase the cropping index. • Increasing livestock production, specifically broiler chicken and beef cattle. • Developing a national strategic beef cattle program in Sepaku Subdistrict, North Penajam Paser Regency.
East Kalimantan Province (EKP), New Capital City of Indonesia (NCCI)	• Suboptimal land use (dry land, ex-mining land) and limited agricultural technology support. • Underdeveloped livestock businesses (beef cattle, broiler chickens). • Limited capacity of farmer groups in agricultural product processing.	• Programs to optimize existing (14,876 ha) and create new (100,000 ha) rice fields. • Increasing cropping index through mechanization and superior seeds. • Developing beef cattle programs in Sepaku Subdistrict, North Penajam Paser Regency, and broiler centers across EKP. • Providing rice milling and supporting meat processing facilities.
South Kalimantan Province	• Declining rice production due to climate change (drought). • Suboptimal use of dry and tidal land in production centers.	• Land use optimization and the expansion of pump irrigation systems across 41,829 hectares. • Promoting beef, chicken, and egg production to fulfill its role as an NCCI buffer province.
East Java Province	• Decreasing productive land due to conversion. • Limited farmer access to capital. • Low farmer bargaining power in marketing.	• Controlling agricultural land conversion. • Increasing rice production through the expansion of pump irrigation systems. • Providing farm credit, modernizing agriculture, and stabilizing commodity prices.

by contrasting trajectories and critical vulnerabilities.

The story of beef production (Table 4) is one of modest overall growth (2.27% annually), masking significant internal volatility and a troubling trend of urban displacement. While regencies like Paser and North Penajam Paser saw dramatic growth (>40%), likely linked to targeted government programs like the national strategic cattle program in Sepaku Subdistrict, this was partially offset by a sharp decline in major urban centers. Samarinda City and Balikpapan City experienced declines of 28.16% and 22.22% respectively. This starkly illustrates the pressure of urban expansion, where agricultural land is directly converted for other uses, undermining production in the very population centers where demand is highest.

The layer egg sector (Table 5) shows steadier, though more modest, growth of 4.64% annually. Driven by private-sector investment, production is concentrated in a few key areas: Samarinda City, Kutai Kartanegara Regency, and Berau Regency. However, this growth has proven insufficient. As established in the regional food balance analysis, EKP maintains a substantial deficit in layer eggs. This critical nuance reveals that the livestock sec-

Table 3. Rice Production by Regency/City in East Kalimantan Province (EKP), 2021–2023 (Tons)

No.	Regency/City	2021	2022	2023	r (%/year)
1	Paser	30,230.50	25,556.41	15,338.02	–31.41
2	West Kutai	1,175.83	798.72	780.86	–21.50
3	Kutai Kartanegara	60,750.49	61,725.02	61,895.95	0.93
4	East Kutai	7,631.26	7,079.05	6,268.86	–9.74
5	Berau	13,008.91	11,453.00	11,792.76	–5.03
6	North Penajam Paser	24,505.74	24,773.28	25,665.05	2.32
7	Mahakam Ulu	542.17	284.68	378.63	–20.35
8	Balikpapan City	205.99	183.58	90.09	–36.24
9	Samarinda City	4,965.21	3,016.05	2,927.36	–28.02
10	Bontang City	205.26	160.73	90.08	–37.88
	East Kalimantan Province	142,321.38	135,030.52	125,227.66	–6.37

Source: BPS-Statistics EKP (2024).

Table 4. Beef Production by Regency/City in East Kalimantan Province (EKP), 2021–2023 (Tons)

No.	Regency/City	2021	2022	2023	r (%/year)
1	Paser	477.23	478.49	1,025.86	41.53
2	West Kutai	300.93	245.17	300.46	–0.08
3	Kutai Kartanegara	749.41	777.84	874.36	7.80
4	East Kutai	707.07	903.25	769.95	3.96
5	Berau	595.86	517.04	708.97	9.31
6	North Penajam Paser	229.06	557.56	602.50	40.33
7	Mahakam Ulu	11.85	13.43	17.53	19.93
8	Balikpapan City	1,794.34	1,362.49	1,155.58	–22.22
9	Samarinda City	2,951.08	1,956.46	1,709.08	–28.16
10	Bontang City	702.97	653.84	711.34	0.61
	East Kalimantan Province	7,529.80	7,465.56	7,875.63	2.27

Source: BPS-Statistics EKP (2024).

tor's growth is not a panacea; it has so far failed to address this specific commodity gap, leaving the NCCI dependent on external sources for a crucial source of protein and nutrients, a point confirmed by stakeholders in South Kalimantan.

The highest growth is found in the broiler meat sector (Table 6), which expanded at a remarkable 10.52% annual rate, adding over 12,800 tons of production between 2021 and 2023. Heavily driven by integrated private enterprises in feed, medicine, and trade, this growth represents the success of a market-led development pathway. However, this success introduces a new strategic vulnerability: extreme spatial concentration. The production is overwhelmingly centralized, with Samarinda City and Kutai Kartanegara Regency accounting for over 50% of the total provincial output in 2023. This concentration, explicitly flagged as a risk by Logistics Affairs Agency officials, creates a fragile supply chain. A disease outbreak, logistical disruption, or economic shock in one of these core hubs could jeopardize a significant portion of the province's primary meat supply, undermining the food security it is meant to bolster.

The central conclusion for NCCI planning, derived from integrating quantitative data with

Table 5. Layer Eggs Production by Regency/City in East Kalimantan Province (EKP), 2021–2023 (Tons)

No.	Regency/City	2021	2022	2023	r (%/year)
1	Paser	1,556.80	1,483.72	1,498.56	–1.85
2	West Kutai	418.57	424.55	428.80	1.21
3	Kutai Kartanegara	3,669.02	3,726.94	3,764.21	1.29
4	East Kutai	1,310.25	1,799.30	1,817.29	19.16
5	Berau	2,371.80	2,262.04	2,284.66	–1.81
6	North Penajam Paser	770.45	777.91	785.69	0.98
7	Mahakam Ulu	49.01	48.15	48.63	–0.38
8	Balikpapan City	937.43	945.85	955.31	0.95
9	Samarinda City	3,195.57	4,027.44	4,067.71	13.52
10	Bontang City	123.67	98.43	99.41	–9.71
	East Kalimantan Province	14,402.57	15,594.33	15,750.27	4.64

Source: BPS-Statistics EKP (2024).

Table 6. Broiler Meat Production by Regency/City in East Kalimantan Province (EKP), 2021–2023 (Tons)

No.	Regency/City	2021	2022	2023	r (%/year)
1	Paser	2,627.88	2,653.23	3,223.17	10.50
2	West Kutai	2,409.64	2,434.67	2,957.66	10.54
3	Kutai Kartanegara	13,989.87	14,126.97	17,161.60	10.51
4	East Kutai	3,561.20	3,597.75	4,370.59	10.53
5	Berau	1,689.92	1,707.75	2,074.59	10.54
6	North Penajam Paser	1,704.67	1,721.72	2,091.56	11.24
7	Mahakam Ulu	70.73	71.43	86.77	11.24
8	Balikpapan City	12,228.08	12,351.30	15,004.50	11.24
9	Samarinda City	14,799.23	14,946.29	18,156.92	10.51
10	Bontang City	3,503.11	3,539.08	4,299.31	10.53
	East Kalimantan Province	56,584.33	57,150.19	69,426.69	10.52

Source: BPS-Statistics EKP (2024).

stakeholder perspectives, is that EKP's current production system cannot serve as a standalone anchor for food security. This is due to a dual dependency: first, a non-negotiable dependency on external staples, driven by a declining rice sector that EKP and central government officials attribute to systemic land and technology challenges; and second, a dependency on a vulnerable private sector for livestock, which, while dynamic, is concentrated in areas that logistics officials warn are at risk from urban expansion.

This integrated analysis provides a more nuanced understanding than either dataset could alone. It reveals that the core challenges are not just about volume but also about governance, including aligning central and local plans, the geographic specificity of threats in buffer zones, and the sectoral dynamics of contrasting drivers and risks associated with crop versus livestock production. The following sections will quantify these deficits through a food balance analysis and map the vulnerable supply chains that the new capital must urgently address.

Production Balance and Food Needs in the NCCI Area

This section analyzes the 2023 balance between food production and consumption in EKP. The results, summarized in Tables 7 and 8, provide a critical quantitative baseline, revealing that the NCCI's food security starts from a position of high dependency on external staples, despite emerging strengths in livestock production. This analysis of commodity needs is crucial for ensuring supply and enabling local economic development, particularly in agriculture (Ingram, 2011; Kay, 2021; Robert & Mullinix, 2018).

The quantitative data reveal EKP's most critical vulnerability: a deep structural deficit in its primary staple food. As detailed in Table 7, the province faced a rice deficit of 224,694 tons in 2023, with domestic production meeting only about 36% of total needs. This finding directly validates the concerns raised by central and regional government stakeholders in FGDs (Table 2), who highlighted suboptimal land use and low productivity as fundamental constraints. The deficit was nearly universal, with severe shortfalls in major urban centers such as Samarinda City and Balikpapan City underscoring the intense pressure urban populations place on the food system (Mbow et al., 2022). A critical, though isolated, exception was North Penajam Paser Regency, which recorded a surplus of 7,977 tons (Figure 3a). This aligns with qualitative reports on targeted agricultural programs in the NCCI area but also highlights that local capacity is insufficient to secure the food supply for a rapidly growing

Table 7. Balance of Rice and Beef by Regency/City in East Kalimantan Province (EKP) ((EKP), 2023 (Tons)

	Rice			Beef		
Regency/City	Production	Needs	Surplus/deficit	Production	Needs	Surplus/deficit
Paser	15,338.02	25,427.85	−10,089.83	1,025.86	136.37	889.49
West Kutai	780.86	15,853.14	−15,072.28	300.46	85.02	215.44
Kutai Kartanegara	61,895.95	67,732.71	−5,836.76	874.36	363.26	511.11
East Kutai	6,268.86	40,767.25	−34,498.39	769.95	218.64	551.31
Berau	11,792.76	23,116.96	−11,324.20	708.97	123.98	584.99
North Penajam Paser	25,665.05	17,687.89	7,977.16	602.50	94.86	507.64
Mahakam Ulu	378.63	3,022.42	−2,643.79	17.53	16.21	1.33
Balikpapan City	90.09	63,548.58	−63,458.49	1,155.58	340.82	814.76
Samarinda City	2,927.36	76,131.39	−73,204.03	1,709.08	408.30	1,300.78
Bontang City	90.08	16,633.58	−16,543.5	711.34	89.21	622.13
East Kalimantan Province	125,227.70	349,921.77	−224,694.07	7,875.63	1,876.67	5,998.96

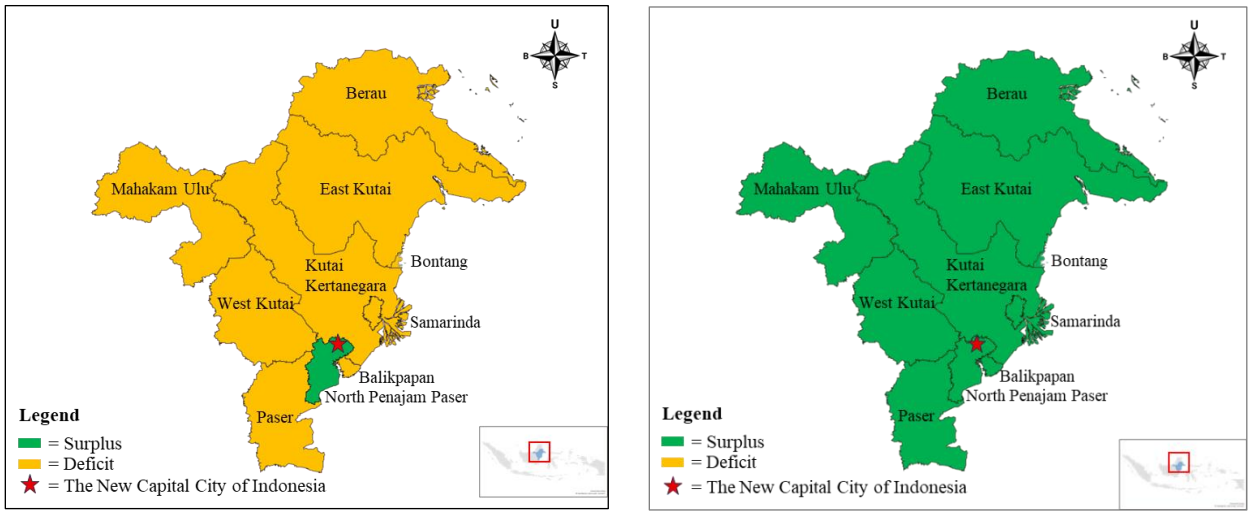
Source: BPS-Statistics EKP (2024),

capital city, whose population is projected to nearly quadruple (IKN, 2022).

The analysis reveals a dualistic reality within the animal protein sector, characterized by substantial surpluses alongside a persistent, specific deficit. EKP produced a significant surplus of beef (5,999 tons) and a massive surplus of broiler meat (43,676 tons), as shown in Tables 7 and 8. The universal regency-level beef surpluses (Figure 3b) and the scale of broiler production indicate a robust sector that has successfully transitioned EKP into a net exporter. This strength aligns with the emphasis placed by private traders in the FGDs on investment-driven growth, demonstrating a market-led development pathway.

In stark contrast, EKP maintained a substantial deficit for layer eggs (–15,767 tons), as seen in Table 8. This widespread shortfall (Figure 4a) corroborates reports from provincial officials on the constraints within the layer poultry sector. It reveals a clear commodity-specific gap that the current market growth has not yet filled, underscoring

Figure 3. Food Balance of Rice (a) and Beef (b) in East Kalimantan Province (EKP), 2023



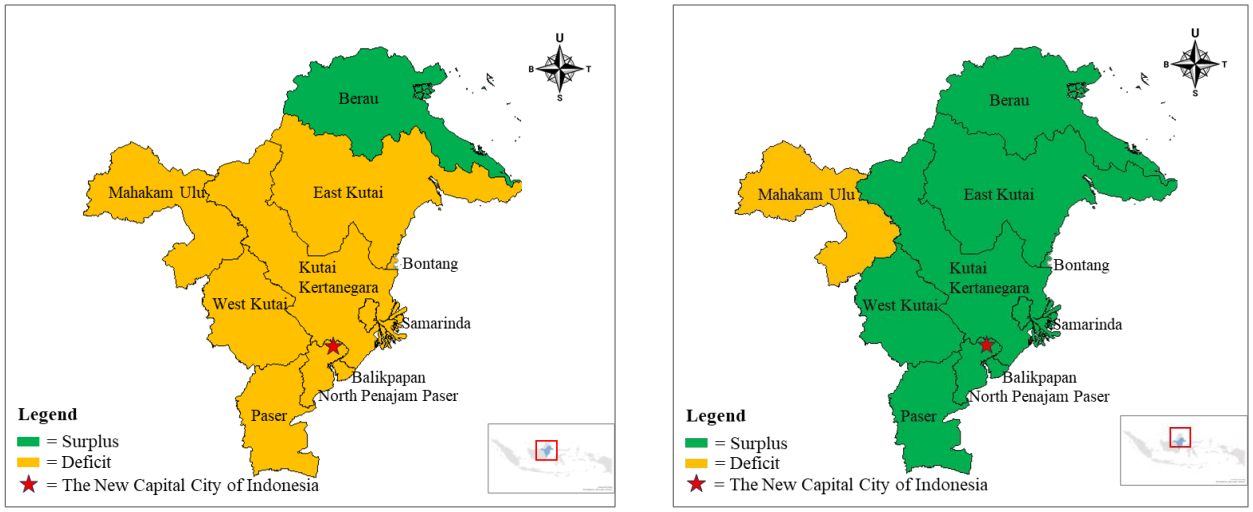
(a) (b)

Table 8. Balance of Layer Eggs and Broiler Meat by Regency/City in East Kalimantan Province (EKP), 2023 (Tons)

	Layer eggs			Broiler meat		
Regency/City	Production	Needs	Surplus/deficit	Production	Needs	Surplus/deficit
Paser	1,498.56	2,289.60	–791.04	3,223.17	2,505.50	717.68
West Kutai	428.80	1,432.30	–1,003.50	2,957.66	1,567.35	1,390.32
Kutai Kartanegara	3,764.21	6,099.72	–2,335.51	17,161.60	6,674.89	10,486.71
East Kutai	1,817.29	3,671.49	–1,854.20	4,370.59	4,017.68	352.91
Berau	2,284.66	2,082.22	202.44	2,074.59	280.10	1,794.49
North Penajam Paser	785.69	1,593.00	–807.31	2,091.56	1,743.21	348.35
Mahakam Ulu	48.63	272.75	–224.12	86.77	298.47	–211.70
Balikpapan City	955.31	5,722.68	–4,767.37	15,004.50	6,262.29	8,742.21
Samarinda City	4,067.71	6,856.00	–2,788.29	18,156.92	750.25	17,406.67
Bontang City	99.41	1,497.22	–1,397.81	4,299.31	1,638.40	2,660.92
East Kalimantan Province	15,750.27	31,516.98	–15,766.71	69,426.69	25,750.14	43,688.56

Source: BPS-Statistics EKP (2024).

Figure 4. Food Balance of Layer Eggs (a) and Broiler Meat (b) in East Kalimantan Province (EKP), 2023



that regional food security requires support across production, access, and utilization (Rohr et al., 2021; Yudha et al., 2023). Conversely, EKP experienced a substantial surplus of broiler meat (43,689 tons), a direct result of the expanding broiler farming industry and its supporting trade in inputs and products. This broiler meat surplus was evident in nearly all regencies and cities throughout EKP (Figure 4b).

The integrated quantitative and qualitative analysis leads to a clear strategic imperative for NCCI planning. The province's food system is defined by a "high-dependency profile"; it must import the majority of its staple grain while maintaining self-sufficiency in key meats. This finding highlights the importance of holistic ecosystem planning and collaboration in achieving food self-sufficiency, as emphasized by the EKP Food, Food Crops, and Horticulture Office. This duality means that securing the NCCI's food supply requires a targeted strategy that addresses the root causes of the staple crop deficit, rather than a one-size-fits-all approach. The following section will now trace the geographic pathways of these crucial food imports, mapping the supply chains that currently sustain the region.

Food Supply to the NCCI in EKP

This section analyzes the complex supply chains that sustain the NCCI, integrating stakeholder perspectives from across the system. The analysis reveals that the capital's food security depends on a multiprovince network that is currently characterized by fragmented logistics and infrastructure limitations, exemplifying the known systemic gaps in Indonesia's food system, such as long supply chains and poor institutional integration (Rachman, 2019; Sulaiman et al., 2017). This situation is further pressured by the universal challenges of meeting urban food demands amid land conversion and population growth (Ikerd, 2013; Kusumastuti, 2014).

A synthesis of views from key actors, presented in Table 9, reveals a consensus on the core challenges but differing focal points. Central government officials in Jakarta identified weather-dependent and hampered distribution facilities as a primary constraint, emphasizing the need for transportation subsidies and improvements to the sea toll policy. This perspective was echoed by EKP and NCCI authorities, who specifically highlighted insufficient storage facilities and the need for formal cooperation with buffer provinces. Their insights point to a critical gap in the "last mile" of the supply chain within EKP. Buffer provinces confirmed their role but detailed their own constraints; South Kalimantan Province reported limitations in collection warehouses and land transport, while East Java emphasized the critical need for smooth sea transportation links. This collective diagnosis underscores that the NCCI's food supply

Table 9. Stakeholder Views on Challenges and Policies for the New Capital City of Indonesia (NCCI) Food Supply, 2024

Stakeholder	Key Challenges	Policy Recommendations
Central Government, Jakarta.	• Food distribution facilities to EKP, including the NCCI, are frequently constrained and disrupted by adverse weather or other distribution barriers.	• Provide transportation cost subsidies to distributors via National Food Agency programs. • Continuously improve the maritime toll policy to facilitate sea-based food distribution.
East Kalimantan Province, the New Capital City of Indonesia	• Food distribution from food buffer provinces to EKP remains hindered by persistent logistical challenges. • Food storage facilities (warehouses, cold storage) within EKP are limited.	• Establish formal food supply cooperation with buffer provinces (e.g., South Kalimantan, East Java). • Develop warehouse and cold storage facilities to stabilize supply and prices. • Utilize entities like Post Indonesia and local marketing institutions for last-mile distribution to the NCCI.
South Kalimantan Province	• Facilities and warehouses for collecting food commodities for export are limited. • Land transportation and warehousing for interprovincial supply are often constrained.	• Strengthen supply chains through local traders, the Agribusiness Sub-Terminal, and interprovincial traders. • Ship rice via land transport supported by the Logistics Affairs Agency and state-owned logistics companies. • Increase the number of storage units to enhance capacity for supplying the NCCI.
East Java Province	• The primary challenge is the adequacy and reliability of sea transportation facilities to the NCCI.	• Encourage and formalize cooperation in food supply to EKP. • Support and streamline the existing supply chain managed by interisland traders using sea transportation.

system is only as strong as its weakest logistical link.

The mapping of supply chains for key commodities quantifies these dependencies and highlights different risk profiles, directly stemming from the production capacities analyzed in the previous sections.

Rice: As the main staple, EKP's rice supply is highly fragmented and externally dependent. This heavy reliance is a direct consequence of the province's substantial structural deficit. With total annual rice needs reaching 349,922 tons, local production of 125,228 tons meets only 35.79% of provincial demand (Table 7). The NCCI's core regencies alone require a significant portion of this. Specifically, North Penajam Paser Regency needs 17,688 tons, and Kutai Kartanegara Regency needs 67,733 tons, highlighting concentrated demand within the capital area.

Traders report that approximately 90% of rice originates from external sources, specifically South Kalimantan and South Sulawesi (35% each, via land and sea) and East Java (20%) provinces. The geographic pathways of these critical external supplies are mapped in Figure 5. This reliance on long-distance maritime and land routes, a noted vulnerability among central government stakeholders, exposes it to weather disruptions, logistics costs, and price volatility. The projected increase in goods flow underscores the urgent need for improved road and port infrastructure, as well as the strategic warehouses near Kuala Samboja Village, Kutai Kartanegara Regency, identified in earlier studies (ICASEPS, 2023).

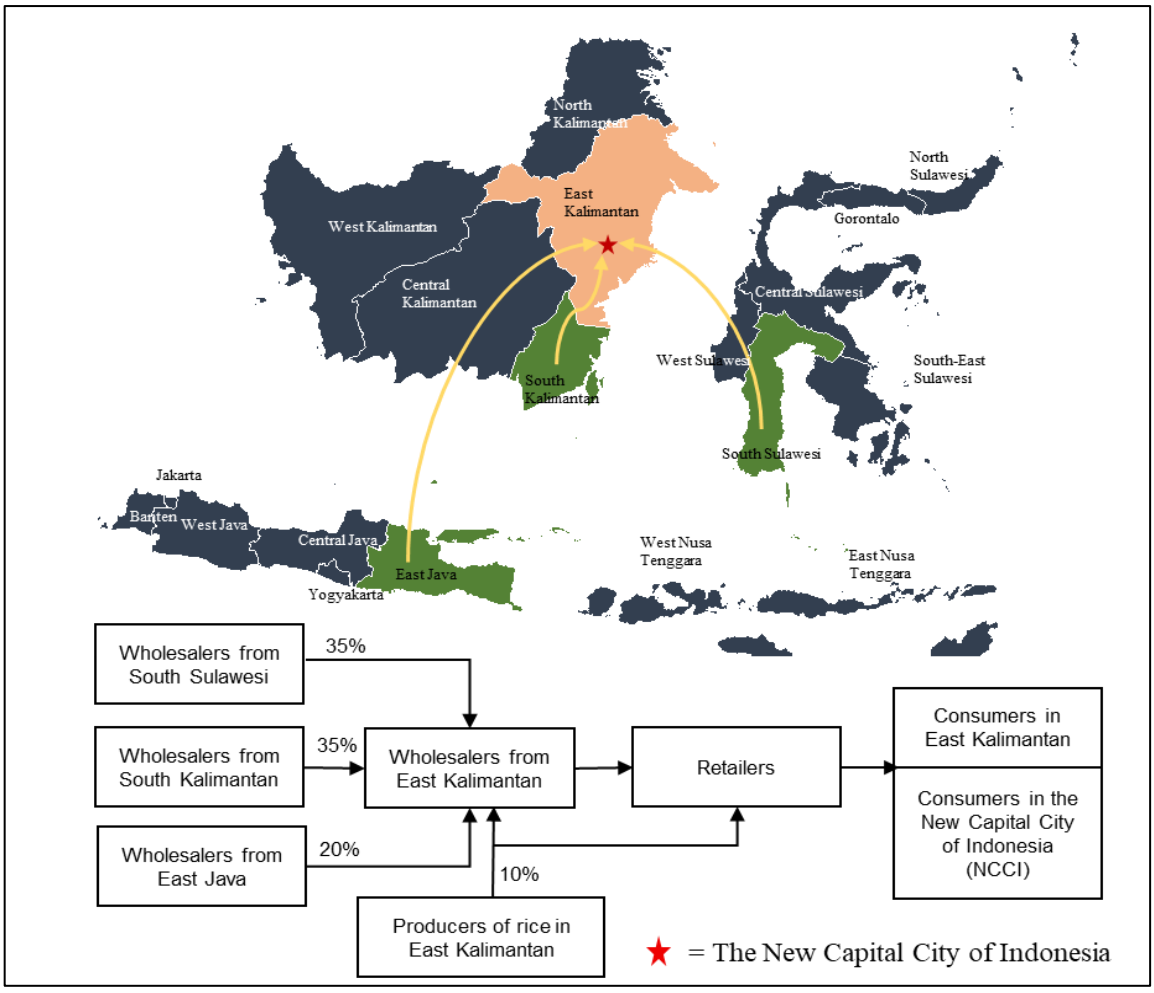
Beef: The beef supply chain presents a more diversified and strategic picture compared to the rice supply chain. While EKP itself supplies a significant 40% of its needs, supported by a modest annual production growth of 2.27% (Table 4) and a provincial surplus of 5,999 tons (Table 7), it maintains a deliberate 60% dependency on a multi-sourced interisland trade network. As illustrated in Figure 6, the NCCI's beef supply is strategically sourced from the provinces of South Sulawesi (20%), East Java (20%), and East Nusa Tenggara (20%). This diversification mitigates the risk of relying on a single external region.

East Nusa Tenggara Province primarily provides breeding cattle for fattening within EKP. This practice supports the ongoing development of a national strategic beef cattle program in Sepaku Subdistrict, North Penajam Paser Regency. This program directly addresses the stakeholder-identified need for developing livestock businesses and enhances local value addition. However, as noted by logistics stakeholders, the presence of a modern slaughterhouse with efficient transportation links remains crucial to fully capitalize on this potential and facilitate the flow of beef from these various production centers, both local and external, to consumers across the province.

Layer Eggs: The layer egg supply chain reveals a persistent deficit that external sources must fill. The total provincial requirement is 31,517 tons, with significant demand concentrated in the NCCI regencies of Kutai Kartanegara (6,100 tons) and North Penajam Paser (1,593 tons). Despite EKP supplying 60% of its needs, a substantial shortfall of -15,767 tons (Table 8) necessitates imports from four different provinces: South Sulawesi, South Kalimantan, East Java, and West Sulawesi, each accounting for 10% (Figure 7).

This 40% dependency persists even though the industry in Muara Badak Subdistrict, Kutai Kartanegara Regency, has developed technologically advanced farms housing 5,000-20,000 chickens with automated feed systems. According to farmers, EKP's egg needs can be met locally, and studies confirm that centers like Samarinda City are

Figure 5. Rice Supply from Food Buffer Provinces to the New Capital City of Indonesia (NCCI) in East Kalimantan Province (EKP), 2024

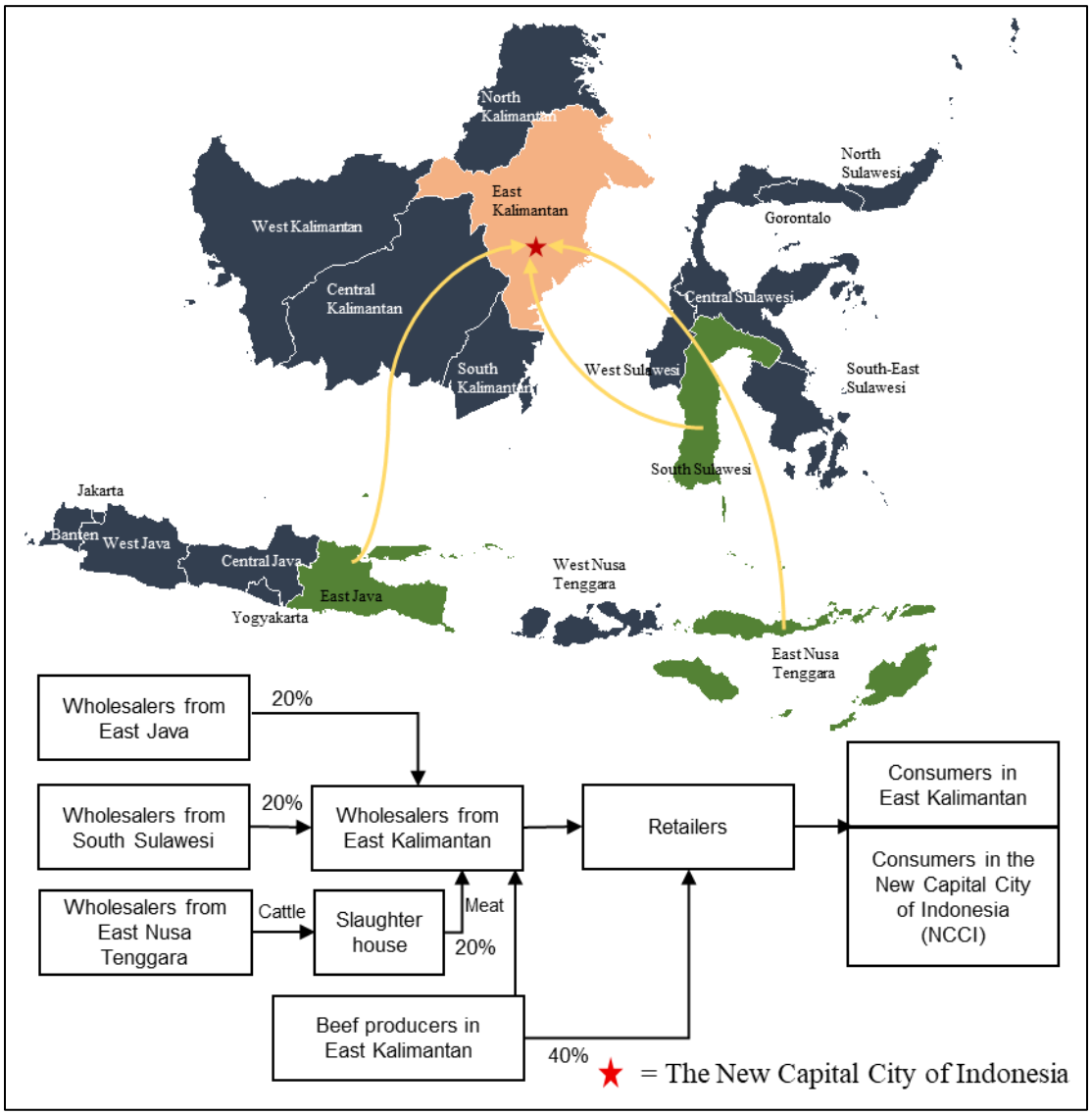


self-sufficient, while Balikpapan City relies on East Java Province (ICASEPS, 2023). This contrast highlights a disconnect between latent production capacity and adequate market supply, likely driven by the cost structures and distribution inefficiencies identified by stakeholders in Table 9.

Broiler Meat: The broiler meat sector demonstrates a high degree of self-sufficiency, underpinned by robust local production. EKP's total annual requirement is 25,750 tons, with significant demand from the NCCI regencies of North Penajam Paser (1,743 tons) and Kutai Kartanegara (6,675 tons). The province supplies approximately 70% of its needs internally, a direct result of the remarkable 10.52% annual production growth (Table 6) driven by private investment. The remaining 30% is sourced from South Kalimantan and East Java provinces (15% each), with the complete supply network detailed in Figure 8.

This established sector offers strong investment opportunities, especially as consumption is projected to reach 69 thousand tons by 2025, driven by the influx of 2.5 million new residents. To support this growth, stakeholders must address

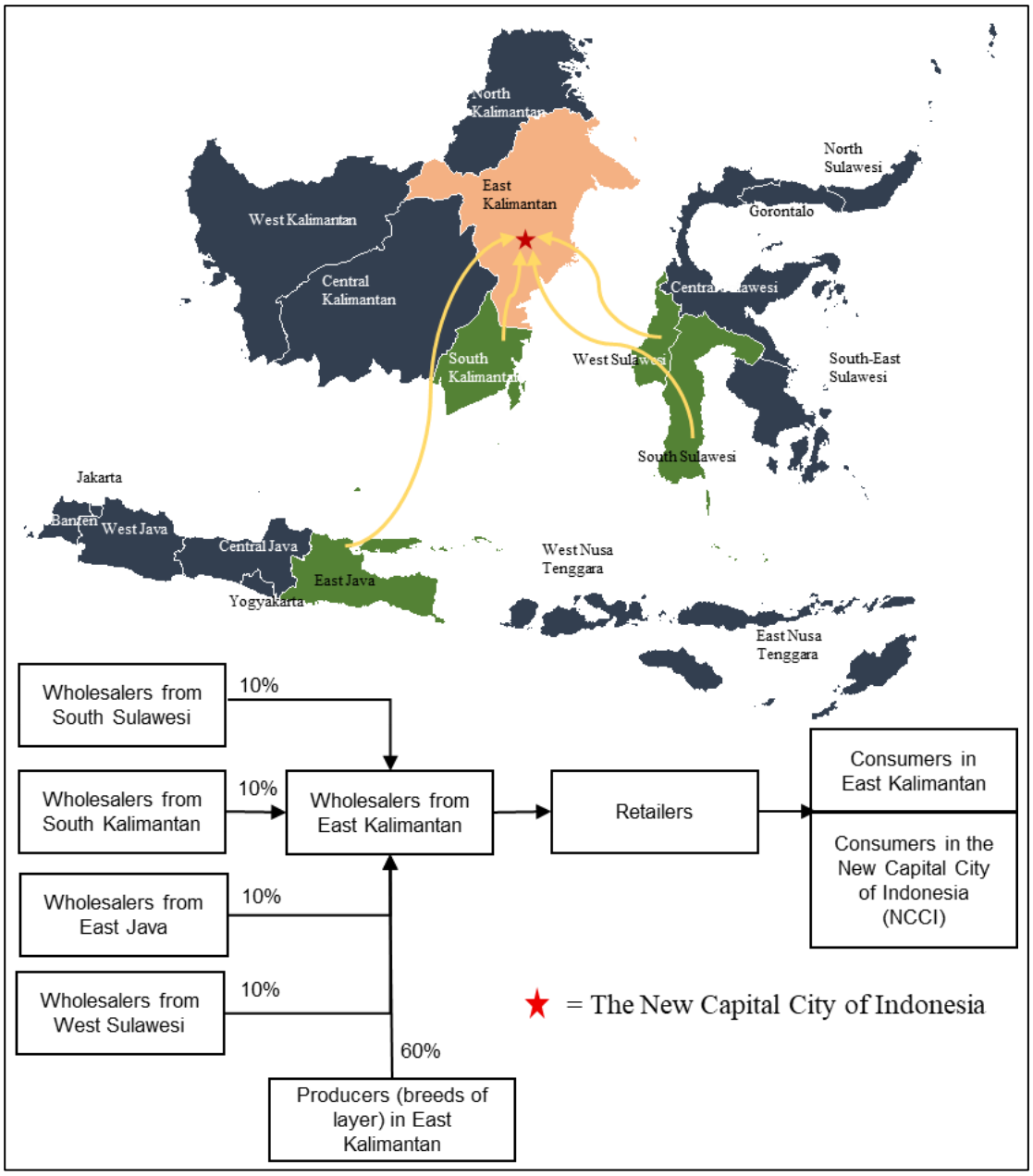
Figure 6. Beef Supply from Food Buffer Provinces to the New Capital City of Indonesia (NCCI) in East Kalimantan Province (EKP), 2024



critical constraints, such as strengthening breeder capacity and ensuring sufficient animal feed production. The strategic development of a maize-based feed industry in Balikpapan City and Samarinda City, as suggested by the EKP Food, Food Crops, and Horticulture Office (2018), along with planned processing facilities in Paser and North Penajam Paser regencies, will be crucial to capitalize on this potential and secure the sector's future.

The interconnectedness of the NCCI's food supply is its defining feature and its greatest vulnerability. The system is not a single pipeline, but a web of independent routes operated by various traders and agencies, each with its own bottlenecks. The central finding is that increasing production, while essential, is insufficient. The key to resilience

Figure 7. Layer Eggs Supply from Food Buffer Provinces to the New Capital City of Indonesia (NCCI) in East Kalimantan Province (EKP), 2024

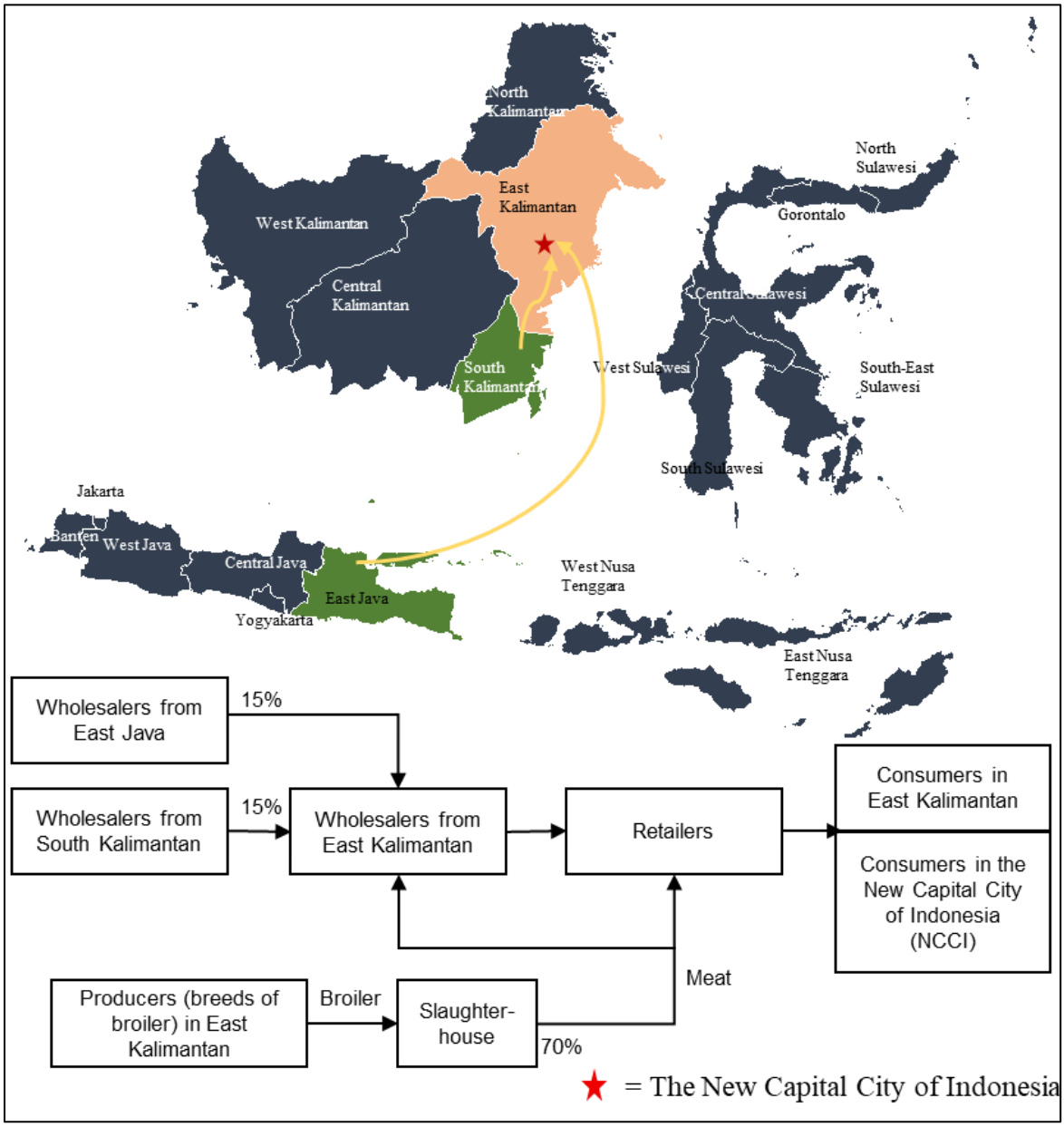


lies in integrating and strengthening the logistical infrastructure connecting the NCCI to its buffer zones, specifically by heeding stakeholders' calls for improved warehousing, reliable sea transport, and interregional government cooperation to create a more cohesive, reliable food system, thereby addressing foundational gaps in regional food distribution.

Strategies to Enhance Food Supply from Buffer Zones to the NCC

Based on the integrated analysis of production balances, supply chains, and stakeholder perspectives from FGDs, the following strategic recommendations are proposed as a direct input for the detailed planning and implementation of the NCCI's food security system:

Figure 8. Broiler Meat Supply from Food Buffer Provinces to the New Capital City of Indonesia (NCCI) in East Kalimantan Province (EKP), 2024



1. Increase local food production in EKP and the NCCI. This foundational strategy directly addresses the province's severe staple crop deficit by targeting the core challenges of suboptimal land use and limited technology. A primary focus must be on improving soil fertility, a critical barrier in the NCCI area (Armanto, 2024). The strategy should be implemented through three proven pathways: extensification, by rehabilitating marginal and ex-mining land to develop new rice fields; intensification, by increasing the cropping index on existing farmland through the deployment of pump irrigation systems; and productivity enhancement, through the dissemination of superior seeds and modern technology. This integrated approach, supported by established research (Aprillya et al., 2019; Burchi & De Muro, 2016), provides a clear framework for achieving local production growth. According to Azzurri (2024) and Puspitoarum (2017), an effective approach to food security requires agricultural land, productivity-enhancing technologies, and strong distribution partnerships.

2. Implement climate-resilient agricultural support. As consistently highlighted by stakeholders across regions, investment in irrigation infrastructure, particularly water-pumping systems, is critical. This will mitigate climate risks (a key challenge for South Kalimantan), optimize land use in buffer zones, and directly support the goal of increasing the cropping index in EKP.

3. Strengthen core logistics and distribution infrastructure. This recommendation directly responds to the calls from the central government, EKP, and officials of the buffer provinces. Strategic investment is required in (a) road networks and maritime transport facilities to accommodate the growing flow of goods and improve upon the sea toll policy, and (b) a network of modern warehouses and cold storage at key hubs to address the reported limitations in storage facilities and reduce post-harvest losses.

4. Foster intergovernmental and public-private partnerships. Formal cooperation mechanisms between the EKP/NCCI government and the governments of buffer provinces are essential to streamline policies, as recommended by Bahtiar & Raswatie (2023). Furthermore, strategic partnerships with the private sector, specifically involving traders, processors, and input suppliers, are crucial for driving investment, as emphasized by Suryana (2014) and confirmed by our FGDs.

5. Promote strategic investment in processing and human capital. To build a resilient, value-added food system, investment should be channeled into: (a) downstream processing industries within EKP to add value and reduce dependency; and (b) human resource capacity, especially for breeders and logistics operators, to ensure the sector's long-term sustainability.

Conclusion and Policy Implications

The development of NCCI in EKP poses a significant challenge to food security. This study concludes that the NCCI's food system begins from a position of high dependency, characterized by a critical deficit in staple rice and layer eggs, alongside a robust surplus in beef and broiler meat. This duality necessitates a heavy and strategic reliance on a multi-province buffer zone, primarily comprising South Kalimantan, East Java, South Sulawesi, East Nusa Tenggara, and West Sulawesi.

The integrated analysis, combining quantitative data with stakeholder perspectives, reveals that the core vulnerability lies not only in production gaps but also in fragmented and inefficient supply chains. Therefore, policy interventions must be dual-pronged. First, they must aggressively address local production constraints, such as suboptimal land use and limited technology, through programs that optimize land use, enhance irrigation (including water-pumping systems), and disseminate productivity-enhancing technologies. Second, and equally critical, is the need to strengthen logistical integration. This requires immediate investment in road and maritime transport infrastructure, as well as modern warehousing and cold storage facilities, a point consistently emphasized by stakeholders

across the government and private sectors. This dual-pronged approach provides a necessary roadmap for policymakers and urban planners. The strategies presented are not only vital for the NCCI but also offer a transferable, evidence-based framework for planning food systems in other new capital cities across the developing world.

Ultimately, achieving food resilience for the NCCI depends on formalizing cooperation and collaboration. This includes intergovernmental partnerships between EKP/NCCI authorities and buffer province governments to streamline policies, as well as public-private partnerships to leverage investment for processing, distribution, and market development. Future research should build on this foundation by incorporating the critical social and environmental dimensions of this vast urban transformation.

Acknowledgments

The authors extend their sincere gratitude to all respondents for their invaluable contributions to this study. We thank the officials from the National Food Agency and the Directorates General of Food Crops and Livestock and Animal Health in Jakarta. We are also indebted to government officials and food system stakeholders, including farmers, traders, distributors, and businesses in East Kalimantan, South Kalimantan, and East Java, for their invaluable cooperation and insightful contributions.

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Journal of Agriculture, Food Systems, and Community Development
ISSN: 2152-0801 online
https://foodsystemsjournal.org

Beyond the shade: Family farmers' perceptions of silvopastoral systems in the Amazon

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Submitted April 25, 2025 / Revised August 16, October 16, and December 3, 2025 / Accepted January 29, 2026 / Published online March 30, 2026

Citation: Sodré, E., Olival, A. d. A., Weihs, M., Rojas, D., & Petersen, C. (2026). Beyond the shade: Family farmers' perceptions of silvopastoral systems in the Amazon. *Journal of Agriculture, Food Systems, and Community Development*, *15*(2), 183–200. https://doi.org/10.5304/jafscd.2026.152.037

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Abstract

This exploratory study examines the efforts of family farmers in the Brazilian Amazon to establish silvopastoral systems that integrate trees, pasture, and cattle in the same area. These systems offer an alternative to conventional livestock rearing practices that remain the primary source of income for many impoverished families, and yet are also major drivers of ecological degradation, with far-reaching regional and global climate impacts. Using a qualitative case study approach, we conducted in-depth interviews with 17 smallholder families living in zones of rapid soybean expansion to identify the factors that support and constrain the adoption of silvopastoral systems. Our analysis highlights six issues that emerged from farmers' accounts: the cultural dominance of monoculture agriculture; experiences of ecological problems associated with conventional agriculture; community-based alternatives to dominant agricultural practices; relationships between farmers and technicians involved in silvopastoral implementation; emerging farmer insights

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on ecological dynamics and biodiverse livestock systems; and the material limits of these innovations. Taken together, these findings advance four key arguments relevant to efforts to build alternatives to environmentally damaging food-production regimes. First, historical settlement patterns, long-standing socio-economic exclusion, and the cultural dominance of conventional agriculture continue to bind many smallholders to conventional livestock systems despite their declining ecological and economic viability. Second, community networks and non-governmental organizational (NGO) initiatives grounded in Freirean participatory pedagogy can create openings for cooperation, dialogical learning, and the production of situated silvopastoral knowledge. Third, these socio-technical relations foster new practices through which farmers revalue biodiversity as both an ecological and economic asset. Fourth, the adoption of silvopastoral systems remains limited by labor demands, knowledge and skill requirements, and initial environmental conditions that slow system establishment.

Keywords
agroforestry, deforestation, Brazil, participatory rural development, sustainable food production, Amazon

Disclosures
The authors disclose that there are no financial or other relevant interests that could be construed as resulting in an actual, potential or apparent conflict.

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Funding Disclosure
We acknowledge the support of BBSRC-GCRF grant BB/P022898/1 Improving agroforestry and silvopastoral systems in Latin America by maximizing species and genetic diversity of the multipurpose legume Inga; the EPSRC grant: EP/T015268/1 University of Exeter GCRF Global Research Translation Award: Sustainable Solutions to Food Security Challenges; the GCRF Facilitation Fund 2020/2021 grant: Investigating the contributions of women's agroforestry activities to renegotiating gender equality and food security in Brazil; and the FAPESP grant: 22/13095-9 Family Agricultural Enterprises for Strengthening the Resilience of Socio-Ecological Systems.

Introduction

Dominant rural development models follow a productivist paradigm that privileges large-scale monocultures, often at great cost to communities, ecosystems, and the global climate (Elouattassi et al., 2023; Thompson, 2017; 2020; Weihs et al., 2017). However, such agricultural methods are not the only way of producing abundant food (Ikendi, 2022). Archeological evidence suggests that large pre-Hispanic Amazonian populations fed themselves growing native trees and crops on the same land (Furquim et al., 2023; Miller & Nair, 2006). Much of this knowledge was lost with the demographic collapse following the conquest of the Americas and development efforts that, starting in the 1960s, have promoted monoculture expansion over native forests and agrobiodiverse spaces maintained by Indigenous peoples (de Assis, 2005; Montgomery, 2012; Thompson, 2017; Urzedo & Chatterjee, 2022).

Our research examines how non-Indigenous family farmers in contemporary Amazonia advance similar agricultural practices growing native trees and domesticated animals on the same land with beneficial social and ecological outcomes. Although our interlocutors, like most Brazilians, have Indigenous and African heritage, they grew up in non-Indigenous families and territories. Moreover, they were often born outside the Amazon region, arriving there as workers in state-directed development efforts that framed Indigenous and traditional practices as "backwards" (Ramos, 1998). We explore how implementing biodiverse agricultural approaches requires landholders to reconsider these dominant developmental ideas and reassess the nonhuman world and their relationship to it.

We suggest that this line of inquiry is particularly important in the Amazon, which, despite decades of human-driven ecological destruction, continues to be one of the most biodiverse ecosystems on the planet (Guayasamin et al., 2024). The Amazon region, moreover, sustains regional and global climate patterns as well as various biogeochemical cycles and rainfall dynamics (Fearnside, 2005; Lovejoy & Nobre, 2019). Replacing biodiverse forests with monocultures has led to drier, fire-prone landscapes and increasingly frequent and severe droughts and fires (Dias-Filho &

Lopes, 2020; West & Fearnside, 2021), which today place the region at risk of large-scale ecosystem collapse (Flores et al., 2024).

None of the above ecological attributes means much in the context of the dominant rural development efforts that mobilize technologies and methods designed to transform whole landscapes in the shortest time possible (Domingues & Sauer, 2022). Grounds for livestock, for instance, can be quickly established by eliminating native vegetation cover and then seeding the land with engineered seeds that in a few months can already feed cattle (Walker et al., 2009). In our fieldwork we heard from farmers about defoliating areas by spraying herbicides by plane and then seeding grass from the air. Contact with the land in this type of case is limited to the moments when cattle are transported in and out of the area. Although this is an extreme case, the point is that conventional, large-scale agricultural approaches require little familiarity with the land and rely on the application of pre-made technological "solutions" to the problem of how to produce as much and as quickly as possible (Ikendi, 2023; Thompson, 2017; 2020).

This conventional agricultural model (the productionism paradigm) has helped Brazil become one of the world's largest exporters of rural commodities such as soybeans and beef (Hecht et al., 2024; Ioris, 2015). However, almost none of this wealth from the exports goes to family farmers in the Amazon, most of whom rely on small agricultural activities to make a living. Monoculture agriculture tends to deplete soil nutrients over the years, which leads to dwindling pastures, shrinking herds, collapsing revenue, and, for many families, selling their land to wealthier farmers (Dias-Filho & Lopes, 2020). Many families have been displaced to urban centers that offer few economic opportunities, while landed elites have grown their estates by incorporating land previously managed by impoverished families. This process results in the Amazon being one of Brazil's poorest regions, with some of the highest levels of income inequality (de Oliveira & de Souza, 2021; Ioris, 2015).

All these problems are hard to address in a cultural context in which monoculture-based systems continue to be seen as the most desirable food production method. A culture of "clearing the land" is very much rooted among large segments of the population in the Amazon who, having come to the region from other parts of Brazil, embrace the notion that agriculture is synonymous with replacing native ecological conditions (Weihs et al., 2017). In this context, we argue that finding alternatives to monoculture-based food production systems is both a technical or ecological problem and a socio-cultural issue. We address it by focusing on efforts to implement silvopastoral systems that emulate traditional and ecologically oriented practices by maintaining pastures, cattle, crops, and native vegetation in biodiverse areas (de Almeida, 2010).

Silvopastoral Systems

Establishing silvopastoral systems differs from conventional pasture building by requiring site-specific assessments of topography, soil, water availability, and the relationships between native species, cattle, and grass (Dias-Filho, 2006). Once a system is established, landholders engage in long-term vegetation management—trimming, adding species, and protecting them from threats such as insects—while adapting to unexpected outcomes under changing climate conditions. Iterative experimentation produces heterogeneous landscapes with tree clusters, humid microclimates, diverse forage patches, rotational grazing areas, and streamside vegetation shaped by local topography (de Castro & Paciullo, 2006).

Research on silvopastoral systems emphasizes their dual production-and-conservation benefits (de Almeida, 2010; Olival et al., 2022). Compared to conventional pastures, silvopastoral systems maintain greater vegetation cover, which increases humidity and shade, maintains cooler temperatures, enhances soil microbial activity, promotes nutrient retention, and sustains cattle-friendly microclimates (de Almeida et al., 2019; de Azevedo et al., 2010; Parron et al., 2019). These conditions improve soil fertility, raise productivity, and reduce costly inputs like fertilizers (Chará et al., 2019; de Andrade et al., 2012; Dias-Filho, 2023; Wilson & Lovell, 2016). Biodiversity sustained by silvopastoral systems also enhances landscape connectivity and gene flow among native trees, increasing resilience to climate change (Breed et al., 2011; Peri et al., 2016).

We advance this literature by addressing the underexamined question of "what factors facilitate and limit the implementation of silvopastoral systems in socio-cultural contexts that largely favor conventional agricultural practices?" In many rural Amazonian communities, cultural norms value the flat homogeneity of conventional pastures, while native vegetation growing among grass is viewed as a sign of laziness that has resulted in an "unkept" property. Similarly, maintaining good personal ties with agribusiness companies' representatives and government officials who supply standardized agricultural "solutions" is often considered essential to the economic survival of rural operations. In contrast, silvopastoral system initiatives facilitate alternative understandings of native ecological conditions as supporting the economic activities of families as well as the notion that rural communities can themselves be the source of knowledge on which livestock operations can be based (Altieri, 2019; Canuto et al., 2013).

Working with family farmers who have taken part in projects supporting the implementation of silvopastoral systems, we ask three questions:

1. How did family farmers come to view pasture monocultures as a viable livestock practice?
2. What, in contrast, led farmers to question conventional agricultural practices?
3. What benefits do innovative silvopastoral strategies offer, and to what extent do farmers believe these systems could become their main source of income?

These questions illuminate socio-cultural aspects of alternative livestock methods that could play a role in the urgent task of transforming dominant food systems in response to the climate emergency (Intergovernmental Panel on Climate Change [IPCC], 2023). Succeeding in this task requires a better understanding of economic or ecological issues and also a deeper insight into enabling shifts in cultural perceptions and social relations (Mackay-Smith et al., 2025).

Research Context

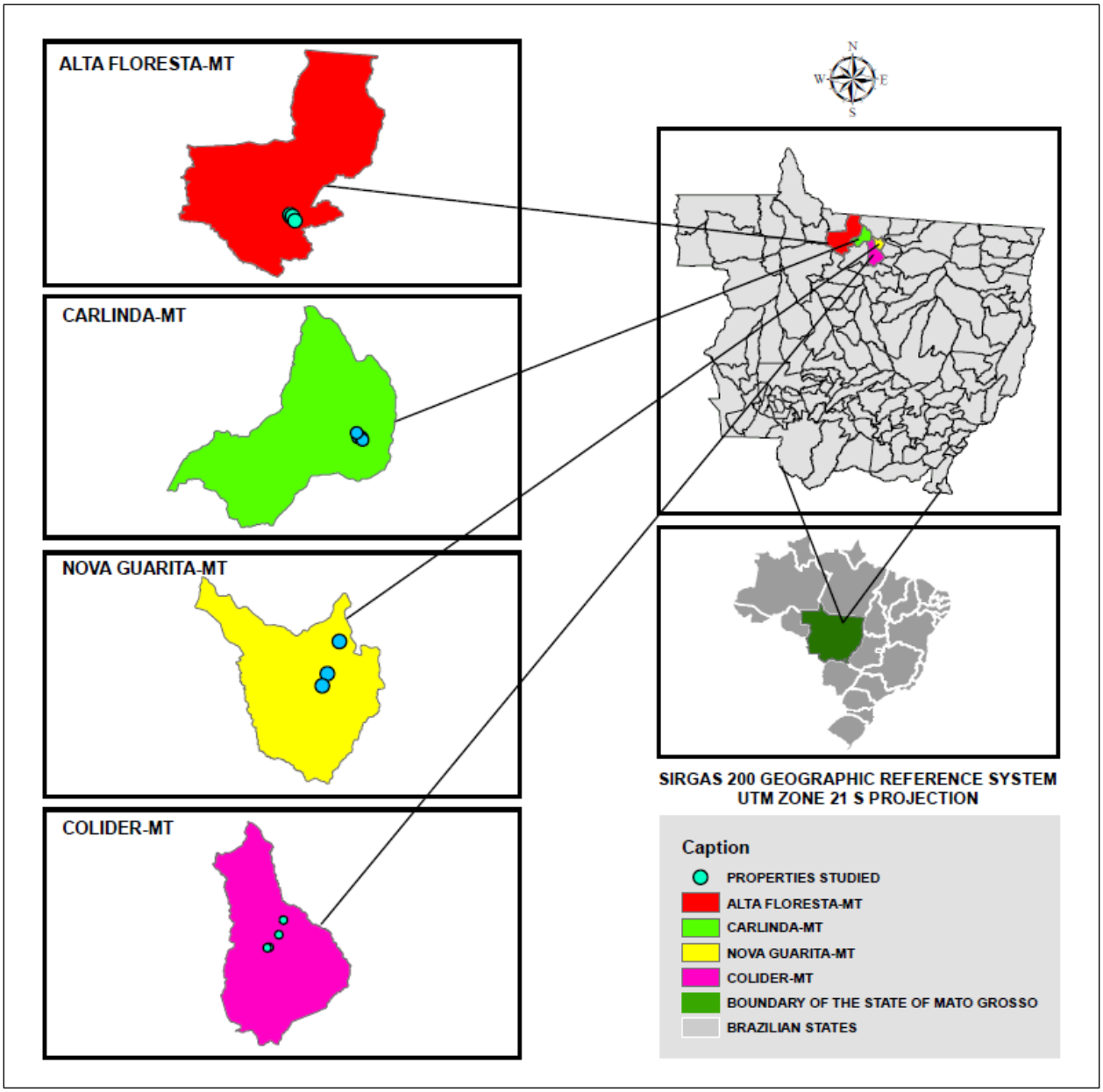
Our research draws on in-depth, semi-structured interviews conducted with 17 family farmers living in four municipalities (Figure 1) that were established through colonization efforts carried out by Brazil's military government beginning in the late 1960s. As documented by the National Truth Commission's investigations (2012–2014) into human rights violations under the dictatorship that ran Brazil from 1964 to 1985, these colonization projects entailed widespread violence against Indigenous peoples (Torelly, 2018). Military units tasked with opening highways across Amazonia frequently used force to displace Indigenous groups, thereby facilitating the transfer of their lands to private companies responsible for founding new agricultural settlements (Telo et al., 2021). Gold miners, loggers, farmers and ranchers were similarly implicated in processes of displacement and dispossession that remain underexamined despite ongoing efforts by Indigenous organizations to document them (Trinidad & Faria, 2025). Today, more than 95% of the population in the cities in the region self-identifies as non-Indigenous, and the overwhelming majority have no contact whatsoever with Indigenous peoples living in territories located in areas that colonization companies deemed too remote or economically unviable (Instituto Brasileiro de Geografia e Estatística, 2025).

The agricultural counterpart to the anti-Indigenous violence was a set of state programs promoting the expansion of monocultures. In the 1970s, government institutions began supporting the replacement of native Amazonian vegetation with permanent crop monocultures such as cocoa, guaraná, and coffee. These efforts were part of a broader national development model in which Amazonia was envisioned as a supplier of cheap agricultural commodities to meet the growing demand of an expanding urban population in southern Brazil (Bunker, 1988). Unexpected difficulties in producing and transporting these crops led to a second wave of rural development beginning in the 1990s, centered on cattle ranching. The government actively encouraged this shift through credit lines and agronomic research focused on pastures and cattle breeds suited to Amazonian conditions (Hoelle, 2015). More recently, the region has witnessed the spread of large, capital-intensive soybean plantations oriented primarily

toward European and East Asian markets (de Oliveira & de Souza e Silva, 2021).

All 17 families in our study are non-Indigenous, part of an impoverished rural population whose labor fueled successive waves of development in Amazonia after they migrated from other regions of Brazil (Hecht et al., 2024). Encouraged by state institutions seeking to defuse growing land inequality in traditional agricultural zones without pursuing land redistribution, these families were promised the chance to claim land in the Amazon if they could demonstrate "active possession"—a requirement that effectively meant clearing native vegetation to establish monocultures (Neto, 2021).

Figure 1. Map of the Municipalities in Which the Research Was Conducted



Note: The authors created this map using ArcGIS Tools with administrative layers adopted from the Brazilian Institute of Geography and Statistics (IBGE), Malha Municipal Digital, SIRGAS 2000 coordinate system (https://www.ibge.gov.br/en/geosciences/territorial-organization/territorial-meshes.html)

The smallholder development programs our interlocutors encountered created top-down flows of agronomic knowledge, directing them to purchase standardized "packages" of seeds, chemicals, and tools from large agribusiness. The livestock farming approaches promoted provide small landholders with some cash flow but rarely lift them out of poverty (Hoelle, 2015). This approach poses problems for the eight families in our study living in *assentamentos*—settlements officially designated by the federal government for smallholder farming. Unlike large ranches and farms near urban centers that benefit from good soils, infrastructure, and market access, *assentamentos* often have degraded soils and poor transportation that hinder both production and commercialization. These conditions further reduce the already slim revenue margins of conventional agricultural strategies. Our research involves populations struggling with rural development strategies which are not designed for small landholders' needs and make them dependent on externally designed agricultural techniques.

Positionality

The five authors of this paper are moved by a shared interest in applied academic research to support grassroots efforts to advance rural development approaches that meet the needs of poor families left behind by traditional models of agricultural growth. We have carried out this work from different positionalities. Three of us are Brazilian, all born in Southern Brazil but with a long experience in Amazonia after arriving in the late 1970s (Weihs) and early 2000s (Olival and Sodre). The other two authors are foreigners but with considerable experience in the region, with one (Rojas) working there since 2009 and the other (Petersen) since 2020. With these varied trajectories, we have all established collaborative relations with the Instituto Ouro Verde (IOV), an NGO that has worked in Amazonia since 2004 supporting the adoption of agroecological strategies among family farmers. None of us, however, is employed by this organization. In 2015, the IOV began supporting silvopastoral system methods among family farmers; in 2023, Sodre began a master's research project under the supervision of Olival and with advice from Weihs.

This article grew out of master's research which we built upon following Bendfeldt et al.'s (2021) insights regarding the need for "engaged" and "generative" research that supports farmer knowledge rather than technocratic agendas that may be at odds with community needs. Although the IOV was instrumental in introducing us to the 17 families included in this study, the data collection and analysis was carried out by us independently of the IOV. While Weihs conducted the data collection, all of us were involved in data analysis. Moreover, our goal is not to identify "best practices" that may be monetized as part of a ready-made agricultural solution some institution could sell. Rather, ours is an effort to co-produce knowledge alongside family farmers by illuminating the conditions under which communities respond to rural problems by creating new applied knowledge based on their specific conditions and needs (Blay-Palmer et al., 2016). Crucially, this approach entails a critical analysis of current silvopastoral system programs, which highlights the limits of IOV's actions.

Applied Research Methods

This section describes the research methods used in the study for data collection and analysis.

Conceptualization, Recruitment of Research Participants, and Data Collection

Our exploratory case study (see Yin, 2009) began at a 2022 meeting attended by one of the authors alongside IOV technicians and the smallholder families collaborating with IOV. Silvopastoral efforts were discussed at this event as responses to pressing economic and ecological challenges. Participants also expressed strong interest in learning from one another's experiences and in understanding what they had collectively achieved through their experiments to date. Recognizing both the relevance of these practices and farmers' willingness to engage in research that could illuminate the outcomes of their efforts, we developed an interview script that included questions about each family's trajectory in the region (e.g., year of arrival, initial land conditions) and the current situation of their family and property (e.g., household composition, main income sources, land area). Rather than

testing a hypothesis about why families adopted silvopastoral systems, our exploration approach aimed to create conditions for open-ended dialogue in which smallholders' reflections would guide our understanding of their motivations and practices.

After obtaining approval from the research ethics committee, we piloted an initial version of the interview script with farmers of similar socioeconomic profiles who were not included in the final study. We then revised the script to facilitate meaningful exchanges capable of illuminating silvopastoral systems from the perspective of those establishing and maintaining them. We identified 17 families to participate, selecting them based on (1) having implemented silvopastoral systems since at least 2019, (2) their stated interest in joining the study, and (3) the relative proximity of their sites to urban centers, which facilitated travel. Participating families had relatively small properties (compared to regional and national farm sizes) and small households of two to four members.

Interviews were conducted at participants' sites, which are located in areas characterized by high deforestation rates. Each interview lasted between one and two hours and involved the household members most actively engaged in establishing and managing silvopastoral systems. The participants included five women and 12 men, aged 34 to 67. To protect confidentiality, we identify them as E1 through E17. Interviews were audio-recorded and often evolved into open-ended conversations in which participants described their biodiverse agricultural strategies within the broader context of their efforts to work the land.

Data Analysis

Following transcription, we manually coded the interviews, identifying emergent themes using an inductive approach inspired by Bogdan and Biklen's (1994) understanding of human knowledge as a multifaceted assemblage of ideas and experiences that intersect, diverge, and take shape through practice. This approach allowed us to trace patterns in how smallholders understood silvopastoral systems, the challenges they faced, and the kinds of ecological knowledge generated through their experimental livestock practices. Following the coding process, all authors collaboratively reviewed the initial codes and refined the themes that emerged from farmers' accounts of their knowledge and experiences with both conventional agriculture approaches and silvopastoral systems.

Results and Discussion

We identified six interrelated themes that illuminate the socio-ecological conditions shaping the adoption, implementation, and perceived outcomes of silvopastoral practices. These themes consist of:

1. Culturally dominant views of the relationship between agricultural practices and Amazonian ecologies.
2. Farmers' experiences of ecological problems associated with conventional agriculture.
3. The role of community relations in sustaining traditional farming practices and enabling alternative approaches such as silvopastoral systems.
4. Relationships between farmers and technicians involved in supporting silvopastoral system implementation.
5. Emerging understandings of Amazonian ecologies and the key insights farmers gained through their work establishing silvopastoral systems.
6. Perceived limits and constraints of innovative silvopastoral agricultural methods.

These themes collectively offer insight into how long-standing agricultural practices become entrenched, even when they produce deleterious socio-ecological outcomes, and how situated practices and collaborations can open possibilities for rethinking and transforming human–environment relations. In the sections that follow, we examine each theme in detail, showing how farmers articulate the challenges and potentials of silvopastoral systems within the broader political-ecological context of Amazonian cattle ranching.

The Culturally Dominant View

Assessing silvopastoral system implementation among small landholders requires understanding how the economic and social conditions of their

arrival in Amazonia produced practices and ideas that framed local ecological conditions as problems to overcome. Our interviews with the family farmers illuminate how arriving as workers who cleared forests and managed monocultures led them to embrace conventional agricultural approaches. Crucially, pressure to establish monocultures often emerged through informal conversations and everyday interactions.

One participant described arriving in Amazonia during the 1980s as monoculture farming expanded and how the dominant views of the forest as an obstacle became normalized for him. "Before we had our own land, we lived our whole lives in the middle of [a large monoculture] farm [that was owned by landed elites]," he said. This system limited his opportunities to learn about local ecology, while witnessing fortunes made from monoculture landscapes created associations between prosperity and forest removal. "We [in our family] thought that the important thing was for the pasture to be clean [without any native vegetation], we didn't have that notion [that native vegetation could support economic endeavors]" (E17).

Beyond describing monocultures as economically desirable, interviewees revealed a context where alternatives to dominant thinking were scarce. One participant explained how, arriving as a worker in the 1980s, he helped create landscapes with no apparent room for anything beyond monoculture. "I worked a lot on farms cutting forests at the time [in the 1980s], cutting with an axe and everything," he said, describing crews who moved deep into forests, spending weeks or months in isolation cutting and burning native vegetation without heavy machinery. He repeated this work across the region, experiencing the construction of landscapes that excluded other ways of engaging land. "I moved to one part of this region [cutting the forest for landholders who were claiming territory]. Then [after that work ended] I moved to another area [doing the same thing for someone else]. There was nowhere to go [as the years went by and more of the forest was cut]" (E1). Thus, the dominance of monoculture-based agriculture not only determined how workers could claim land and seek to generate an income but restricted alternative engagements with native ecologies.

In this historical context, a monoculture society emerged not from direct state coercion but primarily through implicit cultural notions reinforced by everyday interactions. "When we arrived here [at our site], even the ideas [about deforestation] were different," one participant explained. "We tried to clean all native vegetation up to the edge of the stream [running through our property], cleaning all of it, nobody explained anything to us [regarding forest conservation]. We had a notion of keeping things clean, of cleaning it up" (E6). Another described similar ideas circulating through daily conversations: "A lot of people would say, 'you cannot leave shades [of trees] in the pastures because it will ruin your grass.' That was our outlook. If we had two shades [from two trees] we would cut one [tree] to protect the grass." Coming from other Brazilian regions and with little contact with native populations these families followed common-sense assumptions that produced uniform landscapes.

Experiences of Ecological Problems Arising from Conventional Agricultural Activities

While socio-economic and cultural conditions promoted negative views of native forests while making monocultures seem desirable, over the years family farmers also recognized mounting ecological problems from conventional agricultural methods. Initially, Amazonian forests may have seemed like an all-powerful environment requiring hard struggle to build roads, farms, and cities. Yet over time, farmers witnessed how human activities undermined ecological conditions, developing increasingly complex views of economic impacts that created fertile ground for silvopastoral system proposals.

Nutrient cycling emerged as one ecological problem apparent to family farmers. As one interviewee explained, "back then [when state-supported agricultural development projects arrived in the region, the forest] produced its own livelihood, and today it does not" (E10). His comments refer to a key ecological feature: dense forest vegetation creates thick layers of decomposing leaves and branches that further nutrient cycling. While newly established pastures can still benefit

from remaining soil nutrients and ash from burned trees, the absence of vegetation leads to soils inexorably losing their fertility.

Family farmers described this as an ecology that was increasingly unable to sustain cattle. "The land no longer responds as it used to," an interviewee (E10) explained, noting that "back then [in the months and years following the cutting of the forests] it seemed that the soil was stronger." Over time, pastures weakened, making feeding the same cattle numbers increasingly difficult. "Today the soil is weak … it is not responding as it should," he concluded. Rather than the promised predictable outcomes, standardized agricultural methods were seen to lead to unexpected problems. And in response to these, state and agribusiness technicians offered only another pre-made response (fertilizing and tilling), but these costly methods remained unaffordable for most family farmers.

As conventional rural development models failed both to prevent ecological problems and to offer viable solutions, farmers became increasingly open to changing their approaches. "Today it is changing," a participant said referring to shifting ecological conditions, "and we need to adapt our practices to keep up with these changes," he concluded (E10). In agreement with these ideas, another interviewee recounted how "we saw that it [conventional agriculture] was not working … and when the grass became less plentiful, everything [including the milk from their cattle] ran out. We wanted to change [our agricultural methods due to these problems] and we did" (E13). Here soil nutrient depletion is more than a technical problem; this raises questions about a conventional development model whose methods lack answers to key challenges. In this situation, as we will see in the next section, farmers became more open to trusting knowledge and land-engagement strategies generated by themselves and other farmers.

Building Interest in Alternative Livestock-Rearing Approaches Through Community Networks

Our interlocutors often described how although silvopastoral systems were at odds with dominant understandings, they were in line with some practices they had developed through years of working on the land. "We used to let some of the small trees we found in the pasture keep growing so they could provide shade," one participant explained. "Over time, the little tree would grow into a full tree, and when we worked in that area, we could enjoy the shade" (E10). Another mentioned that "from the beginning when we cleared the forest, we left some trees standing, because we saw that was good for us" (E11). Despite monocultures being promoted as economically desirable and discussed as the "right" way to do things, some people created desirable work conditions (humid, colder, shaded areas) by engaging with native vegetation.

Even when families saw such creative actions as improving their lives, believing they could generate alternative livestock strategies using their own knowledge remained difficult. This became possible only in the context of community networks that hosted meetings, workshops, and field days through which families came together to discuss the challenges they faced at their sites, and early silvopastoral system adopters shared their experiences. The process made it possible to develop trust in people whose actions contradicted established common-sense knowledge. "I had never seen how [silvopastoral systems that combine native vegetation and grass in the same area] worked. I had never seen or heard of it. [At first] I didn't believe in it" (E8). What ultimately convinced him was not abstract knowledge about silvopastoral systems' technical or economic aspects, but witnessing people like him accomplishing things at their sites. "But [despite not believing in silvopastoral systems,] I said, I'm going to take part [in the meetings of this project]," this participant added, "I am not going to [establish my own silvopastoral systems area] this year, but I'm going to take part [in] meetings, to see how things work [in other sites where silvopastoral systems are being established]" (E8).

Besides meetings, silvopastoral system adoption was encouraged through visits to sites where families were creating places that looked and felt different. "And then [in the context of community interactions] we learned about a project [on the land of a family participating in grassroots interactions] that had shade [trees in the pastures]. We

went there, [to this farmer's site, and] we saw not only the importance of trees for the animals, but for the grass itself" (E17). The interview data showed how our interviewee, who had previously seen trees mainly as sources of shade, came to recognize their role in improving nutrient cycling, retaining humidity, and sustaining healthier pastures. The visit broadened his ecological perspective, revealing ecological conditions that could be improved to the benefit of humans and nonhumans alike.

The community networks that hosted silvopastoral systems meetings and field trips represented the culmination of a decades-long process. When eight of our participating families arrived in this region, they settled in public areas without authorization, and petitioned state authorities for land-tenure recognition with other landless families. These collective actions and mutual support networks are not rare in the first years of settlement, but they seldom last. Isolated family farms are located among large conventional agricultural areas, and families tend to prioritize relationships with landed elites—who control credit, seeds, and chemicals—over connections with local family farmers. Against this trend, families participating in our research preserved solidarity networks beyond initial land claims. The IOV has supported these efforts since 2003, helping communities increase family incomes through collective undertakings such as craft-making initiatives, community markets, reforestation, and silvopastoral system strategies. Community members direct these initiatives through a general council comprising representatives from smaller local councils gathering families in each locality. These meetings have enabled families to cultivate the mutual trust necessary to value their work despite contradicting mainstream cultural norms.

Solidarity Networks and Participatory Knowledge-Making

It may seem unusual that an article about NGO-supported silvopastoral systems efforts principally addresses the NGO's role only at this point in the argument. This reflects the fact that the most decisive factor in the adoption of silvopastoral systems was arguably not external intervention, but the decades of solidarity-building among family farmers themselves. These networks provided the trust necessary to collaborate and challenge entrenched cultural and economic approaches to agriculture. Moreover, silvopastoral system initiatives did not emerge from NGO staff acting as authoritative sources of technical knowledge; rather, silvopastoral system efforts created spaces for farmers to use their community networks to generate knowledge through experimentation and to share results with peers. As noted in the introduction, establishing silvopastoral systems is an iterative process requiring permanent, close attention to local conditions—something only resident farmers can sustain.

One interviewee emphasized that this approach depended on long-term collaboration between NGO staff and farmers: "[IOV staff] were involved in our efforts to claim our sites since the time [when we established a landless peasant encampment] by the side of the road" (E15). Support in their struggle for the land was the starting point, making clear that the NGO's goals were not narrowly environmental but aimed at building livable environments for humans and nonhumans alike. The next step was helping families make a living on their reclaimed land. "I did not have any idea of what to do [in my new site once we succeeded in claiming our land]," the same participant recalled, "because the only thing we had [in the land that became ours] were weeds growing on depleted soils. Then we started to take part in IOV projects, [we] started learning to reforest, to establish silvopastoral areas, all the things we have learned since [those early days]" (E15). From this perspective, silvopastoral system implementation is meaningful only as part of a broader undertaking to develop communal strategies that may enable dispossessed farmers to remain on the land.

These learning processes were grounded in an institutional structure rooted in local populations. All IOV's staff live in the Amazon, and most of its technicians are young and from smallholder farming families. This staffing model fosters expectations on both sides that initiatives such as silvopastoral systems will be carried out through dialogue and horizontal interaction. As one interviewee put it, "We sought knowledge from [IOV

staff] … knowing we had to work in partnership, we tried to give our best, you know, to make it happen, for the project to get to where it is today" (E2). Crucially, for this farmer the project stems from their seeking knowledge and rests on their own hard work, rather than responding and being solely advanced by an external organization.

A sense of farmer ownership was cultivated through knowledge-sharing activities such as organizing visits for groups of six to 20 people to sites where other farmers presented their work, including both challenges and successes. One participant recalled: "I always cut [all native vegetation] but then I started seeing these [silvopastoral system] projects [established by other farmers], and the person would explain how trees offer shade to milk cows who dislike being in the sun constantly" (E5). Seeing innovative sites and hearing directly from his peers about improvements in milk production from shaded pastures encouraged him to let native trees grow and to plant new ones, understanding how they would have positive effects on his herd.

This grassroots approach was dialogical in the sense that knowledge-sharing continued through the implementation stage. As a farmer put it, "It was good to see [sites in which silvopastoral systems were already implemented], it was good because there was that meeting, that chat, that conversation while you were planting [native species in your own pastures]; [while you worked] dividing [your own] pastures [into segments that enabled controlled grazing]; [while you were] planting the trees. It was nice [to have those constant interactions], it was really good" (E3). In this way, farmers and IOV staff enacted a strategy that echoes Freire's (1983) conception of technicians as facilitators who support personal learning processes through which people and communities open themselves to, and generate, new knowledge.

Silvopastoral Lessons Learned

According to Freire's (2005) principles of dialogical education, exchanges between groups such as family farmers and technicians may not only strengthen local knowledge but also generate critical reflection and actions necessary to transform their reality. In this case, such dialogue helped reframe family farms as living laboratories, where farmers engaged in cycles of action and reflection by systematically assessing the diverse outcomes of their interventions in local conditions. The knowledge produced was not limited to technical understandings, such as nutrient cycling or pasture productivity, but also encompassed a subtler, equally transformative capacity: cultivating the observational skills and caring routines required to engage with local ecologies in attentive, responsive ways. These habits of perception and care were themselves forms of praxis, shaping how farmers related to the land and to the broader socio-ecological systems they inhabited.

These relationships between practice and knowledge emerge vividly in families' accounts of the insights they gained through silvopastoral system initiatives. One interviewee, whose profit-maximizing approach had once led him to cut native vegetation despite personally preferring shade trees, was pleased to conclude that "the first thing that [his silvopastoral systems] improves is the soil. Because where you plant a tree, it makes fertilizer for [the pasture]" (E11). Crucially, as he explained, if the tree "makes fertilizer," it is due to the farmer's careful engagement: "Right here, I have to trim this tree … and then leave [the branches and leaves] at its base, and this results in this beautiful thing—fertilizer made by the tree [clippings]" (E11). The lesson here is not only that clippings can enhance nutrient cycling, but that his particular farm benefits when he invests time and attention in the needs of specific trees there: trimming them at the right moment and finding creative uses for the resulting material. A similar point was made by another participant who recalled that in the past, "any little tree I saw in the pasture I would eliminate," but "now I pay attention to trees [that grow in the pasture and] that [I think may] provide something [for my site], [trees that have] a good size, and I don't cut them down anymore" (E5).

Later in the interview, he explained that such attention had yielded tangible results: "[My silvopastoral systems] certainly improved [agricultural conditions at this site] a lot," he noted. "It improved the [health of] pastures, [so now the grass can] support more [cattle grazing, even] in the

drought. [My silvopastoral systems] even increase milk production" (E5). Much of this learning emerged through trial and error. One participant, for example, recounted planting several trees in close proximity when first establishing his silvopastoral systems. "So I would do this [in the future]," he said, "I would carry out a more limited [intervention] just to protect the trees. I say that trees in the pasture are fine—just not so close to each other" (E6). Only with time, he began to understand rates of growth, canopy size, the effects trees have on one another, and the site-specific conditions best suited to each species—transforming his farm into an experimental ground. Similarly, another interviewee reflected on species selection: "I would not plant *amarelinho*. I would try [planting] *amoreira* [instead], and would plant some additional *pente de macaco*, which I can do because those that I already planted will fruit this year" (E12). The knowledge emerging here extends beyond pastures or individual tree species, reflecting a deliberate, ongoing engagement with local ecological complexity as part of the everyday work of livestock farming.

From the perspective of farmers, the lessons learned were not limited to the information available on establishing forest in pastures having a range of positive impacts on nutrient cycling and biodiversity, water streams and agricultural productivity (Chará et al., 2011; de Almeida et al., 2019; Olival et al., 2021). It also included lessons regarding the kind of practices that can be relied on to build a family farm site. The notion that what is essential in a farm is access to the kinds of tools and technologies that landed elites can provide gives way to the understanding that there are several other resources available to family farmers: attentive observation to spaces composed of complex ecological relations, conversations with neighbors who share their experiences and insightful observations, and careful engagements with plants, animals and soils.

Limits to Silvopastoral Innovation

By illuminating ways of transforming farm sites, silvopastoral systems' practice-based learning approach not only revealed new ways to shape the material reality of family farmers but also illuminated clear limits to what they could accomplish through such programs. The vast majority of our interviewees appreciated the outcomes of their silvopastoral systems work, with 15 of 17 participants evaluating the areas they established positively. However, they still saw significant challenges they would need to overcome to reach the economic conditions they desired. As family farmers, they confronted challenges exceeding silvopastoral system efforts' reach—complex long-term socio-ecological problems related to unequal land tenure systems and highly exclusionary models for rural development. Family farmers also understood the difficulty of relying on silvopastoral systems as their main agricultural strategy due to labor conditions and ecological obstacles.

These ecological obstacles proved particularly formidable in degraded landscapes. In the previous section we highlighted possibilities for ecological restoration that families found through observation and experimentation, but they also encountered significant hurdles. "The ants attack [destroying tree stems]," one participant recounted. "They attack too much and so it's difficult because we're struggling there, we are planting trees every year, but they [are] not growing because the ants eat the stems" (E1). His story alluded to the absence of native vegetation in monoculture areas leading to extreme food scarcity for insects that seek nourishment from any introduced tree. Hundreds of trees and days of hard work can be lost in a few days under such conditions. Preventative control measures are fundamental to system success, such as choosing tree species adapted to local conditions that are fast-growing, working with high species diversity, using healthy, good quality seedlings, planting at the beginning of the rainy season, with periodic crowning practices and mulch protection (de Castro & Pacciulo, 2006).

Another limiting factor inherited from the recent history of these areas concerns logistical problems in impoverished rural areas. As mentioned above, family farmers often live in areas removed from urban centers with limited infrastructure which means logistical challenges to delivery of key materials such as wood and wire for fencing. For families to be able to work with these materials they have to be available at the right

moment, when the rainy season can benefit the trees, and the grass is not too high so that it hampers the construction of fences. But such timing is complicated by silvopastoral system programs having to reach dozens of families, some of which are hundreds of miles away from one another. One farmer alluded to the issue when he noted that "in the future [the distribution of] things [needs] to be more organized so that it happens sooner. When I received the wire [for fencing], my grass was already grown, I almost died" (E9). The very vivid terms in which the impacts of logistical problems are described illuminates how farmers are working under great pressure under a tight schedule and with very limited resources.

Silvopastoral system strategies are valuable given that they provide alternatives to fertilization, for example, but this comes at the cost of additional investments in time and attention. More complex than monoculture grass pastures, these biodiverse strategies require more planning, constant decision-making, and greater availability of labor and infrastructure (Dias-Filho, 2006). Systematic observation of cattle-tree interactions, constant surveillance of shifting ecological conditions, and time devoted to trimming may seem like minor expenses, but they add to an already heavy workload for the family unit. As one farmer expressed, "the problem with these trees [growing in the pastures] is [that we need to work constantly] trimming them up, maintaining them … that's the hardest thing. It's a lot of work, because you have to keep that area clean" (E4). These hardships are inherent to building complex systems that require specific management practices, which imply costs and constant, skilled labor. Farmers must rethink how they organize and allocate their time to the various activities on their properties, accounting for the seasonality of activities and income sources.

What our interlocutors learned regarding the factors limiting the adoption of silvopastoral systems in regions of the Brazilian Amazon is constrained by several intersecting factors: the need for specialized labor and infrastructure, the absence of local traditions or prior experience with such innovative methods, and the broader trend of declining labor availability in family farming (Canuto, 2013; Dias-Filho, 2006; Olival et al., 2021). These constraints are particularly acute in the initial years, when degraded environments demand intensive management to restore ecological health. At this stage, the systems require frequent interventions—monitoring pasture and tree growth, implementing pest control, and carrying out maintenance—all of which call for sustained, skilled labor. For some, these demands pose significant barriers. Older farmers, or those unfamiliar with the principles of integrated pasture-forestry management, often find it difficult to adapt, particularly when such work must be incorporated into already demanding agricultural schedules and diversified livelihood strategies.

The adoption of this type of system in regions of the Brazilian Amazon faces challenges, such as the need for specialized labor and investment in infrastructure, combined with the lack of tradition and experience with innovative farming practices and the increasing shortage of labor in family farming establishments (Canuto et al., 2013; Dias-Filho, 2006; Olival et al., 2021). These challenges are particularly critical in the initial years of the systems, given the high level of environmental imbalance and the need for more intensive labor actions, especially for those who are of advanced age or have difficulty understanding the new principles of pasture and forestry management.

Conclusions

This research examined factors supporting and constraining silvopastoral system adoption in the Brazilian Amazon. Six themes emerged from the analysis of our interviews with smallholders: the cultural dominance of monoculture agriculture; experiences of ecological problems from conventional agriculture; alternative, community-based agricultural approaches; farmer-technician relationships supporting implementation; emerging farmers' views and insights on silvopastoral systems; and the limits of biodiverse livestock farming efforts. Drawing on our interlocutors' experiences and insights on these themes, we make four main assertions regarding dominant agricultural approaches and the conditions that facilitate their implementation.

First, historical and cultural conditions can lead small landholder populations to adopt monoculture

strategies despite the profound ecological and economic problems these generate. Small landholders' early experiences in Amazonia, often as laborers clearing forests and working in expanding monoculture operations, shaped a dominant view of native ecologies as hindrances. Everyday interactions reinforced these assumptions, naturalizing the idea that prosperity required "clean" pastures and the removal of trees, while leaving little space for alternative practices or ecological knowledge. As a result, many families arrived at their own properties predisposed to replicate monoculture landscapes.

Second, community networks and NGO interventions (such as those of IOV) built on Freirian models (2005) successfully encouraged small-scale family farmers to take leadership roles in the process of integrating trees with pasture in their livestock farming practices. Such a participatory approach was rooted in long-term relationships between communities and NGO staff that led to the generation of new, site-specific ecological knowledge, with smallholders willing to contribute to efforts which they saw as designed to meet their own needs and concerns. Such knowledge proved transformative when it emerged from dense community networks and a dialogical learning process rooted in farmers' active participation.

Third, these grassroots undertakings resulted in novel practices that led to better socio-ecological and economic outcomes for both farmers and the environment. When farmers are active members of NGO-supported socio-technical networks, they develop new forms of decision-making attuned to local ecological conditions and seasonal variations. Likewise, families incorporated into their work schedules agroecological and agroforestry practices that realized the multifunctionality of trees in improving economic and ecological conditions. These practical skills were grounded in farmers gaining a new perspective on their properties' ecological conditions insofar as the labor of integrating trees, pastures, and animals in the same areas created spaces and moments of reflection and ecological appreciation. Families gradually came to value ecological elements previously considered undesirable, recognizing the importance of native species and local natural resources for maintaining their production systems.

Fourth, the study identified practical agronomic and ecological barriers to silvopastoral system establishment. Farmers valued the ecological and economic potential of silvopastoral systems, yet they also emphasized the challenges imposed by the conditions needed for these systems to be productive, including labor constraints, degraded soils, and logistical complications in remote rural areas. Additional difficulties included pest pressures, precise planning, and the intensive management required in silvopastoral systems' early years. Overall, our interlocutors underscored how despite strong appreciation for silvopastoral outcomes, adoption remained constrained by structural factors tied to land degradation, rural precarity, and the absence of local traditions supporting integrated livestock-tree systems.

Recommendations and Implications

Silvopastoral systems worked well as part of a larger puzzle that included community organizing, political engagement, and continuing ecological work. Our research results provide important insights into the design of public policies aimed at promoting sustainable food production practices that are likely transferable to other locations. It is important for policymakers to consider developing new rural development infrastructure that can offer alternatives to those that have created an agrarian extractive frontier, at great human and ecological cost. Such a task would support both biological *and* cultural diversity, through actions such as instituting local centers for research and knowledge-sharing. These spaces would support the creation of alternative development spaces by training rural extension agents who, embedded in communities, would provide technical support to farmers in developing systems adapted to each specific context. These community networks and knowledge infrastructure additionally could be paired with novel financial mechanisms capable of funding the costs of transitioning from conventional to biodiverse systems (Mier et al., 2018).

The experiences documented in this study demonstrate that alternative rural futures in the Brazilian Amazon are both necessary and possible. Answers to the social and ecological problems posed by dominant rural development approaches,

however, do not come in the form of a quick technocratic fix. They come in the form of participatory encounters involving family farmers, community networks, and NGOs (such as IOV) that enable participants to shift their views of forests as obstacles, to recognizing biodiversity as fundamental to their livelihoods. The profound potential of participatory, community-based efforts to reshape rural development could be further harnessed by larger social and technical infrastructures and policies that could enable participants to create ecologically regenerative and socially just rural landscapes. 

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Journal of Agriculture, Food Systems, and Community Development
ISSN: 2152-0801 online
https://foodsystemsjournal.org

The role of civil society networks in catalyzing agroecological transitions in Uganda

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Submitted June 9, 2025 / Revised August 10 and October 16, 2025 / Accepted October 20, 2025 / Published online February 5, 2026

Citation: Tumuhe, C. L., Katusiime, D., Ssekamatte, D., Muloi, J., Audain, K., Kamau, H., Byaruhanga, R., & Molina, G. A. R. (2026). The role of civil society networks in catalyzing agroecological transitions in Uganda. *Journal of Agriculture, Food Systems, and Community Development*, *15*(2), 201–227. https://doi.org/10.5304/jafscd.2026.152.004

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Abstract

Agroecology is increasingly recognized as a transformative pathway for building resilient and equitable food systems and addressing climate challenges. In Uganda, civil society organization (CSO) networks play a pivotal role in promoting agroecology through training, advocacy, and the facilitation of farmer-led innovations. This study examined the role of the Participatory Ecological Land Use Management (PELUM) Uganda, a CSO network,

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in facilitating agroecological transitions through coordinated civil society action. A qualitative case study involved review of 27 internal organizational documents and four in-depth interviews with PELUM Secretariat staff members. The research focused on five key intervention domains of PELUM Uganda: (1) capacity building, (2) research and innovation, (3) networking and collaboration, (4) advocacy, and (5) climate change engagement. Findings indicate that PELUM Uganda employs a multi-approach strategy, combining grassroots farmer training with policy advocacy at regional and national levels. The Secretariat has fostered peer-to-peer learning platforms, promoted agroecology integration into climate policies, and supported leadership development within its member organizations. However, challenges persist, including inadequate documentation systems, limited post-training follow-up, underfunding, institutional fragmentation, and inconsistent member engagement.

The analysis shows that civil society networks play a central role in connecting farmers, researchers, and policymakers. Within this system, PELUM Uganda functions as a coordinating hub that facilitates knowledge exchange between farmers and research institutions while representing member organizations in policy discussions. Evidence from interviews and institutional documents indicates that these interactions have led to including agroecology in national climate and agriculture strategies and have strengthened district-level farmer training programs. The findings therefore highlight that scaling agroecology depends on sustained public investment in decentralized research, participatory extension, and structured collaboration with networks like PELUM to develop localized initiatives into national frameworks for climate adaptation and food systems transformation.

Keywords
agroecology, food systems, climate adaptation, advocacy, civil society organizations

Introduction

Uganda, like many countries in Sub-Saharan Africa (SSA), is grappling with intersecting ecological degradation and entrenched socio-political challenges that jeopardize the sustainability of smallholder farming systems (Chavula, 2021; Twinomuhangi, 2019). Persistent climate variability and land degradation undermine crop productivity and resource base resilience (Muir et al., 2023; Olarewaju et al., 2025). Insecure land tenure and weak governance of natural resources impose structural constraints on long-term investment and sustainable practices (Chagutah, 2013; Lovo, 2016). Together, these proximate problems reflect deeper institutional and political-economic barriers challenging rural livelihoods and agrarian relations in Sub-Saharan Africa (Azadi et al., 2021;). These systemic pressures not only erode the viability of smallholder farming but also stifle long-term investments in sustainable land use, intensifying the urgency for contextually grounded, socially and ecologically sound agricultural alternatives.

Funding Disclosure
We recognize the African Centre for Agroecology and Livelihood Systems (ACALISE) project of Uganda Martyrs University for providing part of the financial support for this study.

Ethical Considerations
Ethical approval was granted by the Uganda Christian University Research Ethics Committee (number UCUREC-2024-772), and the research was registered by the lead author with the Uganda National Council for Science and Technology (UNCST) under registration number A409ES. Informed consent was obtained verbally from all participants before data collection. The draft methodology and initial findings were shared with the PELUM Uganda Secretariat staff for peer validation, ensuring factual accuracy and alignment with internal documentation.

Positionality and Reflectivity Statement
As a Ugandan agroecology practitioner and PhD researcher, the lead author's dual role positioned him both as an insider with deep contextual knowledge and an academic committed to critical inquiry. His affiliations with civil society networks, including past work with a PELUM member organization, offered trust and access but also required careful reflexivity to mitigate bias. He maintained a reflexive journal, conducted member validation through two meetings, and engaged peer debriefings with all co-authors to ensure that participants' voices remained central.

Conflict of Interest Statement
The authors declare that they have no known competing financial or personal relationships that could have appeared to influence the work reported in this paper.

Agroecology has gained global prominence as such a transformative framework, that responds to the interlinked climate, ecological, and social crises confronting contemporary food systems. International initiatives, such as the Food and Agriculture Organization of the United Nations' (FAO) Scaling Up Agroecology Initiative (FAO, 2018a) and the High-Level Panel of Experts of the Committee on World Food Security (CFS HLPE) report (2019) on food security and nutrition, position agroecology not merely as a technical fix but as a paradigm that reconfigures power relations in food systems through bottom-up, ecologically attuned, and socially just practices (Anderson et al., 2020). Beyond its ecological and agronomic merits, agroecology is increasingly recognized for its potential to democratize food systems, empower local communities, and redress structural inequities in access to land, knowledge, and decision making (Bezner Kerr et al., 2019; FAO, 2018b, 2025).

The experience of Latin America demonstrates that agroecology can be scaled effectively when embedded in enabling political environments and championed by strong grassroots movements. For instance, Brazil's Landless Workers' Movement (MST) (Landertinger, 2008) has played a pivotal role in institutionalizing agroecological practices through state-supported programs and progressive national policies (Giraldo & Rosset, 2018; Meek et al., 2019; Mier y Terán Giménez Cacho et al., 2018). Across Africa, agroecology has deep roots in traditional farming systems that have long focused on diversity, soil conservation, and community cooperation (Altieri, 2004). Contemporary regional alliances and national CSOs have helped reframe and promote these indigenous practices within modern policy and research agendas inspired by agroecology principles and elements (Gliessman et al., 2020). An example is the Alliance for Food Sovereignty in Africa (AFSA), a broad-based coalition comprising farmer organizations, NGOs, indigenous groups, CSOs, and consumer movements, which has been instrumental in consolidating a continental vision for agroecology and food sovereignty. Through coordinated campaigns, knowledge-sharing platforms, and strategic policy engagement, AFSA and its affiliates have enhanced the visibility and legitimacy of agroecology as a viable alternative to industrial agriculture (Byaruhanga, 2024; Gliessman, 2020). For example, AFSA successfully advocated for the integration of agroecology into the African Union's Framework and Guidelines on Sustainable Agriculture, supported the development of national agroecology strategies in Uganda, Kenya and Ethiopia, and mobilized regional learning hubs that document and scale farmer-led innovations across 13 African countries (Byaruhanga, 2024).

In many sub-Saharan African regions agroecology has developed primarily through civil society initiatives rather than large-scale government programs or mass movements. Civil society organizations (CSOs) in Uganda such as PELUM Uganda, East and Southern Africa Farmers Forum (ESAFF), and the National Organic Agriculture Movement of Uganda (NOGAMU) have been central in piloting farmer training models, influencing sub-national policy dialogues, and integrating agroecology into district development plans (Byaruhanga, 2024; Isgren, 2018). These efforts have laid the groundwork for gradual state adoption of agroecological principles within formal agricultural frameworks. Members of the PELUM Association have been instrumental in shaping national agroecology strategies across Eastern and Southern Africa. In Kenya, PELUM Kenya's input in county and national agroecology policies and strategies led to adopting localized extension frameworks that promote farmer field schools and seed sovereignty initiatives (Chumba et al., 2024). PELUM Tanzania's work informed the development of the National Ecological Organic Agriculture Strategy, supporting the inclusion of smallholder-friendly certification systems (Biovision Foundation for Ecological Development, 2024).

In Uganda, PELUM Uganda has played a key role in coordinating stakeholder consultations for the National Agroecology Strategy, aligning it with the Nationally Determined Contributions and National Development Plan III (Sinyangwe et al., 2023). At the community level, PELUM member organizations have facilitated more than 10 community-managed seed banks, piloted the Climate Resilient Agro-Ecosystems Model (CRAEM), and documented from their interventions measurable increases in soil organic matter and household food

diversity outcomes (Akanmu et al., 2023; Debray et al., 2019; Gliessman, 2020).This bottom-up, knowledge-sharing approach, anchored in farmer field schools, peer learning networks, and community seed initiatives, has transformed agroecology from a set of technical practices into a broader movement for food system change. Through participatory exchanges, farmers have collectively organized to advocate for land rights, push for pesticide regulation reforms, and influence national dialogues on sustainable food systems (Anderson et al., 2020; Tibasiima et al., 2022).

Despite growing recognition of CSOs' strategic role in agroecological transitions, much of the literature remains focused on normative and technical accounts of agroecology's potential (Isgren, 2016; Martiniello, 2015). There is limited empirical analysis of how these organizations mobilize actors, disseminate agroecological knowledge, influence policy processes, and sustain systemic transitions over time. Thus the role of CSO networks in bridging grassroots innovation and national policymaking is under-documented and insufficiently theorized in current academic discourse in Africa. This study explores how CSO networks operationalize agroecological transitions through what we identify as networked transformation, a process by which locally rooted, horizontally organized initiatives interface with vertically oriented advocacy and policy engagement to drive systemic change (Loorbach et al., 2020). PELUM Uganda uses this hybrid model to provide an alternative to top-down state-led approaches, focusing on decentralized innovation, cross-scalar collaboration, and multi-actor governance (Anderson et al., 2019; Pimbert et al., 2021).

This study seeks to examine the role of PELUM Uganda as a central civil society actor catalyzing agroecological transitions in a resource-constrained and institutionally fragmented context. As the Ugandan chapter of a wider regional PELUM Association network present in 14 African countries (360 members), PELUM Uganda coordinates over 74 member organizations operating in 123 of the country's 146 districts. Its members include NGOs, farmer associations, and research institutions committed to promoting ecological land use, agroecological knowledge, and food sovereignty. Since its inception in 1995, PELUM Uganda has positioned itself as a key facilitator of farmer-led innovation, capacity building, and policy engagement, with tangible outcomes that demonstrate its catalytic role in advancing agroecology. Between 2018 and 2023, the network organization supported its members in establishing 10 community-managed seed banks, training over 3,000 farmers in the CRAEM model, and documenting measurable improvements in soil fertility and crop diversity across pilot districts. PELUM Uganda also coordinated national consultations leading to the drafting of Uganda's National Agroecology Strategy and contributed to integrating agroecology principles into the country's Nationally Determined Contributions (PELUM Uganda Annual Report, 2023).

Drawing on a qualitative case study approach, this paper analyzes how PELUM Uganda operationalizes agroecology through five interlinked strategic domains: (1) capacity building, (2) research and innovation, (3) networking and collaboration, (4) policy advocacy, and (5) climate change engagement. In this paper, agroecology is understood as both a movement, a science and a practice system that applies ecological principles to agricultural production while integrating social, cultural, and economic dimensions (Gliessman, 2020). Agroecology's key principles, including diversity, co-creation of knowledge, recycling, synergies, human and social values, and responsible governance, form the analytical foundation for assessing how these five domains are implemented within PELUM Uganda's programming. By synthesizing data from organizational documents and key informant interviews with staff members of the PELUM Uganda Secretariat, the study explores the specific practices, challenges, and opportunities shaping agroecology transition work. Although the findings are not intended to be generalized beyond this case, they offer useful insights into how civil society organizations in similar contexts can facilitate agroecological transitions for sustainable food systems. In this paper, sustainable food systems refer to systems that ensure food and nutrition security for all in ways that are economically viable, socially just, and environmentally regenerative (FAO, 2021). This study therefore contributes

modestly to ongoing discussions on institutional pathways for agroecology within Uganda and comparable regions in the Global South.

Research Methods

Study Design

This study utilized a qualitative case study methodology to analyze the institutional role and strategic approaches employed by the PELUM Uganda Secretariat in advancing agroecology transitions. The case study design was selected for its capacity to yield in-depth insights into organizational processes within real-world institutional settings (Baxter & Jack, 2008; Creswell & Poth, 2023). PELUM Uganda was selected as the case study due to its extensive documentation of programs and outcomes over nearly three decades of operation and its coordination of 74 member organizations implementing agroecology initiatives. Examples of its work include facilitating the CRAEM model across multiple districts, supporting the establishment of community seed banks, and coordinating multi-stakeholder consultations for Uganda's National Agroecology Strategy (PELUM Uganda, 2023). These factors provided a sufficiently rich empirical basis for examining how a civil society network operationalizes agroecology within institutional structures. The research employed a Deductive Thematic Coding Matrix (Groenland, 2016) developed collaboratively by the authors and refined through consultations with PELUM Uganda Secretariat staff members to guide data organization and interpretation. The framework focused on five core domains structuring the work of PELUM Uganda: capacity building, research and innovation, networking and collaboration, policy advocacy, and climate change engagement. These domains, which align with the organization's stated "Benefits of Membership" (PELUM Uganda, 2024), provided an analytical lens for examining how institutional strategies contribute to agroecological scaling. Data were coded deductively, based on these predefined themes, and inductively, to capture emerging insights from documents and interviews. This approach allowed for a comprehensive understanding of how PELUM Uganda and its network mobilize resources and partnerships to advance agroecology at multiple levels.

Positionality and Reflexivity

Positionality refers to the researcher's social and professional position in relation to the study situation and participants. Reflexivity involves continuous self-examination of how position influences the research process and interpretation of findings (Berger, 2015). In this study, acknowledging positionality and practicing reflexivity were essential for maintaining transparency and analytical rigor. The research team consisted of scholars familiar with agroecology and civil society networks in Uganda, which provided contextual insight but also required conscious efforts to avoid bias. To address this, the team developed the analytical framework collaboratively, validated it independently through document review, and triangulated data from multiple sources. A reflexive journal was maintained to record decisions, assumptions, and reflections throughout the analysis (Cadman et al., 2024). Draft findings were shared with PELUM Uganda Secretariat staff for factual verification, to ensure accuracy while maintaining critical distance. These practices enhanced the credibility and trustworthiness of the study.

Data Sources

Document Review

The primary data consisted of documents produced or co-produced by PELUM Uganda from 2010 to 2024. Due to archival limitations, materials predating 2010 were unavailable for analysis. All analyzed documents were publicly accessible through the PELUM Uganda website. Document selection criteria required that materials either address one or more of the five thematic domains under investigation or contribute to institutional planning, monitoring, or external communications. The review process identified 47 potentially relevant documents from the PELUM Uganda website. Following application of the predetermined inclusion/exclusion criteria (Supplemental Material 3A), 27 documents were selected for final analysis. The retained documents comprised eight national or regional strategy and planning documents, six

policy briefs, five advocacy statements, and eight event or activity reports.

The documents underwent rigorous qualitative analysis, which involved systematic reading, coding, and categorization to identify recurring themes, patterns, and shifts in institutional focus over time. The process began with open coding to capture key ideas related to agroecology, followed by axial coding to link the ideas to the five analytical domains. The analysis emphasized tracing how strategic priorities evolved across annual reports, policy briefs, and project evaluations, allowing the study to reconstruct the PELUM Uganda' institutional narrative and assess its changing role in promoting agroecology. The diversity of document types, including reports, strategic plans, and public communications, enabled methodological triangulation across both format and temporal dimensions. The multi-faceted approach provided comprehensive insights into the Secretariat's evolving agroecological strategies and implementation patterns.

Key Informant Interviews

To complement the document analysis, four semi-structured interviews were conducted with purposively selected PELUM Uganda Secretariat staff members during November and December 2024. Respondents included the country coordinator and three program officers who were chosen based on their direct engagement in key organizational functions, including program implementation, advocacy initiatives, and research coordination. To ensure targeted data collection, the interview protocol was structured around the five thematic domains: capacity building, research and innovation, networking and collaboration, policy advocacy, and climate change engagement. Questions under each domain were designed to extract specific examples and reflections from interviewees. For instance, participants were asked to describe successful capacity building initiatives, explain how research findings informed programming, outline networking mechanisms that enhanced collaboration, identify advocacy outcomes achieved through policy engagement, and discuss how climate change adaptation was integrated into agroecological practices. These domain-specific interviews provided nuanced insights that contextualized organizational documents and deepened understanding of PELUM Uganda's internal strategies and challenges.

Data Extraction Process

A structured data extraction form was developed using Microsoft Excel to ensure systematic and consistent analysis of all reviewed documents (see Supplemental Material 1). The tool was organized into six analytical categories: general information, capacity building, research and innovation, networking and collaboration, advocacy and livelihoods, and climate change (see Supplemental Material 2). The research team conducted comprehensive document reviews through a three-stage process: (i) summarizing key content, (ii) categorizing information according to the predefined themes, and (iii) cross-verifying content relevance. Documents containing substantial content spanning multiple thematic domains were coded across all applicable categories. This methodological approach enabled both cross-sectional deductive thematic analysis and longitudinal comparison of institutional approaches over time (Groenland, 2016).

Data Analysis

The study employed a Deductive Thematic Coding Matrix (Gale et al., 2021) to systematically examine data derived both from institutional documents and key informant interviews. A structured Microsoft Excel matrix facilitated deductive coding (Groenland, 2016) according to the five predefined thematic domains. To ensure methodological rigor, we maintained (1) analytic memos in a reflexive journal to track emerging insights, conceptual connections, and interpretive reflections (Cadman et al., 2024), and (2) detailed field memos during interviews to record contextual observations, emotional dynamics, and interactional nuances, implementing the principle of thick description to preserve the rich textures of social relationships (Cadman et al., 2024; Sankofa, 2023). The dual documentation system, combined with consistent application of the thematic framework, strengthened methodological transparency while enhancing both the trustworthiness and

interpretive depth of the findings through systematic triangulation.

Qualitative Content Analysis

Organizational documents were analyzed using a structured qualitative content analysis approach (Richards & Hemphill, 2018), guided by the five predefined domains. The coding process began deductively, using domains as initial categories, and was refined inductively as new themes emerged from the data. Each document was reviewed line by line, and text segments relevant to the research questions were coded manually. To ensure analytical rigor, only excerpts that clearly illustrated institutional practices, outcomes, or learning processes were retained as representative quotations. These excerpts were triangulated with information from interviews and other documents to verify accuracy and contextual relevance. Quotations are therefore used as evidence that supports interpretive analysis of PELUM Uganda's strategies and contributions.

Data were managed using Microsoft Excel. The coding process followed a framework analysis approach (Dixon-Woods, 2011; Mason et al., 2018) structured around the five predefined thematic domains. Emergent subthemes such as "donor influence," "staff turnover," and "follow-up gaps," were added through iterative coding rounds. To enhance reliability, two researchers independently coded a sample of five documents and all four interviews. Coding consistency was assessed through intercoder comparison and discrepancies were resolved through discussion and consensus. Analytic memos and code annotations recorded reflections and emerging patterns, ensuring systematic interpretation while allowing space for contextual and unanticipated findings to surface.

Results

The study explored how PELUM Uganda facilitates agroecological transitions through its institutional strategies and multi-level engagements. The findings are presented across five interrelated domains mirroring the organization's operational structure: (1) Capacity Building, (2) Research and Innovation, (3) Networking and Collaboration, (4) Policy Advocacy, and (5) Climate Change Engagement. Each section highlights specific practices, achievements, and challenges that illustrate PELUM Uganda's role in advancing agroecology within Uganda's development.

Capacity Building

In this study, capacity building refers to strategic efforts to equip member organizations and their affiliated farmers, other CSOs, and government actors with technical skills, leadership abilities, and institutional support needed to advance agroecological transformation. It includes trainings, mentorships, and practical learning in agroecology.

Capacity building emerged as one of the most consistent and well-documented functions of the PELUM Uganda Secretariat across the reviewed documents (Supplemental Material 3B). According to one document:

> PELUM Uganda … empowers their affiliate smallholder farming communities in practicing agroecology through capacity building, research and innovation, networking, advocacy for equitable improvement in their livelihoods. (PELUM Uganda, n.d., p. 2)

A staff member confirmed PELUM's capacity building efforts among members:

> We work to empower member organizations so that they can effectively work with the smallholder families.

The Secretariat supports agroecological transformation through a layered learning model, targeting farmers, CSOs, youth, and government actors. In the Ugandan agricultural context, this model refers to a multilevel capacity-building approach that intentionally targets different actors in the agroecology system. Such actors include the PELUM Uganda Secretariat, member organizations, community facilitators, government officials, and smallholder farmers. Rather than delivering training solely at the farm level, the Secretariat focuses on strengthening intermediary civil society organizations through training-of-trainers, mentorship, and institutional support, enabling them to translate agroecological principles into locally adapted practices. Learning is further reinforced

through farmer field schools, peer-to-peer exchanges, exposure visits, and demonstration sites such as the ELUM Centre. This approach is used because Uganda's agricultural extension landscape is fragmented and under-resourced, and because agroecological transitions require coordinated technical, social, and institutional learning across scales. Key capacity building activities include training workshops, mentorship programs such as African Women Leaders in Agroecology (AWOLA), farmer learning exchanges, and organizational development support. These efforts combine technical training with leadership development, often linking agroecological themes with land justice, gender equity, and climate resilience. Another staff member added:

> In addition to agroecology, climate resilience, agroforestry, post-harvest handling, marketing, and value addition, we also build capacity in governance, knowledge management, and financial sustainability. These are generic institutional areas that strengthen our members' overall performance.

To emphasize their capacity building mandate, a PELUM staff member said, "our mandate is one, to build capacity of our member organizations in the different thematic areas." Another added that "[we] … work with member organizations … providing training and technical backstopping." Documents provided evidence that Secretariat delivered capacity building efforts directly to members and through member organizations with regional reach. Capacity building activities were frequent and diverse as noted in one document:

> The [PELUM Uganda] network has … grown in number and influence on currently 66 [now 74] member organizations operating in 122 districts in Uganda, reaching approximately three million farmers, 60% of whom are women. (PELUM Uganda, n.d., p. 2)

However, some documents, such as the PELUM Annual Report (2024), noted limited geographic reach and occasional gaps in post-training follow-up, particularly in under-sourced districts. The role of regular monitoring and evaluation in tracking and improving agroecology programs is highlighted here:

> PELUM Uganda conducted a biannual monitoring and evaluation exercise to assess programme implementation progress and generate learnings to inform future and ongoing implementation. Notably, during the monitoring visits, there are reported increases in the adoption of agroecological practices, with 70% of smallholder farmers having at least three agroecology practices integrated on their farms. (PELUM Uganda Annual Report 2022, p. 31)

The reported increase in farmers adopting agroecological practices shows meaningful uptake and behavioral change, indicating that program interventions are effective in promoting holistic, sustainable farming systems.

A staff member described capacity building as a core pillar of PELUM Uganda's work but acknowledged that the impact varied across member organizations, as the quote from PELUM staff below indicates. They pointed out that while training was frequent and well- intentioned, the real test was whether the knowledge was applied and shared. They stressed that the Secretariat needed to invest more in follow-up and assess how training was translated into organizational change at the farmer level.

Our findings also revealed some operational gaps in capacity building efforts. One challenge was a mismatch between the expertise of the nominated participants for training and the actual topic, leading to poor knowledge uptake. Another was the need to train at least two people per organization to avoid knowledge loss due to staff turnover and to improve internal learning within member organizations. A PELUM Uganda Secretariat staff member said:

> … but also, [another challenge is] the representation. Because sometimes you might have an advocacy specific event, or an M&E related [capacity building] event but the representative sent to you is a finance person. So, you realize that the knowledge they are going to gain from

> such an engagement is not going to spread because that is not their area [of specialization]. So that leads to a gap in adoption of practices that are got through capacity building. Two, we find also a challenge that some of the membership focal persons do not send out the information that is got from the secretariat to their respective organization. So, you realize it is only the focal person who is engaged. … Then another one [problem] is the staff turnover, especially for the member organizations. You can build a lot of capacity in a certain staff member and when you return for a follow up visit [you find when] this person is not there [anymore]. [A] … solution would be on training more members within the organization instead of training just one person … to widespread the risk.

The Pesa Agro-Enterprise Marketing Model (PESA Model) developed by PELUM Uganda emphasizes that facilitators involved in capacity building must be well-versed in group dynamics, leadership, and participatory processes to ensure effectiveness and sustainability. The PESA Model supports this goal by encouraging grassroots groups to define their own development paths through visioning exercises that link climate risks with local solutions:

> The group discusses where they are now and where they would like to be in five years, three years and one year... The approach is intended to build a common plan of action, based on aspirations. (PESA Model Guide, p. 18)

Capacity building focused on training member organization staff to transfer knowledge to farmers, although this relied on internal systems that were not always effective. PELUM staff noted that capacity building was often limited to one-off workshops, demonstrating need for sustained, tailored support that includes leadership and strategic planning for CSOs. In the two quotes below, PELUM Uganda staff highlighted the collaborative and capacity-building ethos of the network, emphasizing both peer learning and targeted technical training for members.

> The strength of the network lies in the strength of its members. We do exposure visits, where members learn from each other.

> PELUM Uganda … with support … is convening MOs [member organizations], Youth, Agroecological Entrepreneurs in a 3-days training on product development (quality assurance, value addition, packaging, branding) and certification processes. The training is hosted at MOS23 … and majorly focusing on agroecological inputs.

To strengthen training, PELUM Uganda has established the Ecological Land Use Management (ELUM) Centre in Busuubizi Village, Mityana District, as a hub for demonstrating and promoting agroecological practices. The ELUM Centre serves as a practical learning ground for small-holder farmers, students, and development practitioners, offering hands-on training in sustainable farming methods, ecological land use, and natural resource management (PELUM Uganda Strategic Plan 2023–2026, pp. 30, 36, 45). Operating under the Agroecology and Sustainable Natural Resources Management (ASNRM) Department, the ELUM Centre contributes to PELUM Uganda's broader mission of improving livelihoods and environmental resilience through participatory ecological land use. It also functions as a site for research, innovation, community outreach, and policy influence, helping to build agroecological knowledge and food sovereignty across Uganda.

Gender, youth, and equity promotion were visibly embedded in capacity-building activities. The AWOLA mentorship program was a flagship example, targeting young women leaders across member organizations to strengthen their confidence, strategic leadership, and advocacy skills. This initiative explicitly addressed gender gaps in agroecological leadership by equipping women with technical knowledge and the tools to navigate decision making spaces:

> PELUM Uganda, under the AWOLA program, has been pivotal in supporting and amplifying these efforts. PELUM Uganda, we are driven by a vision of "Empowered and

> Resilient smallholder farming Communities Sustainably utilizing their natural resources." This vision frames every initiative we undertake and guides our journey towards Agroecology. (Stories of Change, AWOLA 1st Cohort, 2024, p. 9)

However, staff interviews pointed out that achieving genuine gender transformation would require going beyond participation to meaningful follow-up support. Structural support was needed to ensure women are present and able to lead within organizations and communities.

Operational issues were also raised, including high staff turnover within member organizations, misaligned training participation, and weak internal communication structures.

A staff member reported: "Some members won't even respond to our training invitations. The ones who are active keep getting selected, while those who ignore communications miss out entirely." Low attendance at training sessions hindered the overall effectiveness of capacity building efforts. In some cases, participation was limited to a single individual, which led to failed knowledge dissemination efforts for some organizations. Other operational issues included some member organizations expecting funding rather than technical support, and weak documentation practices, both of which limited the scaling of promising innovations.

Research and Innovations

Research, innovation, and publication are framed in this study as participatory and community-driven processes, with PELUM Uganda facilitating farmer-led innovations rather than generating formal academic research. Research activities focused on practical solutions like seed banks, soil health, and local certification systems, documented qualitatively through case studies and reports. Research and innovation played a strategic but varied role in PELUM Uganda's approach to agroecological transformation. Across the reviewed documents, PELUM Uganda was positioned more as a facilitator and mobilizer of farmer-led experimentation and participatory inquiry than a formal academic research generator (Supplemental Material 3C).

A staff member stated the organization prioritizes "documentation, success stories, online communication to share this information with the member organizations." Another member. describing models such as the Climate Resilient Agro-Ecosystems Model (CRAEM), Community-Managed Seed Systems (CMSS), the PESA Agro-Enterprise Marketing Model, and the Gender Action Learning System (GALS), claimed that PELUM acts as a "breeding point for knowledge … where innovations happen, and after developing these innovations, we take them to the member organizations." Members are involved in participatory research: "we have a list of tools … under the participatory assessment for climate disasters and risks … to suggest the solutions … then we come up with an action plan." Other crucial innovations and research areas supported by PELUM Uganda included participatory guarantee systems (PGS) for organic certification, community seed banks, and experiments on biochar-based soil health practices. The Secretariat also promoted farmer-managed natural regeneration and documentation of local ecological knowledge. Additional research focused on market access barriers, policy gaps, and agroecological entrepreneurship to inform advocacy and capacity building initiatives.

While some reviewed documents contained summaries of findings or evidence-based recommendations, few presented formal research methodologies. Most innovations were documented through case studies, workshop reports, or evaluation narratives. The Secretariat often collaborated with local universities, farmers' organizations, and regional networks such as the Knowledge Hub for Organic Agriculture (KCOA), but PELUM Uganda lacked a central repository for research outputs or a formal research agenda. Research and innovation activities were community embedded, often responding to community needs rather than externally driven research agendas. Despite limited formal peer-reviewed publication, the recorded participatory methods and grassroots innovations align with agroecological principles and climate resilience objectives. PELUM Uganda is not a conventional research institution but facilitates research through partnerships. Most innovations emerge from farmers and member organizations

via peer learning and experimentation. However, documentation of these grassroots practices remains inconsistent, limiting their scalability and use in advocacy. While the Secretariat excels in supporting farmer-led innovation and promoting knowledge exchange, weak technical capacity among some members and disconnect between donor agendas and farmers' needs hinder broader uptake and long-term impact.

Networking and Collaboration

In this study, networking and collaboration refer to the role of PELUM Uganda in cultivating and sustaining strategic relationships among diverse stakeholders, including member organizations, government bodies, regional platforms, and international advocacy networks, to collectively advance agroecology, food sovereignty, and climate justice. It encompasses peer learning, joint advocacy, knowledge exchange, and coordinated action through advocacy platforms. These collaborative efforts are participatory and decentralized, to enable grassroots voices to influence policy while building institutional credibility, expanding reach, and mobilizing resources.

PELUM Uganda played a central convening role in national, regional, and continental agroecology networks (Supplemental Material 3D). The Secretariat consistently positioned itself as a connector of actors engaged in agroecology, food sovereignty, and climate resilience. Its networking activities spanned peer learning, regional knowledge exchange, multi-stakeholder partnerships, and platform building. The collaborative approach of PELUM Uganda reflects its philosophy of participatory, decentralized change, using partnerships to build a shared ecosystem for agroecological learning and action. Collaborations reinforced its credibility, scaled its reach, and created opportunities for grassroots policy engagement, while the networks served as spaces for knowledge sharing and avenues for collective advocacy, resource mobilization, and peer accountability. Documents showed the focus on horizontal learning across PELUM Uganda's 70+ member organizations and its facilitation of joint submissions to policy consultations.

According to the PELUM Strategic Plan (2022–2026), PELUM Uganda identifies as a "network of stakeholders acting together to promote agroecology among smallholder farming communities in Uganda." The 2023 Annual Report further states, "PELUM Uganda, in collaboration with her member organizations, undertook several initiatives that were expanded to benefit their smallholder farmers. This occurred across five key areas: 1) Agroecology and Sustainable Natural Resource Management, 2) Agroecological Markets and Business Development, 3) Policy Advocacy, 4) Program Quality and Delivery, and 5) Organisational Functioning."

PELUM Uganda engaged in several significant networks to promote agroecology, including leading the Uganda hub KCOA and contributing to AFSA's continental advocacy on agroecology and climate justice. It also facilitated Regional Agroecology Actors Platforms (RAAP) to coordinate local transformation efforts and organized collaborative seed and food fairs as learning and community engagement spaces (Figure 1). The PESA model encourages strategic engagement by guiding farmers and facilitators to build trust and collaboration with other value chain actors, laying the foundation for inclusive and effective partnerships.

Findings showed that PELUM Uganda's networking strength came from its member organizations' collective energy and expertise. The Secretariat acted as a connector, facilitating exposure visits and learning exchanges that allowed members to learn from one another in practical and contextually appropriate ways. Interview respondents stated that partnerships were increasingly becoming important, particularly with donor preferences. According to a PELUM staff member, "funders are more inclined to support consortia or alliances rather than individual organizations." This made it necessary for PELUM to strengthen its coordination and joint proposal development processes. Another PELUM staff confirmed: "We provide a platform for networking ... when we notice [complementarity], then we are able to provide a network." Collaboration also extended beyond the network to include external actors, such as government ministries, local governments, and regional civil society alliances. Such relationships were seen as highly

important to advancing agroecology on greater scales.

A staff member reported:

> PELUM Uganda collaborates with other networks; for example, the ministry department and authorities like the ministry of agriculture, ministry of trade, ministry of gender, ministry of lands and for some we have even ongoing MOUs [memoranda of understanding] with government authorities like KCCA [Kampala Capital City Authority], … UNBS [Uganda National Bureau of Standards] and all that. But also, with the local partners like the civil society organization, our donors, different networks and platforms like the ecological organic agriculture platforms.

However, aligning diverse stakeholder priorities requires ongoing negotiation and effort, according to another staff member:

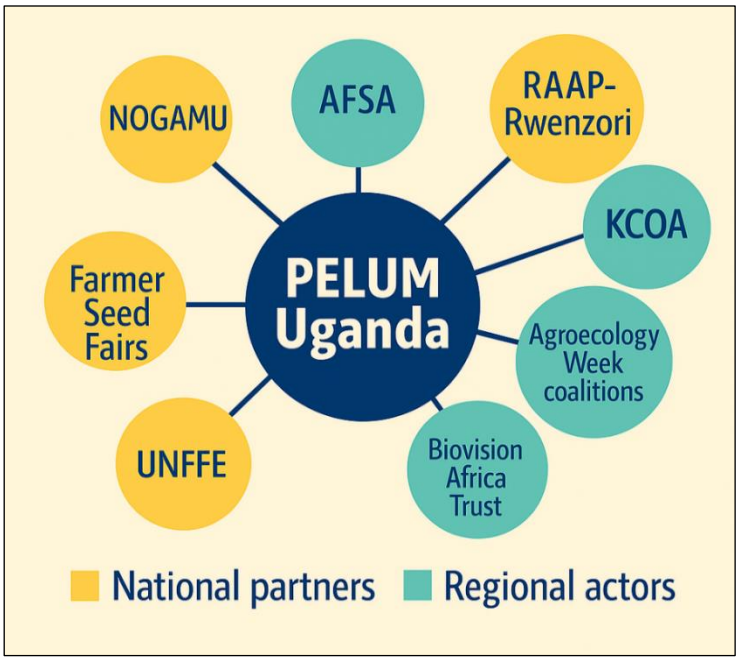
> The strength of the network lies in the strength of its members. We do exposure visits, where members learn from each other. That's where real innovation spreads.

A staff member stated:

> We work with AFSA, Food Rights Alliance, and others … donors now prefer to fund consortia and networks. There is a positive outlook on the working relationships with these partners.

Together, these reflections underscore how strong partnerships and peer learning drive innovation and attract collaborative funding. It should be noted, however, that although the Secretariat created spaces for collaboration, such as WhatsApp groups and thematic working committees, not all members participated consistently.

Figure 1. Network Map of Participatory Ecological Land Use Management (PELUM) Uganda Institutional Collaborations Highlighting National Partners



Legend: PELUM Uganda: Participatory Ecological Land Use Management Uganda; NOGAMU: National Organic Agricultural Movement of Uganda; UNFFE: Uganda National Farmers Federation; RAAP-Rwenzori: Rwenzori Advocacy Platform; AFSA: Alliance for Food Sovereignty in Africa; KCOA: Knowledge Centre for Organic Agriculture in Africa. Adapted from the 27 reviewed documents and interviews with PELUM staff.

Advocacy

In this study, advocacy means the strategic mobilization and policy engagement led by PELUM Uganda to advance equitable, agroecology-based food systems by influencing land rights, seed sovereignty, climate justice, and public financing, while ensuring the inclusion of marginalized groups such as women, youth, and smallholder farmers in both decision-making and implementation. The advocacy work of PELUM Uganda is rooted in its mission to promote equitable livelihoods for smallholder farmers, which is aligned with agroecology principles. The Secretariat has championed various issues through policy engagement, grassroots mobilization, and coalition building (Supplemental Material 3E), blending local legitimacy with national and continental reach.

The PELUM Strategic Plan 2022–2026 highlights a strategic objective to "focus on influencing

policy and practice change on agricultural and natural resource management issues." Early efforts focused more on farmers' rights and land. However, recent years have shown a stronger focus on climate resilience, territorial food systems, and rights-based approaches. Across all domains, PELUM highlighted equity, particularly gender and youth inclusion, as essential to livelihood improvement. For example, PELUM has advanced women's leadership in agroecology through targeted initiatives: "During the first cohort of the [AWOLA] programme, we have enhanced leadership capacities of seven young women leaders in the agroecology sector across Uganda. Mentors and mentees engaged in meaningful exchanges that built their skills, knowledge, and networks necessary for leading agroecological initiatives" (AWOLA Stories of Change, p. 10).

PELUM advocacy efforts can be best understood by grouping them by focus area (see Supplemental Material 3F):

(a) PELUM Uganda has consistently advocated for secure land tenure, especially for women and youth. Efforts have included supporting district-level by-laws that protect customary land ownership and arable land. In 2024, the organization played a key role in mobilizing communities during Land Awareness Week, which included the submission of district petitions to the Ministry of Lands.
(b) In parallel, PELUM Uganda has remained a strong civil society voice against the commercialization of genetically modified organisms (GMOs), promoting Indigenous seed systems and food sovereignty as viable alternatives. It has co-organized regional seed fairs and forums, collaborated with AFSA and the East and Southern African Farmers Forum (ESAFF) in anti-GMO mobilization, and contributed to the development of local ordinances, such as Kikuube District's food security bylaw.
(c) Between 2019 and 2020, PELUM Uganda led budget advocacy campaigns targeting agricultural allocations in national and local government plans. This included submitting budget policy statements, lobbying for spending aligned with agroecological priorities, and participating in public dialogues and budget hearings. Although no direct climate framing was found in these earlier budget campaigns, later documents such as the Strategic Plan (2023–2027) reflected a shift toward climate-resilient financing.
(d) Climate advocacy has become increasingly visible in recent years. PELUM Uganda's activities included participation in Africa Climate Week 2023, contributions to national climate dialogues, and advocacy for polluter-pays principles, climate finance equity, and local adaptation planning.

PELUM Uganda's strength lies in policy advocacy, especially for agroecology and land rights, often achieved through unified engagement with like-minded organizations.

PELUM Uganda has shaped national agroecology policy processes. In the 2022 Annual Report, the country coordinator wrote:

> Critical to note is the integration of agroecology into the revised Uganda National Determined Contributions and initiating the process of the development of the Uganda National Agroecology Strategy for scaling up Agroecology, processes…done in close collaboration with the Ministry of Water and Environment and the Ministry of Agriculture, Animal Industry and Fisheries. (p. 6)

However, some member organizations struggle to see the value of advocacy without immediate financial returns.

Equity is central to PELUM Uganda's work, particularly in land rights and seed sovereignty, with initiatives such as Land Awareness Week engaging marginalized communities to protect customary land rights and indigenous seed systems.

PELUM Uganda has supported community engagement on land rights and governance. Several quotes demonstrate PELUM Uganda's longstanding commitment to safeguarding community rights

and natural resources through advocacy, awareness, and policy engagement. A 2024 PELUM Uganda Bulletin stated:

> The 8th National Land Awareness Week … engaged over 5,000 individuals, including small-scale farmers, local leaders, women, and Persons with Disabilities… Key outcomes include increased awareness of land policies, legal support for marginalized groups, and strengthened collaboration among stakeholders. (p. 4)

A PELUM Uganda (2010) report stated that:

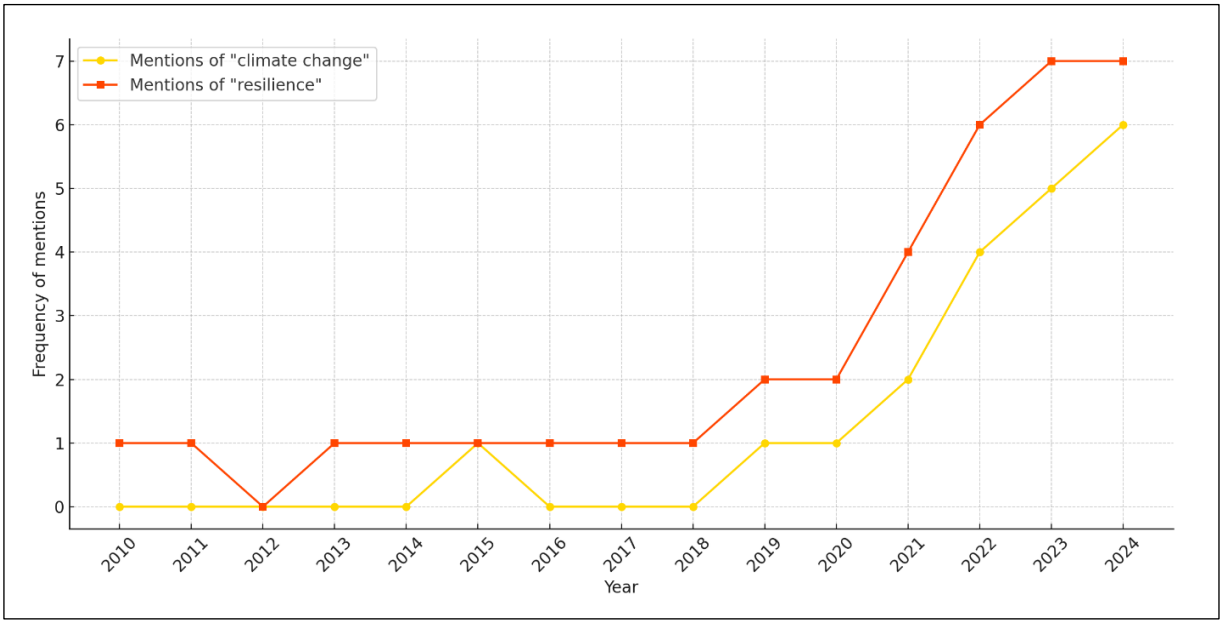
> Workshops were conducted for MOs [member organizations] on seed security for food security; specifically … as [awareness creation on] GMO seed, which increased members' knowledge of the concept. With the knowledge gained from the workshop, participants actively engaged in advocacy; analysing the sustainable agriculture study conducted by PELUM Uganda, the draft national seed policy, and the national biotechnology and biosafety policy for advocacy issues. (p. 11)

Despite strong equity messaging, disparities in institutional capacity limit some members' participation in advocacy, weakening representation of smallholder voices.

Climate Change Engagement

In this study, climate change engagement refers to PELUM Uganda's evolving efforts to position agroecology as a climate mitigation and adaptation strategy through advocacy, farmer-led innovations, and localized resilience programming. It involves integrating climate literacy, gender-responsive planning tools, and participatory risk assessments into practice, while navigating donor-driven agendas and internal challenges to ensure equitable, context-relevant climate action across its network. The engagement of PELUM Uganda with climate change has evolved significantly over the past decade. In earlier documents (2010–2015), references to climate change were either non-existent or framed only in indirect terms such as environmental sustainability or resilience. In contrast, documents from 2022 onwards consistently have presented climate change as a central thematic focus. Figure 2 shows the increased references to "climate change" and "resilience" across the reviewed documents, reflecting this growing emphasis. This focus

Figure 2. Trend of Climate Terms in Participatory Ecological Land Use Management (PELUM) Uganda Documents



has included explicit discussions of climate adaptation, locally led responses, and agroecology as a climate solution. This shift reflects a broader transition in institutional priorities: from promoting agroecology primarily as a sustainable alternative to conventional agriculture to positioning it as a critical climate mitigation and adaptation strategy.

Climate change awareness, mitigation, and adaptation emerge as some of the most prominent and deeply embedded themes across all four documents. One staff member highlights "climate resilience" as a core element of PELUM's strategic domain of agroecology and sustainable natural resource management. This position emphasizes the organization's commitment to helping member organizations and communities cope with and adapt to shifting environmental conditions. PELUM Uganda does not treat climate change as a standalone issue but as a cross-cutting concern integrated into broader efforts such as agroecological farming, land rights advocacy, and participatory governance.

Another staff member expands on this strategic focus by detailing several practical community-driven models employed by PELUM. The CRAEM model facilitates holistic community engagement, ensuring that all stakeholders collaborate on climate solutions. The CMSS model addresses seed sovereignty by enabling communities to produce and preserve their own locally adapted seeds. The GALS framework ensures that gender dimensions are considered in building climate resilience at the household and community levels. The PESA model links ecological practices to financial empowerment, helping communities turn sustainable practices into viable livelihoods.

Additional depth of climate programming is in the CRAEM Facilitator's Guide (2016) developed by PELUM Uganda, which presents a modular, community model for building household and agricultural resilience to climate change. It clarifies:

> This facilitators' guide is intended to provide an application process of the CRAEM model by the facilitating organizations at community level while empowering the beneficiary communities to take lead role in building their own resilience to climate change. (p. III)

CRAEM offered a systematic framework for integrating climate adaptation and mitigation through ecologically sound practices such as agroforestry, greywater reuse, soil conservation, and early warning systems. Unlike climate-smart agriculture, CRAEM explicitly critiqued industrial inputs and focused on farmer agency, gender equity, and local innovation as central to climate resilience. The Guide also incorporated structured training on climate change literacy, gender-differentiated vulnerability assessments, and practical tools, including the Gender Action Learning System (GALS) methodology for climate responsive planning.

Climate change has become a thematic driver and a framing lens for PELUM Uganda's work. Whether in advocacy, research, or grassroots mobilization, the Secretariat has increasingly used climate language and evidence to position agroecology as ecologically viable and socio-economically urgent. Its engagement is characterized by high level participation in policy spaces and localized strategies rooted in farmer knowledge.

It was noted that despite climate change becoming more integrated into Secretariat programming, some member organizations continued to perceive it primarily as a donor-driven agenda. This perception did not reflect a denial of climate-related risks, but rather a concern that climate change was often framed through externally defined project language, reporting requirements, and funding priorities, rather than through locally articulated livelihood challenges. In several cases, agroecological practices that farmers already associated with food security, soil fertility, and water management were not necessarily recognized by members as "climate action," contributing to the view that climate programming was externally imposed rather than locally owned. Local actors in Uganda and across Africa often view climate change as driven mainly by major industrial economies in the West who significantly contribute to greenhouse gas emissions. They see climate funds, channeled through donors, as coming from these same external powers. While climate adaptation efforts are seen as relevant, mitigation is viewed as largely irrelevant. In response, the Secretariat made efforts to frame climate action in more practical

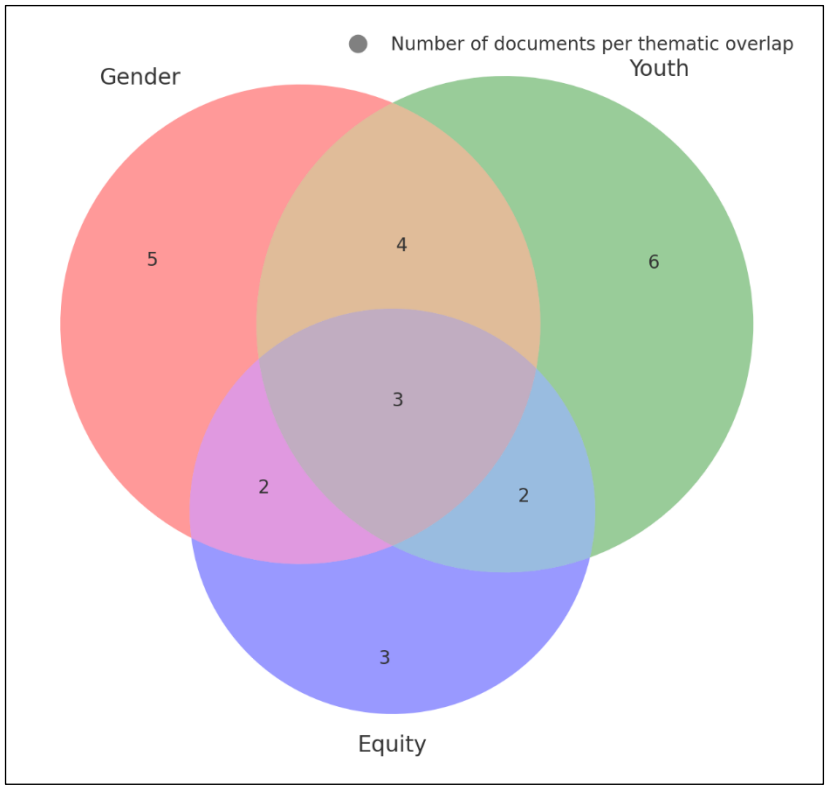
livelihood terms fostering adaption, highlighting the contribution of agroecology to food preservation, efficient water use, and drought resilience. It was also observed that although climate change was positioned as one of the Secretariat's four core advocacy themes, its practical implementation across the network remained inconsistent. In many cases, whether climate considerations were integrated into programming depended heavily on donor requirements or the focus of specific projects.

One respondent described agroecology as inherently aligned with climate adaptation, citing examples such as crop diversification, agroforestry, greywater reuse, and food preservation as practices already in use by farmers. The Secretariat's role was seen as strengthening and systematizing these approaches to help scale resilience in the face of increasing climate stress:

> Agroecology helps address drought through agroforestry, crop diversification, grey water reuse, and food preservation during bumper harvests. (PELUM staff)

Climate resilience programming within PELUM Uganda is intentionally linked to gender, youth, and equity considerations as part of the organization's broader institutionalization of agroecology. These dimensions reflect agroecology's social principles, emphasizing inclusivity, participation, and justice. Integrating gender and youth perspectives ensures that capacity building and livelihood programs address the structural inequalities that shape access to land, inputs, and decision-making. Equity, in this context, refers to fair distribution of resources and opportunities across different social groups. Recognizing these linkages demonstrates how PELUM operationalizes agroecology not only as an ecological approach but also as a socially transformative process (Figure 3). The CRAEM model, for instance, included gender-sensitive planning tools such as the Gender Action Learning System (GALS) and explicitly addressed the differentiated impacts of climate change on men and women. In the Ugandan context, these differences commonly manifest in women experiencing increased labor burdens related to water collection, food provisioning, and caregiving during periods of drought or erratic rainfall, alongside more limited control over land and productive resources. Men, by contrast, are often more directly affected through climate-related losses in crop production, livestock assets, and market income. Such can increase economic pressure and labor migration. The incorporation of participatory tools that surface these gendered vulnerabilities and responsibilities allows CRAEM to ensure that climate adaptation strategies respond to distinct household and community-level realities

Figure 3. Venn Diagram Visualizing the Intersection of Gender, Youth, and Equity in Participatory Ecological Land Use Management (PELUM) Uganda's Programming 2010–2024



rather than assuming uniform impacts. Through CRAEM, adaptation strategies were promoted that reflected the priorities of women and marginalized groups through emphasis on participatory climate risk assessments and inclusive action planning. However, despite firm commitments in strategic plans, staff reported inconsistent mainstreaming of gender and equity across climate-focused projects. In many cases, donor interests more than vulnerable populations' needs and realities shaped climate programming'. This concern is consistent with critiques raised in PELUM Uganda's 2017 policy recommendations for Uganda's draft Climate Change Bill. The document noted that directive policy processes often overlook the lived realities of farming communities. It advocated for inclusive legal frameworks prioritizing local adaptation strategies and equitable access to climate change mitigation finance. It also noted need for legislation to recognize and embed indigenous knowledge as a valid and essential part of the climate response in Uganda.

Across the reviewed documents and staff reflections, recurring institutional and systemic challenges affect PELUM Uganda's ability to scale agroecology, build capacity, and influence policy (Supplemental Material 3G). Nevertheless, the Secretariat has demonstrated adaptive learning by investing in internal systems, partnerships, and grassroots alliances. Continued focus on implementation, equity, documentation, and climate-responsive planning remains key for future progress.

As previously noted, some member organizations viewed climate programming as donor driven, creating challenges in aligning external priorities with local needs. It was also observed that despite increased engagement in policy spaces, a significant gap remained in translating agroecological strategies into widespread practice. Uptake was described as uneven, and without stronger buy-in, particularly at district levels, agroecology risked being perceived as a niche rather than a mainstream development pathway.

Discussion

PELUM Uganda's integrated strategy mirrors global agroecological transition models in its emphasis on systems thinking, participatory learning, and policy engagement. However, achieving a balance between programmatic breadth (working across multiple domains) and depth (ensuring measurable impact within each domain) remains a continuing challenge (Anderson et al., 2019; HLPE, 2019). The Secretariat excels at convening actors and influencing policy, and study findings highlight their strengths in promoting farmer-led learning and research. However, challenges persist, particularly in internal documentation, uneven member engagement, and inconsistent post-training support.

Capacity Building: Strengths and Gaps in Training Models

As a core strategy for agroecological transition, capacity building enables CSOs such as PELUM Uganda to translate principles into practice. Among the five domains, this was the most consistently documented function. Training workshops, leadership mentoring, and farmer exchange visits were found to be frequently deployed to strengthen agroecological skills across CSO staff, youth, and smallholder farmers. These efforts reflect the "training of trainers" model and echo the ethos of agroecology's *campesino-a-campesino* [farmer-to-farmer] approach (Rosset et al., 2019). However, the findings also revealed limitations. Although 70% of farmers reportedly adopted at least three agroecological practices post-training, weak post-training follow-up often undermined long-term knowledge retention (PELUM Annual Report 2022, 2023). This is consistent with observations in Kenya, where up to 40% of trainees reverted to conventional practices without mentorship (Kaguongo et al., 2014). This confirms that iterative learning cycles, involving follow-up coaching and adaptive feedback, are essential for agroecological transformation (Friis-Hansen & Duveskog, 2012; Pimbert et al., 2021; Waddington et al., 2014).

Gender equity and youth inclusion were central to PELUM Uganda's capacity building, notably through programs such as AWOLA, which align with feminist agroecology and leadership-building goals (Bezner et al., 2022; Zaremba et al., 2021). However, interviews pointed to persistent barriers,

such as land tenure inequities, sociocultural norms, and limited access to credit, that constrain transformative gender outcomes. Training alone may be insufficient because structural barriers including discriminatory legal frameworks, sociocultural norms, and limited access to resources continue to impede gender equality in governance structures. These findings align with studies in Uganda showing that gender inequalities persist in agricultural and environmental sectors despite policies promoting women's participation (Aganyira et al., 2020). Unequal access to land, credit, and leadership positions continue to constrain women's agency within agroecological initiatives. This mirrors broader African research showing how formal representation alone does not dismantle entrenched gendered power relations (Makulilo & Bakari, 2021). Transformative approaches including education, empowerment, advocacy, and collaboration as employed by the Tanzania Gender Networking Programme (TGNP) have shown promise in promoting women's empowerment and political participation (Makulilo & Bakari, 2021).

Research and Innovation: Facilitating Farmer-Led Knowledge

In the domain of research and innovation, PELUM Uganda plays a facilitative role rather than acting as a formal research body. It supports community-based innovations such as seed banking and PGS (HLPE CFS 2019; Greenberg et al., 2023), which reflect a territorialized model of innovation. These grassroots experiments align with the principles of agroecology, but our review found limited systematization and formal documentation. This challenge aligns with broader observations about the under-recognition of informal innovation within agrifood systems, as discussed by FAO (May et al., 2023), particularly in the context of rural transformation.

Drawing from Malawi's experience, integrating participatory action research (PAR) with long-term impact assessments strengthens policy advocacy (Snapp et al., 2023). In Tanzania, universities are enhancing the sustainability of their outreach activities through PAR, as demonstrated by Sokoine University of Agriculture's fostering of community transformation and researcher-farmer and researcher-CSO collaborations (Busindeli et al., 2024). Our findings suggest that collaboration with universities could support PAR and help systematize learning. However, attention must be given to power collaboration challenges that persist around asymmetries in research partnerships (Ozano et al., 2020).

Networking and Collaboration: Building a Civil Society Ecosystem

Networking and collaboration are strategic strengths of PELUM Uganda, demonstrated through its leadership in national and continental platforms such as AFSA and KCOA. The network's "meshwork" governance structure (Figure 1) facilitates exposure visits, horizontal learning, and collective advocacy. Nevertheless, our findings point to uneven participation among members and dependency on donor-driven projects, which are common coordination challenges in CSO networks (Nicholls et al., 2016).

To improve resilience, a tiered membership model or pooled funding mechanism could help diversify resources and strengthen internal cohesion. In the Ugandan context, where civil society organizations vary widely in size, capacity, and access to donor funding, a tiered membership model would allow differentiated levels of participation and contribution, rather than assuming uniform engagement across the network. Similarly, a pooled funding mechanism that draws on modest contributions from multiple donors, partners, or membership fees, could support shared functions such as coordination, capacity building follow-up, and documentation, while reducing competition among member organizations. For instance, Uganda has recently discussed an agrochemical levy, a small tax on imported synthetic fertilizers and pesticides, intended to support sustainable agriculture initiatives. Such a mechanism could provide a public revenue stream for ecological agriculture programs and partnerships that align with PELUM Uganda's mission, thereby creating opportunities for collaborative financing rather than direct organizational funding. Despite challenges, PELUM has influenced national policies on agroecology, seeds, climate, and nutrition, although sustaining member engagement demands that the

Secretariat provide clearer communication about long-term advocacy benefits (Anderson et al., 2020), as they take time to manifest.

Policy Advocacy: Strategic Influence and Long-Term Impact

PELUM Uganda's advocacy track record is notable. It has shaped key national policies, including the National Organic Agriculture Policy and the draft agroecology strategy (Biovision, 2024). It has also mobilized seed sovereignty and land rights actors, and is positioned to lead on legal frameworks such as a seed sovereignty bill. Climate engagement is growing, with policy actors positioning agroecology as a climate solution. However, the value of advocacy is not always evident to grassroots members, especially when financial benefits are indirect or delayed. Our interviews suggest that clearer communication about long-term policy successes is needed to maintain momentum (Anderson et al., 2020).

Despite growing international recognition of agroecology as a climate adaptation strategy, the framing of agroecology around climate goals remains contentious among some stakeholders, particularly where it is seen as donor driven. This tension is partly geopolitical. In Europe, agroecology has been increasingly institutionalized through academic, policy, and farmer networks that emphasize climate resilience, soil carbon sequestration, and diversified agroecosystems as central objectives (Bellon et al., 2018). Research and training institutions across Western Europe actively promote agroecology as a transformative response to climate change, often embedded in national policy (Bellon et al., 2018). In contrast, the U.S. demonstrates more resistance. Whereas agroecological practices are gaining traction among grassroots movements and researchers, the broader climate framing is often met with political skepticism or mistrust of federal agendas (Wills et al., 2024).This 'divide' shapes how donors, particularly from the Global North, frame project goals. U.S.-based funders are therefore more likely to adopt a technocratic or productivity lens, potentially clashing with the more holistic and politicized visions held by European and Global South actors (Wills et al., 2024). This tension is salient in Latin America, where stakeholders recognize agroecology's role in climate adaptation but express concerns about top-down, often foreign-based donor narratives that can misalign with local priorities (Carolina et al., 2023) This divergence has implications for African initiatives such as PELUM Uganda. Members may perceive climate-oriented funding as externally imposed, which highlights broader concerns about agroecology's depoliticization when filtered through donor logics (Nicot et al., 2018). Therefore, when major donors originate from regions where climate action is politically polarized, this dynamic can influence PELUM Uganda's funding model and implementation choices. For example, donor preferences may shape the framing of resilience programs, either reinforcing locally grounded approaches such as CRAEM and CMSS or steering resources toward externally defined climate priorities. This affects funding predictability as well as how PELUM balances accountability to donors with its commitment to farmer-led agroecological models.

Climate change engagement has evolved from peripheral to a core theme in PELUM Uganda's strategy. The study's document review shows increasing use of climate framing to promote agroecology as both an adaptation and mitigation strategy (Intergovernmental Panel on Climate Change, 2022). The CRAEM model, for example, embodies locally led adaptation by incorporating traditional knowledge, agroforestry, and greywater reuse (Barbato & Strong, 2023). However, tensions persist between farmer-defined resilience and donor-driven metrics such as carbon sequestration and carbon markets (Levidow, 2018). Study interviews revealed that some members still perceive climate action as donor imposed. This risks reducing agroecology to a mitigation toolkit, sidelining food sovereignty principles (Levidow, 2018).

Embedding agroecology in livelihood programs, such as water conservation, can boost relevance of climate adaptation strategies by aligning ecological practices with local development priorities (Isaac et al., 2021). PELUM Uganda and other CSOs assist farmers to adopt agroecological practices that improve soil fertility, biodiversity and climate adaptation, reducing dependence on chemical

inputs, and conserving natural resources (FAO, 2025). PELUM's approach addresses technical, social, and political agroecological dimensions (Wezel et al., 2020), but scaling impact requires stronger documentation, equitable member engagement, and post-training follow-up.

Comparative insights show that PELUM Uganda occupies a hybrid niche within the region. Whereas Kenya's KOAN focused on organic certification and decentralized support through Counties Agroecology Hubs, PELUM Uganda takes a more assertive, policy-focused approach. Its collaboration with the MAAIF and ties to AFSA offer regional influence and reflects adaptive pragmatism, enabling institutional access. However, it also raises the risk of co-optation, as seen in Ethiopia's top-down agroecology programs (Mier y Terán Giménez Cacho et al., 2018). To remain effective, PELUM must offer evidence-based, farmer-driven models that promote food sovereignty, ecological restoration, and chemical-free farming. Lessons from West African networks, such as Burkina Faso's CNABio (Sib et al., 2023) and Mali's CNOP (Coulibaly et al., 2021), suggest that scaling agroecology requires strong farmer organizations, decentralized governance, and flexible funding arrangements. In these contexts, funding flexibility refers to access to core or pooled resources that are not narrowly earmarked to short-term project outputs. This allows farmer organizations to allocate resources across training, peer learning, coordination, and follow-up support. Such funding enables longer time horizons, adaptive responses to local priorities, and sustained farmer-to-farmer exchange. These conditions are essential for scaling agroecological practices that rely on social learning, ecological adaptation, and collective action rather than standardized technological inputs.

While PELUM is viewed as a civil society network leader, critics argue grassroots networks often lack scalability in fragile institutional settings (Isgren & Ness, 2017). There is also tension between strong capacity-building efforts and weak post-training follow-up, echoing concerns that short-term interventions lack lasting impact (Lussier, 2016). Similarly, PELUM's stance on markets appears contradictory, resisting market-driven agroecology while integrating tools such as the PGS to empower farmers through localized certification (Bouagnimbeck, 2014). Leveraging the Africa Continental free trade area (AfCFTA), Uganda could promote the PGS as a Pan-African standard, reducing certification costs and expanding smallholder market access (Ezeonu, 2021). PELUM's nuanced strategy must therefore balance grassroots principles with policy engagement to scale agroecological transformation.

Taken together, these five domains reveal how civil society organizations operate as multi-level brokers of agroecological change: facilitating learning, building credibility, and navigating complex donor and policy landscapes. The case of PELUM Uganda illustrates both the opportunities and tensions involved in scaling agroecology through networked, resource-constrained systems.

Navigating Donor Dynamics and Internal Constraints

Our study also confirms broader tensions facing civil society. Although organizations such as PELUM are central to agroecology as a "modernization from below," their policy influence is often shaped by relationships with the state and with donor priorities (Isgren, 2018). Some members view advocacy as disconnected from local realities (Bottazzi & Boillat, 2021), exposing a gap between national-level influence and perceived grassroots benefits. Moreover, civil society's policy impact in Uganda remains limited, often shaped by internal governance and by relationships with the state and political actors raising questions about the long-term effectiveness of advocacy without deeper local engagement and institutional reform (Njoku, 2022; Robinson & Friedman, 2007).

This paper provides an account of how networked CSOs drive transitions to agroecology through diverse initiatives. Further studies could analyze how PELUM Uganda navigates its engagements with the state. Agroecology does not operate in a vacuum; it is shaped by state-civil society relations, competing interests from agribusiness, and international development agendas. As the literature has noted, the impact of civil society in Uganda depends heavily on state receptivity and internal governance, with technocratic state priorities having the potential to

marginalize agroecological initiatives (Isgren, 2016, 2018).

Scaling Agroecology: Horizontal and Vertical Approaches

PELUM Uganda's efforts illustrate both horizontal and vertical scaling of agroecology. Horizontal scaling initiatives such as peer learning, exposure visits, and community exchanges align with horizontal diffusion, akin to the Latin America campesino-a-campesino model (Rosset et al., 2019). In contrast, PELUM's integration into Uganda's national agroecology strategy and its influence on the National Organic Agriculture Policy is a promising example of vertical scaling, but questions remain about consistency and depth of implementation. Comparative experiences from Latin America, such as Brazil's agroecology policies, and West Africa, such as Senegal's National Agroecology Program, show that vertical scaling often hinges on sustained civil society pressure and political will (Mier y Terán Giménez Cacho et al., 2018). PELUM Uganda offers legitimacy, localized knowledge, and flexible organizing, which generally contrast with the top-down, technocratic approaches of state agencies (Anderson et al., 2019). However, PELUM's reliance on donor funding and uneven capacity across member organizations can constrain reach and depth. This study's findings show that balancing these approaches is difficult. Horizontal scaling promotes localized relevance but can be sidelined without institutional support; vertical scaling brings policy traction but risks diluting grassroots values. A hybrid model that anchors vertical legitimacy in farmer agency may be key to systemic agroecological change.

Although recognizing PELUM's push to institutionalize agroecology, this study does not fully engage with the potential risks to agroecology's emancipatory ethos. It is acknowledged that institutionalization can dilute agroecology's radical potential by aligning it with technocratic metrics, donor agendas, and elite co-optation (Giraldo & Rosset, 2018, 2023). To preserve the transformative ethos, PELUM must maintain a strong grassroots anchor, resist elite capture, and elevate local priorities over external metrics.

Equity and Institutionalization: Safeguarding Agroecology's Ethos

Enforcing equity must become a central pillar of the agroecological initiatives PELUM supports. This involves working closely with the Ministry of Gender, Labour and Social Development to expand successful programs such as AWOLA into broader women's funds such as the Uganda Women Entrepreneurship Programme. Such funds could provide female farmers with targeted grants and land titles, addressing systemic gender disparities. Burkina Faso's Femmes et Agroécologie demonstrates how land security and financial support can empower women and strengthen agroecological leadership at the community level (Diendéré & Wadio, 2023). PELUM's advocacy initiatives, including its annual Land Awareness Week and its work addressing land tenure insecurity and large-scale land acquisitions, are among the tools the network seeks to scale up to advance equity. Land Awareness Week focuses on community sensitization, legal literacy, and dialogue with local authorities on land rights, with particular emphasis on women, youth, and smallholder farmers. Complementary advocacy efforts engage cases of land dispossession linked to large-scale investments or contested land transactions, supporting community mobilization and policy engagement to strengthen tenure security and protect customary land rights..

Conclusion and Recommendations

This study contributes original insights into how CSOs can drive agroecological transformation within low-resource communities, where financial, technical, and institutional capacities are often limited. By coordinating capacity building, research, advocacy, and climate engagement, PELUM acts as a key link between farmers, policymakers, and regional networks. PELUM Uganda employs a hybrid model that involves linking grassroots innovation with policy advocacy. The model offers a compelling case of "networked transformation." However, this potential is constrained by weak documentation systems, unequal member engagement, limited follow-up mechanisms, and donor dependence, hindering long-term impact. Despite these issues, PELUM's experience offers valuable lessons. Strengthening internal systems,

equity, and alignment with national strategies is crucial for civil society to remain an effective driver of agroecological transformation. Moving forward, PELUM's impact could be amplified by embracing a dual strategy that integrates the relational depth of horizontal learning ("out-scaling") with the institutional leverage of vertical advocacy ("up-scaling") (Mier y Terán Giménez Cacho et al., 2018). Anchoring the strategy in a more participatory governance framework would help reconcile tensions between donor demands and grassroots priorities and solidify PELUM's role as a catalyst for food sovereignty in Uganda and beyond. Achieving deeper institutionalization of agroecology can be achieved through addressing documentation gaps, centering intersectional equity to ensure fair participation and benefit sharing across gender, age, and socioeconomic lines, and forging bolder alliances. For PELUM Uganda, equity involves responding to the different ways social categories such as gender, youth status, and resource access shape engagement in agroecological initiatives. Integrating this perspective strengthens networked transformation by making collective action more inclusive of diverse farming constituencies. These lessons resonate across East Africa, offering a roadmap for other networked institutions like PELUM Kenya seeking to align ecological resilience with social justice. PELUM Uganda exemplifies the potential of civil society networks to drive agroecological transitions through hybrid strategies, blending grassroots mobilization with policy pragmatism. As climate shocks and agribusiness encroachment intensify, however, the PELUM Uganda Secretariat must navigate tensions between adaptation and transformation, collaboration and resistance.

Finally, as climate stress intensifies and food systems face increased privatization, civil society organizations such as PELUM must not only facilitate adaptation but also assert a bold vision for transformation. Strengthening documentation, amplifying farmer agency, and fostering cross-regional alliances will be critical for building an agroecological future rooted in justice, equity, and resilience. To address persistent gaps in agroecological transformation in Uganda, we call on the government to support PELUM Uganda in designing and implementing context-specific actions on community-led climate adaptation and resilience strategies, multi-stakeholder collaboration, and innovation for inclusive development that are aligned with Uganda's National Development Plan IV (NDP IV) [FY 2025/26–2029/30]. We also call on the Uganda government to support CSOs such as PELUM Uganda in realizing priorities of the African Union Agenda 2063 (2015), specifically Aspiration 1, Goal 5 of Agenda 2063, on sustainable and climate-adaptive agriculture through promotion of agroecology

In parallel, PELUM Uganda and its partner networks, such as ACSA, AFSA, and ESAFF, in order to amplify their impact should advance the following initiatives. First, strengthening documentation systems within CSOs is essential to enhance knowledge sharing, institutional learning, and evidence-based advocacy. A more systematic approach would ensure that successful practices are captured, preserved, and disseminated across member organizations. Second, mobilize like-minded partners to launch a national Agroecology Innovation Fund to retain and share local innovations more effectively. This fund could support the digitization of farmer knowledge by facilitating credit access to small-scale farmers. Third, pressure their national governments to deepen the integration of climate change considerations into agroecological policies and integrate agroecological approaches into climate policies; for example, advocating for amendments to Uganda's Climate Change Act 2023). Fourth, advance benchmark comparison of different conceptual frameworks across the continent. For instance, in Senegal since 2019 multiple stakeholders have coalesced under the DyTAES initiative (Dynamique pour une Transition Agro-écologique au Sénégal) to contribute to government policy deliberations on developing a national agroecological transition policy (Bottazzi & Boillat, 2021; United Nations Development Programme, 2025). Future studies should explore how CSOs could balance pragmatic collaboration with state actors while safeguarding the transformative rights-based foundation of agroecology.

Acknowledgment

We acknowledge the immense support from PELUM secretariat staff members who provided data for this study.

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Journal of Agriculture, Food Systems, and Community Development
ISSN: 2152-0801 online
https://foodsystemsjournal.org

Using a screening survey to understand the appeal of poultry meat label attributes to support small-scale producers

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Submitted May 8, 2025 / Revised August 6, August 27, August 29, and October 28, 2025 / Accepted October 29, 2025 / Published online February 4, 2026

Citation: Liang, C.-L. (K.), & Collins, B. (2026). Using a screening survey to understand the appeal of poultry meat label attributes to support small-scale producers. *Journal of Agriculture, Food Systems, and Community Development*, *15*(2), 229–246. https://doi.org/10.5304/jafscd.2026.152.006

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Abstract

Antibiotic use to sustain poultry health has been a controversial and mysterious subject for consumers. Consumers also wonder about terms on packaging such as antibiotic-free, free range, organic, non-GMO, and humanely raised. There is only limited research-based information that explores how consumers perceive poultry meat attributes on various commercial packages. This paper discusses the results of a screening survey to explore consumer perceptions of specific characteristics on packages via convenience samples. We identified attributes based on a literature review and real-time market observations from grocery stores. Results showed diverse responses from 362 participants regarding the attributes and designs on fresh, raw chicken breast packages typically found in grocery stores. Preferences of different attributes were further analyzed using factor analysis and clustered into four similar groups of choices based on labeled meat attribute and label color and design. Factor analysis demonstrated a strong tendency to prefer packages due to "negative" or "positive" labeling

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Funding Disclosure

This research was partially supported by the USDA-NIFA SAS Restricted Poultry Production Project USDA/NIFA under Award Number 2020-69012-31823. The supports are gratefully acknowledged.

attributes such as non-GMO that were not present, or attributes such as humanely raised that were labeled as present. The results can assist community organizations and service providers, such as small local food cooperatives, independent grocery stores with a local niche, and Cooperative Extension educators and agents to support local producers in engaging in creative marketing strategies to improve consumer awareness, food safety education, and recognition of differences across terms used on different types of labels.

Keywords
consumer preferences, poultry meat, food safety, local farmers, food labeling

Introduction and Literature Review

From national chain grocery stores to local farm stands, poultry products are among the most popular protein sources (Korver, 2023). Most countries are seeing an increase in poultry meat consumption per capita. For example, from 2000 to 2019 the U. S. saw a steady rise in poultry consumption, from 43.2 kg/capita to 50.1 kg/capita annually (Whitton et al., 2021). Such statistics generate debates in developed countries about reaching peak poultry consumption levels and the best policy practices to manage sustainable increases in consumption across various markets (Kleyn & Ciacciariello, 2021). While demand in the U.S. has steadily risen, the market for poultry products with certain attributes, such as different labels or production claims, is dynamic. What were once niche markets, such as products with organic or antibiotic-free labeling, have now captured a significant portion of market share due to increased popularity among certain demographics of consumers (Parashar et al., 2023). For example, U.S. organic food retail sales for meat, fish, and poultry jumped from US$50 million in 2001 (adjusted for 2021 inflation) to US$2.08 billion in 2021 (U.S. Department of Agriculture Economic Research Service, 2025c). Several studies confirm that consumers have increasingly favorable perspectives on non-conventionally grown poultry meat, supported by their concerns for animal and environmental welfare as well as perceptions that non-conventional poultry is healthier and tastier (Castellini & Dal Bosco, 2017; Mohammadi et al., 2023; Smith-Spangler et al., 2012).

These trends have substantial implications for poultry producers at local, regional, and national levels and at different scales of production: to (1) understand how increasing demand influences practices and management at farm level; (2) acknowledge the new trend of consumer awareness of and preferences about animals wellbeing linking to marketing strategies; and (3) adopt innovative approaches to simultaneously improve the quality of production and of consumption beyond traditional cost-benefit evaluations. Therefore, the direction of the poultry industry is in flux, with competing interests trying to balance increasing demand for poultry consumption while changing the paradigm of how chickens are grown and processed (Kleyn & Ciacciariello, 2021).

This research project sought to better understand current patterns of poultry meat consumption by analyzing high-engagement consumer preferences for specific attributes attached to the poultry products they buy. The information will contribute to the growing discourse on the antibiotic-free movement and help direct-service providers (e.g., Cooperative Extension, community-based health services) and policymakers integrate consumer market profiles and behaviors to enhance overall family and community health and animal well-being. The providers are well-positioned to deliver targeted outreach based on shifting consumer preferences and to support producers in making informed decisions about labeling and marketing (Elliott-Engel et al., 2022; Worley et al., 2024). By integrating consumer behavior data into outreach programming, providers can promote healthier dietary practices and improve the alignment between food production methods and community expectations for animal welfare and environmental stewardship. Therefore, this study intends to benefit producers and the outreach professionals who support them.

The primary purpose of this study is to create a screening survey that targets understanding the characteristics of poultry product labeling before launching a large-scale national survey of a similar

scope. A screening survey is a concise set of questions deployed at the start of research to identify respondents who fit specific criteria or who have relevant characteristics. The Agricultural Resource Management Survey (ARMS), a multiphase questionnaire that asks farmers about their cropping practices and business operations, has continually used screening surveys to gather data to best inform the design of their large-scale questionnaire (U.S. Department of Agriculture Economic Research Service, 2025b). The National Household Food Acquisition and Purchase Survey has also used screening tools to efficiently determine households' eligibility to take part in its survey program (USDA ERS, 2025a). We also consider this study to be filling a research gap in this way, to outline and justify our screening survey as a critical function before launching larger-scale national surveys on consumer behavior. The screening survey is crucial to building a broader research project targeting general poultry production sustainability. Both focus groups and a national survey design will contribute to this overarching research agenda. However, a national survey could not be performed without this initial screening survey.

Before conducting a national survey, the screening survey is intended to validate the factors and characteristics of poultry meat packages in the market. A screening survey is not unusual. However, many Cooperative Extension staff and practitioners do not use this stage. Therefore, in this paper we hope to justify adopting a multi-stage survey approach, and to clarify that we want to show how the screening survey results could be used to narrow down factors in a large-scale study. Results from the screening survey will be used not only to design and develop a national consumer survey, but also to inform farmers about the preferences for information presented on packages and support the design and development of marketing and communication for sustainable transitions of the poultry industry moving forward.

Review of the Poultry Industry and Antibiotic Use

Protein consumption in the U.S. is primarily based on the industrial food animal production system, characterized by large-scale, densely packed animal operations that require external inputs to achieve economies of scale (Franzo et al., 2023). Antibiotic treatment has commonly been used in these operations for disease treatment, disease control, and disease prevention (Wallinga et al., 2022). Antibiotics were also distributed to animals to promote growth. The latter practice was made illegal in 2017 by the Food and Drug Administration in collaboration with the pharmaceutical industry (Gens et al., 2022). However, antibiotics distributed to prevent disease often promote growth, making enforcement of the ban difficult (Patel et al., 2020). Efforts for increased regulation have met with resistance from industrial animal production system stakeholders, who also exploit legislative loopholes (Martin et al., 2015; Singh et al., 2022). Concerns about ongoing agriculture antibiotic use also stem from increasing recognition of the dangers of antimicrobial resistance, which has been labeled as one of the "top global public health and development threats" (World Health Organization, 2023). The main cause of the threat is the misuse and overuse of antibiotics, with antibiotics given to animals at far higher rates than humans (Van Boeckel et al., 2019).

The 2017 repeal of non-therapeutic antibiotic distribution still allows veterinarians to prescribe antibiotics for medicinal purposes; at least thirteen FDA-approved antibiotic treatments can be applied to feed for disease prevention (Wallinga et al., 2022). Veterinarians have autonomy to decide whether a prescription is necessary on a case-by-case basis. This FDA policy differs from both the World Health Organization, which states antibiotic use for disease prevention is unnecessary and a risk to public health (WHO, 2017), and the European Parliament, which banned antibiotics for disease prevention in 2022 and is taking further action to reduce antibiotic use to protect public health (Council of the European Union, 2023).

Veterinarians are given a central role in U.S. distribution of antibiotics on the farm. FDA Guidance #213 and the Veterinary Feed Directive require feed mills to receive an order from a veterinarian before introducing feed with antibiotics to animals, a policy that has come under scrutiny for failing to address antibiotics administered through other avenues besides feed, such as orally, through

injection, or through drinking water (Wallinga et al., 2022). With U.S. federal action lagging behind European policy, certain states are addressing the issue. Maryland state law SB471 of 2019 prohibits poultry antibiotic use that is considered a "regular pattern" (Maryland General Assembly, 2019, p. 1). Under these terms, drugs cannot be administered routinely to an individual chicken or a group of chickens, such as during a specific time of season or when the chickens reach a certain age. The law also introduces a robust reporting policy that tracks which animals are administered antibiotic treatment through strictly necessary medical means, the specific antibiotics used and their active ingredients, and the veterinarian who oversaw the treatment. (The Maryland Department of Agriculture 2022 report "The Use in Maryland of Medically Important Antimicrobial Drugs in Cattle, Swine, and Poultry" makes this collected information available to the public.[1])

California's earlier bill on antibiotic use (SB835) mirrored federal guidelines. With growing calls for more aggressive action on agricultural antibiotic use, SB27 was passed in 2015 to restrict "regular pattern" distribution (Megaro, 2015, p. 3). Preventive use was allowed for medically necessary scenarios. SB27 was also the first law in the nation to require extensive data on antibiotic sales and usage. However, there have been setbacks in overcoming state confidentiality guidelines, which means little of the data is open to the public. The law has also received criticism for not meeting its original goals, partly due to misinterpretations of the law's language (Wallinga et al., 2022). Maryland and California have introduced the most direct actions to restrict antibiotic use, setting an example for other states. New York, Illinois, North Carolina, and Oregon have also started the process of passing similar laws.

Antibiotic use is one of several important attributes displayed on packages across various markets. The safety of poultry meat consumption affects all consumers, regardless of where they purchase (e.g., grocery stores, farmers market, mail order) (Donelan et al., 2016; Topalcengiz et al., 2025). It would be essential to learn how consumers perceive the information shared by producers, often present on the food package labels, regarding antibiotic use and other accompanying attributes (e.g., organic, grass-fed, free range). The revealed preferences may also enhance the design and delivery of services and educational programs to individuals and families via Cooperative Extension and other community-based health services.

Although some of the mandated policies are designed to assist large, commercial-scale poultry operations, antibiotic use in general poultry operations is relevant to small and medium-sized producers as well. There is limited research on interpretation of poultry meat labels (e.g., antibioticfree, organic, free range) by U.S. consumers that would help small farmers and support local food initiatives. A study of consumer preference for different poultry labels focused on large-scale consumerism, however consumers were only buying from large grocery stores (Powers et al., 2020). This contrasts with our focus on small-scale consumerism to assist small farmers and local food groups.

Consumer Preference for Poultry Attributes and Links to Marketing Strategies

Market research has shown that consumers are willing to pay a premium for meat products of higher quality and that have been ethically produced (Fatha & Ayoubi, 2023; Froehlich et al., 2009; Verbeke et al., 2005). Labels are the primary method of conveying this messaging to the consumer, situating labeling as a key component of driving product demand and shaping consumers' preferences and willingness to pay (Newman et al., 2020). Meat labeling has proliferated to differentiate between the increasingly divergent production methods, such as organic, antibiotic-free, free range, and pasture-raised. (Karavolias et al., 2018). Consumers are also heightening their values regarding how their food is produced, situating food labels as a central intermediary between producer and consumer (Van Loo et al., 2014). Several socioeconomic factors are crucial in consumer willingness to pay a premium for meat products, such as income levels (Mohammadi et al., 2023), sex and

[1] See the report at https://dlslibrary.state.md.us/publications/Exec/MDA/AG3-1004(c)_2021.pdf

age (Fatha & Ayoubi, 2023; Feil et al., 2020; Nielen, 2015), education (Kamphuis et al., 2015), and information awareness about the specific product (Karavolias et al., 2018). Social subgroups with increased willingness to pay generally include younger consumers who live in cities and have above-average income to afford to pay for the premiums. They are also more environmentally conscious and use social networks to gain knowledge about food production practices that align with their social and environmental convictions (Ditlevsen et al., 2020).

The poultry industry offers diverse phrases and buzzwords to distinguish between products that may appeal to select consumer subgroups (Thibault et al., 2022). Ten of the most common production claims used in the poultry industry are summarized in Table 1.

Table 1. Ten of the Most Common Production Claims in the Poultry Meat Industry

Antibiotic-free
Organic
Free range
Raised and harvested in the U.S.
Humanely raised
Vegetarian-fed
No animal byproduct
Non-GMO
No hormones or steroids
USDA-certified organic

We have focused on these 10 production claims due to their prevalence in market reports (USDA ERS, 2025c), academic literature (Van Loo et al., 2014), popular media (Lipton, 2014), and actual observations conducted by our research team in grocery stores. While several research studies have measured consumers' willingness to pay a premium for individual products with niche production claims, such as asking what extra a consumer would pay for certified organic poultry meat, there is a research gap comparing consumers' preferences when given the choice between several production claims (Ellison et al., 2017). Such a research approach would more accurately reflect the consumer shopping environment, where they are presented with an abundance of product choices with diverse and often conflicting production claims.

Applied Research Methods

Guiding Theoretical Framework

There are many ways to model or simulate a food system or network strategies. One theoretical framework is the agent-based modeling approach, which represents linkages between agents (e.g., decision-makers, market venues) across various scenarios (e.g., types of products). Many agent-based models use hypothetical characteristics to design or create agents and interactions (Collins & Liang, 2024; Liang & Collins, 2025). An agent-based model usually seeks to capture the interactions and dynamics between agents within the system domain it is being applied to (Oren et al., 2000). The screening survey designed and implemented in this study was intended to gather generally recognized characteristics from different packages of raw meat to inform the traits that would need to be included to design agents and scenarios, which is the initial stage of building an effective agent-based model to simulate market interactions between producers and consumers.

The agent-based model framework has been applied to simulate general behaviors of poultry supply chains to assist small business development within an effective food system (Collins & Liang, 2024; Liang & Collins, 2025). Unlike traditional aggregate models, this approach requires empirically grounded information about how individual producers and consumers perceive product attributes. We therefore needed to obtain some characteristics from real producers and consumers who would serve as the agents in a more realistic modeling aspect. Thus, we use the information from the screening survey to understand how individuals identify characteristics labelled on each package based on individual preferences. The screening survey findings will help us design or define agents' preferences, which are essential to ensure the model outcomes have some meaning to producers and consumers. Our contribution is to introduce a unique approach to using the results of the screening survey to help design and create meaningful

agents within an agent-based model theory framework, unlike traditional models that assume aggregate behavior for each agent.

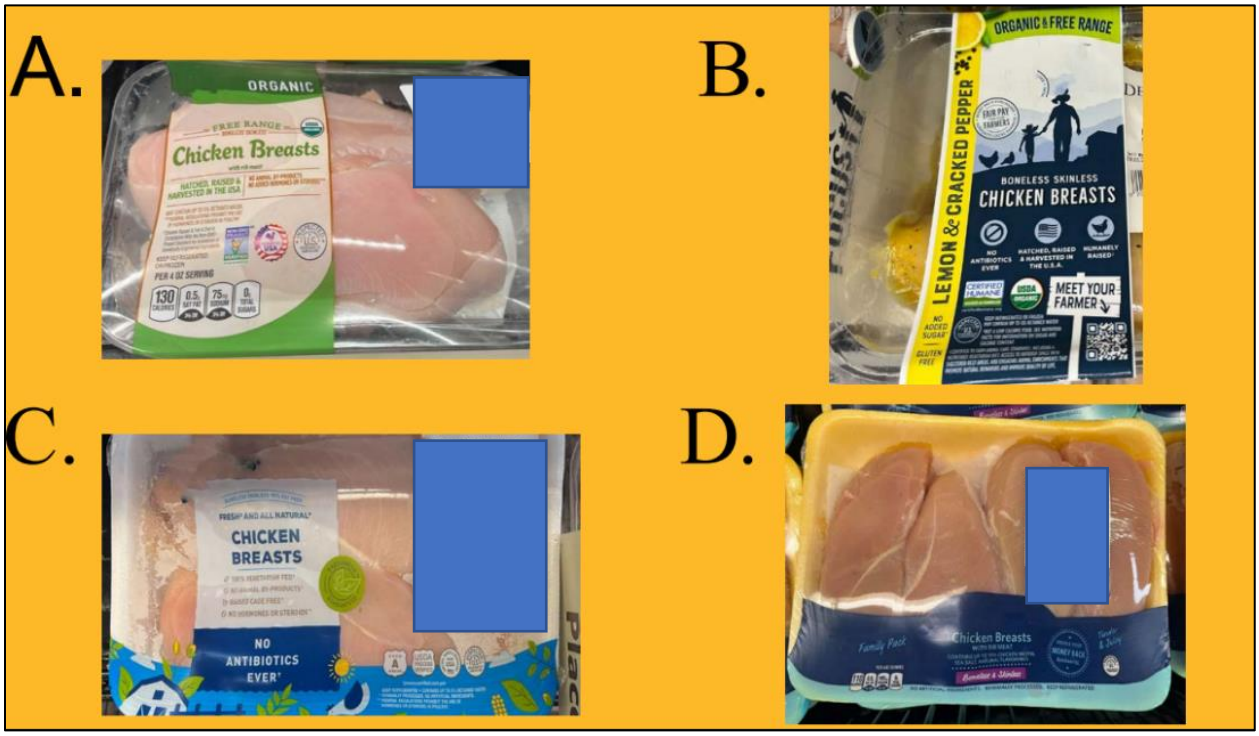
Survey Description

Our screening survey was designed to collect data to capture consumer's shopping preferences when purchasing poultry meat products. It aimed to gather a basic understanding of participants' knowledge and recognition of common poultry meat attributes from package labels; therefore, it is a screening survey. We do not intend to gather data regarding willingness to pay in this stage of our research. The screening survey results are intended to guide the design of a more comprehensive national survey.

The survey instrument was developed through an iterative process that combined a review of academic literature on poultry labeling claims (Van Loo et al., 2014; Powers et al., 2020), USDA ERS market reports (2025c), and direct observations of poultry product packaging across the U.S. While the survey was in the pre-test stage, its structure was reviewed by Cooperative Extension professionals familiar with poultry industry marketing to ensure validity, clarity, and connection to research goals. The binary yes/no format used in the attribute selection section was chosen for ease of completion and to allow for interpretable factor analysis.

The survey has three key components. The first collects background information on shopping habits, asking participants how often they buy poultry meat, what type they buy most frequently, if they buy frozen poultry meat, and where they primarily shop for groceries. It also requests demographic data on age, sex, number of people in their household, and if they live in an urban or rural setting. This information is necessary for secondary analysis, to find demographic themes and patterns in the data. The second component presents four chicken breast products that represent typical choices consumers will find in a grocery store. Each product offers a different combination of production claims (Figure 1; name of store and price identifications were eliminated from the images per IRB approval). Participants were asked to select which package most appeals to them. The

Figure 1. Images for the Screening Survey



third component asks which specific features or attributes of poultry products are attractive to them, selecting from the claims listed in Table 1, with one more option available if they are drawn to the color and design of the packaging. There is a total of 11 choices. Participants indicated which of the options in Table 1 are appealing or not, with a simple yes or no binary question for each option and are not limited to one choice. These binary responses formed the basis for later factor analysis. This structure allowed us to measure key constructs such as purchase behavior, product preferences, and labeling appeal through straightforward questions that mimic real-world shopping experiences. At no point in the survey are participants asked about cost. The screening survey has no price information because it would mislead responses, as at this stage of research we primarily seek to understand the characteristics of packages and not willingness to pay.

Surveys were distributed at four events in North Carolina throughout 2023 (Table 2). We set up poster boards to display images of A, B, C, D, along with IRB approval information and recruiting messages. Participants were asked to participate as they roamed the various events and interacted with North Carolina Cooperative Extension researchers. The participants volunteered to respond to surveys with no financial incentive, and participants could opt out at any time during the survey period. Therefore, this was a more convenient sample than a selected sample. Each questionnaire took 5–6 minutes to complete. No personal identities were recorded. Altogether, 362 surveys were collected across the four events. Participants largely consisted of local actors in the food system from North Carolina and neighboring states, mostly South Carolina, West Virginia, and Virginia. Our participant sample does not represent the average U.S. consumer population, as the convenience sample mostly put us in contact with those directly involved in food systems production and education, who we characterize as highly engaged local food consumers. Reliance on a convenience sampling method does limit the overall generalizability of the survey findings; however, given that this study serves as a screening tool to inform a larger-scale nationally representative survey, we accept this tradeoff at this stage of development. The targeted audience in this survey can still provide valuable insights into labeling perceptions, especially for niche or direct-to-consumer poultry markets. Our national-scale survey will address this limitation by using stratified random sampling to enhance representativeness and allow for broader application of results.

A screening survey that does not use a representative sample is common when the survey is part of a staged sample method. For example, Liang and Dunn (2016) used the method to categorize and analyze multifunctional farms in New England. The project worked with local collaborators to design a screening survey to identify types of multifunctional agriculture activities in New England, such as agritourism, direct sale, value-added operation, and off-farm labor. The rationale for the screening survey in this study is to (1) identify key factors that producers would identify given various production scales and profiles, (2) reduce the burden for consumers to identify factors influencing purchasing decisions not relevant to production decisions, and (3) sort out relevant factors to avoid costly and time-consuming survey procedures. None of these strictly require surveying a representative sample of consumers.

As this sample largely consisted of farmers

Table 2. Events in North Carolina Where Survey Data were Collected

Surveys	Event	Location	Date
1–54	North Carolina Meat Processing Conference	Greensboro, North Carolina	April 6, 2023
55–136	Center for Environmental Systems (CEFS) Field Day	Goldsboro, North Carolina	July 13, 2023
137–207	North Carolina A&T Food Symposium	Greensboro, North Carolina	September 29, 2023
208–362	Carolina Farm Stewardship Association (CFSA) Sustainable Agriculture Conference	Durham, North Carolina	November 11–12, 2023

and individuals directly involved in food system work, the findings are particularly relevant for independent poultry producers not operating under large-scale contracts and who target niche markets for local meat products. These producers often have more flexibility in how they raise, process, and market poultry, and may rely on niche labeling, direct-to-consumer sales, and relationship-based marketing strategies to remain competitive. Thus the survey results offer a snapshot of consumer-facing priorities from the perspective of an audience that is likely already familiar with alternative production practices, which suggests that this market research can support independent operations in making decisions about product labeling, packaging, and messaging that match consumer values related to environmental health and transparency. This study measured stated preference for poultry production claims, but did not include direct measurement of purchasing behavior, such as receipt data or observational tracking. While this is a limitation, the survey was designed to simulate realworld decision-making to capture more realistic responses than abstract questioning alone could do.

Statistical Analysis Methods

Data management and analysis were performed using IBM SPSS 29 statistical software. Descriptive statistics outlined frequencies and general patterns in the data, such as demographic patterns, the most chosen product, and the most favored product attributes. Factor analysis was then used to examine interrelationships in the 11 attribute variables from which participants could choose (the 10 attributes in Table 1 plus the packaging design). The survey was not meant to assess participants' actual understanding of these terms. They were not given definitions or assistance in interpreting each variable's meaning, as we sought to mimic how consumers would assess the variables when making a purchasing decision. By clustering the attributes into similar categories, we can identify common themes across different attributes through factor analysis. Naturally there is overlap between the 11 attributes available for selection, so factor analysis helped determine the underlying factors to create subsets of the independent variables. This is also useful in reducing the number of factors from 11 to a more manageable number to reduce complexity.

Factor analysis has been used in food preference studies with a similar scope to find underlying trends in datasets with many variables (Corallo et al., 2019; Marchioni et al., 2011). Marchioni et al. (2011) used factor analysis to reduce several food group variables into a smaller set of interpretable dietary patterns, which helped summarize dietary habits among their sampled subjects.

We applied exploratory factor analysis to survey participant perceptions of poultry production claims. Each participant was presented with common label claims (e.g., "antibiotic-free," "free range") and asked to indicate whether they found each attribute attractive by selecting either "yes" (coded as 1) or "no" (coded as 0). The resulting binary dataset allowed us to examine patterns of grouping among claims. Extraction for creating factors was based on eigenvalues greater than 1, and rotation coefficients smaller than .45 were suppressed to maintain significance and focus on more meaningful relationships. Eigenvalues were calculated as a standardized way to identify overlap between variables. Kaiser-Meyer-Olkin tests and Bartlett's Sphericity tests were also calculated to verify that the reduced clusters were statistically significantly different. These procedures allowed us to identify coherent and statistically significant clusters of label claims that were commonly grouped together by survey participants. Because exploratory factory analysis is most often applied to continuous data, we recognize the limitation of applying it to binary data. Therefore, our results should be interpreted as a preliminary exploratory clustering pattern, such that other statistical methods may be more applicable for statistical validity, such as using tetrachoric or polychoric correlations to find relationships between binary variables (Holgado-Tello et al., 2010).

Binomial logistic regressions were used to uncover relationships between the identified factors and the sample's demographic subgroups of sex and rural/urban location, while multinomial logistic regression was used to uncover relationships between created factors and the sample's ages. Regression models determined if there was a differ-

ence in consumer preference based on whether the consumer lives in an urban or rural environment, or if there is a difference based on age or sex. In each case, the demographic variables were the dependent variables, and the factors created from the factor analysis were the covariates.

Results

Descriptive Statistics

A total of 362 survey responses were collected; see Table 3 for the demographic summary.

Product B was the most popular product, receiving 206 of the 362 votes (67%) (Table 4). Organic labeling was the most popular choice, with 218 choosing it as a favorable attribute (Table 5). Free Range, Raised and Harvested in the USA, Humanely Raised, Package Color/Design, and Antibiotic Free were the next most popular choices. Vegetarian-fed and No Animal Byproduct were the least commonly chosen options.

Table 3. Demographic Summary of Survey Participants

Sex	Count	%
Male	135	37
Female	227	63
Urban or rural		
Urban	188	52
Rural	174	48
Age		
1–20	14	4
21–40	150	42
41–60	121	33
61+	77	21
Number of people in household		
1	65	18
2	113	31
3	78	21
4	62	18
5+	39	11
Did not respond	5	1
How often do you buy poultry meat?		
More than once a week	79	22
Once a week	136	38
Once a month	106	29
Never	39	11
Did not respond	2	~0
Where do you shop for groceries most of the time?		
Large grocery stores	271	75
Small-/medium-scale stores or farmers markets	79	22
I grow my own	12	3

Factor Analysis

Four components had an eigenvalue of >1, creating four independent factors (Table 6). The Kaiser-Meyer-Olkin score of .692 and Bartlett's Sphericity Test significance score of <.001 indicated the data was sufficiently suitable for factor analysis and that there was strong separation between factors. These results confirm that the underlying assumptions for conducting factor analysis were met, including the size of the sample and the presence of statistically significant correlations between variables. Factor 1 consisted of the following loadings: No Animal Byproduct, Non-GMO, and No Hormones or Steroids. Factor 2 consisted of Organic, Free Range, Raised and Harvested in the U.S., Humanely Raised. Factor 3 consisted of Antibiotic-free and Vegetarian-fed. Factor 4 consisted of USDA-certified and the Color and Packaging Design.

Accounting for the weight of each variable's coefficients in each component, each factor was assigned a generalized factor theme (Table 7). Factor 1 was determined to most closely measure participant preference for "negative labeling," by which we mean attributes framed around the absence of undesirable inputs or practices (e.g., no animal byproducts, no hormones or steroids, no GMOs). Conversely, Factor 2 aligned with preference for "positive labeling," referring to attributes framed around the presence of desirable practices (e.g., raised humanely and organically in the U.S., roaming free range). Factor 3 strongly aligned with preference for an antibiotic-free product. Factor 4 primarily measured attention to the color and design of the package as the main feature that attracted them to buy the product.

Binomial Logistic Regression

Logistic regression models were generated to predict the relationships between the study's inde-

pendent and dependent variables. The choices of independent variables and dependent variables were based on previous studies of consumer behaviors. The independent variables were location, sex, and age (Aklilu, et al., 2007; Vanhonacker & Verbeke, 2009). The dependent variables were the four factors created through factor analysis, not the original 11 attributes. Because sex and age are dichotomous dependent variables with only two categories, and age has more than two categories, different logistic regression models are necessary. Binomial logistic regression was used for age and sex, and multinomial logistic regression was used for age. Binomial logistic regression revealed no significant difference between males and females in likelihood to have a preferred attrib-

Table 4. Assessment of Product Popularity

	Option A	Option B	Option C	Option D	No Response	Total
Total	85	206	49	17	5	362
Male	33	83	13	5	3	137
Female	52	123	36	12	2	225
Chi-Square (*P* value)	.1 (.752)	.403 (.526)	3.214 (.073)	1.549 (.213)		
Rural	45	93	22	11	3	174
Urban	40	113	27	6	2	188
Chi-Square (*P* value)	1.006 (.316)	1.487 (.223)	.186 (.666)	2.093 (.148)		
Age 1–20	3	8	3	0	0	14
Age 21–40	32	92	20	6	0	150
Age 41–60	29	73	13	5	1	121
Age 61+	21	33	13	6	4	77
Chi-Square (*P* value)	.459 (.928)	6.398 (.094)	2.74 (.433)	2.875 (.411)		

Table 5. Assessment of Each Production Claim's Popularity

Variable	Antibiotic-Free	Organic	Free Range	Raised and Harvested in U.S.	Humanely Raised	Vegetarian-Fed	No Animal Byproduct	Non-GMO	No Hormones or Steroids	USDA-Certified	Color and Design of Package
Total	153	218	186	181	172	46	55	69	92	135	181
Urban	83	116	86	92	99	20	31	32	54	69	102
Rural	70	102	92	89	73	26	24	37	38	64	79
Chi-Square (*P* value)	.399 (.528)	.166 (.684)	3.196 (.074)	.241 (.623)	2.846 (.092)	1.306 (.253)	.642 (.423)	1.243 (.265)	2.039 (.153)	.023 (.881)	1.745 (.187)
Male	55	79	64	66	57	14	19	24	32	50	63
Female	98	139	122	115	105	32	36	45	60	85	118
Chi-Square (*P* value)	.829 (.362)	1.008 (.315)	2.56 (.110)	1.396 (.237)	1.186 (.276)	1.308 (.253)	.343 (.558)	.275 (.6)	.570 (.45)	.08 (.777)	1.6 (.206)
Age 1–20	8	7	10	9	9	3	5	2	6	7	7
Age 21–40	72	99	70	85	83	12	19	24	37	66	91
Age 41–60	41	73	67	50	46	16	19	27	33	34	51
Age 61+	32	39	39	37	33	15	12	16	16	28	32
Chi-Square (*P* value)	6.178 (1.03)	5.225 (.156)	4.83 (.185)	7.735 (.052)	9.48 (.024)	7.31 (.063)	5.221 (.156)	1.974 (.578)	3.29 (.349)	7.842 (.049)	9.572 (.023)

ute factor, as the minimum significance value for any of the factors was .146 (as outlined in Table 8). Likewise, participant urban or rural living location was not significant in having a preferred attribute factor (minimum significance value of .239).

Multinomial Logistic Regression

Multinomial logistic regression revealed that age influenced the likelihood of having different factor preferences more than either sex or living location (Table 9). Using an accepted significance of .1, factor 2's significance of .091 finds significance for age as a determinant in favorability towards positive labeling claims. Factor 4's significance score of .006 indicates that age also significantly impacted participants' favorability towards packaging design.

Discussion and Implications

Product B (Figure 1) was by far the most favorable choice, followed by A and C. Interestingly, the attribute labels for Product B were roughly similar to Products A and C. Products A and B both were labeled USDA organic, free range, and raised and harvested in the U.S. Product A had labels for no animal byproduct and no added hormones, which were absent from Product B. Product B was distinct from A in that it had a certified-humane label and was antibiotic-free. Product C also had the following labels: 100% vegetarian fed, no animal byproducts, raised cage-free, antibiotic-free, and no hormones or steroids. While not an option in the survey, several participants noted two extra labeling features on Product B: the "Fair Pay for Farmers" stamp and the "Meet your Farmer" QR code. Some participants also commented that the color of the packaging was more appealing, and the image of the farmer helped create a sense of the chicken having been raised on a family farm rather than a large-scale operation. Product D received by far the least support, receiving only 4% of the votes. Product D has the least number of labeling features compared to the other three products, making no mention of any of the 10 attributes anywhere on its packaging. The only attributes shown are "no artificial ingredients" and "minimally processed."

The most favorable attribute feature was organic labeling, with 60% of participants listing it as something they look for. Similar scoping research tends to affirm that organic labeling is the most ubiquitous

Table 6. Component Matrix after Running Factor Analysis

	Component			
Variable	1	2	3	4
Antibiotic-free			.820	
Organic		.713		
Free Range		.717		
Raised and Harvested in US		.552		
Humanely Raised		.563		
Vegetarian-fed			.557	
No Animal Byproduct	.791			
Non-GMO	.659			
No Hormones or Steroids	.792			
USDA-certified				.467
Color and Design on the Package				.899

Table 7. Explanation of Four New Factors, Based on Their Primary Loadings

Factor	Loading Attributes	Dominant Common Theme
Factor 1	no animal byproduct, non-GMO, no hormones or steroids	Focused on labels with negative connotations associated with animal welfare
Factor 2	organic, free range, raised and harvested in the U.S., humanely raised	Focused on labels with positive connotations and ethics associated with animal welfare
Factor 3	Antibiotic-free, vegetarian-fed	Focused on preference for antibiotic-free
Factor 4	USDA certified, color and packaging design	Focused on attraction to package color and design

food label in terms of what consumers search for besides a product's brand and graphic elements (Gracia & De-Magistris, 2016). However, a significant portion of the population does not pay attention to organic label claims: Drexler et al. (2017) found that in their study of consumer inspection of food product labeling, 27% of participants did not pay attention to or care about organic labeling. Free range and raised and harvested in the U.S. were the second and third most listed attributes, followed by color and design of the package, and humanely raised. Antibiotic-free labeling was the next most common.

Table 8. Results of Binomial Logistic Regression in Examining the Difference in Factor Preference Between Sex and Location

Dependent variable = sex	B	S.E.	Wald	Sig.	Exp (B)
Constant	.485	.111	19.192	<.001	1.624
Factor 1: Negative Labeling	.072	.112	.412	.521	1.075
Factor 2: Positive Labeling	.162	.112	2.112	.146	1.176
Factor 3: Antibiotic-Free	.107	.111	.923	.337	1.113
Factor 4: Package Design	.104	.111	.872	.350	1.109
Dependent variable = location					
Constant	–.091	.107	.726	.394	.913
Factor 1: Negative Labeling	.049	.107	.212	.645	1.050
Factor 2: Positive Labeling	.043	.107	.159	.453	1.044
Factor 3: Antibiotic-Free	–.080	.107	.563	.239	.923
Factor 4: Package Design	–.126	.107	1.385	.394	.882

The three least favorable attributes were non-GMO, no animal byproduct, and vegetarian-fed. This discrepancy appears to demonstrate why Product B was viewed more favorably than Product C. Product B had labeling with the four most popular attributes, but Product C had some of the least popular attributes, such as vegetarian-fed and no animal byproduct, while omitting labeling as to whether the product was organic and was free range or raised and harvested in the U.S. Despite Product C offering labeling with some of the least favorable attributes, it still received much more attention from the participants than Product D, which offered none of the attributes.

Factor analysis was a fruitful way to group the attributes into smaller clusters with similar underlying factors, creating four distinct consumer preference profiles. This is a novel contribution from this research, because the four factors that were created demonstrate natural components into which participants grouped the attributes they value. These preference profiles are valuable because they demonstrate that the instrument could capture meaningful clustering patterns, providing an evidence-based foundation for refining or scaling the survey for future research. Additionally, the preference profiles offer useful insights to small and niche poultry producers to tailor their marketing strategies to the most relevant attribute groupings.

Factor 1 was determined to refer to consumer preference for attributes that make use of "negative labeling" (no animal byproducts, no hormones or steroids, non-GMO), while Factor 2 involves consumer preference for "positive labeling" (organic, free range, raised and harvested in the U.S., hu-

Table 9. Multinomial Logistic Regression Results in Examining the Difference in Factor Preference Between Age Cohorts

Dependent variable = age	B	S.E.	Coefficient Beta	t	Sig.
Constant	2.718	.044		61.389	<.001
Factor 1: Negative Labeling	.044	.044	.052	.991	.323
Factor 2: Positive Labeling	-.076	.044	-.089	-1.696	.091
Factor 3: Antibiotic Free	-.052	.044	-.062	-1.169	.243
Factor 4: Package Design	-.121	.044	-.145	-2.745	.006

manely raised). The distinction between these two labeling structures reflects whether product labels highlight what the product does have, such as free range, or what it does not have, such as non-GMO. Framing labeling structures in this way provides a unique way to understand how consumers may interpret different types of packaging information. Factor 3 was a unique factor that mostly accounted for antibiotic-free preference, suggesting that consumers seeking antibiotic-free products seek this trait in isolation, or not in conjunction with other common attributes. Factor 4 strongly correlated with a heightened valuation of the color and design of the packaging. Because this factor mostly targeted one attribute (despite USDA-labeling also a loading in the factor, but not strongly, with a coefficient of only .467), this suggests that a subgroup of the participants seems to only focus on color and design either in isolation or not in pairing with other common attributes, similar to Factor 3 and antibiotic-free preference. (These factors will be introduced in a national-scale survey.) These preference clusters also connect with the agent-based modeling perspective that asserts that individual decisions, even when simple or binary, can lead to emergent group patterns.

Logistic regression offered possibilities for uncovering how demographic characteristics of the survey sample impacted their preferences. Using binomial logistic regression, the model that was created suggested that there was no significance in the impact of survey participants' sex or living location on preferred attributes. However, a multinomial logistic regression model showed that participant age did appear to impact choices. While studies have already demonstrated a linkage between independent variables such as age, sex, and living location, and perception of food products with enhanced production claims, none have specifically examined these variables in conjunction with a wide range of poultry meat attributes. For example, while several studies linked age as a determinant in support of organic products (Feil et al., 2020), our study broadened the range of consumer choices to include several product attributes, mirroring the actual choices consumers face when buying poultry. Most studies specifically examined consumer preference for select variables in isolation, such as organic (Yadav et al., 2022), antibiotic-free (Jahanabadi et al., 2023), or pasture-raised (Stampa et al., 2022). To our knowledge, we believe this study is the first of its kind to offer participants the many choices they would see in their grocery.

Unsurprisingly, organic was the most popular attribute, as it is ubiquitous in both media and social discourse. The literature suggests that increased awareness and education about food labeling tends to increase popularity and the likelihood of making purchases with the organic label in the grocery store. For example, a study collected participants' valuation of organic poultry meat before and after exposure to educational information on what organic labeling entails; after exposure, nearly 50% of subjects increased their valuation of the same product (Gifford & Bernard, 2010). This suggests a strong relationship between consumer awareness of production claims and the likelihood of pursuing products with these claims in the marketplace.

While research tends to indicate that antibiotic literacy is growing (Bradford et al., 2022), favorability for an antibiotic-free product lagged behind several other production claims. It is unclear whether in this study those who chose not to list antibiotic-free as an important attribute did so because they do not think it is significant or because they don't know about the issue. Despite increasing antibiotic literacy, multiple surveys have found over half of their respondents have limited knowledge about antibiotic use in the food system (Adam & Bruce, 2023). Further research would do well to assess consumer awareness of the production claims presented in this study. Several studies have reached the general conclusion that in many cases the public is either not given enough education about the numerous production claims, or that there is conflicting information which leads to confusion. Both cases lead to declining informed decision-making by consumers (Henryks & Pearson, 2010; Kuchler et al., 2020; Wilson et al., 2020).

Despite our participants not knowing the full extent of products and attributes they were asked to rate, the results provide a snapshot of current consumer behavior. While our screening sample is not broad and scoping enough to directly inform antibiotic policies, exploring consumer attitudes

towards antibiotics and other labeling claims remains a significant avenue for future research. This screening survey precedes larger-scale research, which will be designed with a representative nation-wide sample for informing policies surrounding antibiotic use. Exploring consumer attitudes towards antibiotic use in the poultry products they seek can further inform antibiotic policies and directives, which are currently rapidly changing (Zheng et al., 2025). Consumer attitudes towards antibiotics will also influence the production choices made by producers (Meerza et al., 2022). Furthermore, our factor analysis revealed that some consumers make decisions based on packaging design alone, which is rarely surveyed in food labeling studies. Aesthetic factors matter even among our food-literate sample. Research on the aesthetics and design of poultry meat packaging and how they influence consumer behavior is currently a research gap worthy of exploration.

Because a significant portion of our survey participants are directly engaged in regional food systems, the findings from this study are especially relevant to small and medium-sized poultry producers operating outside of integrator contracts. These producers often rely on direct-to-consumer sales, niche marketing, and transparent labeling to differentiate their products in increasingly competitive markets. The insights presented here can help guide decisions about which product attributes, such as organic, free range, or antibiotic-free, carry the most consumer appeal, particularly among values-driven and health-conscious audiences. Furthermore, this screening survey served to verify the instrument itself. The statistical tests that we used, and the emergence of recognizable factors, indicate that the instrument captured meaningful distinctions among poultry label attributes. However, any generalizations from this research should be within the context of locally engaged producers and consumers who value niche poultry markets.

Findings from this study can also inform how Extension personnel engage with their local communities around food purchasing decisions. Educational materials and public workshops developed through Extension programs could emphasize consumer understanding of poultry product attributes such as antibiotic-free or raised and harvested in the U.S., particularly in settings such as farmers markets, local food hubs, and public health initiatives. Similarly, community-based organizations working to enhance nutrition and food access may benefit from incorporating these insights into their outreach strategies, including nutrition education for families and technical assistance for small poultry producers. These organizations can bridge knowledge gaps by helping consumers navigate the increasing complexity of poultry meat labels.

Acknowledgments

The authors are grateful for comments provided by reviewers.

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Journal of Agriculture, Food Systems, and Community Development
ISSN: 2152-0801 online
https://foodsystemsjournal.org

Virginia independent food retailer perceptions of their role in planetary health promotion

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Submitted August 26, 2025 / Revised November 17, 2025, and January 7, 2026 / Accepted January 12, 2026 / Published online April 3, 2026

Citation: DeNunzio, M., Houghtaling, B., Olayemi, V., Serrano, E., Gardezi, M., Kraak, V., Hedges, S., & Misyak, S. (2026). Virginia independent food retailer perceptions of their role in planetary health promotion. *Journal of Agriculture, Food Systems, and Community Development*, *15*(2), 247–273. https://doi.org/10.5304/jafscd.2026.152.025

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Abstract

Healthy food retail initiatives have been common approaches to promote nutrition security in the U.S.; however, they have under-emphasized planetary health promotion, despite the close connections of healthy earth systems to ensuring nutrition security. The purpose of this study was to explore the perceptions of independent food retail owners and managers about their role in planetary health promotion, identify potential planetary health promotion practices, and describe barriers and facilita-

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See additional author information and disclosures, next page

tors to implementation. Twelve semi-structured interviews, informed by the Consolidated Framework for Implementation Research (CFIR) 2.0, were conducted with independent groceries, cooperatives, and on-farm store members of Virginia Fresh Match, a statewide fruit and vegetable incentive food retailer network. Descriptive inductive codes and *a priori* barrier and facilitator codes from CFIR constructs were used by two independent coders to describe and categorize the data. Results showed that retailers had a range of interest in planetary health promotion, with cooperatives including planetary health in all business decisions, farm stores primarily focusing on agricultural practices, and grocers most interested in those practices that aligned with profit potential and customer expectations. Among all retailers, amenability to planetary health practices varied by community context. Planetary health practices included: agricultural practices of suppliers, bulk offerings, energy usage, food miles, local foods, animal source protein reduction, and waste reduction. Profit potential and alignment with customer expectations were the most important consideration for retailers to implement any planetary health practice and were barriers and facilitators depending on practice and community context. Partnerships and other external supports were identified as facilitators for planetary health promotion. The results can inform future research that investigates differences in retailer-preferred practices across contexts, explorations of how to frame planetary health messages to align with customer expectations, and tailoring of implementation strategies.

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Author Note

This manuscript represents a portion of DeNunzio's (2025) doctoral dissertation.

Keywords

healthy food retail, planetary health promotion, food retailers, agents of change

Introduction

Nutrition security in the U.S. involves the accessibility, availability, and affordability of foods that support high-quality diets and optimal health across all segments of the population (Mozaffarian et al., 2021; Seligman et al., 2023; Thorndike et al., 2022; Tucker et al., 2024). Current definitions of nutrition security exclude planetary health, defined as the vitality of the natural systems on which humans depend for survival (Whitmee et al., 2015). Planetary health and nutrition security are intertwined, as food systems contribute significantly to planetary health outcomes, and nutrition security across populations requires healthy and resilient natural systems (Swinburn et al., 2019; Webb et al., 2020; Willett et al., 2019). There is an urgent need to address planetary health promotion in food systems to support positive concurrent public and planetary health outcomes (Shah & Merlo, 2023; Webb et al., 2020; Zurek et al., 2022). Nevertheless, planetary health considerations are excluded from most nutrition security conceptualizations in the U.S., a meta-ethnography noting that only one of 58 qualitative studies used to inform a nutrition security framework explicitly addressed planetary health promotion (Faul et al., 2025).

Healthy food retail is a type of initiative that uses policy, systems, and environmental change strategies to promote nutrition security, and that is often implemented in independently owned food businesses (Fergus et al., 2021; Jilcott Pitts et al., 2021; Karpyn et al., 2020; Minkler et al., 2019). In the U.S., healthy food retail emphasizes five components of the food environment: affordability, availability, quality, convenience, and promotion, while a sixth component, the planetary health impacts associated with foods from land to landfill—or farm to fork—are under-emphasized in current efforts (Falbe et al., 2024; Hearst et al., 2021; Hecht et al., 2020; Kao et al., 2023; Pinard et al., 2016; Sutton et al., 2019), although food retail practices contribute to planetary health outcomes (Winkler et al., 2020). Because of the connections between nutrition security and planetary health

promotion, adapted programming that is designed to improve outcomes for people and the planet could be delivered through existing public health infrastructure, but the under-emphasis on planetary health promotion in current U.S. healthy food retail programming means that the perspectives of key actors, practices, and resources needed to integrate planetary health promotion into existing initiatives are poorly understood.

Owners and managers of food retail sites (hereafter referred to as retailers) are key decision-makers and agents of change within independent food retail settings, and their perspectives are critical to inform healthy food retail programs, including identifying barriers and facilitators to implementation (Andreyeva et al., 2011; Bahl Szczepaniak et al., 2022; Boys et al., 2021; Gittelsohn et al., 2014; Haynes-Maslow et al., 2018; Houghtaling et al., 2019, 2020; Martinez et al., 2018; McDaniel et al., 2018; Meza et al., 2021). Independent food retailers often have more autonomy regarding store layout, stocking patterns, marketing, and other business practices than stores with corporate ownership (Houghtaling et al., 2019; Martinez et al., 2018; Pinard et al., 2016). While all food retail ownership models contribute to planetary health outcomes (Winkler et al., 2020), independent food retailers are an appropriate sample for exploratory research on new initiatives because their decision-making can be more aligned with community and owner or manager priorities, and understanding decision-maker perspectives can inform healthy food retail practice. Given that the primary goal of an independent food retailer is to generate profit, prioritizing the perspective of decision-makers within the business is critical to understand how planetary health promotion strategies could be integrated to support both public and planetary health and profit potential. Addressing planetary health through healthy food retail could be an opportunity to leverage existing program infrastructure to support the built and the natural environment determinants of nutrition security, but the perspectives of U.S. independent food retailers on planetary health promotion has not been explored.

Informed by contextual inquiry, implementation science is the study of how to translate evidence-based innovations into practice in a range of contexts and its use supports more efficient research to practice translation for public health promotion (Bauer et al., 2015; Davis & Beidas, 2021; Eccles & Mittman, 2006; Shelton et al., 2020). Implementation strategies are techniques that improve the adoption, uptake, and scaling of evidence-based practices across settings, and may include, for example, technical assistance, leveraging partner organizations, facilitating peer learning, and provision of resources (Balis et al., 2024; Leeman et al., 2017; Powell et al., 2015). Expanded application of implementation science to healthy food retail has been recommended to inform transfer of innovative practices and tailoring of implementation strategies for the range of situations in which healthy food retail programs operate (Houghtaling et al., 2023). Contextual factors like community setting, store size, and ownership structure influence the design and implementation of healthy food retail interventions (Gupta et al., 2022; Rushakoff et al., 2017; Sanchez-Flack et al., 2021; Thatcher et al., 2017), and applying implementation science to exploratory research can help categorize contextual factors with standardized language, so that interventions can be designed with consideration for key barriers and facilitators.

The purpose of this study was to explore the perceptions of independent food retailers about their role in planetary health promotion. A secondary purpose was to identify barriers and facilitators to implementing planetary health promotion practices, using an implementation science approach. This information can be used to inform expanded research and practice of healthy food retail to include planetary health promotion.

Methods

The exploratory study used principles of community engaged research and qualitative inquiry.

Approach

This study was a collaboration between academic researchers and Virginia Fresh Match (Fresh Match), a statewide network of Supplemental Nutrition Assistance Program (SNAP)-authorized food retail sites, including groceries, on-farm stores, and food cooperatives, that offer produce

point of purchase incentives. At the time of data collection, Fresh Match had 15 grocery, farm store, and cooperative members that were the participant population for this study. Fresh Match was interested in expanding membership and technical assistance among these brick-and-mortar sites, and the author team, which included the director of operations for Fresh Match, collaborated to ensure utility of the project to inform Fresh Match programming. This study was deemed an evaluation and 'not research by the Virginia Tech Institutional Review Board (#23-1306) in December 2023. The principles of template analysis, a type of codebook-based descriptive analysis, were applied in this stud, to capture the *a priori* implementation constructs and an inductive description of the data (Brooks et al., 2015; King, 2012). Researchers drew on a realist approach for data collection and analysis (Wiltshire & Ronkainen, 2021).

Positionality

The first author, a White female with advanced degrees, had no relationship with Fresh Match prior to the conceptualization of this study. The senior author had collaborated with Fresh Match on a range of projects for more than eight years and facilitated the connection between the first author and Fresh Match during study conceptualization and design. All authors lived in areas where they could access one or more Fresh Match retail locations as a customer.

Instrumentation

In consultation with Fresh Match leadership, MD developed a semi-structured interview guide with six questions. Questions addressed retailer perceptions of their role, potential planetary health promotion practices, and barriers and facilitators to implementing practices. The Consolidated Framework for Implementation Research 2.0 (CFIR) (Damschroder et al., 2022), an implementation determinants framework, was used to develop the interview guide in tandem with a conceptual framework for a healthy food retail environment (John et al., 2023). Constructs within two CFIR domains, inner and outer settings (inner setting signifies the domain in which implementation specifically takes place, the outer setting is the overall domain in which the inner setting exists; Damschroder et al., 2022, p. 5), were used as probing questions to collect additional information about contextual factors that were barriers and facilitators to planetary health promotion. Probes for example planetary health promotion practices were derived from the Business Impact Assessment-Sustainability (BIA-Sustainability) indicators (Mackay et al., 2022), a list of planetary health domains that are directly actionable by food retailers. Potential practice probes spanned the BIA-Sustainability domains of packaging, greenhouse gas emissions, energy use, food loss and waste, animal-source foods, and relationships with other organizations (Mackay et al., 2022). Retailers were asked to define planetary health and describe practices; the interviewer provided example practices, if needed, from BIA-Sustainability indicators to help the retailer define planetary health. A pilot test of an early version of the guide was conducted with a Fresh Match retailer who was not part of the final study sample. Following the pilot test and in consultation with Fresh Match leadership, additional questions on resources required to implement planetary health promotion practices were added to the guide. Two authors with experience in healthy food retail research and practice reviewed the guide. MD conducted a mock interview to test flow and readability, after which small changes to question wording and order were made. Table 1 displays the primary six questions included in the final interview guide.

During the interview, retailers were asked to provide their age, race, gender, and how long they had worked in their current position. Rurality of retail locations were classified according to the 2023 Rural-Urban Continuum Codes (U.S. Department of Agriculture Economic Research Service [USDA ERS], 2023).

Participants and Recruitment

The director of operations for Fresh Match sent email invitations to 15 member groceries, on-farm stores, and cooperatives in April 2024, with instructions to contact MD for scheduling an interview. The "warm handoff" recruitment strategy, with initial contact made by a familiar person, was recommended by Fresh Match leadership to maximize retailer response. Twelve member retailers

Table 1. Semi-Structured Interview Guide Questions to Explore Independent Food Retailer Perceptions of Their Role in Planetary Health Promotion

Topic	Question
Retailer Role in Planetary Health Promotion	What do you consider the role of your store to be in your community?
	When I say the words "planetary health," what does that mean to you?
Planetary Health Promotion Practices	How do your store and business practices influence planetary health, as you just defined it?
	If you were going to make changes in your store to support planetary health, what would they be?
Barriers and Facilitators	Let's discuss some of the factors that might influence how easy or difficult it would be to make the change you just stated.
	What support do you need to make [x change]?

completed interviews and received a US$20 gift card for their time. The three retailers who did not participate cited a lack of time. As the purpose of the study was to inform programming for Fresh Match, no recruitment of food retailers outside Fresh Match membership was conducted. Other interview- based exploratory healthy food retail studies have used data from less than twenty interviews to draw preliminary conclusions on a novel topic (Bahl Szczepaniak et al., 2022; McDaniel et al., 2018; Nussbaumer et al., 2019).

MD conducted interviews via Zoom (n = 9) and phone (n = 3) according to retailer preference and schedule. Interviews lasted between 18 and 58 minutes and were recorded and auto-transcribed by Zoom. Immediately following interviews, MD prepared a summary, noting significant takeaways and points of emphasis from each retailer.

Data Analysis

A codebook was developed to include *a priori* codes from the inner and outer settings of the CFIR and descriptive, inductive codes from the interview data. The inner and outer settings of the CFIR were selected to form a preliminary understanding of how the food retail environment and community context may influence the eventual implementation of a range of planetary health promotion practices (innovations). Following CFIR guidance, the CFIR inner setting was defined as the in-store food retail environment, with factors external to this organizational setting, the community where the store is located and the broader U.S. food system, were defined as the outer setting. Each inner and outer setting construct of the CFIR was described with language for food retail settings and used as an *a priori* code (Appendix A). Inductive descriptive codes were developed in an iterative process between two authors using three transcripts that represented the data (Brooks et al., 2015). Authors met to refine the codes until consensus was reached for six descriptive codes (Appendix A).

The coding was completed in NVivo 15. Two authors (MD and VO) independently coded each of the twelve transcripts and met four times to discuss alignment, refining the codebook at each meeting through discussion. Some data were coded to multiple constructs, representing the interconnected and overlapping factors that influence implementation in community settings. Following coding completion, MD sorted the *a priori* and descriptive CFIR codes into categories for reporting the most prominent results, following recommendations for template analysis (King, 2012). The categories are combinations of the CFIR construct codes and inductive descriptive codes. One inductive descriptive code (planetary health practices) aligned with the CFIR domain of innovation, "the thing being implemented" (Damschroder et al., 2022, p. 5). Several CFIR constructs from the inner and outer domains (Appendix A) had no applicable data and were not included in the results. The results are presented in the order in which interview questions were asked, with a description of each retailer's definition of planetary health promo-

tion and examples of practices provided first, followed by a description of barriers and facilitators, presented in order of prominence.

Results

Twelve retailers, representing three cooperatives, three on-farm stores, and six groceries participated in semi-structured interviews. Retailer participants were five females and seven males between the ages of 25 and 69. Retailers identified as White (n = 8), Black (n = 1), and Native American (n = 1). Two retailers did not identify their race. Participants had been in their current positions from 18 months to 27 years. Retailers operated in metro (n = 9), nonmetro (n = 2), and rural (n = 1) regions.

Definition of Planetary Health (CFIR Innovation Domain)

Grocers defined planetary health at various levels of detail, from descriptions like "organic, eco-friendly, something along those lines" (Grocer) to more specific statements that included goals for decreasing pollution and use of chemicals and plastics. The farm store participants had a range of planetary health definitions; one retailer said "health for all life on earth," one specified access to nutritious food across social and economic segments of the population, and one described their agricultural practices: "We feel organic if you want it, if you want to call it that, we don't use any chemicals. Everything that we have is healthy. We offer all natural products" (Farm). All cooperative participants described planetary health promotion as a core component of their store's mission:

> Planetary health is everything from the health of all the ecosystems … not just the earth, but also the people, microbes, animals, and plants, and the whole ecosystem … being good stewards to all of those things. … Planetary health means recognizing that all of those things, including us, are interconnected. (Cooperative)

Planetary Health Promotion Practices (CFIR Innovation Domain)

Planetary health promotion practices were identified across seven categories: agricultural practices of suppliers, bulk offerings, energy use, food miles, animal-source protein reduction, local foods, and waste reduction. Retailers identified practices currently implemented and the considerations for practices they might be willing to implement in the future. There was general interest in these practices among retailers, with variations by store type and locality (Appendix A). Cooperatives and grocers recognized the impact that agricultural practices of suppliers have on planetary health and were interested in procuring from suppliers that used environmental stewardship practices or were local to the retail store. Farm stores focused on their own agricultural practices and the potential to reduce single-use packaging.

Improving energy efficiency and sources and reducing food miles were the practices of most interest among all the retailers interviewed. Cooperatives, grocers, and farm stores discussed food miles in terms of local procurement and with consideration to consumer access, sharing that a rural store location or offering produce in bulk decreases the distance and frequency that consumers must travel to obtain groceries. Retailers presumed that bulk produce offerings decreased the number of shopping trips that a consumer would need. Cooperatives had implemented bulk food offerings, and grocers were interested in expanding this practice. Across all store formats, food waste reduction was perceived as important for planetary health promotion, retailers stating that they implemented many practices to sell food and divert potential waste from landfills. Cooperatives and farm stores highlighted the dual financial and planetary health benefits of avoiding landfills. Cooperatives, grocers, and farm stores stated that there was little more they could do to reduce food waste in their business, and that their current practices were sufficient. Cooperatives and grocers shared how they reduced non-food waste through recycling systems or use of suppliers with less single-use packaging, but that cost was a common barrier to expanding these practices.

When asked about animal and plant proteins, cooperatives and grocers perceived plant-based foods to be novel plant-based protein alternatives, but grocers did not perceive a customer demand for those products. Grocers stated they would

stock more plant-based protein alternatives if there were sufficient customer demand. Cooperatives stocked a robust selection of plant-based protein alternatives. Grocers and cooperatives stated that their store layout promoted plant foods like fruits and vegetables, and that they would consider using shelf-stable plant foods (e.g., dry beans) on endcap displays; however, amenability to this practice varied by community context, with rural retailers less willing to consider this practice.

In Table 2, we present general implementation considerations that span multiple planetary health promotion practices in independent food retail settings identified in this study.

Table 2. Prominent Implementation Factors for Planetary Health Promotion in Independent Food Retail Settings and Retailer Perceptions of Factors as Barriers or Facilitators

Implementation Factor(s)	CFIR Construct(s) Aligned with Implementation Factor	Noted as a Barrier	Noted as a Facilitator	Recommended Implementation Strategy for Future Tailored Definitions and Development Research
CFIR Inner Setting: Food Retail Store				
Cost	Available resources	• Low profit margins in food retail and high initial investment for many practices • Purchasing from producers that are local and/or use environmental stewardship practices is often more expensive • Hesitation to pass on initial cost of planetary health investments to consumers	• Tax incentives for energy system improvements • Planetary health promotion is a long-term investment in the health of the community, with the perceived value of the investment also related to local attitudes • External funding for special projects	• Providing resources • Leveraging funding sources • Tailoring recruitment strategies
Time resources and compatibility	Compatibility, available resources, relative priority	• New practices may require staff training or adjusting workflows • Evaluating procurement options and planetary health partnerships can be time-burdensome or technically difficult	• Partners providing consumer education or marketing materials would decrease time burden on retailer • Bulk products can lessen labor hours for packing and unpacking	• Providing resources • Providing technical assistance
CFIR Outer Setting: Community Context				
Customer expectations and satisfaction (local attitudes)	Local Attitudes	• Consumers are motivated by cost	• Independent food retailers have some agility to respond to customer requests • Store infrastructure upgrades have been well-received by customers in the past	• Choosing strategic partner organizations • Engaging partners
Local attitudes and conditions	Local attitudes and conditions	• Planetary health promotion not perceived as a priority for consumers or as culturally inappropriate	• Consumers are proud of hometown store, want to support an independent business and efforts to keep dollars local • Local infrastructure supports planetary health promotion through policies and programs	• Choosing strategic partner organizations • Engaging partners • Tailoring recruitment strategies

Mission Alignment and Relative Priority (CFIR Inner Setting)

Food cooperatives shared that planetary health promotion was integral to their store goals, and described ongoing initiatives, including energy efficiency upgrades, bulk product offerings, and elimination of single-use bags. Grocery retailers gave examples of energy efficiency projects, food waste reduction, and purchasing goals that promote planetary health. One cooperative described how planetary health is prioritized in decision making:

> One of our core values is sustainability and we strive to center that in all our decisions. It's not just something on the side. … Our store does a lot in terms of sustainability, and it's something that's never completed. It's something we can always improve in every aspect of our co-op.

Grocery and farm store participants were amenable to planetary health practices if the practices supported profitability and customer expectations. For example, when asked how easy or difficult it would be to eliminate single-use paper or plastic bags at checkout, one retailer explained that while there was interest in eliminating bags, they were concerned about how the action would influence customer perceptions of the store:

> I think [it would] affect the customer more than it would affect me. We don't charge for bags, but it is a huge expense, so I wouldn't mind seeing some kind of change there. We're paying about three to five cents per bag right now, so you figure customers get five to ten bags, that adds up … but there's a lot of customers that don't want paper bags… (Grocer)

Issue and Message Framing (Inductive Descriptive)

Retailers often framed their amenability or averseness to practices as based on economic considerations or through the lens of expected customer priorities. For example, retailers had high interest in improving their energy efficiency across store format and local conditions because of the perceived cost savings or tax credits. One grocer explained: *"*We're trying to increase our efficiency and reduce our electrical usage. It's both a financial and social decision.*"* Cooperatives stocked a range of plant-based food products, and grocers were willing to consider increasing them if they perceived customer demand.

Retailers discussed their in-store or social media communication strategies (i.e. shelf tags, in-store signage, cashier communication) they currently used or would consider using to inform their customers about planetary health promotion. While retailers were amenable to using these techniques to share information about planetary health with customers, they emphasized that customers would likely be more interested in potential cost-saving, local economic stimulus, or nutrition and personal health as co-benefits of planetary health promotion. Other retailers discussed the importance of the local natural environment, with one retailer framing planetary health promotion practices as a protection for natural resources located in the community:

> One of the primary things, take care of our bees. Take care of our properties. When it comes to planetary health, I honestly think that [region] has, other than our coal mining indus
>
> try, they got it pretty close to being nailed when it comes to taking care of the ground because that grows our foods … even property around the house, where you're growing your garden. … I think people here are more careful most of the time with their land, because they know. Hey, I can't pour this out, or that out because it's going to destroy the property, and I won't be able to grow anything there, if the ground is hurt. (Grocer)

Partnerships and Connections (CFIR Outer Setting)

Retailers discussed how their existing relationships could influence their capacity to implement planetary health promotion practices. Grocers and food cooperatives were amenable to business connections for procurement from suppliers with agricultural practices that supported planetary health. Across all store formats, retailers were interested in technical assistance for identifying external funding

and assessing trade-offs for planetary health promotion practices. Retailers stated their uncertainty about best practices for planetary health promotion and asked for external guidance, while emphasizing that existing barriers may still limit action:

> I've tried reaching out to different package-free businesses … and just asking them for guidance … if there is some model to follow or some resource for doing that kind of thing, I would love to know about it, but I don't know of any. It feels like everything we've done so far … [is] just making [it] up as we go. … We did have support from one local retailer … [who] went through our store, and gave us suggestions, and all of their inventory sheets before we opened, and all of their wholesalers, and made some good suggestions for what sells the best. … My original vision was to be zero waste, but it evolved. … Maybe we could get to be a completely package-free store. That would take a lot more work. It's hard to know whether that would be profitable. (Grocer)

Retailers described multiple opportunities for partners to support their efforts, with high levels of interest for consumer education efforts, grant acquisition, and marketing. Implementation strategy assistance that required minimal input from the retailer was preferred, and retailers emphasized that any effort must promote profit opportunities:

> We've talked about it, doing all those things, but it's really, it would just be better if somebody else did it. And they can use the space to do whatever. We're more interested in just if it can drive traffic and if it could have a positive outcome for everybody that would be good. … If you guys have like a demo team … (Grocer)

Available Resources and Financing (CFIR Inner and Outer Setting)

Retailers were interested in expanding planetary health promotion practices, but cost was a prominent barrier: *"*Money. Money. That's legitimately. That's the thing*"* (Grocer). Retailers emphasized the economic benefits of reducing food waste, installing more efficient energy systems and reducing packaging in their supply chain.

> Recognizing that grocery retail operates with low profit margins, retailers were interested in funding sources for special projects, such as self-serve bulk bins. Several retailers shared examples of previous grant-funded projects and stated an interest in future external opportunities. Additional, specific resources that retailers stated would support planetary health promotion included electronic shelf tags, community event spaces, and partnership coordinators.

Local Attitudes (CFIR Outer Setting)

Retailers described their perceptions of how community members and store shoppers made food decisions and how local attitudes could influence planetary health promotion efforts in the retail setting. The perceived priorities of each community varied, as retailer participants operated in a range of socio-cultural contexts. Some planetary health practices were more aligned with local attitudes in certain contexts. Many retailers perceived selling organic foods to be a planetary health promotion practice and one grocer discussed how local attitudes about organic foods influenced their stocking decisions:

> If I put the word "organic" on it anywhere, it will rot before it sells off that shelf. They refuse. I don't care if it's produce, if it's organic cereals, anything, you can take something that isn't organic, and put the word organic on it, and they still will not buy it. (Grocer)

However, another retailer shared that when they first opened their business, they did not label organic food, believing that their customer base was uninterested. The retailer later discovered that customers were interested in organic food, and started labeling products as such. Nuances of planetary health promotion practices and the difficulty of understanding impacts in order to make business decisions were explained by this retailer:

> But then around, organic produce pesticides, those kinds of things. I would say people are aware of it, but they are not interested in it, or willing to pay for the price of it, particularly our low-income folks are not willing to pay that price. … And we try to get organic produce … customers are like, oh, we want this organic, it's better. Well, that organic produce is from the Baja Coast of Mexico, while, we have noncertified organic, no spray produce that is, from like three miles away. There's a weird disconnect around larger system thinking. I would like to start carrying more organic but I wouldn't want to be organic from the Baja Coast. (Grocer)

Depending on the practice, local attitudes were described as either a barrier or a facilitator to implementation. One retailer, who used Facebook to ask customers to bring plastic bags to the store in lieu of offering new single-use bags, described how local perceptions of the store bag policy was a facilitator, but that planetary health promotion was a secondary effect from this practice:

> Recycling the bags wasn't a move that I made for planetary purposes. … It was that people need to feel like their own hometown store. And that was one of the things that I thought, oh, everybody has bags at home. So yeah, everybody has been bringing in bags … their old grocery bags, and that works out great. (Grocer)

Another retailer, when asked about removing single-use plastic bags, described the local perception of that practice as a barrier:

> I couldn't imagine anyone really liking it. They're used to the plastic bag. They use them for other stuff. That's just the reality. At least right now. … It's another part, where it'd be nice, but, at least at this point, not practical … it's just business wise. (Grocer)

While several retailers stated that they had a personal interest in planetary health promotion, they did not perceive that their customers prioritized planetary health in their food purchasing practices and thus the retailers aligned their business to support customer preferences. Retailers dis\cussed the importance of demonstrating benefit to the local community of any new initiative:

> I think people would like it as long as it highlighted how it benefited this community. Not just, the overall earth … like to help the environmental health of this community. I think that's what people care about here. Local is a big factor, which I think is for the overall environment as well. (Grocer)

Local Conditions (CFIR Outer Setting)

Local conditions such as availability of suppliers, recycling infrastructure, social cohesion, and transportation options influenced retailers' capacity to participate in planetary health promotion. When discussing food waste reduction, several retailers explained that expired food was diverted from landfill because community members collect the food and use it for compost or feeding farm animals. Retailers recycled their non-food waste, but were limited by infrastructure that accepted only a limited number of materials or did not offer pickup services: *"*We recycle, of course. That did become a little more complicated because our town got rid of recycling. I have to drive the recycling myself to the recycle center, which is like a 10 min, 15 min journey*"* (Grocer).

Informal food access networks were a barrier for some retailers to stock locally produced items, but ultimately benefited consumers:

> These are really, really good people in this area. If you're a local farmer and you grow extra and you know somebody down the road is struggling. You go give it to them. You don't sell it to a grocery store. … But it's a barrier again, that I'm like I can't knock them for being good people. Try to take care of their neighbors. That's a blessing. … That's been a drastic barrier as far as trying to get locally grown produce in here, when they're busy giving it away. (Grocer)

Compatibility (CFIR Inner Setting)

Retailers stated that favorable planetary health practices would align with their current business systems and workflows. One retailer provided an example when discussing single-use plastic reduction:

> Last year, we used compostable packaging, but I will tell you frankly, that it was a lot of work because you had to heat seal, and the bags, because they are compostable, they are quite a bit lighter, so taking them to market, often, the seams would either break or something, so we're going to have to move away from that this year. We would love for there to be some better options. (Farm)

Grocery and cooperative retailers recognized the potential impact of their procurement decisions on planetary health and shared that they had high levels of autonomy in making purchasing decisions: "There's no procedure. We just buy from whoever we want to…It's a very quick decision. If we want to buy from someone we buy from them. If we don't, we don't*"* (Grocer). Despite store-level autonomy in purchasing decisions, retailers were constrained by price and volume misalignment between distributors, farmers, and small stores:

> Sometimes we don't have the size to get products from certain types of distributors, because it would be incredibly costly, the freight is either really expensive or you have to reach minimums that we might not be able to reach. In terms of local farmers, it really has to do with consistency. A lot of the farmers that we work with because they can consistently. … I think that there are smaller farmers that we may support, they just don't have the ability to grow the volume that we would need. (Cooperative)

Incentive Systems (CFIR Inner Setting)

Retailers discussed fruit and vegetable incentive systems as approaches to improving food access and nutrition security, but did not connect these existing incentive systems with planetary health promotion. The only mention of incentive systems for planetary health promotion was a retailer who described their glass milk bottle return program. While the retailer recognized the program's impact in reducing single-use packaging to promote planetary health, they described operational barriers to the program like customers returning dirty bottles or not returning bottles at all.

Structural Characteristics (CFIR Inner Setting)

Retailers discussed physical structures, such as displays and building components, that would influence their potential to promote planetary health. Farm stores stated that they could reduce single-use packaging by providing bulk bins of produce but were uncertain how to do so within food safety regulations. Among grocers and cooperatives, current practices included quick-sale racks at the front of the store, to encourage buying close-to-date foods, and large bins with food items in bulk. All retailers were interested in making physical improvements to increase energy efficiency, with cost as the most commonly cited barrier.

Policies and Laws (CFIR Outer Setting)

Retailers shared examples of regional or local government policies that affected their capacity to participate in planetary health promotion. Policies that would incentivize energy improvements, local food procurement, and recycling infrastructure installation were desired among retailers in all contexts. Retailers recognized that policy could be a mechanism to mitigate some of the cost barriers to implementing planetary health promotion, one retailer discussing solar panels: "One policy would be making [energy company] actually honor the tax credit for solar panels. We want to put them on our other two stores, but they are aggressively fighting that. … They are refusing to comply [with the tax credit]*"* (Grocer).

Discussion

Healthy food retail initiatives in the U.S. present an opportunity for increased focus on planetary health promotion. This is the first study to document owner and manager perceptions of planetary health promotion in U.S. independent food retail settings. This study provides initial evidence that planetary health promotion practices are possible and of

some interest for independent food retailers, if the practices align with retailer motivations for profit potential and if customer satisfaction and implementation support is available. The perceived role for planetary health promotion varied based on store format and community context. The main findings extend what is known from existing healthy food retail literature into planetary health topics (Adam & Jensen, 2016; Alsubhi et al., 2024; Blake et al., 2019; Gupta et al., 2022; Sanchez-Flack et al., 2021; Setiono et al., 2024).

Food cooperatives were the most interested in planetary health promotion among the 12 retailer participants and had already implemented many practices. Previous research suggests that cooperatives have a holistic view of community health promotion and their role in it, including human and planetary health promotion, (Dillahunt-Holloway, 2023; Hale & Carolan, 2018; Shariatmadary et al., 2023; Sumner et al., 2014) thus this study aligns with these results. Two food cooperative participants shared that they voluntarily reduced profit potential or contributed in-kind donations to support planetary health promotion. Cooperatives may be more willing to embrace planetary health promotion, and healthy food retail researchers and practitioners should consider these settings for future research and pilot initiatives. Working with food cooperatives also necessitates careful consideration of inclusivity and accessibility, due to perceptions that alternative food business models may not be designed for historically marginalized communities (Alkon et al., 2019; Clark et al., 2019; Johnston & Szabo, 2011). In the interviews, food cooperative owners and managers were aware that their stores may not seem accessible to consumers with limited financial resources, and stated that participation in fruit and vegetable incentive programs expanded their accessibility.

Among farm store participants, their role in planetary health promotion seemed to be primarily related to agricultural practices. This finding could represent an opportunity for healthy food retail researchers and practitioners to collaborate with agricultural experts in technical assistance partnerships. Cooperative Extension, a land-grant university-based system with practitioners in many U.S. communities, provides technical assistance and other implementation strategies for healthy food retail programs and is often a trusted partner among retailers (Bahl Szczepaniak et al., 2022; Boys et al., 2021; Powers, 2018; Stotz et al., 2023; University of Missouri Extension, 2023). Extension systems could consider cross-disciplinary work, because of the rich agricultural knowledge in the Extension system and its current focus on leveraging the system for public health promotion (Buys & Rennekamp, 2020; USDA National Institute of Food and Agriculture, 2025). Farm store interview participants were also interested in plastic reduction, but were uncertain of the tradeoffs the practice necessitates, particularly regarding cost and food safety concerns. Technical assistance could support farm stores with food safety education for bulk product offerings, and draw on the extensive food safety outreach and education capacity within the Extension system for farm and farm-adjacent retail settings (Rajagopal et al., 2016; Scheinberg et al., 2022; Shaw et al., 2015).

The 12 independent retailers interviewed shared examples of practices they have implemented or would like to implement because of their economic benefit. Initial and long-term costs and profit potential must be prioritized as researchers evaluate the trade-offs of economic benefit and planetary health impacts in implementing planetary health practices in food retail settings. A recommended best practice is for public health partners to use economic data to make a viable business case for new practices that retailers can implemented (Setiono et al., 2024). Those working in healthy food retail partnerships may consider discussing new planetary health practices in economic terms to align with retailer priorities. Framing planetary health promotion as an opportunity for economic gain is a long-recommended strategy to encourage buy-in among a range of groups (Nisbet, 2009; Spence & Pidgeon, 2010). The tailored framing of planetary health practices under economic considerations could be developed and named as the implementation strategy of tailored recruitment strategies (Balis et al., 2024), in which food retailers are the priority population.

Partners like Extension could play a role in alleviating barriers to implementing planetary health promotion practices, as implementation

strategies are needed for successful healthy food retail programs and multiple retailer-desired opportunities for support were identified in this study (Boys et al., 2021; Caspi et al., 2016; Greco et al., 2020; Rushakoff et al., 2017). Retailers were interested in low-input options like signage or social media messaging to promote planetary health, consistent with previous findings that practices requiring few retailer resources (e.g., shelf tags) are often favored by retailers for healthy food retail initiatives (Cameron et al., 2016; Karpyn et al., 2020). Additional opportunities for technical assistance were identified, including identification of and assistance with grant applications and partnership development. Our findings that retailers valued and were interested in partner support is an important foundation to inform future research on defining and tailoring implementation strategies, such as providing technical assistance, choosing strategic partner organizations, providing resources, leveraging funding sources, and engaging partners (Balis et al., 2024).

Community context (e.g. local attitudes and conditions) were key determinants of retailer interest and amenability to planetary health promotion, particularly among grocery participants. As retailer participants represented twelve different community contexts, and interviews were designed to identify key implementation determinants rather than explore determinants in detail, we provide only general recommendations and discussion on the role of community context in planetary health promotion for healthy food retail. Robust understanding of the context in which the store operates is crucial for successful programming, and our findings indicate that local understanding may be even more important for planetary health promotion, given the polarizing nature of the topic (Goldberg et al., 2021; Hornsey et al., 2018; Kellstedt et al., 2008; Sarathchandra & Haltinner, 2021; Scapin et al., 2024). Knowing the characteristics and attitudes of customers must be a foundational step in future work to integrate planetary health promotion into healthy food retail practices, reflecting existing research recommendations (Hecht et al., 2020; Scapin et al., 2024). Understanding the community context can inform appropriate issue and message framing to align planetary health promotion with the salient values and priorities of store customers (Fielding & Hornsey, 2016; Hurst & Stern, 2020; Wolsko et al., 2016), and would contribute to a robust implementation strategy of tailoring recruitment strategies to encourage participants in healthy food retail programming (Balis et al., 2024). Tailored message framing could potentially mitigate the perceived disinterest or confusion about planetary health promotion that retailer participants in this study described among their customers. An additional area of local attitudes and conditions to explore is consumer perspectives on planetary health, and desire or disinterest in accessing food stores that promote planetary health. Such inquiry would provide valuable information on consumer demand for planetary health promotion that could inform development of retail-level practices that align with customer expectations.

Retailers recognized policy, especially at the local level, as an important "outer setting" contextual factor for implementation of planetary health promotion practices, particularly to improve energy efficiency. Exploring policy options to support independent food retailers may be an enabling factor for a retailer to implement new practices, and would align with recommendations for healthy food retail research to work with local governments (Scapin et al., 2024). Although energy sources and energy efficiency are not within the scope of current healthy food retail programming, it is important to note that retailers were highly interested in improving their energy use practices to support planetary health. Policy options within healthy food retail for energy improvements could include prioritizing refrigeration systems with low global warming potential through infrastructure grants, as refrigeration is expensive for the retailer and a high emitter of greenhouse gases (Coulomb, 2021; Vuppaladadiyam et al., 2022). One area for future interdisciplinary research is to evaluate trade-offs of planetary health practices across key environmental indicators (e.g., greenhouse gas emissions, water use, land use, biodiversity) and social, economic, and public health considerations. Defining the practices that have the most impact on priority planetary health indicators is a much-needed evidence base to inform decision making

(Béné et al., 2019; Blackstone et al., 2024; Cattaneo et al., 2021; Mackay et al., 2022).

This was an exploratory study that included three food retail store formats in one U.S. state and that was focused on understanding general perceptions of independent food retailers for planetary health promotion. The planetary health promotion practices identified each has specific implementation considerations that need to be explored in depth, as the results of this study indicated that some practices, like food waste reduction, were more amenable among retailers than other practices, like animal-source protein reduction. The factors listed in Table 2 could inform future research assessing the trade-offs that are inherent in planetary health promotion, particularly in business settings, and are a starting point for future exploration of detailed barriers and facilitators and tailoring of implementation strategies across contexts. Recommended implementation strategies to further define and test are tailoring recruitment materials, leveraging funding sources, providing technical assistance and resources, and choosing strategic partner organizations and engaging potential partners (Balis et al., 2024)

Limitations

While conducting the interviews via Zoom and phone allowed for more flexibility in scheduling, multiple retailers had poor connections, however, and despite the interviewer's efforts asking for repeated answers, some information was likely lost. Several retailers had limited time available for an interview, and thus the interviewer had to be judicious when probing about specific practices; having to work within retailer's busy schedules is a common consideration in healthy food retail research (Ayala et al., 2017; Houghtaling et al., 2021; Zhang et al., 2024). Use of the term "planetary health" may have influenced how retailers described their perceived roles. The author team selected "planetary health" as the term they anticipated to be the least politicized for discussions regarding ahistoric shifts in weather patterns and natural systems, to mitigate potential bias among retailer responses. Terminology can influence stated perceptions and responses to probes (Feinberg & Willer, 2012; Hurst & Stern, 2020), and future research should explore the most appropriate terminology to use when discussing planetary health topics with food retailers. Retailers were asked to define planetary health, so results are skewed through the retailer perceptions of planetary health promotion, and robust exploration of known high-impact strategies for planetary health promotion in the food system (e.g., promoting plant food as a substitute for animal-based protein; Willett et al., 2019) did not occur in all interviews. Additional focused research is needed to understand how food retailers can operate using high-impact planetary health strategies, particularly support for plant-based diets. Future research should explore potential effects of social desirability bias on food retailer's reported planetary health practices.

Recommended Next Steps

The partnership with Fresh Match for this study provided a statewide sample of food retailers already engaged in nutrition security programming, and results can inform practice efforts within Virginia. To inform healthy food retail programming nationwide, larger studies with additional retailer perspectives are needed. Differences across store format and community context are of particular interest for future research, given their importance in these findings and previous recommendations for healthy food retail research (Hecht et al., 2020). Application of implementation science frameworks and compilations to explore contextual factors and implementation strategies should be prioritized in future efforts in order to facilitate transferability of findings across settings (Balis et al., 2024; Bauer et al., 2015; Houghtaling et al., 2023; Shelton et al., 2020).

This study identified a potential set of planetary health promotion practices for independent food retail settings. In addition to defining implementation strategies for planetary health in food retail, future studies could use existing resources for measuring feasibility and appropriateness to assess how a larger sample of food retailers might prioritize the practices identified in this study. Understanding the feasibility and appropriateness of planetary health promotion practices, coupled with assessments of the impact of practices on key planetary health indicators, is necessary to prioritize

practices that are realistic for implementation in independent food retail settings.

Conclusions

This study was informed by implementation science and used interviews with twelve independent food retailers located in Virginia to explore their perceptions of planetary health promotion and identify barriers and facilitators to planetary health promotion practices. Overall, the findings indicated that retailers could play a role in planetary health promotion, although retailer amenability to planetary health practices depended on alignment of practices with profit potential and customer expectations. Preferred practices varied by store format and community context and were influenced by customer expectations in these settings, thus highlighting the need to tailor implementation strategies and other program aspects. Results of the study align with and extend known considerations for healthy food retail research and practice into the previously unexplored topic of planetary health promotion in independent food retail settings. Implications of these results are that healthy food retail researchers and practitioners can leverage known best practices and infrastructure to work on designing expanded programming that includes planetary health promotion. As the first study to document U.S. independent food retailers' perceptions of their role in planetary health promotion, the results provide formative evidence for future research that investigates differences in retailer-preferred practices across store type and communities, explores message framing with healthy food retail partnerships, and defines and tailors recommended implementation strategies.



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Appendix A. Codebook and Supplemental Results

Table A1 presents methodological information and displays the *a priori* CFIR construct codes and descriptive code names and definitions that were developed in a collaborative process between two authors. Table A2 presents findings and displays the planetary health promotion practices that were identified across the interviews and implementation considerations that varied by store format and community context.

Table A1. A Priori CFIR Construct Codes and Descriptive Code Names, Definitions, and Illustrative Quotations for Semi-Structured Interview Data from Independent Food Retailers

***A Priori* Codes from Inner and Outer Setting Constructs from Consolidated Framework for Implementation Research (CFIR)**		
Name of Code	**Definition**	**Illustrative Quotation**
CFIR Outer Setting Constructs		
Critical Incidents	Large-scale and/or unanticipated events influence implementation and/or delivery of planetary health practices	No data
Local Attitudes	Sociocultural values (e.g., shared responsibility in helping to promote planetary health) and beliefs (e.g., convictions about the worthiness of planetary health) influence the community to support or not support implementation and/or delivery of planetary health practices	On one side of it, they're [customers] like, look here, I've got garden fresh tomatoes. I'll go home and make me a tomato sandwich. But then on the flip side of it, if you have organic tomatoes, for some reason, those are different. Those are not like any other tomato. Organic tomatoes, they get you sick, in their mind. I think there's kind of an attitude here, where it's like, we live in the country…what we do out here is not bad for the earth. What the city people do is bad. You know what I mean…Don't come up in here and tell us what to do. That kind of attitude.
Local Conditions	Economic, environmental, political, and/or technological conditions influence the community's desire to implement and/or deliver planetary health practices	We recycle, of course. That did become a little more complicated because our town got rid of recycling. So I have to drive the recycling myself to the recycle center, which is about like a 10 min, 15 min journey. To eliminate plastic bags … we would definitely have to increase our stock on reusable bags. We already sell them … maybe the county imposes a tax on plastic bags, for the customer, for the consumer. So that way, it's not looked at like bad, and I wouldn't lose customers over it, but you know we're all in it together.
Partnerships and Connections	The food retail store is networked with external entities, including referral networks, academic affiliations, and professional organization networks	Fifteen or 20 years ago those food co-ops got together and they created a national organization that they owned. It's like a co-OP of food co-ops, called the National Co-OP grocer. So [we are] part of that co-OP, we all own collectively, and they negotiate with producers, and suppliers for things that we can't buy locally … like cereal or soap, or you know, pasta, or whatever, they negotiate really good prices so to save money for the food co-ops nationally. For rural areas … our biggest challenge would be the driving. One of our other ideas was to try to figure out a way where many people up here in businesses, food businesses up here are driving down to Costco and then coming back like on the same day … sometimes you're behind them. It would be great if we could find a way to combine that

		into one vehicle that's doing these runs and coming back up. So that was one of the things we had thought of for a grant application.
Policies & Laws	Legislation, regulations, professional group guidelines and recommendations, or accreditation standards influence implementation and/or delivery of planetary health practices	As far as planetary health, we have difficulties dealing with our town, with incentives on power savings, because they buy the power from [power company] and are a reseller of it. So all of these opportunities that [power company] presents, we don't have access to, because there is a middleman. It's really hard with a lot of our products coming from not around here … we would actually like to buy local product, if you could get it at a decent price. Like if it was subsidized … you have to subsidize either the farmers or the wholesalers, because it doesn't make sense. … Fresh Match is kind of a headache for retailers and it's a headache for customers. But if you did it on the back end, and you pushed Virginia product…
Financing	Funding from external entities (e.g., grants, reimbursement) is available or not available to implement and/or deliver planetary health practices	It would be really great if we had some sort of grant that had something so we could bag produce, and it was, actually recyclable or reusable, obviously would be ideal.
External Pressure	External pressures drive or inhibit implementation and/or delivery of planetary health practices	No data
CFIR Inner Setting Constructs		
Structural Characteristics	Infrastructure components support functional performance of the food store. Including layout and configuration of space and materials; telecommunication, electronic documentation, point-of-sales systems, and data storage, management, reporting, and analysis; Organization of tasks and responsibilities within and between individuals and teams, and general staffing levels	We have a lot of vegan offerings throughout the store, a lot of organic offerings throughout the whole store. We have a separate vegan, plant-based meat … two kinds of yeah, they're not frozen, but they're refrigerated sections, with plant based, just plant-based selections. We have plant- based cheese, plant-based milk interspersed with the dairy-based stuff. One big problem we've had, a recurring problem, is our freezers. This used to be a [brand store]. It's a pretty old building, refrigeration is old, and other things are old, as far as freezers are. Our freezer section has gone out twice now, to the point where we've had to get rid of every single product in the freezer, and we restock. So that's happened, two times, that that's a major one right there.
Relational Connections	There are high quality formal and informal relationships, networks, and teams within and across store staffing levels and business departments	No data
Communications	There are high quality formal and informal information sharing practices within and across store staffing levels and business departments	No data

Culture	There are shared (between management, staff, and investors) values, beliefs, and norms across the food store for inherent equal worth and value of all human beings, caring for welfare of customers and employees	No data
Tension for Change	The current operating model of the food store business is intolerable and needs to change	No data
Compatibility	Planetary health practices fit or do not fit with workflows, systems, and processes	Last year, we used compostable packaging, but I will tell you frankly, that it was a lot of work because you had to heat seal, and the bags, because they are compostable, they are quite a bit lighter, so taking them to market and stuff, often, the bags themselves, the seams would either break or something, so we're going to have to move away from that this year. We would love for there to be some better options.
Relative Priority	Implementing and delivering planetary health practices is important compared to other initiatives	So in the context of our business, it's something that we wouldn't be against [planetary health promotion]. But currently, we kind of go with things based off of mostly quality and partially cost. We don't try to just get the least cost, because most of the time that's not gonna be the best quality. But we don't go for the top, top tier quality also because we have to keep the cost in mind. It's a balance. Good quality products, but not the highest end. Another aspect that we're working toward is to have more and more of our products be local…we prioritize buying local, we're right around 15% of our products are local…we want to keep bumping up that local percentage for a couple of reasons. One, that, we don't need to be shipping- if we can buy products locally instead of shipping them from around the world, it reduces that transportation, the use of fuel for that for transporting those items. And that has a direct benefit to the environment. Secondly, we want to keep the dollars local, within our local community.
Incentive Systems	Tangible and/or intangible incentives and rewards and/or disincentives and punishments that support implementation and delivery of planetary health practices in a food store	One of my big pet peeves with our glass bottle milk is people don't clean the glasses when they bring them back to the store … we sometimes have to wash them because the glass bottles for milk get picked up once a week and so then that's like super stinky and not exactly food safe to have these dirty bottles just like lying around in your storage area. We have actually gotten stricter about that with customers, and we're like, sorry you don't get your deposit back until this bottle is clean. And then a lot of customers are just really bad with our bottle deposit program on the milk … I think we're running, already this year, we're already at a 300 bottle deficit. It's not running neutral.
Mission Alignment	Implementing and delivering planetary health practices is in line with the overarching commitment, purpose, or goals of the food store	Most farmers pick things by bushel, or, 50 pounds of potatoes into a single bag, and then you take it to your grocery store, and then you break open that bag and re bag it, or bag it up, and, every time you touch something that makes it more expensive. … We offer a bulk rate. Like for planetary health, it's less packaging overall, less trips to the grocery store folks have to make, more food preservation. And on our retail end, we see less waste, because okay, you bought 50 pounds of potatoes, and there might be 3, or 4, or 5, 6 bad potatoes in your 50 pounds, but the store doesn't throw it away and the customer pays for them.

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Available Resources	Resources are available to implement and deliver planetary health practices in the food store, including funding, physical space, and supplies	If I had everything I wished for to make an in more of an impact at the shelf level … at least currently it is out of reach for us, but electronic shelf tags. That's something that could both promote attributes and efficiency. Right now, we're doing paper coated paper shelf labels that that get thrown away. They can't even be recycled. And it's wasteful, and it's a lot of time and effort on our part. If we had electronic shelf labels, that would help the labor piece for us. And also you can program those so that they not only show the price, but they can revolve through some messaging at the shelf level, which is really interesting for me … it is very expensive.
Access to Knowledge and Information	Guidance and/or training is accessible to implement and deliver planetary health practices	No data
Descriptive Inductive Codes		
Role in Food Access	Descriptions of how the store or business contributes to food access in the community, including descriptions of specialized roles or cultural representation	We have two dollar stores, so we don't have a grocery store. We're not really filling that middle range just like a typical grocery store role, we're more of like a natural food store. The options are dollar store or natural food store. There's nothing in between … and we also sell a lot of the local produce and local meats and all that kind of thing … we are filling a hole that was there.
Role for Technical Assistance Partners	Descriptions of support needed for changes or current business practices; responses to how Extension could help facilitate change; statements about "I wish there were someone who could …"	I don't know how to do it, but, some kind of communication line to the local farms via Fresh Match. To say, hey, these are our partner locations. You may want to pop in and see if they're interested in buying local from you. It would be really great if we had some sort of grant so we could bag produce, and something that is either, actually recyclable or reusable, obviously would be ideal. And then, have some information on that tag about, why, it's important to use reusable things, or why it's important to recycle. Stuff like that, as far as marketing goes.
Planetary Health Practices	Statements of strategies or business practices that influence planetary health. Both current and desired practices. Includes retailer perception of store contributions to certain practices. Subcodes include specific details of practice, such as food waste reduction- composting	We have a heavy focus on local. We're reducing the amount of miles the food is traveling to get to people. Supporting the local environment, we tend to purchase, you know, only from farmers that don't use pesticides, not necessarily certified organic or anything like that, but, and then same with the meat production … all our meat comes from local farms, that, raise small amounts of animals. And I see them as beneficial for the land … like regenerative farms. We don't sell any like fake meat, but we do sell tofu, and I mean certain vegetables have protein. But we don't sell, what do you call it? Like soy chicken, like I don't consider that good for the environment. Just don't eat chicken if you're not going to eat chicken. That's just my viewpoint on it. If we get a request for something like that, we do pick it up for people when we go on Mondays. If there was a demand for like a soy-based pepperoni, or whatever, we would add it based on what people request.
Interpretive Framing	How public health organizations and researchers need to think and communicate issues like planetary health to partners. Considerations for framing for partners to direct partners attention to planetary health. Researchers and public	When you were looking at [name of the business], I don't have anything referencing the [name] Park on it. It's one of our largest interstate parks, it's one of the few interstate parks, because it goes over [two states], and it's less than 10 miles from [name of the business]…You'll be able to see what kind of terrain that I'm talking about, our woodland areas, things like that. And as far as planetary, the Nature Conservancy owns

	health organizations need to understand moral foundations, social norms, and relationships of partners to frame planetary health promotion within partner's worldview	about 86% of [County] … our area does more a little bit more to put forth the effort, I think, than some other areas, do that makes sense? I'm not sure, if we're affecting the entire planet. But I do know that people here care about the woods and the trees and our mountainsides, and our dirt and our ground and our animals, and through the entire ecosystem.
Message Framing	Descriptions of how the store is messaging to customers through their in-and out-of-store advertising and social media accounts	We have indicators on our shelf tags, and we're not real happy with the effectiveness of it, because the shelf tag is so small, it's about an inch and a half by 3 quarters of an inch, but we have little round colored shapes on there that indicate several attributes of products: Gluten free, certified organic, locally grown … a variety of them. … And then we have the description of what those mean tagged around the store in places where, if customers are interested, they can find what that information is. But the lucrative way that we've put this [Fresh Match] in front of the customer, is just cashier engagement at the register. We've got a couple cashiers that are very verbal, and that seems to make the biggest impact. I do all the social media. … I post what we have available that week. And it is actually, really helpful. It works here, because the people out here use Facebook for everything. … People do actually look at our Facebook and Instagram, and use it to come make their shopping choices.
Store and Community Culture	How the in-store culture must match the community values and culture; descriptions of how the store environment must be comfortable for shoppers from the community	People here, ok, like at [name of their business], if I put the word organic on it anywhere, it will rot before it sells off that shelf. They refuse. I don't care if it's produce, if it's organic cereals, anything, you can, you can take something that isn't organic, and put the word organic on it, and they still will not buy it. That's the first thing.

Table A2 displays the planetary health promotion practices that retailers identified for potential implementation. For each practice, the key perceptions of retailers are listed and supported with illustrative quotations.

Table A2. Key Perceptions of Independent Food Retailers towards Planetary Health Promotion Practices

Category of Planetary Health Promotion	Key Perceptions	Illustrative Quotations
Agricultural Practices of Suppliers	• Farm stores shared their status as certified naturally grown or certified organic farms, or their farming approaches to promote planetary health • Grocery and cooperative retailers recognized nuance and trade-offs in agricultural practices • Procurement of organic, certified natural, or regenerative food overlapped with discussions of local food procurement	We don't use chemicals. So we're not gonna contaminate our water…So I guess, our business contributes because we make sure we don't use chemicals" What orchard would be going out willy nilly spraying an extra [US]$5,000 worth of product? You would never overspray…I like the organic because it's a respected label. But some of it to me is like, is it actually better for the environment if it's from, you know, 1,000 miles away? So we just really focus on carrying local stuff within 150 miles.
Bulk Offerings	• Offering food items in bulk quantities, or customer-determined quantities, was a favorable practice • Consumer 'sticker shock' at per pound prices is an initial barrier but has been successfully mitigated by several retailers • Retailers requested support on food safety considerations for customer self-service • Physical space and cost barriers for some retailers to purchase additional bulk bins	It's less packaging overall, less trips to the grocery store folks have to make, more food preservation. And then on our retail end, we see less waste, because okay, you bought 50 pounds of potatoes, and there might be 3, or 4, or 5, 6 bad potatoes in your 50 pounds, but the store doesn't throw it away and the customer pays for them. I think once people get past the hurdle of like, this is confusing and I don't want to do it wrong, people really seem to like that department. And past the sticker shock, of thinking, I'm paying so much money, you're really not.
Energy Usage	• In-store energy use and energy sources were unpromoted responses when asked how business practices influenced the natural environment • High interest in improving energy efficiency of store operations, lighting, refrigeration, and installation of solar panels • Barriers to energy improvements included high start-up costs and operating in historic sites	We have solar panels on our main store on the roof. We're trying to increase our efficiency and reduce our electrical usage. It's both a financial and social decision.

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Food Miles	• Highlighted and discussed often by retailers • Rural stores noted their location may influence the environmental impact of customer transportation	In [rural area], to go to either of the other stores, you're gonna be traveling about seven to ten miles. Seven one way, ten the other…Say you need a gallon of milk. You're gonna drive 20 miles, all total to get a gallon of milk, or you're going to go less than a mile across the [river] and go to [name of the business]. And so I think that helps with planetary health, as far as keeping the travel, the distance down. Keep the trucks off the road. Keep trucks coming from closer, rather than further away from us. So we try and maximize things.
Local Foods	• Focused on reducing environmental impact of food transportation • Social and economic considerations of local food procurement were discussed	Most of our produce…has a local footprint, so that there's less fossil fuel used to transport it. Often we take a lower margin on local products, especially things that have a shorter shelf life…Local products tend to have a higher price point than nationally sourced or internationally sourced products. And we try to get that price point as best we can of the local product close enough to that nationally sourced product…and we're encouraging them [customers] to make the decision supporting…all the attributes that local products bring.
Animal-Source Protein Reduction	• Retailers perceived plant foods to mean novel alternative protein products or plant-based milk products • Food cooperatives stocked a wide selection of plant-based food products, and integrated the selection throughout the store • Grocers discussed the expectations of their consumers and local culture as key factors that influence the promotion of plant-based foods in their store	One of the facts, that a lot of people don't want to talk about is that animal food consumption has a very negative impact on planetary health…but] it's a personal decision. We're not the food police. And it's not all, all or nothing kind of thing. But we have a great selection of vegan products. We don't only sell vegan products, but we have a great selection. I would say the best in town by far. In general, our clientele is not, I would say they're just not exactly interested in that. And then, we do carry a lot of plant-based stuff. And a lot of the plant-based stuff is related to planetary health, but nobody really seems to care. That's all dietary, not environmentally concerned. Our community perception is that when you're poor, that's what you have to eat, is beans, because you can't afford anything else…Beans in this area…are what you get at the end of the month, when you run out of money. That's the way they see beans. So that's a cultural thing.
Waste Reduction	• Retailers recognized the environmental impact of food waste but were not concerned about food waste in their operations and shared multiple reduction and diversion strategies • Interest in reducing single-use packaging but cost and customer expectations were barriers • Participated in recycling; time and cost could be barriers to entry	Our fresh baked bread does, some of it comes in a plastic bag. Like in the thin bread bag…I would like to cut that out, as long as it wouldn't affect the freshness of the bread…maybe use the compostable bags on the on the roll. But I don't know that our wholesaler offers them. We need to find out and find out the cost. We recycle, of course. That did become a little more complicated because our town got rid of recycling. I have to drive the recycling myself to the recycle center, which is about like a 10 min, 15 min journey.

Journal of Agriculture, Food Systems, and Community Development
ISSN: 2152-0801 online
https://foodsystemsjournal.org

Social innovation strategies to improve agroecological product marketing: A case study in rural Colombia

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Submitted April 14, 2025 / Revised July 3, September 18, and October 15, 2025 / Accepted October 17, 2025 / Published online February 10, 2026 / Corrections to citation Mancha-Cáceres & Ramírez-García, 2018, made February 20, 2026

Citation: Aguilar-Galeano, E., Diaz-Ariza, D. M., & García-Castiblanco, C. P. (2026). Social innovation strategies to improve agroecological product marketing: A case study in rural Colombia. *Journal of Agriculture, Food Systems, and Community Development*, *15*(2), 275–291. https://doi.org/10.5304/jafscd.2026.152.003

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Abstract

The purpose of this study is to identify improvement strategies in the commercialization of agroecological products based on social innovation factors. A qualitative methodology based on case studies was adopted, focused on the Asociación de Mujeres Microempresarias de Tenjo (Association of Women Microentrepreneurs of Tenjo, or AS HOGAR), in Colombia, through interviews and analysis using ATLAS.ti software, where categories such as prevalence, accessibility, relevance, supply, and demand creation were explored. The results reveal challenges including limited economic resources, barriers to obtaining certifications in sustainable production, unfair competition, and insufficient product promotion. In response, social innovation strategies were co-designed with the producers, including product diversification, implementation of digital marketing, and strengthening of networking. These actions aim to enhance the competitiveness and sustainability of agroecological producers. The study highlights social innovation as a transformative tool to overcome structural barriers and promote inclusive and sustainable development in rural communities.

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Keywords
social innovation, marketing, agroecological products, sustainability, strategies, Colombia

Introduction

Global interest in sustainable development, formalized in the 2015 Sustainable Development Goals (SDGs), has driven international agreements and public policies committed to a future that balances economic growth, social inclusion and environmental protection. In Colombia, initiatives such as the 2014 National Green Business Plan (Plan Nacional de Negocios Verdes), the 2018 Green Growth Policy (CONPES 3934), and the 2019 Mission of the Wise Men demonstrate this national commitment.

Within this framework, sustainable businesses, particularly those linked to agroecological systems, ecotourism, and non-timber products, form the backbone of Colombia's green markets (Aguilar et al., 2020; Díaz-Ariza et al., 2022; García-Castiblanco et al., 2021). Agroecology is an integrated approach combining ecological and social principles to optimize interactions among plants, animals, humans, and the environment. It also addresses the social dimensions necessary for a sustainable and fair food system (Food and Agriculture Organzation of the United Nations [FAO], 2018).

This approach aims to transform food systems through locally driven solutions and co-created knowledge, by empowering communities and emphasizing the rights of women, youth, and Indigenous peoples. Hence, agroecological businesses, as part of this productive ecosystem, represent an opportunity to diversify Colombia's exportable supply (Minciencias, 2020), while generating decent employment and improving rural incomes.

However, this type of business faces competitiveness issues due to its small size and limited support (Díaz-Ariza et al., 2022), with inefficient marketing networks (Varón, 2011), unfair conditions in terms of prices and payment conditions (Marín-Rivera et al., 2018), and with structural problems such as the absence of a brand, limited marketing strategies, and weak administrative management, among others (Díaz-Ariza & Aguilar-Galeano, 2024). These issues hinder business consolidation and access to markets.

In this context, social innovation is proposed as a tool to improve the participation, empowerment, and competitiveness of agroecological systems (Da Silva et al., 2020; Mancha-Cáceres & Ramírez-García, 2018; Yacamán-Ochoa & García-Llorente, 2020) as it facilitates a cooperative approach, collaborative networks, associativity and agreements between the different actors.

Social Innovation and Agroecology

Social innovation has been approached from various perspectives, although it has generally been understood as a strategy for addressing systematic social problems, oriented toward social transformation and promotion from empowerment, inclusion, and participation (Bataglin & Kruglianskas, 2022), cooperation, and associativity networks (Yacamán-Ochoa & García-Llorente, 2020). It is considered to arise when a group of individuals modifies its attitudes, behaviors, and perceptions, transforming into a network that works toward common interests (Pel et al., 2020). These cooperative actions not only generate changes within the group but also foster broader social improvements, benefiting the communities where they operate (Rover et al., 2017).

There are three categories through which it can be measured: resonance, which assesses participatory processes that design future scenarios by describing how individuals and networks interact to generate alternatives to current situations; scale, which measures the number of people impacted, whether directly or indirectly; and scope, which reflects changes in formal and informal rules, norms, and institutions (Soma et al., 2019).

Over the last decade, research on social innovation has grown significantly, expanding from fields such as sociology and anthropology to areas including as management and business (Bataglin & Kruglianskas, 2022; Haskell et al., 2021). This interest has intensified because of crises such as 2009 global economic downturn and the COVID-19 pandemic, highlighting the need for tools to strengthen local economies (Bataglin & Kruglianskas, 2022). Among the recurring themes, social entrepreneurship, sustainability, and govern-

ance stand out, suggesting that social innovation can facilitate more effective local solutions to global challenges, although more empirical research is required (Haskell et al., 2021).

The relationship between social innovation and agroecology has gained relevance in recent years, highlighting its role in strengthening sustainable practices that integrate economic, social, and environmental dimensions (Bezner Kerr et al., 2022). Recent studies show how social innovation fosters cooperation, increases social capital, and improves economic outcomes for both producers and consumers (Espelt, 2020; Piccoli et al., 2021; Yacamán-Ochoa & García-Llorente, 2020). Additionally, it enables the redefinition of production and consumption practices by promoting shorter supply chains, reducing costs, and fostering greater community engagement (Espelt, 2020; Mancha-Cáceres & Ramírez-García, 2018). Cooperative networks and social innovations have proven to be strategic in strengthening producers' capacity to adapt and transform, by enabling the collective sharing of resources, knowledge, and problem-solving, which in turn reduces vulnerability to market shocks and ensures long-term viability (Castella et al, 2022; De Grandpré et al., 2022; Oliveira & de Oliveira, 2022).

Furthermore, women play a leading role in many agroecological initiatives, although their contribution is often undervalued across food systems. Women are key agents of social and environmental change in agroecology. They engage in all stages of the food system as entrepreneurs and innovators (Dagoudo et al., 2023; Malapit et al., 2020; Zaremba et al., 2021). Studies document women's leadership in cooperative formation, participatory innovation, and farm-level agroecological design (Gomori-Ruben & Read, 2023; Oliver, 2016; Benítez, 2023; Souissi et al., 2024).

However, challenges remain. These include low economic compensation for producers, a lack of public and private support, and the disarticulation of value chains (Muñoz et al., 2021). Networks face structural and contextual limits; these can weaken their protective effects or capacity to scale (Anderson et al., 2021; Mesa Valencia & Hendrickson, 2024). Constraints on women's leadership include less schooling, weaker legal and de facto control of land and resources, and limited access to credit and support services. The "triple burden" of productive, domestic, and community responsibilities further complicates matters (Malapit et al., 2023). Social innovation emerges as a viable pathway. It enhances adaptive capacity, influences policy, and enables scaling for agroecological systems.

Accordingly, this study aims to address the following research question: How do social innovation factors influence the improvement of the marketing of agroecological products in rural areas of Cundinamarca? Addressing this question is significant because strengthening agroecological businesses requires the identification of strategies that enhance their marketing processes, based on social innovation principles. Such strategies have the potential to improve the competitiveness and sustainability of such organizations (Haskell et al., 2021), while at the same time equipping producers with tools to systematize the information needed to manage their production processes (Espelt, 2020).

To that end, this article analyzes the interests, needs, and aspirations of an association of agroecological producers in Cundinamarca, Colombia, with particular attention to their access to markets. The study describes the co-design—through an interdisciplinary collaboration between producers and academic actors—of social innovation strategies aimed at addressing the identified challenges, and highlights both the opportunities and difficulties involved in this participatory process.

Methodology

A qualitative approach was used to identify improvement strategies in the commercialization of agroecological products from the perspective of social innovation, as it allows for an in-depth exploration of experiences, perceptions, and dynamics (Da Silva et al., 2024; Pigatto & Brunorim, 2021) of the agroecological producers who were part of the study.

In this context, a case study methodology was adopted, as it enables for the collection and analysis of valuable data that provides a deep understanding of the context, the connections between the actors involved, and the impacts generated by social innovation (Novikova, 2022). It facilitates a

detailed understanding of how social innovation influences commercialization dynamics and the results obtained.

The study was carried out with members of the Asociación de Mujeres Microempresarias de Tenjo–AS HOGAR (Tenjo Association of Women Microentrepreneurs), a collective of women producers committed to agroecological and sustainable farming practices since 2002. Based in the municipalities of Tenjo (Cundinamarca) and Turmequé (Boyacá), central Colombia, the association seeks to connect women producers, strengthen their processes, and facilitate the marketing of their products. Their offerings include over 60 varieties of vegetables and greens, along with byproducts such as dried herbs and spices. While each production unit manages its own direct sales channels—mainly in nearby municipalities and Bogotá—they also collaborate under the group "Camino Verde," selling collectively at the Tenjo farmers market every Sunday.

Between 2023 and 2024, five in-depth interviews were conducted with women producers who are members of the association. They were middle-aged and older women purposefully selected for their experience, their leadership in both the association's actions and their support for the transformation of the region's production systems toward agroecological systems, and the marketing of the network's products through managed spaces in local markets. Therefore, visits to each of their production units were conducted during the study period, complemented by virtual meetings.

The interviews were designed with open-ended questions that allowed the participants to express their perceptions and experiences related to the commercialization of their products, as well as the barriers and opportunities identified in this process.

The theoretical categories used for analysis (Table 1) were based on principles of social innovation defined by Soma et al. (2019) and De Silva et al. (2020). ATLAS.ti software was used to code and analyze the interviews, organizing the information according to the predefined categories. Two main categories were identified: "Social" and "Market Opportunity." These categories were used to organize the codes applied in ATLAS.ti.

The "Social" category included the codes *accessibility*, *prevalence*, and *relevance*, while the "Market Opportunity" category comprised the codes *supply creation* and *demand creation*. In this way, discursive patterns were identified in the interview transcripts and classified according to these analytical categories (Table 1). The analysis focused on identifying patterns and relationships between categories, exploring how social innovation factors interact to influence marketing strategies.

The co-design of social innovation strategies to

Table 1. Criteria Used to Apply the Codes

Principle of social innovation	Theoretical definitions	Classification of discursive patterns
Prevalence	Own needs that translate into social opportunities.	Text segments referring to individual or collective needs that could be addressed by the organization were included.
Relevance	Significant aspects for the strengthening and commercialization of productive units.	Statements were considered that reflected elements considered priorities by producers for strengthening their production units and their commercial integration, specifically in relation to the role of the organization. This included assessments of strategies, resources, or support perceived as key.
Accessibility	Barriers and opportunities to access formal marketing channels.	Content related to structural or logistical obstacles in the marketing process was included, such as geographic, economic, or institutional limitations that affect market access.
Demand creation	Strategies implemented to capture the interest of consumers.	Mentions of differential product attributes (quality, origin, sustainability) and benefits perceived by consumers were considered.
Creation of supply	Elements that strengthen the productive and commercial capacity of the association.	Statements about productive and commercial capacities that require development, from the perspective of the associations, were included.

overcome the identified challenges was based on the interdisciplinary collaboration between Universitaria Agustiniana's academic programs and the producers who participated in the study. This collaboration resulted in proposals that can contribute to improving access to markets. In this way, producers joined with teachers and students from the fields of international business, gastronomy, and marketing.

Results and Discussion

Interview analysis yielded five primary categories: *prevalence*, *relevance*, *accessibility*, *demand creation*, and *supply creation*, each shedding light on specific challenges and opportunities. These categories were analyzed using ATLAS.ti software, through which five codes were generated, and the interviews were reviewed with these codes (Figure 1). Key findings are summarized below.

Table 2 presents the frequency with which each code was applied to data segments in ATLAS.ti, known as code grounding. This measure reflects how often specific themes were mentioned or identified in participants' narratives, allowing for the recognition of their relevance within the analysis. A higher number of quotations associated with a code suggests that the theme was more recurrent or significant during the interviews, providing empirical support for the interpretation of results and the design of social innovation strategies.

Identifying Patterns by Category

The following presents the identification of patterns in the five primary categories, which allow the identification of social innovation factors relevant to the co-design of strategies.

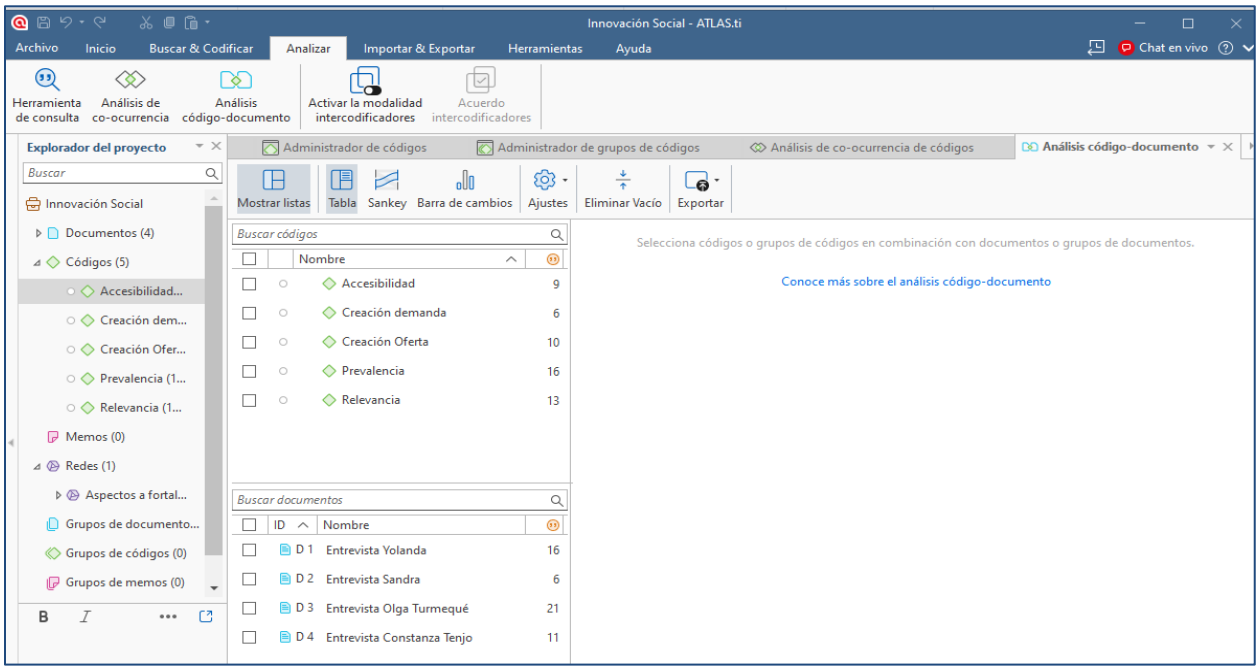
Prevalence

The category of *prevalence* refers to the specific needs of agroecological producers that, within the framework of social innovation, are reinterpreted as opportunities for collective transformation.

Table 2. Frequency Table of Codes

Code	Grounding
Prevalence	16
Relevance	13
Offer creation	10
Accessibility	9
Demand creation	6

Figure 1. Codes Generated via the ATLAS.ti Software



Among AS HOGAR producers, one of the most recurrent themes is the importance of *collaborative work*. As one producer expressed, "I have always thought about joining forces; for me, that is key," while another stated, "It's about awareness. … It is teamwork." These expressions reflect not only a cultural inclination toward cooperation but also a strategic understanding. This aligns with Lucas and Gasselin's (2022) findings, that in the field of agroecological production, and especially in environments with scarce resources, cooperation and collective work become essential to optimize processes, share resources, and strengthen the capacity to face adversity.

Another recurring theme is the centrality of *trust* as a of social capital. Producers highlighted the strength of informal relationships: "We know each other and help each other," and "I have not put a sign that says I sell; it's a network of trust." Trust, in this case, replaces conventional marketing, acting as a mechanism of accountability and a guarantee of quality. This type of *relational marketing*, rooted in personal ties, is especially relevant in agroecological contexts where values such as health, care, and sustainability play a decisive role in consumers choices (Lianu et al., 2024).

Sustainability also emerged as a prevalent concern. One participant noted, "We recycle pollutants. … What the forest does is recycling." This indicates not just practical knowledge but also an *ecological awareness* that underpins their production philosophy. The farmers' practices reflect a clear application of agroecological principles, particularly the reduction of external inputs and the closing of nutrient cycles. This is consistent with the work of Brzozowski and Mazourek (2018), and Hawes et al. (2021), who argue that long-term sustainability requires environmental balance, with practices that reduce the use of external inputs by taking advantage of internal ecosystem services.

Finally, the *lack of generational renewal* emerged as a pressing challenge: "There is no generational change, and there is no one to work with." This concern speaks to the structural vulnerability of the system and the risk of losing agroecological knowledge. Consentino et al. (2023) identify this as a widespread pattern across rural areas, urging for targeted strategies that integrate technology, value rural identities, and make agriculture appealing to youth.

In summary, the prevalence category reveals core issues: cooperation, trust, sustainability, and generational renewal, that shape both the daily experiences and strategic needs of agroecological producers. These findings are not merely anecdotal; they illustrate broader structural conditions and suggest focal points for policy and innovation. Importantly, they also demonstrate how producers are already articulating *incipient forms of social innovation* grounded in lived experience.

Relevance

The relevance category captures the aspects that producers themselves identify as essential to strengthen their production units and improve the marketing of agroecological products. Three key dimensions emerged from the interviews: limited access to resources, difficulties in meeting formal requirements, and the need for institutional support.

First, the *scarcity of economic and technical resources* was repeatedly mentioned as a central obstacle. One producer noted, "Until now, I have not had the resources to do that." This referred to her ability to meet quality standards or scale up operations, highlighting the constraints she is facing. This lack of capital directly impacts competitiveness and scalability. It limits producers' ability to access better technologies, innovate in value addition, or expand their operations. As Zbarsky and Mastylo (2024) explain, access to technical and financial resources is critical for increasing competitiveness, especially in small-scale agricultural ventures.

Second, the *burden of regulatory compliance* emerged as a recurrent barrier, particularly regarding National Institute of Drug and Food Surveillance (INVIMA) certification. While such certification is recognized as a pathway to market expansion ("INVIMA would open a gigantic door to many options"), producers also expressed frustration: "There are several processes and infrastructure aspects for INVIMA to approve it." This tension illustrates a paradox: producers are aware of the value of formal recognition but are constrained by the high costs and bureaucratic complexity.

Anselmi and Vignola (2022) recognized that complying with these regulations can open opportunities to access new markets, particularly more formal or international ones. So, these describe a structural contradiction in certification schemes, where the same processes intended to guarantee safety and quality also exclude smallholders who lack the means to comply.

Third, producers expressed a *desire for support* from public or community institutions to overcome their limitations but found these processes inefficient or disappointing. One interviewee shared: "Last year I was here, at the mayor's office, looking for a business opportunity, but in the end, I had no luck." This reflects not only the expectation of support but also a disillusionment with institutional responsiveness. It reinforces the need for public policies that are context-sensitive, adaptive, and capable of engaging directly with the realities of small agroecological producers.

These findings underscore that relevance, from the producers' perspective, is not limited to market access; it encompasses structural enablers such as resource availability, institutional coordination, and the simplification of regulatory pathways. As Thorpe (2018) and Mohania and Pandey (2024) argue, effective public-private partnerships in agriculture help to catalyze new investments, improving the performance of value chains and facilitating market access, resulting in higher sales volumes and productivity.

The category of relevance reveals how producers interpret their constraints not merely as individual shortcomings but as systemic barriers requiring coordinated solutions. Their testimonies offer insight into a practical understanding of what social innovation must address: the interdependence between institutional design, resource distribution, and regulatory justice. These insights can guide more inclusive approaches to policy and program design in the agroecological sector.

Accessibility

Accessibility refers to the difficulties agroecological producers face in reaching marketing channels and meeting market entry requirements. In the case of AS HOGAR producers, access is largely constrained by three interrelated factors: the prohibitive costs of certification, resource constraints, and knowledge gaps.

A recurring theme in the interviews was the *financial inaccessibility of certifications*, particularly those required by entities like INVIMA. As one producer explained: "When a producer is small, it cannot cost them 50, 60, 100 million [Colombian pesos], because they are going to recover in the long term and often, they do not have that money." This statement captures a fundamental asymmetry in the agroecological sector: the expectations of formal markets contrast sharply with the realities of smallscale production. Certifications, while important for transparency and consumer confidence, often function as gatekeepers that exclude producers without the capital to invest. This finding is consistent with González and Nigh (2005) and Solarte et al. (2023), who note that rigid certification schemes tend to reinforce inequality in access to value chains, marginalizing precisely those who could benefit most from inclusion.

Beyond financial constraints, producers also identified a *lack of resources and adequate logistics* as key barriers. Statements such as "If the product is not sold, I have to keep paying" and "There are many processes and installation issues for INVIMA to approve it" reveal a lack of support systems (storage, processing, transportation) that would otherwise enable producers to meet formal requirements. Without these logistical backbones, smallholders remain locked into short, informal value chains, relying on intermediaries, which limit their autonomy and reduce their profit margins, as noted by Vicente-Vicente et al. (2023).

In short, the accessibility category reveals that market entry is constrained not only by economic factors, but also by a broader ecosystem of exclusion, including financial, infrastructural, and informational barriers. Addressing these barriers requires rethinking certification systems, investing in rural infrastructure, and developing tailored programs that support smallholders as legitimate market actors. From a social innovation perspective, this means co-designing mechanisms of access that are equitable, context-sensitive, and empowering.

Demand Creation

The category of demand creation explores how agroecological producers seek to make their products attractive to consumers through differentiation strategies and relational marketing. For AS HOGAR, building consumer demand involves communicating the distinct value of agroecological practices, innovating in product presentation, and fostering direct trust-based relationships with buyers.

A key insight is that *product differentiation* functions not only as a market tactic but also as an identity strategy. As one producer expressed: "It is our slogan, food with vital energy," while another noted, "That is the added value, because in the tent where I sell it, it is also an agroecological tent." These quotes reflect how producers use narratives to position their products as ethical, healthy, and environmentally responsible alternatives. Such differentiation appeals to conscious consumers who prioritize local and sustainable production. As noted by Chaparro-Africano and Garzón-Méndez (2021), this type of storytelling can reinforce the value proposition of agroecological products and fosters brand loyalty.

The interviews also revealed innovative forms of *value addition* that align with both functional and symbolic benefits. Strategies such as dehydration, the use of attractive packaging, and the focus on eco-friendly features stand out as important differentiators. These products not only reduce waste but also extend shelf life and facilitate transportation and storage—factors essential for scaling operations. This strategy directly addresses barriers discussed in other categories, such as perishability and limited access to cold chains. Connolly et al. (2022) note that processed agroecological goods often perform better in niche markets, especially where consumers seek convenience without compromising on values.

Another core mechanism for demand creation is *direct and relational marketing*, which producers perceive as to build trust, ensure loyalty, and retain higher profit margins. Statements such as "We deliver at home" and "We sell in the local market every Sunday" reflect intentional efforts to bypass intermediaries and maintain close relationship with clients. These practices reinforce social ties while enabling producers to receive real-time feedback and adjust supply. Rode et al. (2023) highlight that these practices not only improve profit margins but also allow producers to better respond to market needs and preferences.

In summary, this category reveals that demand creation among small agroecological producers is driven by a combination of innovation, narrative building, and trust-based trade. These findings demonstrate the agency of rural women entrepreneurs in navigating competitive environments and suggest that social innovation must recognize and amplify such grassroots strategies, particularly when designing programs for market linkage and brand development.

Offer Creation

The category *offer creation* refers to the capacity of agroecological producers to organize, expand, and add value to their production to respond to current and emerging market demands. In the case of AS HOGAR, this involves the articulation of collective work, the incorporation of a business mindset, and the need for infrastructure and policy conditions that enable growth.

Producers repeatedly emphasized the need to *work collectively and pool efforts* as a strategy to strengthen production and marketing capacities. One producer noted, "I think we have to join forces," while another stated, "We have to make some agro-industrial centers." These perspectives reveal a clear awareness that collective action is essential for scaling operations, especially when faced with resource limitations. The desire to develop shared facilities such as processing centers or packaging plants reflects a proactive approach to overcoming barriers typically faced by small-scale producers. This is consistent with Barzola et al. (2018) and Abulbasher et al. (2024), who argue that entrepreneurial orientation among farmers increases when supported by platforms that foster collective innovation.

A second theme relates to the need to adopt a *business-oriented vision* that moves beyond subsistence agriculture. Several interviewees spoke of the importance of planning, standardizing processes, and producing for specific market niches. However, they also recognized that achieving this shift

requires targeted training and technical support. As Mashrabovich and Toxtasinovna (2024) suggest, the creation of agro-industrial clusters can facilitate this transition by providing producers with shared access to technologies and commercial services that increase efficiency and competitiveness.

An additional challenge identified by AS HOGAR members is the *unfair competition* from imported goods and large retailers. Statements such as "All the large stores bankrupt the small ones" and "They bring much cheaper products from India" reflect a perception of structural disadvantage. These conditions not only erode local markets but also disincentivize innovation and investment in agroecological practices. This aligns with Muñoz et al. (2021), who document how industrial food systems often undermine small-scale agroecological networks through price dumping and unequal access to distribution channels.

The offer creation among AS HOGAR producers reflects a dynamic tension between potential and structural constraints. On one hand, there is a clear commitment to innovation and collective work; on the other, systemic barriers continue to limit expansion. Addressing this requires multilevel intervention investment in infrastructure, support for associative models, and protective public policies that help level the playing field. Social innovation, in this sense, must operate not only at the level of ideas but also through concrete mechanisms that enable producers to transform their aspirations into market-ready realities.

Relationships Between Categories

Based on the categories identified during the interviews with the producers, a co-occurrence analysis was conducted using the ATLAS.ti software to explore the relationships among the codes, taking as a reference the frequency of their joint appearance. The results of this analysis are presented in Table 3. The relationships with the highest frequency of co-occurrence, highlighted in the results, are described below.

Accessibility and Demand Creation: Exclusion from Formal Distribution

The co-occurrence between *accessibility* and *demand creation* illustrates a structural barrier: although producers strive to differentiate their products via sustainability narratives and added value, their access to markets is limited by the high cost and complexity of certification processes, even when consumers value characteristics such as sustainability and its perceived quality, as Kharabsheh (2024) established.

This situation creates a paradox: producers have marketable, high-value products, but are excluded from formal distribution channels due to resource constraints. As González and Nigh (2005) argue, this dynamic reinforces a vicious cycle: limited accessibility restricts visibility, which in turn hinders demand growth, undermining the full potential of agroecological entrepreneurship. Certification processes often institutionalize exclusion when applied to smallholders without adequate support.

Table 3. Co-Occurrence Analysis

	Accessibility Gr=13*	Demand creation Gr=9*	Offer creation Gr=13*	Prevalence Gr=16*	Relevance Gr=13*
Accessibility Gr=13*	0	3	1	3	1
Demand creation Gr=9*	3	0	0	0	0
Offer creation Gr=13*	1	0	0	0	3
Prevalence Gr=16*	3	0	0	0	0
Relevance Gr=13*	1	0	3	0	0

* Total number of grounded codes (Gr) for each category.

Prevalence and Accessibility: Structural Needs and Systemic Barriers

The limitations of producers, such as lack of resources and generational renewal, are directly related to the barriers to accessing formal markets; furthermore, the lack of economic resources limits investment in certifications, infrastructure, and technology, which perpetuates a dependence on informal or local markets. These barriers reinforce dependence on informal markets and constrain producers to limited commercial circuits. Solarte et al. (2023) emphasize that without targeted institutional support, these systemic limitations remain unresolved and perpetuate inequality within the agri-food value chain.

Moreover, the absence of young people interested in agricultural activities aggravates this problem, as it hinders the introduction of modern and technological practices necessary to meet the quality standards required in competitive markets, as Ayyıldız et al. (2025) suggested.

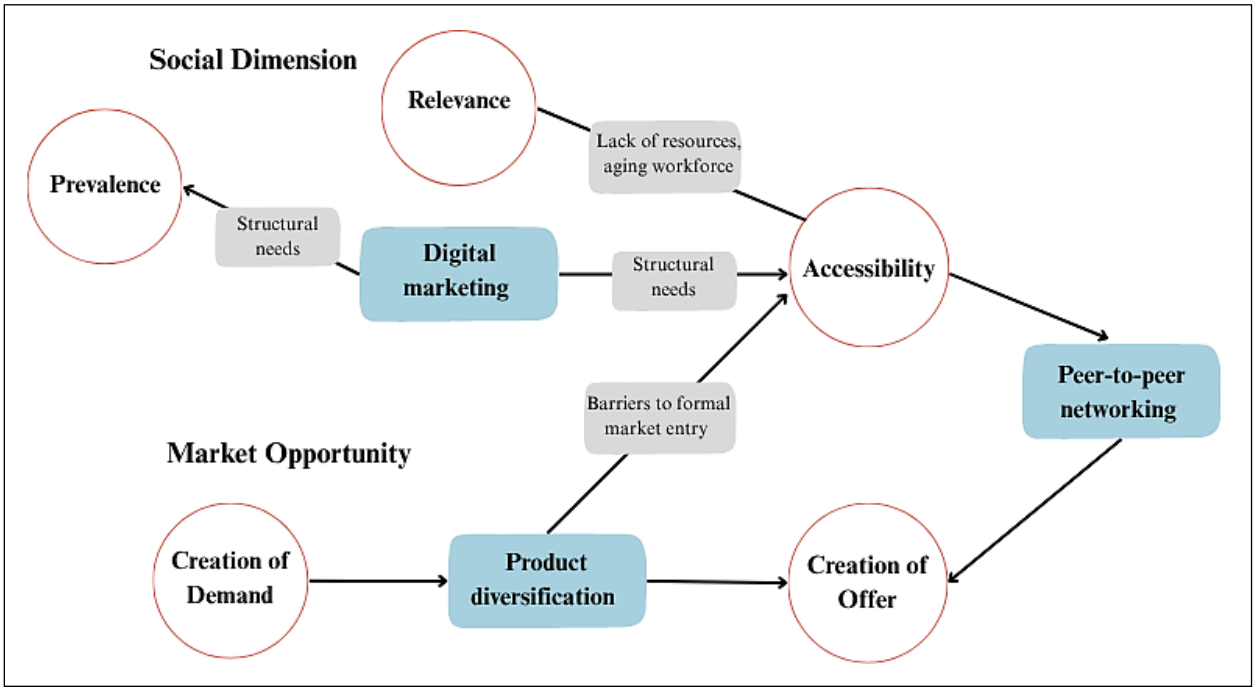
Relevance and Offer Creation: Building Capacity Through Collective Infrastructure

The strengthening of each productive unit, through resources and infrastructure, is linked to the construction of strong producing communities and collective projects. Resources and infrastructure enable smallholders to overcome individual constraints and address more ambitious demands; for example, Ismayilov (2021) implied that agro-industrial or transformation centers not only improve the supply of products but also promote joint work. This relationship indicates that the offer creation is not an isolated task but one anchored in producers' recognition of structural needs and their potential resolution through cooperation and shared assets.

Co-design of Strategies

Based on the co-occurrence analysis and the interpretation of relationships among categories, three core strategies were co-designed through interdisciplinary collaboration between academic teams and the AS HOGAR's agroecological producers. The relationship between categories, identified challenges, and co-designed social innovation strategies is illustrated in Figure 2. These strategies aim not only to respond to specific challenges but to unlock synergies among production, commercialization, and social innovation. Each strategy is grounded in the lived experiences and expressed

Figure 2. Relationship Between Categories, Challenges, and Co-Designed Strategies



needs of the producers and addresses at least one of the systemic relationships identified in the previous section.

Product Diversification for Market Expansion

The co-occurrence of *accessibility* and *demand creation* revealed a structural contradiction: although producers offer differentiated, high-value agroecological products, their access to formal markets is constrained by the costs of compliance with certification and packaging standards. To address this, a strategy focused on product diversification was co-designed with the Gastronomy academic team. This initiative was centered on transforming surplus or cosmetically imperfect vegetables into shelf-stable goods such as instant soups, pastes, and herbal seasonings.

This approach enables producers to increase product value and reduce waste. It also helps them reach new market segments, particularly health-conscious urban consumers. As Kessari et al. (2020) and Connolly et al. (2022) argue, value-added products in alternative food systems not only extend shelf life and simplify logistics but also improve market positioning and resilience. Importantly, producers recognized that this strategy could also stimulate youth engagement by introducing innovation into traditionally undervalued agricultural work.

Digital Marketing to Improve Visibility and Positioning

The link between *prevalence* and *accessibility* elicits how producers' structural limitations—lack of resources, generational renewal, and limited networks—directly affect their capacity to access competitive markets. To address this issue, the marketing academic team collaborated with producers to co-design a digital marketing plan tailored to their context. This plan included practical tools, tutorials, a publication schedule, and low-cost strategies for content creation.

This strategy seeks to position the producers' brand narratives, such as sustainability, community values, and "vital energy" products, on platforms where conscious consumers are active. It reduces dependence on intermediaries and increases direct sales to consumers, reinforcing producer autonomy. As Entsminger and McGowan (2024) note, marketing strategies that leverage social and environmental values are particularly effective in expanding the visibility of marginalized producers in highly competitive environments.

Peer-to-Peer Networking for Certification and Scale

The relationship between *relevance* and *offer creation* pointed to producers' shared recognition that scaling up production and improving quality requires collective investment in infrastructure and technical processes. Many expressed interest in forming agro-industrial centers, but they lacked the support to navigate complex certification procedures.

To respond to this gap, the international business academic team facilitated the design of a peer-to-peer networking strategy. This model relies on experienced producers within AS HOGAR who have already obtained certifications (e.g., INVIMA) to mentor others through the process. The strategy includes a guide for accessing public and private funding and encourages collective applications to reduce costs and improve approval rates.

This approach aligns with the principles of social learning and distributed innovation, where networks become platforms for capability transfer and collective problem-solving. As highlighted by Piccoli et al. (2021), peer networks in agroecological contexts can enhance efficiency, foster innovation, and strengthen social capital—ultimately contributing to the sustainability of producer organizations.

Importance of Social Innovation to Overcome Challenges

The commercialization of agroecological products in rural Colombia faces persistent and multifaceted challenges—economic, infrastructural, institutional, and cultural—that limit the sustainability and competitiveness of small-scale producers. These barriers include limited access to financial and technical resources, the high cost and complexity of certifications, logistical deficiencies, and asymmetrical competition with imported goods and large retail chains. In addition, producers' capacity to communicate the distinctive value of agroecological products remains underdeveloped, which restricts

their ability to capture the growing demand for sustainable food.

Within this context, social innovation emerges as a transformative mechanism capable of reconfiguring not only market access conditions but also the organizational capacities and relational dynamics of producer communities. It facilitates bottom-up processes based on cooperation, shared learning, and the co-creation of solutions adapted to local realities. The findings of this study confirm that when social innovation is applied to commercializing agroecological products, it can function as a strategic lever to overcome systemic constraints and open new pathways toward inclusive development.

In the case of AS HOGAR, the co-design of social innovation strategies—such as the development of value-added products, the adoption of digital marketing tools, and the implementation of peer-to-peer networks for certification—enabled producers to address key limitations identified in the analysis. These strategies directly responded to the relationships between core categories such as *accessibility*, *demand creation*, and *supply creation*, reinforcing the producers' agency while fostering collective solutions.

Specifically, product diversification enhanced the usability of surplus and nonstandard produce, while expanding shelf life and market reach. Likewise, digital marketing plans enhanced brand visibility and helped position agroecological values to better engage conscious consumers. Peer mentoring for certification reduced knowledge gaps and transaction costs while strengthening social capital and solidarity within the group.

These actions demonstrate that social innovation is not merely a technical response, but a sociopolitical process that reinforces producers' autonomy, promotes associative models, and builds the adaptive capacity of rural organizations. The interdisciplinary collaboration between academia and producer associations proved to be a key enabling factor, facilitating the design of strategies that were context-specific, feasible, and aligned with the producers' values and aspirations.

Future research could expand on this study by conducting comparative analyses with other agroecological organizations, assessing the long-term impact of social innovation strategies, and examining how public policy frameworks can more effectively support small-scale producers. It is also important to explore youth engagement in agroecology and develop specific indicators to measure the outcomes of social innovation across social, economic, and environmental dimensions.

Conclusions

This study demonstrates that social innovation is a key enabler for addressing systemic challenges in the commercialization of agroecological products, particularly among small-scale rural producers. The barriers faced—such as high certification costs, limited infrastructure, weak marketing capabilities, and unequal market conditions—cannot be resolved through isolated technical fixes. Instead, they require integrated, participatory approaches that leverage local knowledge, build collaborative networks, and strengthen organizational capacities.

The case of AS HOGAR illustrates how interdisciplinary collaboration between academic disciplines and agroecological producers can foster the co-design of context-sensitive strategies, such as product diversification, peer-to-peer support for certification, and digital marketing plans. These strategies addressed concrete operational limitations and also enhanced the producers' collective agency and positioned their products more effectively within value chains.

Key lessons from the study highlight that collective action and trust-based networks are vital for optimizing resources, particularly in contexts with limited external support. Moreover, value-added strategies, such as product dehydration and eco-friendly packaging, contribute to improving competitiveness and help reduce post-harvest losses. Digital marketing and brand positioning were found to be effective tools for reaching new consumer segments, especially in urban markets that prioritize sustainability. Finally, peer learning and producer networks play a crucial role in lowering entry barriers to formal markets by democratizing access to certification processes and reducing associated transaction costs.

The findings underscore the importance of supportive institutional frameworks. While producers demonstrate strong initiative and adaptability,

their efforts must be accompanied by public and private programs that recognize the structural disadvantages they face and provide targeted support in infrastructure, training, and financing.

This research highlights that social innovation is not just a methodological tool but is also a pathway toward more inclusive and resilient food systems. Its implementation in agroecological contexts promotes economic viability, social equity, and environmental stewardship—contributing to the broader goals of sustainable rural development.

Recommendations

Building on the findings of this study and the experiences shared by AS HOGAR producers, a set of recommendations emerges to guide future research agendas, inform policy development, and shape practical interventions that support the commercialization of agroecological products.

From a research perspective, there is a clear need for longitudinal studies to assess the impact of co-designed strategies (product diversification, digital marketing, peer-to-peer networking) on the resilience and long-term sustainability of the partnership. This would provide empirical evidence of the effectiveness of social innovation, developing and validating specific indicators to measure the results of social innovation in economic (sales, market access), social (social capital, youth retention), and environmental (waste reduction, resource efficiency) dimensions. Such studies could offer valuable insights into the evolution of producer networks, the involvement and retention of young farmers, and the economic viability of value-added production models.

Comparative studies with other women-led agroecological initiatives in Colombia (and across Latin America) could help identify scalable innovations as well as region-specific constraints. Additionally, future research should examine the role of youth and technology in agroecology, particularly the potential of digital tools and targeted training programs to foster generational renewal and improve the efficiency and sustainability of farming practices.

On the policy front, this study underscores the urgent need to reform and streamline certification processes, which remain largely inaccessible to small producers due to prohibitive costs and administrative complexity. Public institutions should consider implementing more flexible, context-sensitive certification schemes, accompanied by technical and financial support tailored to the realities of agroecological producers. Cooperative certification models, where producers share the administrative and economic burden, may offer a viable alternative. Furthermore, public incentives should support the creation of agro-industrial clusters that provide shared infrastructure for processing, storage, and packaging, which are key components for adding value and expanding market access. To protect small-scale producers from unfair competition, governments might also explore mechanisms such as minimum price guarantees, preferential procurement from local agroecological farmers, and regulations to curb the market dominance of low-cost imports.

In terms of practical implementation, a critical strategy for strengthening agroecological commercialization involves reinforcing local networks and promoting peer learning. Peer-to-peer mentorship and cooperative knowledge exchange among producers can enhance collective capacities and reduce dependency on external actors. Training programs in digital marketing and brand development, particularly those targeting consumers who prioritize sustainability and local sourcing, can further increase producers' visibility and competitiveness. Practical toolkits and ongoing advisory support can empower producers to engage more effectively with emerging sales channels, including e-commerce platforms. Finally, this study highlights the importance of partnerships between academia, civil society organizations, and producer associations. These collaborations not only generate contextually relevant innovations but also help bridge the gap between theory and practice, ensuring that solutions are both feasible and transformative.



Acknowledgments

The authors wish to express their sincere gratitude to the producers of AS HOGAR for their active participation, continuous support, and willingness

to share information and grant access to their production units throughout this study. Special thanks are also extended to the students and faculty members from the Marketing, International Business, and Gastronomy programs of Universitaria Agustiniana, whose contributions were essential to the co-design of the proposed strategies.

AI Disclosure

The authors used AI tools from Gemini and Grammarly to improve the English translation of the article, specifically to improve structure, grammar, and syntax. The authors reviewed and corrected the generated material and assume full responsibility for the content of this publication.

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Journal of Agriculture, Food Systems, and Community Development
ISSN: 2152-0801 online
https://foodsystemsjournal.org

From geographical indication protection to food sovereignty: Cassava and Gari Sohoui in Savalou, Benin

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Submitted August 29, 2025 / Revised December 17, 2025, and January 13, 2026 / Accepted January 14, 2026 / Published online April 7, 2026

Citation: Guidimadjegbe, S. J., & Becker, L. (2026). From geographical indication protection to food sovereignty: Cassava and Gari Sohoui in Savalou, Benin. *Journal of Agriculture, Food Systems, and Community Development*, *15*(2), 293–313. https://doi.org/10.5304/jafscd.2026.152.038

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Abstract

Local food is the consequence of a combination of cultural and physical environment conditions. The distinctive qualities of sub-Saharan African local food are threatened by national agricultural policies that emphasize export crops. Protecting local food offers a path to food sovereignty for rural communities. Geographical indication (GI) labeling protects distinctive local food. This case study examines Gari Sohoui, a processed form of cassava, originating from Savalou District (or Commune) in central Benin. Based on fieldwork, the study explores to what extent GI protected Gari Sohoui can foster local communities' food sovereignty. The primary actors involved in this food system, farmers and processors, were surveyed through in-depth, semi-structured individual interviews and participant observations. Interviews revealed that labor constraints for weeding present the most important challenges to production. In the absence of practical agroecological alternatives to manage weeds, growers use herbicides that are widely accessible because of the country's agricultural development strategy. While GI protection of Gari Sohoui in central Benin promises to foster social cohesion, generate substantial economic gains, and promote transition to agroecological practices, the widespread use of herbicides in the case study villages threatens to undermine the status of Gari Sohoui. GI protection for Gari Sohoui empowers local communities to take control of their food systems, especially women, through preservation

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Funding Disclosure

We gratefully acknowledge the Sasakawa Young Leaders Fellowship Fund (SYLFF) and Oregon Lottery Graduate Scholarship for their financial support of this research.

Conflict of Interest isclosure

The authors declare that they do not have any conflicts of interest.

and valorization of local knowledge while contributing to their food sovereignty.

Keywords
Gari Sohoui, cassava, geographical indication (GI), food sovereignty, food system, traditional knowledge, terroir, Savalou, Benin

Introduction

As food insecurity in sub-Saharan Africa increases, some governments in the region have pursued food security by encouraging agricultural intensification for international trade, promoting cash crops such as cotton and cocoa that are cultivated with chemical inputs (Haggblade et al, 2020). The widespread chemical use has had spill-over effects increasingly impairing food crop quality (Biaou et al., 2003; Eclou & Glèlè Kakaï, 2024). This export-oriented cropping system is based on top-down decision-making that has shifted cropping decisions away from local populations, leaving them with little leverage over what they grow and how and where their produce is sold, thus disrupting their foodways and negatively affecting their cultural identity (Grey & Patel, 2015; Kansanga et al., 2019; Rosset, 2011).

In contrast, a food sovereignty framework has been suggested as a means of democratizing production decision making, giving smallholder farmers choices with their crops and agroecological practices that better align with their distinctive socio-cultural and environmental characteristics (Altieri, 2009; van der Ploeg, 2017). The specificities of local communities are essential to understanding how individuals and groups can democratically interact with each other and their environment to solve perceived challenges such as maintaining stable food supplies.

This article presents data from a study of Benin smallholders who initiated geographical indication (GI) labeling as a means of setting apart their terroir-driven agricultural production of cassava processed into Gari Sohoui, exclusively produced within the boundary of the Savalou District (Commune) (Guidimadjegbe, 2024). Gari Sohoui has become a premium product highly praised, consumed and marketed at all socio-economic levels, nationally and internationally (Barnett, 2020; Gerz & Fournier, 2006).

With the goal of documenting and examining the practices of farmers and Gari Sohoui processors who seek to protect and promote their agricultural production in a way that ties it to a specific origin, and who understand its impacts on communities, this study explores Gari Sohoui in the Savalou terroir and the possible implications of GI labeling on local communities' food sovereignty and Benin's food security. This study thus poses the following questions:
1) Why do smallholder farmers in the Savalou area not strictly use agroecological practices in their cassava cropping system? 2) To what extent does GI protection of Gari Sohoui contribute to a transition to agroecological practices among Savalou area smallholders? Related to these questions, the study explores ways that geographical indication protection is used to promote communities' food sovereignty and well-being.

Background

The challenges posed by global food production and hunger, especially in the sub-Saharan region, require more than one-size-fits-all agricultural development recipes to be resolved. Local ecological characteristics and socio-cultural identity play a central role in sustainably empowering communities to achieve food self-reliance and well-being.

Political-Economic Context of Global Food Production

Hunger is best understood when assessing the "agri-food systems and their transition and transformation within political ecologies and economies" (Wittman, 2011, p. 89). Following this perspective, McMichael (2014) asserts that repetitive food crises have resulted from a twentieth-century food regime based on the promotion of cheap food, while Rosset (2009) argues that the agro-export development model has a destructive impact on rural communities. The ability of households to achieve food self-reliance has been hampered by the political-economic decisions of postcolonial governments to produce crops for international trade, emphasizing non-food crop commodities rather than food crop cultivation.

The resulting farming programs generally undermine staple food crop production and limit national food availability (Ambalam, 2014; Wise, 2020).

The market-oriented crop production system, while encouraging food dumping and farming environment depletion (Holt-Giménez & Altieri, 2013; Jacques & Jacques, 2012; Watkins & Braun, 2003), denies rural smallholders the right to their own food culture, exposing them to hunger-crisis risks. Consequently, concerned people worldwide have been raising their voices to demand a paradigm change in the agricultural development strategies of developing countries. The global peasants and farmers movement La Via Campesina, the "Peasants' Way," that began in 1993 advocates a broader, holistic model of food production that emphasizes food sovereignty (Desmarais, 2007). The movement expanded to the African continent with the Nyéléni movement in Mali (Nyéléni, 2007), which insists on the collective right to food production and demands the decolonization of food production, in contrast to the exploitative nature of the food security framework based on monocropping in which seeds, production targets, and ultimately prices are set by multinational agribusinesses that separate smallholders from decision making (McMichael, 2014).

In the case of Benin, successive agricultural development strategies have supported cash crop systems, especially cotton, with financial incentives and elimination of import taxes for its chemical inputs (Lompo, 2019). The government's five-year development plan for 2021–2026 included facilitating import of agricultural inputs (Programme d'Actions du Gouvernement, 2021, p. 41). In 2023, Benin imported pesticides valued at 77.4 million euros (Direction Générale du Trésor, 2025, p. 9). Although Benin is not yet a center for the Peasant Way movement, it has supported various associations that advocate food sovereignty, e.g., Actions pour le Développement Durable (AdeD) and Alliance pour la Souveraineté Alimentaire en Afrique (AFSA). Food sovereignty as an ideological model in Benin dates to 1985 with the founding of the Songhai Center in Porto-Novo by Father Godfrey Nzamujo, a Nigerian Catholic priest, who established the agroecological farming center motivated by the belief that Africa could feed its population by drawing from the collective wealth of indigenous farming knowledge in conjunction with the science of ecology. Supported by like-minded international donors, Songhai operates in about a dozen African countries and in several districts in Benin, including Savalou since 1999. Instructors train youth in methods that enhance their local resources by improving production while respecting the environment and the local culture (Songhai, 2021). In 2010, organizations promoting agroecological practices founded the *Fédération Agroécologique du Benin* (FAEB) and have been lobbying the Benin government to integrate agroecological food production practices into national agricultural policies while reviving disappearing ethnic foods and encouraging young people to reconnect with their cultural identity.

Agroecology as a Path to Food Self-Reliance

In recent decades, agroecological approaches to farming have been suggested by various scholars and organizations recognizing the necessity for an alternative farming model that both improves the livelihoods of farmers and can be sustained by local ecosystems (Bezner Kerr et al., 2018; Food and Agriculture Organization of the United Nations [FAO], 2018; High Level Panel of Experts, 2019; International Assessment of Agricultural Knowledge, Science and Technology for Development, 2009; Pretty, 2003; Rosset, 2011). Agroecological practices aim to increase local resource value, secure biodiversity, and limit reliance on chemical inputs by taking site-specific conditions and contexts—bio-geophysical, socio-economic, and cultural—into account for producing food (Nicholls et al., 2016). These practices have proven capable of preserving local crop cultivars, mitigating the adverse impacts of climate change, increasing the cropping system's resilience, and increasing yields (Altieri et al., 2012; Bezner Kerr et al., 2019; Gliessman, 2014).

Many agroecological methods promote cropping with the local environment characteristics present in indigenous values and cultural knowledge of food production (Gliessman, 2014; Pimbert, 2006; Solomon et al., 2016). The relationship between local land-use practices, farming, and foods has

long been recognized, notably influenced by early 20th century observations of the regions of France by Paul Vidal de la Blache in *Tableau de la Géographie de la France* (1903), and forming the contemporary notion of terroir, Trubek (2008) argues that French journalists and cookbook authors, dubbed "taste-makers," together with "taste producers" such as those who make cheese and wine "effectively shaped how people tasted wine and food" (p. 21) by drawing a connection between place and taste. The terroir concept contrasts with the traditional neoliberal cash crop system based on privatization, monocropping system, and export-oriented production at the expense of local food (Pimbert, 2006).

By building a sometimes-romanticized agrarian image, small farmers and regional dishes gained the attention of those who sought to protect agricultural practices from being displaced by modern large-scale farms oriented toward global markets. Vidal de la Blache's characterization of French regions based on their geography, both physical and human, contributed to bolstering regional agriculture and cuisines, and influenced the regulations certifying the geographic origin of wine and foods. The ability of rural communities to raise terroir food, such as Gari Sohoui in Benin's Savalou district, to national recognition within the traditional local farming system framework indicates the potential of indigenous knowledge to generate steady food production in order to sustain food self-reliance and enhance livelihoods.

Geographical Indication to Empower Local Communities

Geographical indication (GI), now used in some African countries (Belletti et al., 2017), seeks to guarantee a product's specific reputation and quality as based on a particular region. Although African countries endorsed the proposed extension of GI protection to products other than wines and spirits through Trade-Related Aspects of Intellectual Property Rights (TRIPS)[1] in 1994, it was not until 2005 that the African Intellectual Property Organization (OAPI)[2] adopted a declaration creating and installing a special committee for GI in all member countries, that constitutes an avenue for traditional local food systems to reclaim their historical role in fulfilling communities' dietary, health, and livelihood needs (Akinola et al., 2020; Gerz & Fournier, 2006; Guira et al., 2017). Many African countries have already placed some of their unique products under GI protection—*Rooibos* tea and *Kalahari* melon seed from South Africa, *Ohu* white honey and *Penja* white pepper from Cameroon, *Bora Malé* rice from Guinea, and *Violet de Galimi* onion from Niger (African Union, 2019). The richness of the diverse agricultural and food regions of Africa in terms of natural resources, biodiversity, cultural identities, and traditional knowledge makes GI an effective tool to promote African communities' food sovereignty.

Benin began GI protection for its terroir food products in 2009. The initiative to implement GI protection is an opportunity to increase added value to local food, enhance rural livelihoods, and diversify the national economy while promoting agroecological practices (Bérard & Marchenay, 2006; Videgla et al., 2015). A national committee, Comité national de Mise en Place des Indications Géographiques (CoNaMP IG), was established in 2012 to help accelerate the GI process by identifying potential products and assisting with regulation. Gari Sohoui, highly praised because of its qualities of taste, texture, aroma, and crispiness (Barnett, 2020; Gerz & Fournier, 2006), was the second food to receive a GI protection, in October 2025.

Gari Sohoui Processing

The processing of cassava into gari is a highly gendered activity. No men in the study area were gari processors, and more broadly across the gari-making and consuming zone in West Africa the activity is carried out by women (Aminu et al., 2017). Gari Sohoui processors stated that processing is tedious and precise work that requires

[1] TRIPS is an agreement among World Trade Organization members that determines the minimum protection standards each member is to provide (World Trade Organization, n.d.).
[2] The Organization of African Intellectual Property (OAPI), established in 1977 with the Bangui Agreement, oversees all GI protection in Africa (Zografos, 2008).

training over time to master. One of its most crucial aspects is peeling all the cassava roots and grinding them on the harvest day or, at the latest, within two days of harvesting. This process is labor-intensive, making it necessary to recruit sufficient laborers. A complete production session could last up to a week depending on the number of laborers recruited, due to availability and cost. Figure 1 illustrates the steps taken to process harvested cassava into Gari Sohoui, a procedure performed to ensure a high-quality product with characteristic taste, texture, and aroma distinct from a more typical gari.

The sourness of Gari Sohoui fluctuates by the number of days that the ground, pressed cassava ferments before the garification or roasting stage (Figure 2). Draining the ground cassava also helps remove the cyanide compound in the cassava roots, which makes the gari bitter and is hazardous to human health.

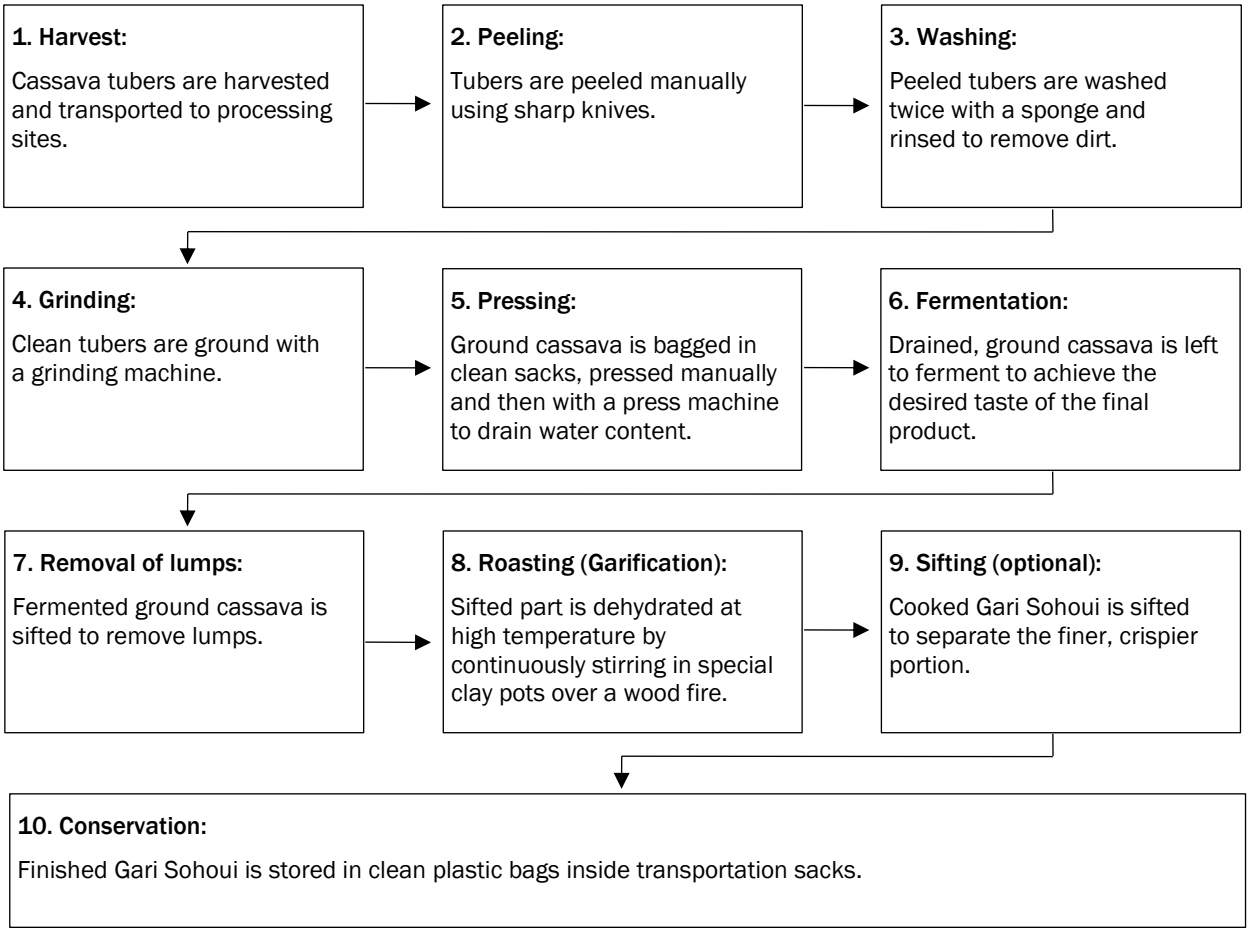
Most Gari Sohoui processors (63%) preferred to avoid the rainy season and start processing in November, while 37% worked year-round. Nonetheless, after the intensive farm work of planting and weeding that follows the first rains decreases, many women start processing cassava (Table 1).

Methodology

This study examines Gari Sohoui in the Savalou terroir and the possible implications of GI labeling for local communities' food sovereignty and Benin's food security. Savalou presents several characteristics that make it an appropriate location for this study: its location within the historical

Figure 1. Steps of Gari Sohoui Processing

Steps 1–10 show the required procedure to meet the Gari Sohoui standards for geographical indication protection labeling.



Source: Fieldwork, 2023

tuber production region band of Africa, its reputation as Gari Sohoui terroir, and author Guidimadjegbe's knowledge of the languages spoken in the area. In consultation with local extension experts responsible for agricultural development in Savalou, two specific villages, Médétékpo and Kpakpassa, were selected for the fieldwork based on cassava production and the potential access to the primary market in central Savalou.

Study Area

Savalou District is in central Benin, West Africa, at an altitude of 120 to 500 meters with ferruginous soil as the predominant soil (Bossa et al., 2012; Capo-Chichi, 2006). The climate is influenced by the annual movement of the inter-tropical convergence zone (ITCZ). The rainfall pattern in Savalou is bimodal with an average annual rainfall of 1,067 mm (Météo Benin, 2023). Cassava is one of the main food crops cultivated, along with maize, yam, and cowpea. Smallholder rainfed agriculture predominates in the region. In 2023, cassava in the Savalou Commune represented 14% of the total area of cassava in Collines Department and 3% of the country (Ministere de l'Agriculture, de l'Elevage, et la Peche (MAEP), 2024).

Data Collection and Analysis

This study used a mixed methods approach centered on empirical ethnographic fieldwork and secondary data. To include experienced growers of cassava and gari processors, the research was carried out with participants who had been active pro-

Figure 2. Roasting Step of Gari Sohoui Cooking
In Savalou, Gari Sohoui is cooked in a clay pot to process the distinctive food.



Source: Fieldwork, 2023

Table 1. Calendar of Gari Sohoui Processing
Some Gari Sohoui processors start in mid-June, early July, or August and continue work until the rainy season begins in February–April.

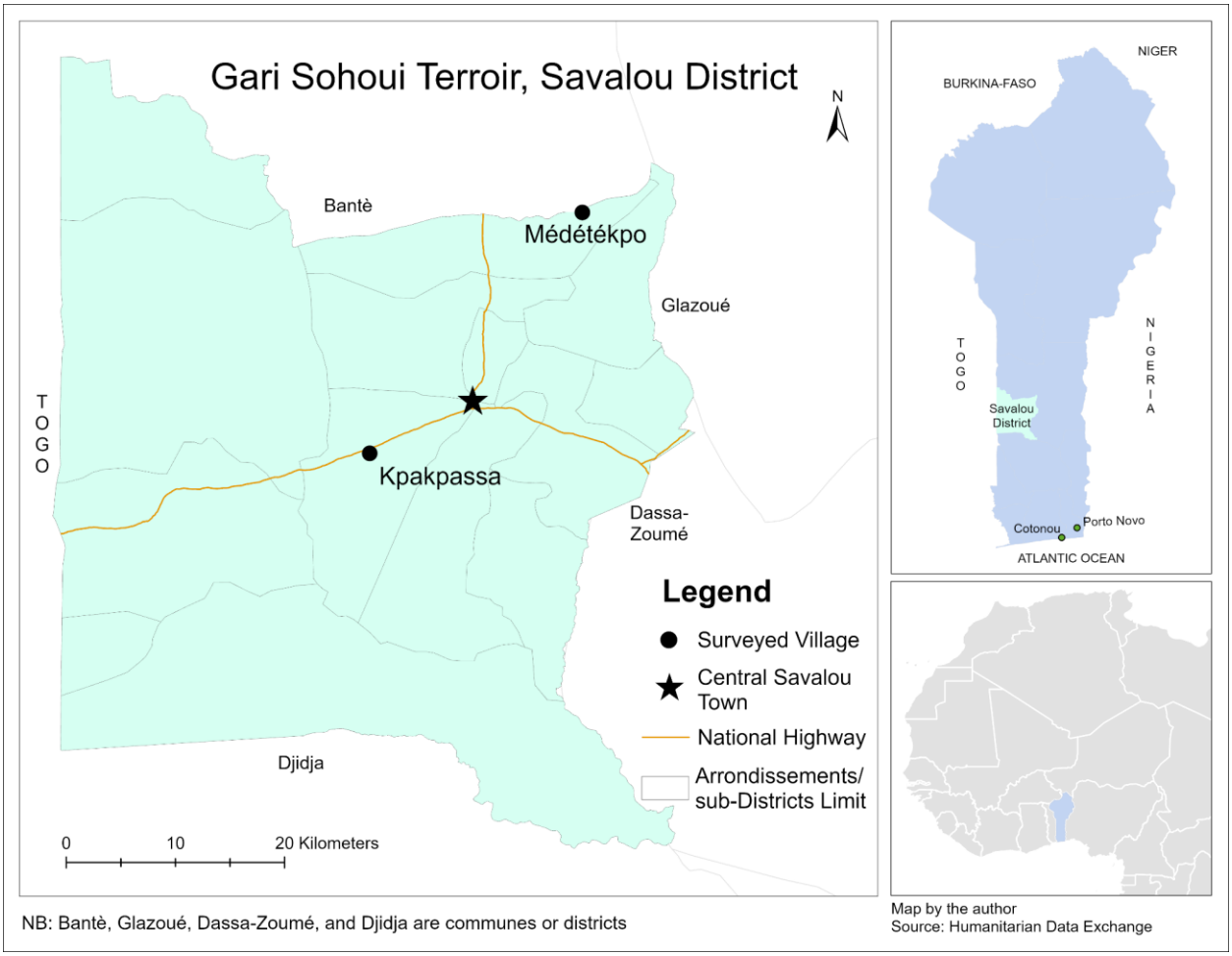
Processors	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Spt	Oct	Nov	Dec
37%												
63%						16%						
								20%				
											27%	

Source: Fieldwork, 2023

ducers for several years and involved in local groups that interacted with various stakeholders of the cassava value chain. A sample of 50 smallholder cassava farmer households, 25 from each village, and 30 Gari Sohoui processors were selected to participate in the study. Cassava farmers were randomly selected—every third name—from the combination of producer lists obtained at the local agricultural extension office and from producer associations in the two villages, Médétékpo and Kpakpassa (Figure 3). Kpakpassa is a relatively large village with an estimated population of 2,222, and Médétékpo is a smaller village with a population estimated at 1,377 (Unpublished village census, 2023). Kpakpassa is crossed by a national highway, and Médétékpo is approximately 15 km from the nearest highway (Figure 3). On the other hand, Gari Sohoui processors were recruited across the district following the snowball approach, with initial contacts through local informants and cassava farmers.

The data collected are based on individual in-depth, semi-structured interviews (45–60 minutes) to solicit participants' perspectives and experiences regarding farming practices, GI protection labeling, and food self-reliance. Participant observation in the field permitted contextualizing the interview data. The secondary data collected were from official reports (government and non-government) and scholarly works.

Figure 3. The Gari Sohoui Terroir, Savalou District Study Area
The Gari Sohoui terroir within the geographical indication-protection boundary includes the two surveyed villages and a central Savalou town where an agricultural extension office is located.



Source: Fieldwork, 2023.

Data analysis utilized the framework of inductive coding to avoid biased conclusions (Thomas, 2006). The categorizations formulated during the coding of the empirical data were triangulated with data obtained through interviews, observations, and reviewing secondary data.

Results

The following section summarizes the outcome of the data analysis. The findings suggest that agricultural development strategies and various socioeconomic circumstances lead smallholders to seek alternative farming practices. Often, these practices use chemical inputs that are expensive and potentially harmful to human health as well as disruptive to the agroecosystem. However, the benefits of protecting local food production through geographical indication labeling hold promise for better living conditions for rural Africa when smallholders are willing and able to adopt agroecological practices.

Cassava Farming Choices

Agroecological principles and practices are an integral part of local, traditional farming knowledge. Smallholder cassava producers interviewed in this study are willing to return to the fundamentals of those local farming methods they learned from their parents that resonate with their cultural identity, if they address the needs of their households.

Limits to Agroecological Practices in the Cassava Cropping System

Smallholder cassava producers in the Savalou District practice intercropping, rotation, and multicropping with cover crop systems, and their efficiency to help regenerate their soil is recognized by the study participants (Figure 4). However, not all farmers use these practices all the time.

Asked why they used herbicides in cassava production, most farmers responded that the use of chemical inputs on their farms for other crops, notably cotton, soybeans, and maize, led to using herbicide to clear plots for cassava cultivation and maintain them free of weeds. About 40% of all cassava producers interviewed applied herbicides to their cassava plots; most of the appliers were from Kpakpassa, compared to Médétékpo (Figure 5). This difference can be explained by the proximity of the highway that offers easy access to agricultural extensions that provides chemical inputs to farmers.

Study participants identified saving time and energy, and in addition expanding cultivated areas

Figure 4. Mixed Cropping System: (a) Goussi Melon, (b) Maize, and (c) Cassava
This illustrates the polyculture cropping system of Savalou cassava growers.



Source: Fieldwork, 2023.

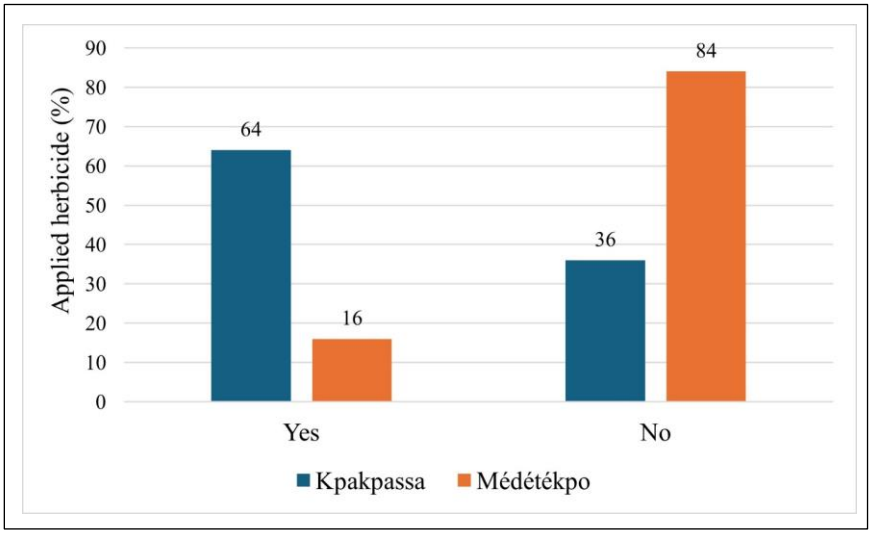
to multiple plots, as the main reasons for using herbicide on cassava plots. At Kpakpassa, 48% of the participants used herbicide to save time and energy while 16% used it to expand their cassava production plots. On the other hand, only 8% of the participants used herbicide for each reason at Médétékpo (Figure 6).

Herbicide use in cassava cropping is one of the ways that farmers mitigate the increasing expense of hiring workers caused by chronic labor shortages. Farmers turned to herbicide applications to minimize farming costs and try to make some profit. Consequently, most cassava producer households appear to be trapped in a vicious circle of herbicide usage. One of the leaders of a cassava producers' group at Kpakpassa stated:

> We do not have enough money to face the multiple duties of our time. Before, our parents did not have a strong attachment to money; they did not know money. They did not send their children to school and, therefore, only had a few expenses. The chemical inputs help us a lot with farm work.

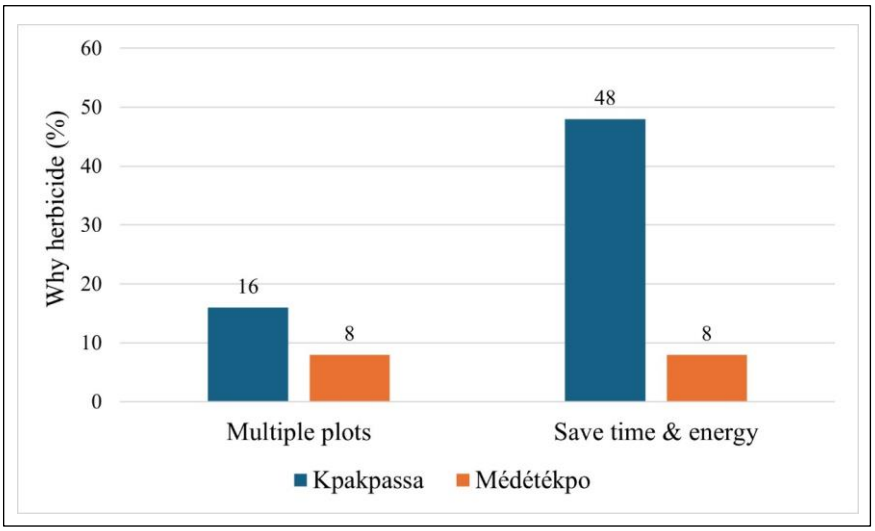
Several farmers said that if they did not manage their farm work wisely now, they would later spend all their income at hospitals and would have to go into debt or beg for food to survive. Therefore, herbicide use saves both time and energy while enabling cultivating several plots. Figure 7 shows the central role of herbicide use in cassava-producing farming systems. Farmers also noted that recurrent poor weather in recent years has led some to take off-farm activities such as driving *Zemidjan*[3] and regular taxis, or engaging in small-

Figure 5. Herbicide Usage by Survey Participants (*N* = 25 per village)
Highway access and proximity to government agricultural office accounts for greater use of herbicides in Kpakpassa.



Source: Fieldwork, 2023.

Figure 6. Main Reasons for Herbicide Usage (*N* = 25 per village)
Herbicides saved time and energy and allowed farmers to expand their crop area.



Source: Fieldwork, 2023.

[3] *Zemidjan* is a local system of moto-taxis that offers job opportunities popular among the unemployed.

scale commerce or craft making, which reduce the usual time allocated to farm work. These off-farm activities are meant to supplement incomes to cover household and herbicide expenses.

Despite these understandable reasons behind the widespread use of herbicide in cassava cropping systems, about a quarter of the surveyed herbicide users stated that they were aware of the negative impacts of the chemical input on their personal health, farmland health, and the quality of the cassava (taste and size). These consequences predisposed the cassava farmers to any alternative practices capable of boosting yield, as well as efficiently preserving the quality of their cassava so as to maintain the reputation of Gari Sohoui.

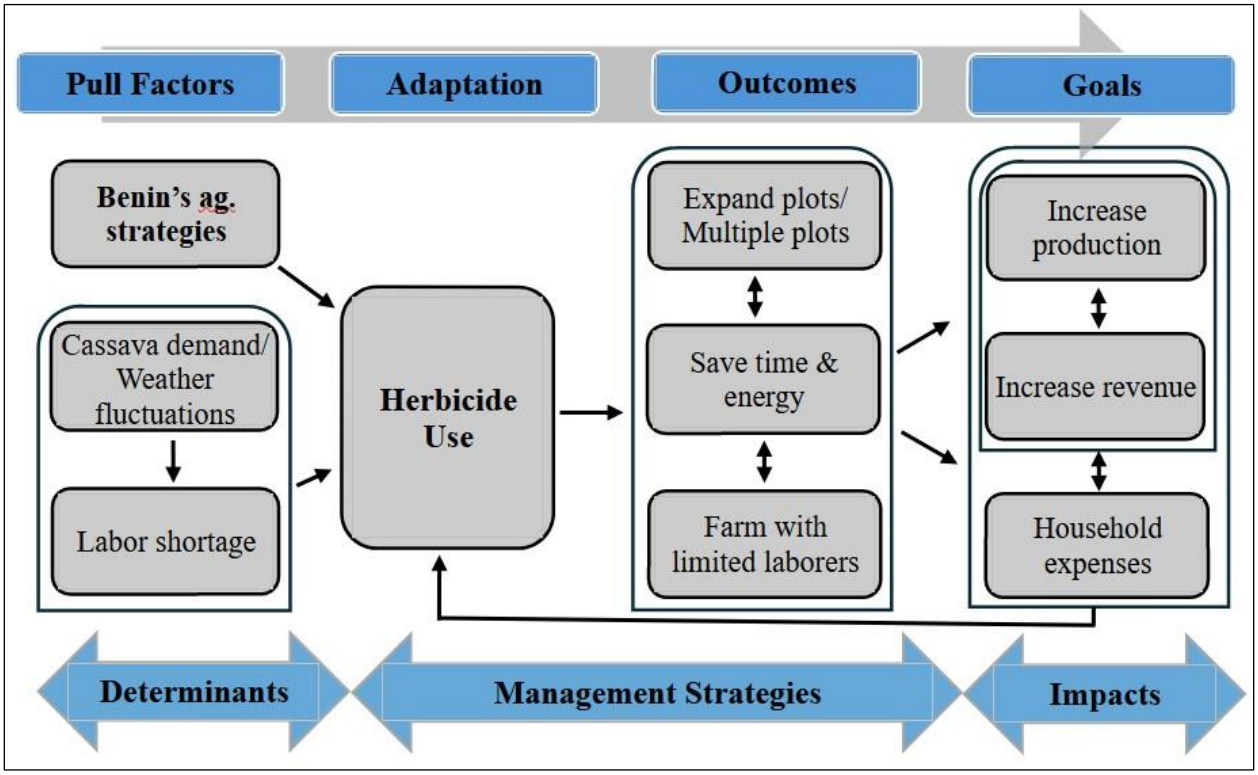
Agroecological Knowledge Among Smallholders

Most cassava producers interviewed (82%) said that they were aware of the potential benefits of chemical-free agriculture as well as expressed their desire to transition to agroecological farming practices, which they referred to as "organic farming." While both villages expressed great interest in agroecological practices, cassava farmers at Médétékpo showed a higher interest compared to Kpakpassa, with 88% and 76% respectively. Three reasons explain the attraction of these farmers to environmentally friendly farming practices: 1) negative impacts of chemical inputs on human and soil health, 2) chemical input costs, and 3) experience with agroecological practices in the past. The high cost of herbicides is the leading reason for wanting to transition in Médétékpo, whereas at Kpakpassa it is the negative impact on health that constitutes participants' greatest concern (Figure 8). This finding can be explained by the accessibility of the herbicides. The long distance between Médétékpo and the highway made herbicides less accessible and more expensive. Farmers thus embraced the more agroecological practices already embedded in their culture because they were less expensive.

There were multiple occasions, during public

Figure 7. Overview of Herbicide Usage Pull Factors

This diagram illustrates decision-making frameworks for herbicide applications among cassava producers in the Savalou area.



Source: Fieldwork, 2023.

meetings and farm visits, when interviewees complained about the rapid degradation of their farmland soil, the need to keep increasing the quantity of chemical use, and access to cost-effective alternatives to chemical input. These perceptions are illustrated in the following statements:

> Chemical inputs kill our farmlands; because of this problem, farmers work on multiple fields in and around the village. …
>
> Chemical inputs destroy our farmland's quality, vegetation, and health, but we cannot abandon them except if we have alternative practices to restore our fields.

A cassava producer household would spend an average of 17,500 FCFA (about US$30) per hectare annually on herbicide when opting for that strategy. While this amount is not only exorbitant for the purchasing power of Benin smallholders, herbicides also expose farmers to toxic glyphosate compounds. Glyphosate-based herbicides are known to be unsafe for human, animal, and plant health. According to the World Health Organization's International Agency for Research on Cancer, glyphosate is carcinogenic to humans (Myers et al., 2016). Furthermore, research on glyphosate effects on aquatic life in Benin shows that prolonged glyphosate exposure can result in memory loss, liver, kidney, and cardiac system damage, perturbation in reproduction, growth, and death to fish, aquatic invertebrates, and amphibians (Agbohessi & Toko, 2021).

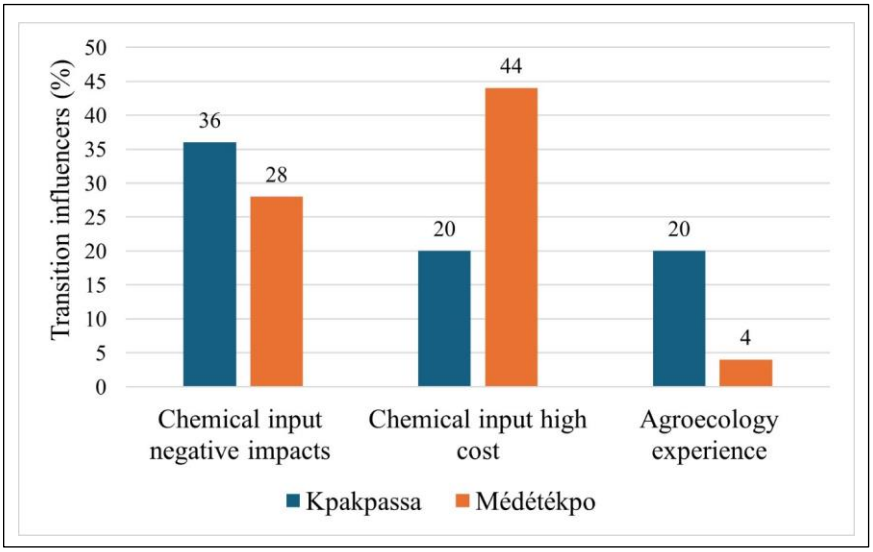
Because of these potential hazards, glyphosate-based herbicides have been banned or restricted in several countries in the EU, the Americas, and Asia (Alcantara-de la Cruz et al., 2021; Marambe & Herath, 2020; Székács & Darvas, 2018). Nevertheless, sub-Saharan countries have been reluctant to restrict glyphosate because it allows farmers to grow more by saving time and labor costs for weeding (Grabowski & Jayne, 2016; Snyder et al., 2015). The persistence of herbicide use in the study area was a clear expression of the absence of credible environmentally friendly and healthier alternative practices because all farmers interviewed stated that they avoided all contact between chemical inputs and planted cassava cuttings or shoots to preserve the quality of their cassava roots.

Determining Factors in a Smooth Transition to Agroecological Practices

Most cassava producers interviewed wanted to transition to alternatives, such as the implementation of agroecological practices. However, in both villages, 72% at Kpakpassa and 88% at Médétékpo, interviewees stated that they would transition only with a guarantee of "success." Two fundamental conditions would enable successful transition to agroecological practices among cassava producers in the study area: (1) efficiency—inhibiting weed growth—of proposed agroecological practices, and (2) accessibility—being affordable and available at village level—of these practices. Efficiency of the

Figure 8. Reasons for Preference to Transition to an Agroecological Approach (*N* = 25 per Village)

The graph highlights factors that motivated cassava farmers to prefer agroecological practices.



Source: Fieldwork, 2023.

agroecological practices represents a crucial motivation to transition in both villages (Figure 9).

Several interviewees commented that agroecological practices that had been initiated in the villages by the ProSOL[4] project failed due to unprecedented rainfall shortly after their introduction and lack of follow-up from the project promoters. After the misfortune with the project, the few households involved were reluctant to continue implementing these practices or to enroll in new programs. Households that had resisted implementing the ProSOL project before it even started became the most reticent to the idea of abandoning the use of chemical inputs. However, the possibility of natural regeneration of depleted soil fertility and enhancement of crop yields associated with the ProSOL project, combined with the possibility of preserving human health, resonated with the aspirations of the study participants. Cassava growers in both villages made clear their interest in cost-effective organic practices, even if initial investment may cost slightly more than chemical inputs. Growers were convinced that their initial investment would pay for itself in the long run. One of the oldest and most experienced cassava producers interviewed asserted:

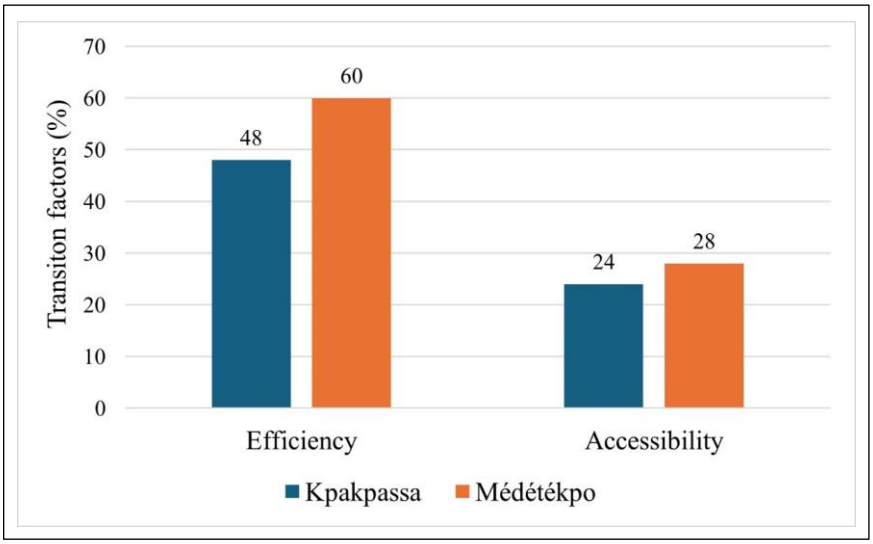
> Local traditional practices are better than [chemical] even though they do not yield as much. We are doing the current practices because they make our work easier. If there are organic practices that do not degrade farmland, like chemical inputs, I will take it even if it will cost me a bit more.

Geographical Indication (GI) Protection

Interviewees indicated that when the cassava tubers contact any chemical inputs, they lose the qualities that set Gari Sohoui apart from other garis produced in other parts of Benin and other countries. Therefore, cassava and Gari Sohoui producers ensure that the cassava tubers intended for their gari processing stay as chemical-free as possible. This increasing emphasis by Gari Sohoui processors could provide an additional reason for cassava growers to avoid chemical inputs. GI protection offers a unique opportunity for local communities in the sub-Saharian region to regain autonomy over the farming practices they utilize and the crops they produce. The participants of this study

Figure 9. Agroecological Practices Adoption Determinants (*N* = 25 per village)

Cassava producers emphasize efficiency and accessibility as factors necessary for successful transition to agroecological practices.



Source: Fieldwork, 2023.

[4] ProSOL is the Soil Protection and Rehabilitation for Food Security project co-funded by the European Union and the Gates Foundation, and monitored by GIZ of Germany. The program trained smallholders in agroecological techniques to protect their soil from erosion and to enhance its quality. Among other soil protection practices, the project introduced cover crops such as *Mucuna pruriens* in some villages. ProSOL has been implemented in Benin, Burkina Faso, Ethiopia, India, Kenya, Madagascar, and Tunisia. In Benin, the ProSOL program ended in June 2024 after a decade (Deutsche Gesellschaft für Internationale Zusammenarbeit [(GIZ]), 2023).

expressed their firm intention to leverage the GI initiative to tap into the potential market it represents, as well as to protect the quality of the soil in their fields.

Factors Influencing Women to Become Processors

Results indicate that diverse factors influence women's decisions to become processors. Half of the interviewees (50%) pursued Gari Sohoui processing to perpetuate their mothers' legacy, and 23% of the interviewees were attracted by the financial independence associated with processing. Additionally, the popularity of Gari Sohoui processing, its contribution to the diets of household members, and the income generated from its sale constitute decision-making factors in the study area for becoming Gari Sohoui processors (Figure 10). Among those women who started processing cassava within the last decade, most were attracted by the possibility of becoming financially independent. However, women who had been processing cassava for more than ten years were motivated by its role in their household well-being. In Savalou, where most women are involved in Gari Sohoui processing, this activity offers financial independence and diet stability to their households.

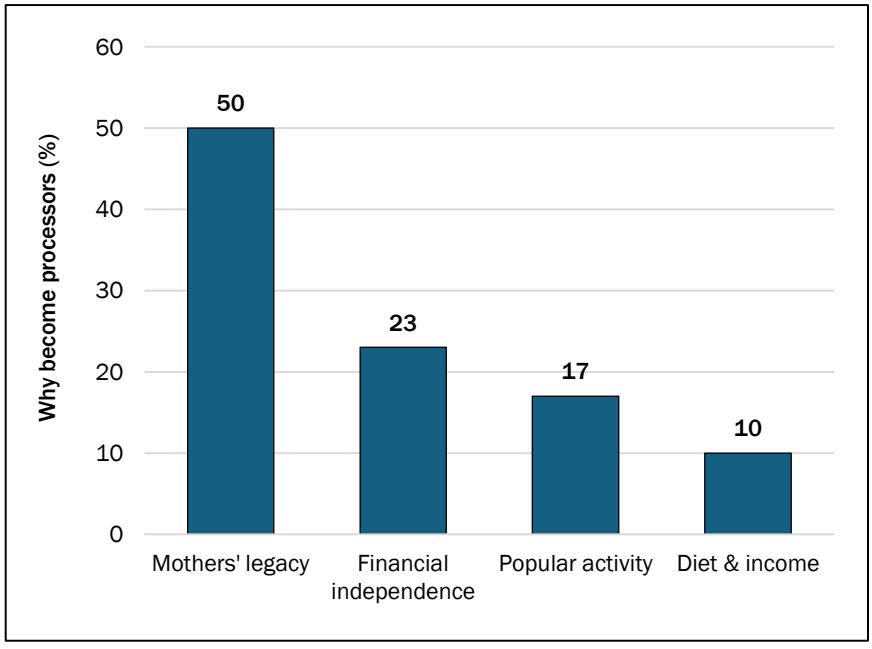
Foreseen Advantages of the GI Foreseen by Processors

Interviews indicated that only half of the Gari Sohoui processors who participated in the study knew about the GI initiative for their unique product; the code of practice was validated in November 2017. The low level of formal education of the women contributes to their lack of information about the GI initiative. Among those who had heard of GI, most had learned of it from the radio, from relatives, in village groups, or at the Savalou market. The two interviewees who had finished middle school actively participated in the procedures to enact the GI protection for Gari Sohoui. Nonetheless, all Gari Sohoui processors had enthusiastic perspectives on the potential of GI protection for their local product, perspectives that centered on three major potential advantages of GI protection for their livelihoods and locality: (1) all processors expected an increase in income, (2) about 75% emphasized protecting their gari's reputation, and (3) approximately half stated that their new purchasing power would allow them to participate in the development of their locality and the country.

Discussing the potential of a Gari Sohoui GI, the excitement of the participants suggested that they were eager to see it established, as they predicted its positive impact on their lives. Some participants reported that it would enhance their livelihoods and their people's well-being. These sentiments are expressed by the following excerpts from interview data:

> It is a very good influence for us—more and bigger markets for good prices. It means well-being for us.

Figure 10. Gari Sohoui Processors' Objectives (*N* = 30)
Four main factors motivate Savalou women to become Gari Sohoui processors.



Source: Fieldwork, 2023.

> This protection will be good as our gari price will increase. It will bring well-being for us, our household, and the community.

Initial Socio-Economic Impacts of the GI

Even before its official GI labelling in October 2025, the advent of GI protection for Gari Sohoui had already led to the creation of Gari Sohoui processing groups across the Savalou district, where women involved in the practice were coming together for mutual aid and cooperation. While several of these groups have been processing Gari Sohoui in the manner recommended by the GI protocols, others are actively working on meeting the requirements. Although all individuals in these groups did not participate directly in the GI discussion at the district level, they relied on the leaders of their cooperatives to represent them. Being Gari Sohoui processors in the Savalou area does not automatically make them members of a GI cooperative association. A processor who wishes to participate in the GI initiative must request admittance by providing the required documentation and fees. Once accepted, members must pay an annual fee and become guardians of Gari Sohoui GI protection in space and time.

Members must respect the standards and regulations set for the product, or they may be refused participation in the GI initiative. All standards are written in the organization's approved protocol,[5] which protects Gari Sohoui's reputation and recognizes the Savalou commune as the sole Gari Sohoui terroir. Gari Sohoui can only be GI-protected "Gari Sohoui of Savalou" if all activities related to the processing, from root peeling to cooking, are done within the boundaries of Savalou. Before final marketing, a GI protection control center located within Savalou Commune, seals the packages.

Across the commune, several processor groups have already benefited from modern kitchens financed by donors. Médétékpo village has obtained a kitchen that is equipped to process the cassava at each step, including grinding and pressing machines and a well for water access (Figure 11). Some groups and even individuals have already created personalized packaging for their products, available in private stores and on stands during local, regional, and national fairs. These fairs give publicity to Gari Sohoui and permit processors to connect with potential new clients, allowing them to increase their revenue.

Discussion

Gari Sohoui was recognized by the Organisation Africaine de la Propriété Intellectulle (OAPI) and

Figure 11. Modern Kitchen for Cassava Processors at Médétékpo
In the middle is the main kitchen building, and on the right is the clean water well. It was funded by the United States African Development Foundation and the Benin government.



Source: Photo by authors during fieldwork, 2023.

[5] Document obtained from the Gari Sohoui of Savalou Defense Group.

received a GI label on October 18, 2025. The new status for Gari Sohoui has the potential to empower women processors, as their product will now receive additional governmental support for introduction and expansion into new, bigger markets, both regionally and internationally. The *Ananas Pain du Sucre d'Allada* received similar support after its GI labeling in 2020 and has been introduced to markets such as the EU and China. GI label protection for Gari Sohoui suggests new profitable markets and increased purchasing power for its processors.

The revenue opportunity for women processors bodes well for men growing cassava in Savalou because it also expands the demand for the raw material, fresh cassava. There is potential for cassava producers to participate in and profit from the success of GI as cassava sales to women processors increase over time, increasing their revenue. The growth of Gari Sohoui through GI protection has the potential to enhance the income of actors along the value chain, including traders and retailers.

While my interviews in the two case study villages revealed no opposition to the GI protection for Gari Sohoui, some were more enthusiastic than others. The GI protection label for Gari Sohoui does not prohibit the production and sale of Gari Sohoui without a GI label. Gari Sohoui producers whose gari does not have the GI label will likely also benefit, however, because of the advertising surrounding the GI-protected Gari Sohoui.

The benefits of GI protection for other agricultural products in Africa have been documented in Cameroon (Ingram et al., 2020). Investigating *Oku* white honey from the Northwest region of Cameroon, Ingram et al. found that after GI protection in 2013, its price increased rapidly, accompanied by an augmentation of volume sold. Similar positive impacts of GI were noted in India by Pant (2015). GI protection facilitated access to markets at reasonable prices while supporting local knowledge.

For the GI-labeled Gari Sohoui to yield similar outcomes, farmers and processors need to continue maintaining the quality of their distinctive product, and the government should create a legal framework with deterrent judicial instruments to discourage counterfeit, theft, usurpation, and profit capturing, and develop an efficient marketing strategy to position the product. With the economic opportunity GI protection offers, local producers gain a reliable source of income to meet the other expenses in their lives—better houses, keeping children at school, and meeting health care costs.

Gari Sohoui GI quality (taste, texture, aroma, and crispiness) is intrinsically linked to the traditional processing techniques, associated with local ecological knowledge. Cassava farmers and processors unanimously insisted that the quality recognized by the GI is guaranteed when cassava tubers do not come in contact with chemical inputs. However, increased herbicide use due to labor shortages in the Commune cropping systems could represent a serious obstacle to GI success, jeopardizing the reputation of Gari Sohoui. GI-protected Gari Sohoui offers an incentive to decrease or stop the use of herbicides. Farmers in the two study villages already would prefer to abandon herbicides, aware of health challenges and costs associated with their use in their fields. This perspective will encourage agroecological practices in cassava cropping systems and may progressively expand to other cropping systems. For example, as a result, farmers using cover crops would save on weeding expenses—herbicide purchase and hired laborers—and increase their revenue and capacity to meet their household needs.

By relying on one another, producers using agroecological practices foster an atmosphere in which processors and consumers are proud of their unique traditional products. This positivity has the potential to bring about constructive outcomes within distinctive GI-protected terroirs such as the Gari Sohoui Commune: social cohesion, employment creation, food self-reliance, and a decrease in rural exodus. Such potential shifts may sway the thoughts of young African people who are considering out-migration to cities and even to Europe, a problem that has increased in the last decade (Hassan & Abubakar, 2024). These foreseen benefits of GI protection align with findings by Samardzic et al. (2013) and Ngo Bagal and Vittori (2011) on the social impacts of GI products. The former found that GI protections are associated with

social cohesion because producers work together; the latter found that GI contributed to preserving natural ecosystems and local knowledge, as well as increasing production, creating jobs, and slowing rural exodus.

Capacity of GI protection to encourage the use of principles based on agroecological practices, such as cover crops, minimal to no tilling, mixed cropping, and organic inputs, promotes and preserves local knowledge, strengthens national identity and cultural pride, and preserves gastronomic heritage. GI protection thus espouses the principles of food sovereignty that advocate democratizing food production, centering local control and local food rights, recognizing local knowledge, and promoting agroecological farming practices. GI can benefit communities in developing countries, particularly in sub-Saharan Africa where local generational knowledge constitutes a significant sense of identity among Indigenous communities.

Limitations

The sample size of 50 farmers from two villages and 30 processors from the entire district (14 villages) could limit the capture of more detailed data on producer and processor perspectives. The villages were selected because of their cassava production and access to the main market. While their characteristics are highly representative, based on the country as a whole, they are in the end just two villages. The data collected do not try to establish a statistical representation of cassava or Gari Sohoui production in Savalou or Benin. Rather, we have taken care to select them in order to gather insightful qualitative data. Also, as Gari Sohoui has just officially received its GI label, the findings may not fully capture its impact on communities. For Gari Sohoui, the study emphasizes the perspectives of women processors on the GI initiative but does not explore in detail the perspectives of farmers. Nonetheless, these limitations do not decrease the significance of the findings. The ethnographic and triangulation methods that were used seek to assess the diversity of perspectives in the communities.

Conclusion

Achieving food sovereignty requires protecting culturally significant foods, such as Gari Sohoui, that people enjoy and that serve as an important source of nutrition. The texture and crispiness of Gari Sohoui produced in Savalou has garnered a reputation that none of the ordinary generic garis have ever received on the African continent, especially in Benin (Fournier, 2010). Since GI protections contribute to conserving and perpetuating the uniqueness of traditional products (Belletti et al., 2017), Gari Sohoui acquiring GI protection is a form of validation of the terroir product, the region's cultural identity, and the cultural landscape the communities have created.

In the present world, where modernity promotes chemical-based farming, especially in sub-Saharan Africa, producing cassava according to principles based on agroecological practices—the use of cover crops, minimal to no tilling, mixed-cropping, and organic inputs— can progressively remove herbicides from the cassava cropping system. The GI initiative for Gari Sohoui of Savalou shows potential to enhance farmers' livelihoods through reducing expenses and increasing the supply of cassava to processors, while allowing them to achieve food self-reliance.

Gari Sohoui processing is a highly gendered activity that daughters inherit from their mothers. About half of the interviewees were processing as their mothers did. In sub-Saharan Africa, where women are often marginalized and without a steady income source, GI protection for distinctive foods such as Gari Sohoui implies empowering women. As expressed by an experienced processor interviewed, GI protection for Gari Sohoui means "more money [through access to new markets] for the well-being of our households and for the country as well." The generated "gari-money" will not only stimulate the development of the economy at the village level but also help improve the welfare of rural households, from heads of households acquiring capacity to build brick houses, to individuals buying new motorcycles or paying off debts. It also helps women acquire financial independence and participate in their household expenses, as well as with keeping children at school until graduation (Field data, 2023).

The interviews with cassava growers and Gari Sohoui producers found a dilemma created by the use of herbicide in the cassava cropping system

simultaneously with the need to preserve the quality of Gari Sohoui GI. At this early stage of GI implementation, this tension is a signal that all parties need to work together, especially in response to the government's agricultural development strategy focusing on chemical inputs to increase the productivity of cash crops. The local ecological knowledge of cassava farming offers some alternatives capable of limiting the use of herbicide and maintaining the quality of cassava to be processed into Gari Sohoui. Until a radical change in agricultural development policy, local cassava growers and processors may need to strategize together to progressively eliminate herbicide use from the cassava cropping system and maintain the reputation of their Gari Sohoui.



Acknowledgments

We would like to thank the following people for their assistance: Ambroise Ahonanhin, Anatole Zanou, Dossou Delidji, Xavier Agbeyohoue, Pamphile Yetondji, Kouame Lateyi, Aboubakar Kpatinde, Albert Amouzou, Martine Gbaguidi, Rigobert Dognon, Jean-Luc Akpovi, August Sacramento, and all the participants. We appreciate Dr. Demian Hommel reading the final draft.

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Journal of Agriculture, Food Systems, and Community Development
ISSN: 2152-0801 online
https://foodsystemsjournal.org

Impact of conflict on Lebanon's food industry: Challenges, needs, and emergency response

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Submitted October 10, 2025 / Revised January 12, January 23, and January 30, 2026 / Accepted February 3, 2026 / Published online April 3, 2026

Citation: Issa, A., Merhi, S., El Hayek Fares, J., Yazbeck, E. B., & Zeidan, M. B. (2026). Impact of conflict on Lebanon's food industry: Challenges, needs, and emergency response. *Journal of Agriculture, Food Systems, and Community Development*, *15*(2), 315–334. https://doi.org/10.5304/jafscd.2026.152.017

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Abstract

Against the backdrop of compounded crises, economic collapse, COVID-19, and violent conflict, Lebanon's food system has become increasingly vulnerable. This study examines war's impact on Lebanon's agri-food small and medium enterprises (SMEs), the backbone of its food industry and economic resilience. This study evaluates the impact of war on operational aspects and identifies key recovery priorities by employing a quantitative survey of members of the QOOT cluster, Lebanon's leading agri-food business network. The results show widespread disruption, with significant challenges in financial performance and market access. Other major concerns include supply chain disruptions, workforce issues, and infrastructure damage. Key business needs identified include emergency financial assistance, alternative market and supplier connections, enhanced workforce safety, and infra-

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Disclosures etc. are on the next page

structural support. The findings reveal vulnerability in Lebanon's agricultural sector due to geopolitical shocks and the urgent need for emergency responses focusing on resilience, diversification, workforce protection, and infrastructure. This research guides humanitarian and development efforts to safeguard food security and economic sustainability.

Keywords
sustainability, food industry, agri-food enterprises, small businesses, emergency preparedness, conflict zones, risk, challenges, Lebanon

Introduction

Food systems face unprecedented threats due to multiple crises: COVID-19, violent conflicts, economic downturns (particularly domestic food price inflation), and devastating climate extremes (United Nations Industrial Development Organization [UNIDO], 2023). These crises have prompted failures across global food systems and supply chains, fueling hunger and limiting livelihoods, resulting in the worst food crisis in human history (World Bank, 2023). These interlinked disruptions directly undermine Sustainable Development Goal 2 (Zero Hunger) by reversing progress on ending hunger, achieving food security, and improving nutrition worldwide (Atukunda et al., 2021).

The efforts toward global food security have been reversed since the COVID-19 pandemic and exacerbated due to several political conflicts, which have added 200 million people to the pre-COVID global food-insecure population (World Food Programme [WFP], 2025). Worldwide, violent conflicts account for 95% of displaced people (94% of whom reside in climate-vulnerable areas) and were a significant contributor to food insecurity (UN High Commissioner for Refugees [UNHCR], 2024). Based on the most recent data, in 2022, about 2.4 billion people were either moderately or severely food insecure, and more than 3.1 billion could not afford a healthy diet (Food and Agriculture Organization of the United Nations [FAO] et al., 2023).

Lebanon exemplifies the devastating interplay of these global challenges. Since 2019, Lebanon has been hit by the most devastating multipronged crisis in its modern history. The country is facing an unfolding economic and financial crisis, with the national currency losing over 90% of its value since October 2019 and with food inflation soaring 5,000% compared to pre-COVID levels (Human Rights Watch, 2022). The health impact of the COVID-19 pandemic, compounded by the devastating Beirut Port explosion in August 2020, has further strained the country, which was already facing sustained structural and resource pressures, including those associated with the prolonged Syrian refugee crisis and ongoing governance challenges (World Bank, 2025). This economic freefall has intensified the country's struggle to provide for its citizens, creating a vicious cycle of poverty, unemployment, and widespread hunger. Poverty has more than tripled over the past decade (World Bank, 2024).

According to the Integrated Food Security Phase Classification (IPC, 2025), acute food insecurity across the country led to 50%of Lebanese families (13%) being food insecure and unable to put food on their tables, while 29% of the population—1.65 million people—faced acute hunger. This precarious situation was exacerbated by the recent escalation in the last quarter of 2024, which included bombardment and ground operations that damaged and affected main agricultural lands in the south of Lebanon, the Bekaa Valley, and Baalbek-Hermel (considered the reservoir for staple food and location of major food industries), disrupting supply chain operations across the country (Dal et al., 2021). These developments intensified the pressure on an already susceptible agri-food sector composed mainly of small and medium-sized enterprises (SMEs) (UN Development Programme [UNDP], 2024). SMEs are key drivers of Lebanon's economy, accounting for 95% of businesses and employing half of the workforce (Farran &

Funding Disclosure
This research did not receive any specific grant.

Declaration of Competing Interest
The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data Availability
Data available upon request.

Fawaz, 2018). SMEs historically account for over 50% of the labor force and contribute around 40% of economic output. Globally, agri-food systems accounted for around 39% of the global workforce in 2021. In agri-food systems, SMEs also form a major component of the agricultural and food value chain, often representing the majority of enterprises and employing a significant share of the workforce. This is particularly the case in the low- and middle-income regions, where agri-food activities constitute a large portion of total employment and economic activity (FAO, 2024). SMEs thrive with support from several initiatives, including financial institutions, accelerators, and venture capital firms (UNDP, 2025). However, the economic freefall, hyperinflation, capital controls, and sociopolitical unrest have severely undermined the resilience of these enterprises. As key drivers of economic growth and job creation, the weakening of SMEs poses a serious threat to Lebanon's ability to sustain its food systems and broader economy.

Since 2019, several international entities, such as the U.S. Agency for International Development (USAID), UNDP, the European Bank for Reconstruction and Development (EBRD), and the Embassy of the Netherlands, among others, have provided unique programs and funding opportunities to enhance the competitiveness, sustainability, and innovation of agri-food SMEs (UNDP, 2025). Among these initiatives, the QOOT Agri-Food Innovation Cluster was initiated in 2019 by Berytech and the Embassy of the Kingdom of the Netherlands. QOOT is Lebanon's leading agri-food cluster, catalyzing sustainable growth, enhancing capabilities and competitiveness, and opening world markets to Lebanese agri-food businesses. Although these strategies have the potential to support the agri-food sector, Lebanon continues to face persistent challenges due to unstable geopolitical conditions and ongoing financial difficulties (QOOT, n.d.). These factors create recurring obstacles that jeopardize the stability and growth of the sector, making it more vulnerable to external and internal shocks. Appendix 1 depicts a detailed timeline of Lebanon's conflict history from 2006 to 2025 to contextualize the compounded crises that have shaped the current socio-economic landscape.

This compounded crisis environment has severely strained Lebanon's agri-food sector, leading to heightened vulnerabilities for SMEs. Seventeen percent of the resident population in Lebanon (874,000 people), are facing high levels of acute food insecurity, a figure projected to rise as humanitarian funding declines (IPC, 2025).

These disruptions in the agri-food sector have disproportionately impacted SMEs, which are vital to Lebanon's economy, providing jobs and contributing to food systems stability. Consequently, this study aimed to identify the challenges faced by agri-food sector SMEs in the QOOT cluster during conflict and to provide actionable insights for future interventions to enhance their adaptive capacity and support their critical role in sustaining Lebanon's economy and food systems.

Methodology

This section outlines the methodological approach adopted to examine the impact of war on SMEs in Lebanon's agri-food sector. It describes the study design, questionnaire development, survey dissemination and data collection procedures, methods of data analysis, and ethical considerations that guided the conduct of the study.

Research Design

This study employed a quantitative research design to investigate how war has affected SMEs in the agri-food sector in Lebanon. A cross-sectional study recruited SMEs in the agri-food business across Lebanon that are members of the QOOT Cluster. An initial online meeting with Cluster members was held to align on the research topic and identify their needs, which facilitated a more targeted approach to data collection. Based on the meeting outcome, a structured questionnaire was designed as a primary data collection tool to gather insights from SMEs in the QOOT Cluster.

Questionnaire Development

The questionnaire was developed based on extensive literature pertinent to the impact of war on SMEs in the agri-food sector (International Trade Centre, 2023).

The questionnaire contained two main sections: (1) questions related to respondents and company information, and (2) Likert-scale ques-

tions assessing the impact of war on the SME across different business areas, including infrastructure, finance, supply-chain and procurement processes, human resources, and market access. In addition, it assessed company needs in each area. Prior to the full-scale deployment of the questionnaire, a pilot test was conducted to evaluate its clarity, relevance, and overall effectiveness. This preliminary testing involved a sample of three participants drawn from the target population of food SMEs in the QOOT Cluster. The pilot test aimed to identify any ambiguities or issues in the questionnaire and to ensure that respondents understood the questions as intended. Feedback from these participants was collected and analyzed to further refine the questionnaire. The pilot test was carried out over one week, allowing sufficient time for participants to respond and provide insights. Based on their feedback, adjustments were made to improve the questions' clarity and relevance. This iterative process ensured that the final version of the questionnaire was well-structured and aligned with the research objectives.

Survey Dissemination and Data Collection Process

The survey was conducted using the Jotform platform, and the dissemination period lasted for one week, from October 4 to October 11, 2024. The questionnaire was disseminated to 135 members of the QOOT Cluster through two primary channels: email and WhatsApp. Out of the 135 questionnaires sent, 62 responses were received, indicating an acceptable level of engagement among participants.

Data Analysis

Quantitative data collected from the questionnaires were analyzed using Microsoft Excel for Microsoft 365 (Version 2601). Descriptive statistics were calculated to summarize demographic information and key variables related to the impact of war on SMEs.

Consent and Ethical Considerations

The data were collected to obtain insights from SMEs in the QOOT cluster in Lebanon without requiring prior consent, as QOOT routinely collects data from its members. Following the data collection, Notre Dame University–Louaize (NDU) secured institutional review board (IRB) approval for its use (IRB 202430).

Results

SME Characteristics

Out of 135 SMEs invited, a total of 62 companies participated, resulting in a response rate of 46%. Almost half were from the Mount Lebanon region (51.6%), 40% were medium-sized (11-50 employees), and 48.4% were food and beverage producing companies. The companies' characteristics are summarized in Table 1.

War's Impact on Financial Losses and Business Operations

Most companies reported being affected by the war (98.4%), among which 9.8% (n = 6) were directly affected through considerable damage to facilities and resources. In addition, 90.3% of the companies reported monetary losses during the war, of which 57.1% (n = 32) estimated their losses or additional expenses to be between US$10,000 and US$50,000.

Out of the various business dimensions affected during the war, the most frequently reported challenges were financial constraints (91.9%) (e.g., cash flow issues and limited access to credit) and reduced access to markets (91.9%) (see Figure 1). Supply-chain and procurement disruption followed, as it was reported to impact 74.2% of companies, while over half of respondents (51.6%) experienced issues related to human resources, such as employee safety and workforce availability. Production management disruption was reported by 33.9% of respondents, whereas infrastructure damage affected 16.1%.

Business Dimension Severities

Between 17 and 21% of the respondents reported a severe impact of the war on different business dimensions (Figure 2). Financial performance and access to markets were not only the most frequently reported challenges, but also the most significantly impacted, as reported by 66.7% and 63.1% of respondents, respectively. Moreover, nearly half (43.9%) of the respondents experienced significant

effects on staff-related issues such as employee availability and safety, and 34.8% considered the impact on their supply chain to be significant.

Table 1. Characteristics of the Responding Agri-food Small and Medium Enterprises (SMEs) (*N* = 62)

Variable	Frequency	Percentage
Location		
Mount Lebanon	32	52%
Bekaa	15	24%
South	6	10%
North	5	8%
Beirut	4	6%
Size		
Small (1–10 employees)	23	37%
Medium (11–50 employees)	25	40%
Large (51+ employees)	14	23%
SME Sub-Industry[a]		
Food	30	48%
Non-food[b]	22	36%
Unspecified[c]	10	16%
SMEs Affected by the War		
Yes	61	98.4%
No	1	1.6%
Directly Affected by the War		
Yes	6	9.8%
No	55	90.2%
Monetary Loss		
Yes	56	90.3%
No	6	9.7%
Ranges of Monetary Loss (US$)		
Less than $10,000	6	10.7%
$10,000–$50,000	32	57.1%
$50,000–$100,000	7	12.5%
$100,000–$250,000	6	10.7%
$250,000–$500,000	3	5.4%
More than $500,000	2	3.6%

[a] The types of firms are detailed in Appendix 2.
[b] Non-food refers to SME in the food sector working on software, equipment, and packaging materials or services.
[c] Unspecified refers to responses where participants selected "Other food products" without providing further details.

Impact of the War on Business Operations and Recovery Needs

Table 2 highlights the impact of the war on business operations and corresponding recovery needs across crucial functional areas. Our findings show that businesses faced the most acute challenges in financial performance, with 98% of respondents citing "cash flow problems due to reduced sales, low collection rate or increased costs" as the main issues; 68% cited "increased dependency on a single market," and 54% cited "difficulty in maintaining liquidity." The major financial need resulting from the war was establishing emergency funds or securing lines of credit (81%), in addition to access to alternative financial support such as bartering and in-kind trading (65%).

Participants also reported major market-related issues, with 82% affected by economic instability and 75% by changes in consumer behavior. The main reported needs included strengthening local and international market distribution (84%), diversifying market channels (68.4%), and partnering with humanitarian organizations (63.2%).

For the supply-chain and procurement processes, around 70% of the companies suffered from disruption in import routes and supplier relationships, along with shortages in raw materials and essential inputs. The major needs to overcome these issues were securing raw material sources and alternative suppliers (67.4%) and partnering with local suppliers (43.5%).

Further, in the area of human resources and availability of the workforce, participants raised concerns about their staff members' physical and mental safety (34%) and disrupted access to the workplace (34%). The companies stressed the need to provide safety nets for workers (65.6%) and to develop a staffing contingency plan (46.9%).

Specific Needs Related to Infrastructure, Financial Support, and Supply Chain

Table 2 also provides detailed insights into the specific recovery needs across financial struggles, market access, supply chain challenges, human resources, and infrastructure. These included:

- Financial Struggles: Establishing emergency funds (81%) and access to alternative financial

support, such as bartering and in-kind trading (65%).
- Supply-Chain Needs: Securing sources of raw material and alternative suppliers (67.4%) and forming partnerships with local suppliers (43.5%).
- Human Resources: Providing safety nets for workers (66%), developing staffing contingency plans (47%), and providing mental health and wellness support (44%).
- Infrastructure: Increased diesel supply (70%), relocation of production or storage sites (70%), and insurance for facilities (60%).

Figure 1. Business Dimensions Affected by the War (*N* = 62)

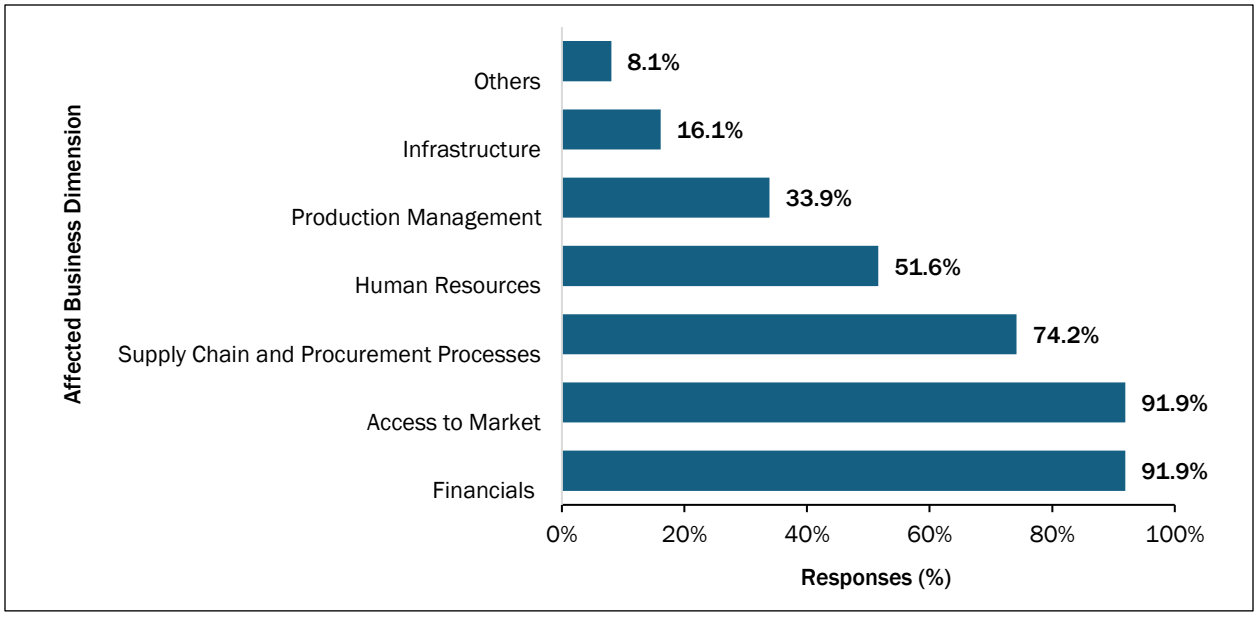


Figure 2. Severity of Impact on Different Business Dimensions During the War (*N* = 62)

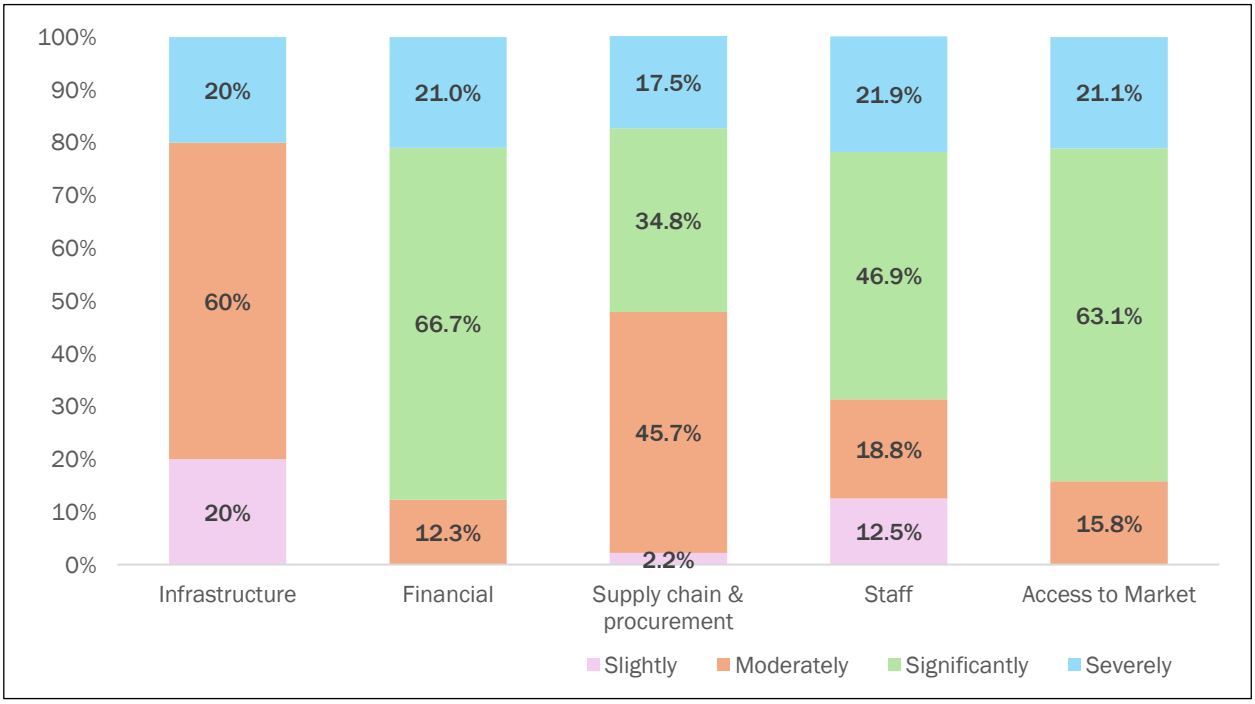


Table 2. Impact of the War on Business Operations and Corresponding Recovery Needs across Key Functional Areas (*N* = 62)

	Responses	
	Frequency	Percent
Financial Struggles		
Cash flow problems due to reduced sales, low collection rate, or increased costs	56	98%
Increased dependency on a single market	39	68
Difficulty maintaining liquidity	31	54
Difficulty accessing emergency funds	25	44
Difficulty in cost control and expenditure tightening	24	42
Financial Needs		
Establishment of emergency funds or securing lines of credit	46	81%
Access to alternative financial support (bartering and in-kind trading)	37	65
Support in developing cost control strategies and cash flow forecasting	28	49
Support in financial planning—contingency plan	26	46
Challenges in Access to Markets		
Economic instability affecting market demand and sales	47	82%
Changes in consumer behavior impacting product demand	43	75
Disruption of access to local markets due to damaged infrastructure or blockades	36	63
Disruption of access to international markets due to trade restrictions or instability	32	56
Needs Related to Access to Markets		
Strengthening local and international market distribution	48	84%
Diversifying market channels (e.g., e-commerce, direct-to-consumer sales)	39	68
Partnering with humanitarian organizations for product distribution	36	63
Linking with local partners or peers to enhance product distribution	32	56
Leveraging digital marketing and transparent customer communication	27	47
Adapting to emerging local market (e.g., adjusting pricing, packaging, product offerings)	20	35
Supply Chain and Procurement Processes		
Disruption in import routes or supplier relationships	33	72%
Shortages in raw materials and essential inputs	32	70
Storage areas at risk	14	30
Challenges in maintaining storage management standards	11	24
Supply Chain and Procurement Needs		
Securing raw material sources and alternative suppliers	31	67%
Partnership with local suppliers	20	43

continued

Table 2, continued

Just-in-case inventory strategies (buffer stocks)	18	39
Initiate or negotiate suppliers' contracts with contingency clauses	15	33
Relocation or diversification of storage areas	8	17
Consolidation or aggregation of goods import with local partners or peers	8	17
Human Resources Challenges		
Staff safety risks or concerns (employees' mental and physical state)	11	34%
Disrupted access to workplaces or displacement of employees	11	34
Difficulty retaining staff	6	19
Temporary staff shortages	4	13
Human Resources Needs		
Need to provide safety nets for workers (e.g., insurance, relocation plans)	21	66%
Development of a staffing contingency plan	15	47
Mental health and wellness support	14	44
Development of crisis communication plans and safety protocols	13	41
Automation and remote monitoring of key processes to reduce dependency on physical labor	13	41
Employee training for emergency responses	10	31
Flexible working arrangements (remote work, adjusted hours)	8	25
Infrastructure		
Business operations stopped due to lack of safety in the area of operations	8	80%
Affected automobiles and transportation vehicles	3	30
Damage to facility production sites	3	30
Damage to facility warehouses and storage areas	2	20
Damaged power and water supply necessary for the business operations	1	10
Infrastructure Needs		
Increase diesel supply	7	70%
Relocation of production or storage sites to safer areas	7	70
Insurance for facilities and assets at risk	6	60
Security and safety measures (installation of CCTV, hiring or outsourcing security personnel)	4	40
Structural reinforcements (fireproofing, backup power, safe rooms)	2	20
Increase water capacity	2	20
Off-site or cloud data backup systems	1	10

Discussion

Our study aimed to evaluate the impact of the war on agri-food SMEs and explore solutions to enhance resilience in future crises. Our findings highlight that SMEs are facing numerous challenges, including financial struggles, limited access to markets, constraints in their supply chain and procurement, and human resources hurdles.

The geographical distribution of SMEs included in our research aligns with the Investment Development Authority of Lebanon (IDAL)'s report on 2018 data, which found that 5% of agri-food SMEs were in Beirut, 48% in Mount Lebanon, 9% in North Lebanon, 6% in South Lebanon,

and 18% in Bekaa (IDAL, 2020). Accordingly, our analysis reflects aggregated findings from all regions across Lebanon and does not compare impacts by regions.

Similarly, the share of small businesses in our study (37%) mirrors the findings of Boumatar et al. (2024), which reported that 37.5% of SMEs employed between six and 10 workers. Our findings highlight that the studied SMEs are facing numerous challenges, including financial struggles, limited access to markets, constraints in supply chain and procurement, and human resources hurdles.

Financial Constraints

The findings of this study highlight the profound and multifaceted impact of war on agri-food businesses, with most companies reporting being affected by the war (98.4%), with the impact most significantly on financial constraints (91.9%) and reduced access to markets (91.9%). These findings are consistent with previous reports showing that SMEs in conflict-affected economies face acute financial pressures due to reduced demand, restricted access to finance, and banking systems instability (Miklian & Hoelscher, 2022; Organization for Economic Co-operation and Development [OECD], 2009). Similar patterns have been documented in Yemen and Syria, where prolonged conflict has depleted financial capital and limited SMEs' access to formal credit, forcing a reliance on internal or informal funding sources (UNDP, n.d.). Furthermore, conflicts pose additional global economic threats, disproportionately affecting SMEs due to their vulnerability and limited capacity to absorb financial shocks (Munro, 2013). While developed nations can mitigate terrorism's economic consequences through security enhancements and fiscal policies (Sandler & Enders, 2008), developing nations lack such resilience (Gaibulloev & Sandler, 2008). Attacks discourage foreign investment, raise operational costs, and disrupt supply chains, all of which increases insurance, transaction, and security risks for SMEs (Asgary et al., 2020). While direct comparisons should be interpreted with caution, these findings suggest that Lebanese SMEs experience financial stress in the framework of reduced demand and constrained credit access. While financial constraints in this study were largely attributed to war-related instability, rising operational costs and cash-flow shortages were likely intensified by lingering COVID-19 effects, including inflationary pressures, disrupted trade flows, and weakened financial systems. Comparable interactions have been observed elsewhere, where SMEs faced simultaneous demand shocks and restricted access to credit (Genkin & Mikheev, 2020).

Market Access and Supply Chains

Market access remains a significant challenge, with 91.9% of the studied Lebanese SMEs reported experiencing difficulties in reaching customers and 74% reporting disruptions in supply chains and procurement processes. Comparable supply chain disruptions have been observed in other crisis contexts. During the COVID-19 pandemic, food supply networks were disrupted due to labor shortages and transport constraints, as reported in Northern India (Genkin, & Mikheev, 2020; Mahajan & Tomar, 2021) and Wuhan, where logistical breakdowns led to food waste and delayed distribution, as goods remained stuck between farmers, wholesalers, processors, and retailers (Zhao et al., 2024). Similarly, the Russia-Ukraine conflict contributed to global food-price inflation, increasing costs and reducing demand for food-related SMEs worldwide (Leal Filho et al., 2023). These comparisons highlight that while the Lebanese agri-food sector faces conflict-related disruptions, its challenges also reflect broader crisis-driven vulnerabilities in food supply chains. In Lebanon, restricted market access and supply-chain disruptions reflect the combined effects of conflict-related insecurity and post-pandemic logistical fragilities. The evidence from India and Wuhan illustrates how pandemic-induced labor shortages and transport breakdowns magnified existing vulnerabilities in food supply chains, a dynamic that parallels the Lebanese context under war conditions (Mahajan & Tomar, 2021; Zhao et al., 2024).

Impact of Conflict on Market Demand and Food Crisis

Our research indicates that 75% of businesses have been affected by shifts in consumer behavior that

have impacted product demand. Conflict-induced economic instability reduces purchasing power and shifts spending habits, decreasing demand for non-essential products (Hortovanyi et al., 2024). Such shifts in consumer behavior can have a cascading effect on SMEs, especially in the food sector, where businesses rely on stable demand and predictable consumption patterns. A relevant example is the Russia-Ukraine conflict, which caused a 24% year-on-year increase in the global Food Price Index by February 2022, adversely affecting market demand for food-related SMEs worldwide (Leal Filho et al., 2023).

Overall, the findings suggest that the impact of war on agri-food SMEs cannot be fully understood in isolation, as residual effects of the COVID-19 pandemic appear to have amplified financial, logistical, market, and human resources constraints observed in the Lebanese context. In fact, while a significant portion of Lebanon's crisis existed before the coronavirus pandemic, the pandemic has severely compromised the nation's potential pathways to economic recovery (Haytayan, 2021). Furthermore, the COVID-19 pandemic has disrupted consumer habits and supply chains, further illustrating how external shocks can amplify demand volatility and operational challenges for SMEs (Genkin & Mikheev, 2020).

Kemmerling et al. (2022) discussed the link between food crises and war and violent conflicts. They highlighted that overall war and violent conflict have an impact on food insecurity since it is associated with four logics, including (a) destruction; (b) conflict-induced displacement; (c) food control; and (d) hunger as a "weapon of war." These logics explain why governments or belligerents are often unable or unwilling to respond to food crises, and why humanitarian assistance faces challenges in reaching people in need while simultaneously avoiding exacerbating conflict.

Human Resources Hurdles

Human resources (HR) challenges emerged as a significant constraint for agri-food SMEs in Lebanon, with 34% of the respondents primarily reporting concerns related to employees' mental and physical well-being and disrupted access to the workplace. Difficulties in employee retention were reported to a lesser extent, suggesting that workforce availability remained relatively stable in the sample surveyed at the time of assessment. Comparable challenges have encountered in other conflict-affected regions. Exposure to conflict-related stress and trauma has been associated with increased rates of anxiety and depression, and reduced productivity among workers (Pizarro et al., 2006). In prolonged conflict settings such as Syria and Ukraine, businesses have additionally faced labor shortages driven by population displacement, migration, and disruptions to education and training systems (Bogov, 2023; Syrian Economic Sciences Society, 2018). Additionally, conflicts hinder education systems, reducing the availability of human capital and diminishing employment opportunities (Imhonopi & Urim, 2016). Together, these findings suggest that while Lebanese SMEs currently report well-being and access-related challenges as the primary HR constraints, other conflict contexts illustrate how prolonged instability can further translate into workforce depletion and skills shortages. The mental and physical well-being challenges reported by SMEs in this study may reflect the cumulative burden of prolonged crises, where war-related trauma intersected with pandemic-related stress, job insecurity, and restricted mobility. Similar compounded effects on workforce well-being and productivity have been reported in conflict-affected and pandemic-stricken contexts, contributing to long-term erosion of human capital (Pizarro et al., 2006; Syrian Economic Sciences Society, 2018).

Local Infrastructure and Global Limitations

In terms of infrastructure, 80% of the SMEs in this study reported that business operations were disrupted due to unsafe working conditions. While only 10% of SMEs reported direct damage to their power and water supply infrastructure, energy insecurity was reflected in the high reliance on fuel-based solutions, as 70% of respondents identified increased diesel supply as a key infrastructure need. This underscores how electricity disruptions, even when not directly damaging facilities, significantly constrain business continuity through increased operating costs and dependence on backup power. Furthermore, the nation's electrical crisis and rising

fuel costs have led to problems with water scarcity, making it challenging to transport goods from the producer to the market, as reported by Ibrahim (2022). Our finding aligns with other evidence from conflict-affected contexts where infrastructure damage and insecurity have hindered business continuity. For instance, in Yemen, damage to infrastructure, financial capital depletion, conflict-related insecurity, and rising operational costs have led many SMEs to suspend their activities (UNDP, n.d.). Similarly, in Syria, damage to agricultural lands, irrigation systems, and critical infrastructure has affected business endurance and food security (Gobat, 2016). Additionally, Ben Hassen and El Bilali (2022) and Béné et al. (2024) reported that war interferes with food production, mobility, and storage. Hassoun et al. (2024) highlighted that the war on Gaza (2023-2024) exemplifies this impact through widespread damage to infrastructure and agriculture, with 28% of cropland and over 70% of fisheries destroyed (Anera, 2024). Analogously, in Ukraine, war has led to significant reductions in winter-crop production, labor shortages due to mass displacement, and damage to agricultural infrastructure, resulting in the abandonment of arable land and decreased global food supply (Jia et al., 2024). Available data suggest that the impact of the conflict on Lebanon was comparatively lower than that reported in Gaza and Ukraine. This difference can be explained by factors such as the shorter conflict duration, the less extensive destruction, the timing of the assessment, and the characteristics of the participating SMEs. Additionally, in the present study, infrastructure-related disruptions were primarily driven by insecurity and unsafe working conditions; however, these challenges were further compounded by residual COVID-19 impacts on logistics, mobility, and service availability. Similar compounded effects of COVID-19 on infrastructure and business continuity have also been reported in other contexts, including China and India (Mahajan & Tomar, 2021; Zhao et al., 2024).

Study Limitations

This study offers key strengths, notably being the first to assess the impact of war on Lebanon's agri-food SME sector and the first to comprehensively examine various business dimensions and recovery needs. Its findings provide actionable recommendations that can be integrated into future crisis preparedness to minimize losses. The use of empirical data and a structured survey strengthens its relevance and practical value. However, limitations include the sample's restriction to QOOT Cluster members, which may limit generalizability and introduce bias due to shared characteristics. The modest response rate, reliance on self-reported data, lack of qualitative insights, and absence of inferential analysis further constrain the study's depth and applicability. Although the study captures responses from agri-food SMEs across multiple regions in Lebanon, the analysis was conducted at an aggregated national level and does not allow for region- or sector-specific comparisons, which may mask localized differences in impact and resilience.

Recommendations

Based on the findings of our work and the general context of the agri-food sector in Lebanon, we suggest the following recommendations to help mitigate the impacts of crisis situations, including unexpected wars.

1. Establish Emergency Funds and Access to Credit

The fact that 92% of the investigated SMEs reported financial struggles because of war highlights the critical need for accessible financial resources. Developing emergency fund plans is essential for maintaining liquidity and operational continuity during crises. Emergency funds can help businesses cover unexpected expenses, maintain operations, and prevent financial collapse during challenging times. Additionally, enhancing financial literacy equips business owners with the necessary knowledge to navigate credit systems effectively and make informed decisions. Encouraging community-based initiatives such as cooperative lending or in-kind trading can provide alternative financing options during times of limited access to formal credit (Abdullah & Othman, 2019).

2. Diversify Market Channels

With 92% of companies facing market access issues, SMEs should explore diversifying their mar-

ket channels both locally and internationally. Geographic expansion can help reduce dependency on local markets during crises. Diversification, both horizontally (by adding new products or services) and vertically (by controlling more stages of the food production process), can capture more value from products and improve profit margins. Strengthening local partnerships and targeting niche markets, such as organic products or health-focused items, can provide additional growth opportunities. Furthermore, e-commerce provides broader access to customers and helps SMEs maintain sales during physical market disruptions (Begimkulov & Darr, 2023; Shiferaw, n.d.; Stevens & Teal, 2024).

3. Collaborate with Humanitarian Organizations

Collaboration with humanitarian organizations can significantly enhance SMEs' resilience. These partnerships provide access to resources, training, and support networks, which can improve market distribution capabilities and provide additional support during crises. SMEs should identify NGOs that align with their business goals and community needs, focusing on economic development, food security, and support for local businesses. In Lebanon, international organizations have implemented input-support mechanisms to improve small farmers' access to essential production inputs during periods of compounded economic, health, and security shocks. This underscores the importance of timely, targeted support measures in enhancing agri-food system resilience under protracted crises (Ibrahim, 2022).

4. Strengthen Supply Chain Resilience

Given the disruption of import routes and supplier relationships reported by many SMEs, it is essential to secure alternative sources for raw materials and establish partnerships with local suppliers. SMEs should diversify their suppliers, build inventory buffers, and invest in technologies for real-time visibility into the supply chain, such as inventory management systems and data analytics tools. Additionally, SMEs can formalize local sourcing through tools like contract farming, which secures raw materials locally and stabilizes costs. Sharing logistics in business clusters can also help improve supply chain resilience by reducing costs and fostering collaboration (Ali et al., 2021; Bak et al., 2020; Loh & Tan, 2024).

5. Invest in Infrastructure Improvements

With 16% of the studied SMEs reporting infrastructure damage, proactive measures are necessary to prevent operational disruptions. SMEs should regularly assess their infrastructure and invest in improvements such as relocating to safer areas or securing insurance for facilities. Climate-smart infrastructure not only enhances resilience against climate change but also contributes to sustainable agricultural practices. Proactive planning can help businesses maintain continuity and reduce their vulnerability during crises (Vostriakova et al., 2022). In parallel, facilitating SMEs' access to energy-efficiency upgrades and renewable energy financing mechanisms may reduce long-term reliance on diesel generators and strengthen continuity during crises (Ministry of Economy and Trade, 2018).

6. Establish a Comprehensive Risk Management Plan

Lebanon is a high-risk country in terms of instability and political unrest. Therefore, it is crucial for any SME to develop a structured risk management plan that identifies various potential risks and includes risk assessments, prioritization, and mitigation strategies. The plan should be complemented with continuous monitoring, evaluation, employee training, and adaptation to various risk-related scenarios. SMEs should develop tailored approaches that address specific vulnerabilities related to war, including infrastructure damage, supply chain disruptions, and financial instability (Florio & Brotto, 2024).

7. Engage in Knowledge-Sharing through Business Clusters

SMEs should actively participate in business clusters, such as the QOOT Cluster, to share knowledge, resources, and best practices. Collaborative networks can provide strategic partnerships that help businesses adapt more quickly to challenges posed by war. Formal clusters facilitate structured

collaboration, allowing businesses to leverage collective strengths to address common challenges effectively. Localizing digital tools, early warning systems, and collective risk mapping can enable SMEs to proactively address infrastructure fragility and market unpredictability, enhancing resilience in the agri-food sector (Ali et al., 2021; Bak et al., 2020).

8. Develop Policies to Safeguard Food Systems

There is a pressing need for policies that recognize the food industry as a critical sector requiring protection during emergencies. Just as cultural sites are safeguarded under international conventions, food systems must be prioritized to ensure continuous access to safe and nutritious food. Policies should include mechanisms for protecting food production facilities, securing supply chains, supporting affected food businesses, and ensuring rapid recovery post-conflict. Governments and international organizations should collaborate to establish legal frameworks that ensure food security even in times of crisis.

In Lebanon, international organizations have implemented input-support mechanisms to improve small farmers' access to essential production inputs during periods of compounded economic, health, and security shocks. This underscores the importance of timely, targeted support measures in enhancing agri-food system resilience under protracted crises (Ibrahim, 2022).

Conclusion

This study identifies the key challenges faced by SMEs in Lebanon's agri-food sector, particularly those in the QOOT network, during conflict, including financial struggles, supply chain disruptions, and workforce issues. The findings highlight the urgent need for targeted interventions to strengthen their resilience, support sustainable food systems, and enhance their critical role in Lebanon's economy.

Ensuring food and nutrition security amidst recurring and extended crises requires robust agri-food systems and sustainable livelihoods. Strengthening these systems demands integrated disaster risk-management strategies that operate across the humanitarian-development-peace framework. Swift and unified action by nations and the global community is imperative to meet both urgent and enduring needs of at-risk populations, fostering the adaptation of agri-food systems to enhance their resilience against future disruptions. Future research could explore the effectiveness of integrated disaster risk-management strategies in Lebanon's agri-food sector, focusing on how these strategies can enhance the resilience of SMEs and ensure long-term food and nutrition security. Additionally, studies could examine the role of global collaboration and policy interventions in supporting sustainable livelihoods in conflict-affected regions, specifically investigating the alignment of humanitarian, development, and peace-building efforts to strengthen agri-food systems in Lebanon and similar contexts.

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Appendix 1. History of Conflict in Lebanon

Lebanon: Conflict and Compounded Crises Timeline (2006–2025)

2006

In 2006, Lebanon experienced a 34-day armed conflict that displaced about one million people. Infrastructure damage was substantial, estimated at around US$2 billion, which represented about 9% of the country's GDP. Additionally, the agricultural, fisheries, and forestry sectors suffered losses amounting to US$280 million (BBC News, 2018; Electronic Intifada, 2006; Human Rights Watch, 2007; International Monetary Fund [IMF], 2007).

2007–2008

From 2007 to 2008, recovery efforts focused primarily on infrastructure and housing, with insufficient attention given to small and medium enterprises (SMEs), financing, and rural livelihoods. This period witnessed business closures, supply disruptions, and investor flight due to clashes in Beirut, the Bekaa Valley, Northern Lebanon, and the Chouf Mountains. Agricultural and commercial activities in northern Lebanon were severely disrupted due to the Nahr al-Bared conflict (Harvie & Saleh, 2008; Ministry of Finance, 2011).

2011

In 2011, Lebanon's government collapsed amidst rising political instability. This period also saw the arrival of over one million Syrian refugees, placing immense pressure on public services, labor markets, and housing. In response to the growing humanitarian crisis, the UN Lebanon Crisis Response Plan was launched to provide relief (Government of Lebanon & UN Office for the Coordination of Humanitarian Affairs [OCHA], 2021; UN High Commissioner for Refugees [UNHCR], 2014)

2015–2018

The period from 2015 to 2018 was marked by chronic fragility and slow economic deterioration. Public debt rose, economic growth stagnated, and governance paralysis set in. Structural vulnerabilities were exposed during this time, including the country's unsustainable public debt, reliance on foreign capital inflows, and a risky banking system, all of which contributed to the pre-crisis economic instability. (Malaeb, 2018; World Bank, 2018)

2019

The year 2019 saw nationwide protests that led to a financial collapse, marked by a banking-sector crisis and currency devaluation. The country experienced a dramatic increase in food prices due to import shortages, which worsened the already critical economic situation. Poverty and unemployment sharply increased, and the World Bank recognized the onset of one of the worst economic crises globally. (Action Against Hunger, 2020; World Bank, n.d, 2020)

2020

In 2020, Lebanon endured a triple shock. The COVID-19 pandemic compounded the economic and social crises, while the Beirut Port Explosion in August caused widespread devastation. The resulting economic contraction accelerated, and Lebanon's health and social systems were overwhelmed by the compounded crises. (UNICEF & International Labour Organization, 2022; World Bank, 2020)

2021–2022

From 2021 to 2022, Lebanon continued to face a prolonged socioeconomic collapse. The country endured frequent electricity blackouts and fuel shortages, further hampering daily life. There was also a notable decline

in access to healthcare and education, deepening the overall crisis. (UNICEF & International Labour Organization, 2022; UNDP, 2025)

2023

The situation worsened in 2023 with renewed armed conflict. Increased insecurity and internal displacement further destabilized the country, exacerbating the humanitarian situation and intensifying the impact on Lebanon's already fragile agrifood sector. (United Nations Development Programme [UNDP], 2024; UNDP & World Bank, 2025)

2024

In 2024, the country faced further conflict-related destruction and mass displacement. Over one million people were displaced as a result of the ongoing violence. The conflict compounded pre-existing economic and social collapse, with the agricultural sector suffering an estimated US$118 million in damages, particularly in southern Lebanon and the Bekaa Valley. The UNDP documented the severe socioeconomic impacts of these ongoing crises. (Food and Agriculture Organization of the United Nations [FAO], 2025; UNDP, 2024; UNDP & World Bank, 2025)

2025

By 2025, the ongoing compounded crises continued to devastate Lebanon. The country's GDP had contracted approximately 40% since 2019, and reconstruction needs exceeded US$11 billion. Political deadlock persisted, exacerbating the humanitarian strain and complicating efforts to recover from the crisis. (UNDP & World Bank, 2025; World Bank, 2025)

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Appendix 2. Types of Firms in this Study ($N = 62$)

Firm type	Percentage	Count (*n*)
Other food products	16.13%	10
Preparations of fruits and vegetables	12.90	8
Food packaging	8.06	5
Dairy products	8.06	5
Wine	8.06	5
Bakery & snacks products	6.45	4
Cacao, chocolate, and sugar confectionery	6.45	4
Agricultural chemicals, seed, and services	6.45	4
Fresh vegetables	4.84	3
Vegetable and animal oils and fats	4.84	3
Agricultural equipment and machinery	4.84	3
Noodles and pasta	3.23	2
Spirits	3.23	2
Software and technology programs	3.23	2
Grain mill products	1.61	1
Fresh fruits	1.61	1

Journal of Agriculture, Food Systems, and Community Development
ISSN: 2152-0801 online
https://foodsystemsjournal.org

A community supported agriculture produce prescription pilot program in the Northern Black Hills: Dakota Food Rx

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Submitted August 21, 2025 / Revised October 20, November 20, and December 24, 2025 / Accepted December 24, 2025 / Published online March 5, 2026

Citation: Bastian, G. E., Lane, S., McMahon, J., Husmann, O. A., & Schumacher, E. A. (2026). A community supported agriculture produce prescription pilot program in the Northern Black Hills: Dakota Food Rx. *Journal of Agriculture, Food Systems, and Community Development*, *15*(2), 335–353. https://doi.org/10.5304/jafscd.2026.152.014

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Abstract

One in eight South Dakota residents faces food insecurity, which has been linked to increased prevalence of chronic diseases such as heart disease and diabetes. Produce prescription (PRx) programs have proliferated to ameliorate food insecurity and prevent chronic disease exacerbation through provision of fresh produce to clinically eligible patients. This study conducted a preliminary process and impact evaluation of Dakota Food Rx, a pilot community-supported agriculture PRx program in the Northern Black Hills of South Dakota. Healthcare providers (Prescribers) referred adults with low income and/or food insecurity and diet-

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Disclosures

None

Funding Disclosure

Dakota Food Rx was made possible by a Beyond Idea Grant from the South Dakota Community Foundation.

related chronic disease (Patients) to receive weekly produce boxes from a local specialty producer (Growers). Evaluation measures included Patient pre-post surveys and key informant interviews with Prescribers, Growers, and Patients. Thirty Patients participated in the program, picking up 434 produce boxes (mean 14.5 per patient) valued at over US$14,000 from June–November 2024. Ten pre- and eight post-surveys were completed (seven completed pre-only, five completed post-only, and three completed both); nine interviews were conducted. Overall, program satisfaction was high among all participants. Patients responding at post-test had higher food security and sense of community than those at pre-test. Thematic analysis of the key informant interviews indicated that Patients improved their diet, food access, and overall health; moreover, relationships were built between Patients and other Dakota Food Rx actors. Prescribers, Growers, and Patients all reported ways in which they had to adapt to the program, and future considerations included increased communication, improved workflow, and additional resources. The Dakota Food Rx pilot showed promise for improving diet, food security, and sense of community belonging for Patients in rural South Dakota with low income and experiencing or at risk of diet-related chronic disease.

Keywords
produce prescription program, preventative medicine, community supported agriculture, food security, access to healthy foods, public health, program evaluation

Introduction

Food insecurity, defined by the U.S. Department of Agriculture (USDA) as "a household-level economic and social condition of limited or uncertain access to adequate food" (Hales et al., 2006), is pervasive in the U.S., with 13.5% of households experiencing food insecurity in 2023 (Rabbitt et al., 2024). Food insecurity involves a lack of food availability or access; an inability to properly utilize food resources; or instability in any of these factors over a certain period of time (Food and Agriculture Organization of the United Nations, 2001). Many factors are associated with it, including low income, unemployment, disability, and participation in nutrition assistance programs (Leitz, 2018). Families that experience food insecurity have been shown to have lower diet quality due to increased intake of highly palatable foods (Leung et al., 2014), which subsequently can contribute to chronic health conditions such as cardiovascular disease and diabetes (Leung et al., 2020; Nagata et al., 2019; Te Vazquez et al., 2021). Research has shown that the additional chronic disease burden is associated with higher healthcare expenditures among those who experience food insecurity (Dean et al., 2020), which may further exacerbate food insecurity itself, perpetuating a cycle of food insecurity and chronic disease (Seligman & Schillinger, 2010).

Produce prescription (PRx) programs have been characterized as programs that involve a referral by a healthcare practitioner (e.g., a physician or nurse practitioner), followed by the provision of vegetables, fruits, and sometimes additional foods through a participating partner or retailer (e.g., grocery store, farmers market, or food bank), and typically some sort of nutrition education (Newman et al., 2022). Patients referred to PRx programs by their healthcare providers usually must meet criteria such as experiencing food insecurity, being low-income, or having a diet-related chronic disease (Newman et al., 2022). A majority of these programs are supported by grant funding via the USDA National Institute of Food and Agriculture (2025). In recent years, PRx programs have emerged as a solution to address food insecurity by improving fruit and vegetable consumption (Harper et al., 2024). Between 2010 and 2020, 108 PRx programs were implemented in the U.S. (Rodriguez et al., 2021), with dozens more implemented since.

Despite these overarching characteristics, there is considerable heterogeneity among PRx programs, including how the produce is sourced and distributed. While PRx models using conventional food retailers such as supermarkets are common, many programs also utilize local food channels such as farmers markets, farm stands, and community-supported agriculture (CSA) (Garrity et al., 2024). Locally sourced PRx may have multiple benefits surpassing conventional models. Shorter sup-

ply chains in local food systems decrease the amount of energy used to ship, package, and refrigerate produce while maintaining freshness and nutrient density (Molin et al., 2021; Villa-Rodriguez et al., 2015). Local food systems also facilitate more community building and interactions between the grower and customer (McDaniel et al., 2021), which in a PRx program may improve the social wellbeing of patients while bolstering business for local growers, strengthening the local economy. These programs aim to improve food security, health, and well-being through provision of produce, making the possibility for additional social health and economic benefits from locally sourced PRx programs enticing for practitioners. However, the U.S. is a net importer of both fruits and vegetables, and substantial agricultural shifts would be needed for most U.S. regions to meet dietary needs through self-production (McCarthy et al., 2023), suggesting that locally sourced PRx programs may continue to be a small part of the food system until there is more capacity to produce locally sourced produce at scale.

In South Dakota, one in eight people experienced food insecurity in 2023 (Feeding America, 2025). The state is characterized by its rurality and low population density, leaving gaps in food and healthcare access for many South Dakotans (U.S. Census Bureau, 2025). South Dakota's harsh, dry prairie climate relegates it to trailing behind other states in fruit and vegetable production (USDA National Agricultural Statistics Service, 2022); nevertheless, a small South Dakota specialty crop scene does exist, with a concentration of small regenerative farms in the Black Hills region. A small forested mountain range on the border of South Dakota and Wyoming, the Black Hills provide a cool, more controlled climate, making it easier to grow produce than in the rest of South Dakota.

In 2021, one such farm, Budding Moon Farm of Spearfish, SD, began a "Veggie Rx" PRx program based on models that the owner-operator had been involved with during his farming apprenticeship in Oregon (Summers, 2025). Instead of supplementation by grants or other programmatic funds, Budding Moon Farm charged a US$5 weekly "co-pay" for patients, who were enrolled in the CSA program as if they were full-paying customers. As interest in the program grew, Budding Moon Farm partnered with South Dakota State University (SDSU) Extension to receive funding from the South Dakota Community Foundation to expand the Veggie Rx model to other CSA farms in the area. The program name was changed to Dakota Food Rx to reflect the organizations' combined goal to expand the CSA-based PRx to other farms in the region, and eventually throughout South Dakota.

This preliminary study aimed to evaluate the feasibility and efficacy of the pilot year of Dakota Food Rx, during the 2024 growing season, using a mixed methods process and impact evaluation involving Dakota Food Rx Prescribers, Growers, and Patients. We hypothesized that the pilot program would be feasible for all three stakeholder groups and that the Dakota Food Rx Patients would experience positive impacts in their food security, dietary behavior, and sense of belonging in a rural community.

Methods

Participants and Setting

Participants in Dakota Food Rx can be classified in three main groups:

Dakota Food Rx Prescribers

Healthcare providers who referred the patients into the program. Any provider involved in patient care and who felt they had the clinical judgment necessary for proper referral could participate. In our pilot, these professionals included physicians, nurse practitioners, and registered dietitian nutritionists. Prescribers worked in the local healthcare system (Monument Health) at clinic sites in Spearfish and Sturgis, SD, or at an independent practice in Belle Fourche, SD (Tri-State Medical Center). Some of the Dakota Food Rx Prescribers were paying CSA members at the same farms to which they referred their Patients. Prescriber locations are shown in Figure 1.

Dakota Food Rx Growers

Farmers who enrolled patients into their CSAs. The Growers' operations were either certified

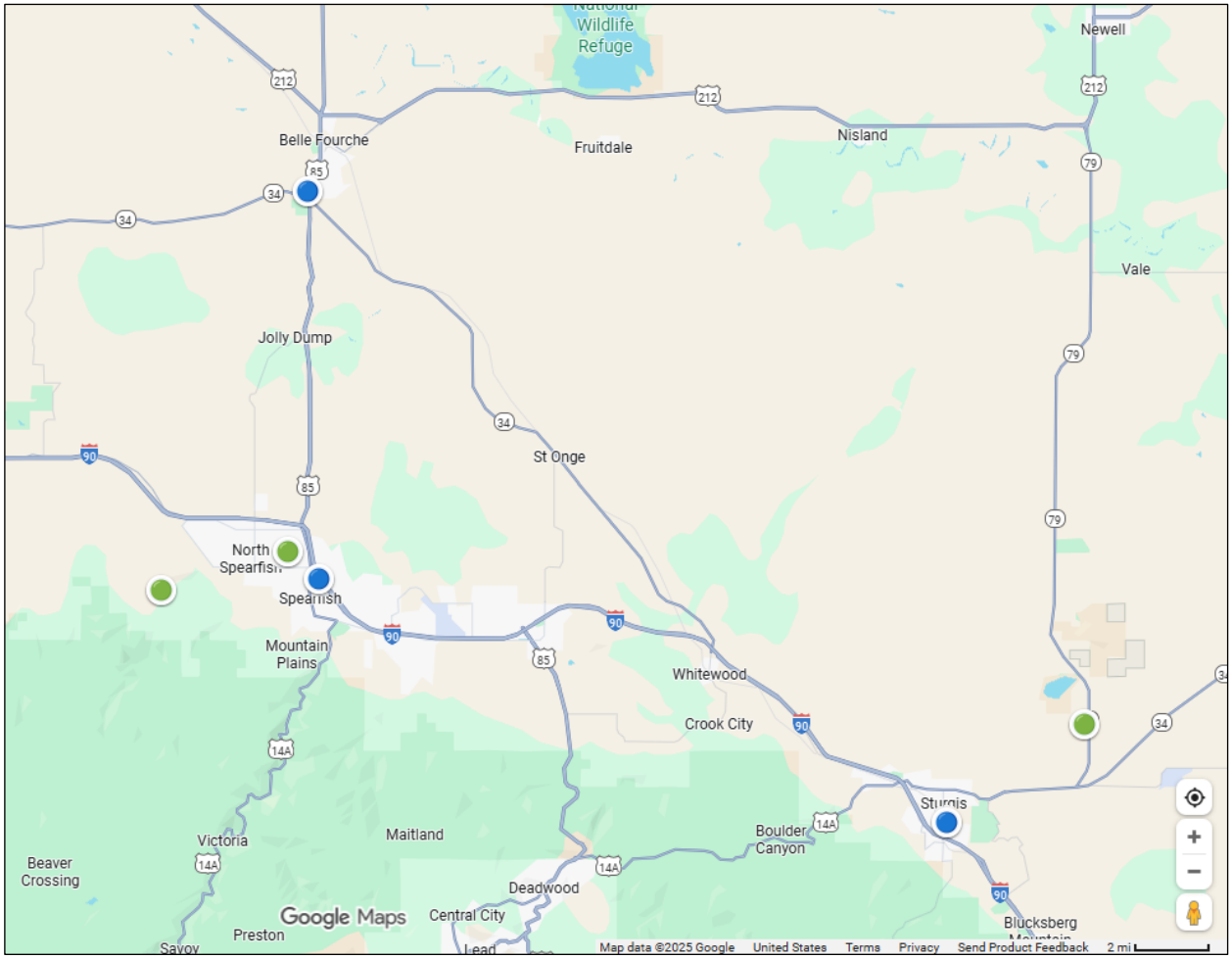
organic or used regenerative agricultural practices. This criterion was important to the owner-operator of Budding Moon Farm, as his farm was certified organic. The CSA seasons for each Grower differed slightly, but they typically ran weekly from June to October/November. The participating growers in our pilot were Budding Moon Farm and Cycle Farm, both located near Spearfish, SD, and Bear Butte Gardens, located near Sturgis, SD (Figure 1).

Dakota Food Rx Patients

Patients were the recipients of the program. Patients could be referred into Dakota Food Rx by a Prescriber if they met three eligibility criteria: (1) They were ≥ 18 years old; (2) they reported either food insecurity or participation in a program like Medicaid or the Supplemental Nutrition Assistance Program (SNAP) designed for low-income populations; and (3) they were experiencing or at risk of developing a diet-related chronic condition. After Prescribers were trained on the criteria, they were given discretion by the team to use their own assessments for identifying food insecurity or program participation. While we consider our audience to be low-income individuals, we did not require means testing for our program. Self-reported income has been shown to be rife with several measurement errors (Moore et al., 2000); moreover, other nutrition programs

Figure 1. Location of Dakota Food Rx Growers and Prescribers in the Northern Black Hills

Green circle icons indicate Dakota Food Rx Growers, blue circle icons indicate Dakota Food Rx prescribing sites.



Source: Google Maps

designed for this population, like free and reduced-price school meals (Food and Nutrition Service, 2025a), and the Special Supplemental Nutrition Assistance Program for Women, Infants, and Children (WIC) (Food and Nutrition Service, 2025b), also use other program participation as a proxy measurement for low income to reduce the burden of means testing for multiple income-based nutrition programs. SDSU Extension provided a list of qualifying diagnoses to Prescribers, such as diabetes/prediabetes, hypertension, hypercholesterolemia, and history of heart attack, transient ischemic attack, or stroke. Notably, to maintain a weight-neutral approach to chronic disease prevention and management, obesity (i.e., body mass index > 30 kg/m^2) was not considered eligible without an existing metabolic comorbidity (Heitmann et al., 2024).

Intervention

Referral

Patients were referred to Dakota Food Rx during a routine visit to their healthcare provider (i.e., the Prescriber). We provided the Prescribers with exam room posters to disseminate more information on the program to Patients (e.g., "Ask your doctor about Dakota Food Rx!"). The Prescriber screened the Patient for eligibility by reviewing their medical records and asking follow-up questions during the visit regarding food insecurity or participation in programs like Medicaid and SNAP. If the Patient was determined to be eligible, the Prescriber provided them with an informational brochure and a "prescription slip" with a QR code that the Patient could scan to enroll in the program.

Enrollment

The QR code led to a form created on the web platform QuestionPro, on which the Patient provided their contact information, household size, preferred CSA pickup locations and time, and details about any dietary allergies or restrictions among the household members. The enrollment forms were screened by SDSU Extension staff and forwarded to an appropriate Grower, who would then reach out to the Patient via phone or text, based on their reported communication preferences. Once the Grower screened the Patient for fit for their specific CSA operation, the Patient was enrolled into the program. All Patient data was kept in a secure cloud-based storage application to which only SDSU Extension staff and Growers had access. No additional contracts or agreements were needed between the Grower and Patient beyond the Growers' typical practices with paying CSA customers.

Distribution

The Dakota Food Rx Patients were treated like regular CSA members by the Growers, and received all CSA member benefits, including identical share sizes for household size, inclusion on CSA email lists, and invitation to CSA member dinners and other gatherings. Patients could pick up CSA shares weekly for the duration of the program (June to October/November). Most Patients picked up shares in the town they lived in (Spearfish and Sturgis); some Patients did travel from neighboring communities such as Deadwood and Belle Fourche (Figure 1). Delivery services were provided to one Patient who had a disability that kept him homebound. Growers direct-billed SDSU Extension to receive payment for Patient CSA shares.

After the team reviewed the typical vegetables grown by the Growers, we anticipated that Patients would be unfamiliar with some of the produce they received (e.g., kohlrabi, Swiss chard). Therefore, to increase program engagement and provide educational resources to the Patients, two additional resources were provided at CSA pickup sites. The first was a suite of 21 "Dakota Food Rx Recipes," developed and tested by a nutrition and dietetics student at SDSU. These recipes were developed to feature vegetables and herbs common in the Growers' CSA shares, to be easy to read by limited-literacy audiences, to use minimal cooking equipment and inexpensive ingredients, and to take a short amount of time to prepare. These recipes were available online (Bastian & Husmann, 2024) and were also printed and distributed at the CSA pickup sites. The second resource was in-person produce and recipe sampling, conducted by two medical students at the University of South Dakota completing rotations in Spearfish. The students

attended CSA pickup periodically and provided samples to all CSA members, featuring produce that was provided in that week's share. This allowed all CSA members, but particularly Patients and their families, to try unfamiliar produce before bringing it home. While non-Patient CSA members' demographic information was not collected for this study, based on conversations with Growers it appeared that Patients typically had lower incomes, less education, and more chronic health conditions than the other members.

Measures

Program impact and success were evaluated using pre- and post-surveys as well as post-program interviews with all three stakeholder groups: Dakota Food Rx Prescribers, Growers, and Patients. The surveys were administered in an online format (QuestionPro) and distributed to participants via email at the beginning and end of the growing season. The majority of measures in the survey were identical to those used by PRx grantees of the USDA Gus Schumacher Nutrition Incentive Program (GusNIP) (Nutrition Incentive Hub, n.d.). All evaluation data were collected after the appropriate Institutional Review Board approvals were granted by SDSU (IRB-2024-63 and IRB-2024-147).

Demographics

Patients provided their age, gender (man, woman, non-binary/third gender, or preference to self-describe), race (American Indian/Alaska Native, Asian, Black/African American, Native Hawaiian, Other Pacific Islander, White, or Other Race), ethnicity (Hispanic/Latino/Spanish origin or not), and zip code. Patients also self-reported their general health status on a 5-point scale from poor to excellent, and if anyone in their household received SNAP in the last 30 days.

Fruit and Vegetable Intake

This 10-item questionnaire was adapted from the larger 26-item Dietary Screener Questionnaire (National Cancer Institute, 2021), an adapted tool used by GusNIP grantees to evaluate other PRx programs. Patients reported their habitual consumption of 100% fruit juice, whole fruit, green leafy or lettuce salad, fried potatoes, other kinds of potatoes, cooked beans, salsa, pizza, tomato sauce, and all other vegetables over the past 30 days. Response options ranged from "never" to "two or more times per day," except for 100% fruit juice, which had an upper range of "six or more times per day."

Food Insecurity

The 6-item USDA Household Food Security Survey Module (USDA Economic Research Service, 2024), wherein Patients answered on behalf of their entire household for the past 30 days, was used to assess Patient food security. Zero or one affirmative responses indicated high or marginal food security (the scale is not sensitive enough to distinguish the two), 2–4 affirmative responses indicated low food security, and five or six affirmative responses indicated very low food security (USDA Economic Research Service, 2024).

Rural Perception Scale

To better understand the effects of Dakota Food Rx on Patients' sense of community belonging, we utilized the 18-item Rural Perception Scale (Kim et al., 2024). The scale has four subfactors: belonging, attitudes, loneliness, and social ties. Patients rated statements on 5-point scales for each question. Two questions on the attitudes subfactor were reverse-coded; we re-coded these questions during our analysis so that we could generate a whole scale score (Kim et al., 2024).

Key Informant Interviews

Key informant interviews were conducted in October 2024, towards the end of the pilot program. Semi-structured interviews were conducted by the first author (G.E.B.) over Zoom, with student research assistants taking notes. The interview scripts were tailored for each of the three stakeholder groups (Table 1). The questions followed the structure of the RE-AIM model, typically used in public health to evaluate community-based interventions (Glasgow et al., 1999). The five RE-AIM components include reach, effectiveness, adoption, implementation, and maintenance. Utilizing this model allowed us to ensure that the interview scripts appropriately addressed all critical compo-

Table 1. Interview Scripts for Each Dakota Food Rx Participant Group

Prescribers	1. What was your experience screening and referring Patients to the program? 2. Were there any specific criteria you used for making referrals? Was there a certain type of patient that was a good fit for referral? 3. Tell me more about the materials provided by SDSU[a] Extension, like the posters, referral pads, and brochures. What was your experience using them? What could SDSU Extension improve upon? 4. Regarding the referral process overall, what would you change to improve it? 5. What feedback, if any, did you receive from Patients who were referred to the program? What clinical improvements, if any, were seen in these Patients? 6. If a colleague at another clinic was about to become a Dakota Food Rx Prescriber, what advice would you give him or her?
Growers	1. Let's start by discussing your interactions with Dakota Food Rx Patients. What has been your experience with the Patients versus your regular CSA[b] customers? 2. As you interacted with patients over the course of the CSA season, what changes did you see? 3. Let's talk about the enrollment process. What was your experience calling up Patients and officially enrolling them in your CSA? What changes, if any, would you make to this process? 4. Let's talk about other logistics. As part of this pilot, SDSU Extension requested invoices for reimbursements and had participant tracking through an online Excel spreadsheet. What was your experience with these processes? What made them successful or not so successful? 5. If you were part of a program like this again, what would you need to be more successful? 6. Let's say a colleague of yours wants to be a Dakota Food Rx Grower next year. What advice would you give him or her?
Patients	1. How did you hear about Dakota Food Rx? 2. You may have gotten produce boxes for several weeks, or you may have only gotten a few. What factors influenced your decision to either stay in the program or stop earlier? 3. What changes in your life happened because of your participation in Dakota Food Rx? 4. Tell us about your experience with the produce you received from the produce boxes. 5. Tell us about your experience with the educational resources provided, such as the recipe samples and recipe sheets. 6. How do you plan to continue the changes you have made after the program ends? 7. If the program comes back next year, what would you want to be different?

[a] South Dakota State University; [b] community supported agriculture

nents of the intervention to gather as much process feedback from each of the three stakeholder groups as possible. The interviewer asked additional, prewritten follow-up questions to elicit additional information when needed (e.g., a potential follow-up to Question 2 in the Patient Interview script detailed in Table 1 was, "Tell us what it was like accessing the farm or pickup site," if the Patient did not describe the pickup process in their answer or struggled to come up with a response). Interviews were recorded and transcribed by the first author with the assistance of an AI web platform for interview transcription (Revoldiv). All interview participants received a US$20 e-gift card as remuneration.

Data Analysis

Quantitative data from the pre- and post-surveys were analyzed using SAS 9.4M7 and descriptive statistics were generated. Inferential statistics were conducted; however, all tests were nonpaired due to the small number of Patients who responded to both the pre- and post-test. T-tests or Wilcoxon signed rank tests were used to determine pre-post differences, as appropriate.

We analyzed the key informant interviews using an inductive thematic analysis utilizing an essentialist framework (Braun & Clarke, 2006). A team of four researchers (G.E.B., S.L., H.M., O.A.H.) familiarized themselves with the data and reviewed two interview transcripts separately, cre-

ating initial semantic codes (i.e., codes based on a surface-level interpretation of the data). These codes were discussed at a team meeting to develop an initial codebook that was then used to code the rest of the transcripts, with only one researcher assigned to each. Code assignments and newly generated codes were discussed at subsequent team meetings, and adjustments to the codebook were made upon consensus by all four researchers. Themes and subthemes were then collectively compiled from codes generated from the analysis and organized in a way that corroborated all researchers' understanding of the data (Braun & Clarke, 2006).

Results

A total of 30 Patients and their families were enrolled in Dakota Food Rx during the 2024 growing season. A total of 434 weekly shares were picked up by Patients, with the average Patient redeeming 14.5 shares (range 1–26). The total value of the produce redeemed by Patients, and paid by SDSU Extension via our pilot grant funds, was US$14,293.80, according to Grower invoicing based on their standard CSA rates.

Survey Results

Ten Patients completed a pre-season survey (RR = 33%) and eight completed a post-season survey (RR = 27%). Only three Patients completed both assessments; the rest of the respondents completed a pre- or post-survey only. Thus, results in Table 2 are presented separately by timepoint and not for the full sample. Most respondents who provided demographic information were female and White non-Hispanic, with a mean age around 60 years. Considerably fewer respondents reported using SNAP benefits in the past 30 days at the end of the program than at the beginning; however, inferential statistics were not performed since the sample sizes were too low to meet the assumptions of a chi-square test of difference. Moreover, food security status was significantly better among the post-season sample ($p = 0.004$), with more respondents indicating a score of high/marginal food security and fewer indicating low/very low food security. No significant differences in vegetable intake were captured in the survey data. Only eight Patients completed

Table 2. Responses from Pre- and Post-Season Surveys ($n = 18$) for Dakota Food Rx Patients

Characteristic [*n* (%) [a] or mean ± SD]	Pre-Season ($n = 10$) [b]	Post-Season ($n = 8$) [b]
Age (years)	59.50 (12.72)	62.50 (15.48)
Gender		
Male	1 (10)	1 (13)
Female	8 (80)	6 (75)
Prefer not to respond [c]	1 (10)	1 (13)
Race		
American Indian or Alaska Native (non-Hispanic)	3 (30)	1 (13)
White (non-Hispanic)	5 (50)	5 (63)
Prefer not to answer [c]	2 (20)	2 (25)
SNAP[d] Participation in last 30 days		
Yes	7 (70)	1 (13)
No	1 (10)	4 (50)
Prefer not to answer [c]	2 (20)	3 (38)
Overall Health Rating		
Poor	1 (10)	0
Fair	3 (30)	1 (13)
Good	2 (20)	3 (38)
Very good	0	1 (13)
Excellent	1 (10)	0
Prefer not to answer [c]	3 (30)	3 (38)
Food Security Score [e,f]	3 (2.16)	2.5 (2.98)
Food Security Category [e]		
High or marginal	2 (20)	4 (50)
Low	4 (40)	1 (13)
Very low	4 (40)	3 (38)

[a] Some percentages do not add to 100% due to rounding.
[b] These data are not matched; only three Patients completed both a pre- and post-survey.
[c] Patients were given the option of "Prefer not to answer" on most survey questions to maintain consistency with the evaluation instrument used by the Gus Schumacher Nutrition Incentive Program.
[d] Supplemental Nutrition Assistance Program
[e] As measured by the U.S. Department of Agriculture 6-item Household Food Security Survey Module.
[f] Wilcoxon Signed Rank $p = 0.004$ between pre- and post-season.

the full Rural Perceptions Scale at pre-season and five completed it at post-season. The pre- and post-season mean scale totals were 53.75 and 68.60, respectively, which were significantly different from each other (T = -2.45, p = 0.03), indicating a higher sense of community belonging and engagement among the post-season sample.

Interview Results

Nine interviews were conducted (Prescribers n = 2, Growers n = 2, Patients n = 5). The thematic analysis indicated nine major themes, defined in Table 3.

Program Fit

Many participants expressed that it takes a certain kind of person to be a Dakota Food Rx Prescriber, Grower, or Patient. Prescribers needed to understand patients holistically and care about social determinants of health. For example, one Patient recounted that she was referred to Dakota Food Rx because her nurse practitioner got to know her and learned that she loved gardening and vegetables, which had not happened with other providers. Regarding Growers, it was indicated that they needed to be passionate about food access in their community to be a good fit for the program. One Grower stated:

> It has to be something that you're passionate about. You have to be passionate about increasing people's access to local food, not just the broad population, but for, you know, the marginalized and at-risk populations. That is a little bit more work than enrolling a regular CSA member. (Grower 2)

He went on to suggest that Growers should "make sure that they're growing and providing a steady supply of the basic accessible fruits, herbs, and vegetables" that would not "intimidate or turn people away."

Both Prescribers and Growers seemed to suggest that there was a specific motivation inherent in Patients that made them a good program fit. One Grower reported that "the ones that were truly interested in changing their diets to improve their health were easy to communicate with. They responded well" (Grower 1). In a similar vein, a Prescriber described:

> Almost every patient was ecstatic for knowing that they could utilize [Dakota Food Rx]. There was a couple that would, I'm going to call it excuses. "I can't drive over to Spearfish and get it," or…I don't think the willpower was there to help themselves. And so I feel like a lot of it is me trying to help Patients that don't want to help themselves. (Prescriber 2)

Relationship Building

Relationships were noted to have been bolstered between Patients and Growers, Patients and Prescribers, and Patients and other community members (e.g., neighbors, non-household family members), but rarely between Patients. Patients expressed deep gratitude for the Growers who provided them with produce, and for the Prescribers who enrolled them into the program. Growers and Patients both expressed that CSA pickup times were moments of socialization, especially for Patients who were disabled or mostly homebound. Relationships with other community members were bolstered through sharing excess produce and herbs from the Patient's CSA share. For example:

> I have shared some [produce] if I have excess or if there's something that I specifically cannot fit into a menu, I do share. And sometimes I cook and I have two or three ladies in my level to come and we'll go down by the mailboxes and have a meal. So it gets shared. It does not get thrown away. (Patient 1)

Adaptability

All groups expressed a level of adaptability that was incorporated into being part of Dakota Food Rx. For Growers, slight changes were made to their CSA operations, usually in the frequency or medium of communication. However, some Growers also adapted their pickup schedules for Patients. One Grower brought a share to a local farmers market to help reduce a Patient's commute; another Grower used his personal vehicle to deliver a share to a Patient who was quadriplegic and homebound. Prescribers expressed that they

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ISSN: 2152-0801 online
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Table 3. Themes and Subthemes Identified from Qualitative Interviews with Dakota Food Rx (DFRx) Growers, Prescribers, and Patients (*n* = 9)

Theme or Subtheme	Definition	Example Quote
Program Fit	An expression that DFRx is a good fit for some Prescribers, Growers, and Patients, but not all.	"A few drop out early on because it doesn't work for them, but the ones that it works for are extremely enthusiastic because it's something that they desire and are unable to access financially during the rest of their life." (Grower 2)
Relationship Building	Improved relationships between DFRx patients and other DFRx stakeholders.	
Patient-Grower Relationships	Improved relationships between DFRx Patients and their DFRx Growers.	"I think it's really rewarding, just the feedback and the encouragement that Patients give to the farmers that I feel embarrassed sometimes of the thanks I get. Because I'm like, no, it's just what I do. I just grow veggies." (Grower 2)
Patient-Prescriber Relationships	Improved relationships between DFRx Patients and their DFRx Prescribers.	"I really appreciate that [a nurse practitioner provided a program referral] because a lot of people would not have pursued it if that wasn't one of their priorities…or would have gone to the lengths that she went to." (Patient 1)
Patient-Community Relationships	Improved relationships between DFRx Patients and non-Patient community members.	"They would gradually get more interactive with my other CSA[a] customers as well." (Grower 1)
Adaptability	When DFRx stakeholders make some sort of change to be part of this program, as opposed to their normal behavior.	
CSA Adjustments	Adjustments DFRx Growers made to accommodate a low-income customer base.	"I think being ready and available for a little bit more communication or interaction, text seems like the most successful and best way for most [Patients]…That's often how I'll get communication of 'I'm going to be late,' asking for reminders, sharing pictures of what they're cooking or pictures of something that they forgot what it was later in the week. So being ready and available with that." (Grower 2)
Screening and Referral Changes	When DFRx Prescribers made changes or expressed making future changes to how they interacted with patients to ensure appropriate patients get referred to DFRx.	"Next year, I would probably, as a provider, I would probably kind of make my list as well of who I referred and maybe contact them a little bit to make sure that we're utilizing it. 'Hey, just reminder it's there. Please utilize it.'" (Prescriber 2)
Cooking Changes	When DFRx Patients cooked more or differently because they had more produce.	"We took the zucchini…and made it into noodles, right? Made into spaghetti. It's the coolest thing ever." (Patient 5)
Food Preservation	When DFRx Patients were preserving excess produce by freezing, canning, dehydrating, etc.	"I've filled that thing [freezer] up…I can tell I'm going to have my winter meals provided to me by the use of the crock pot, just assuming the electricity doesn't go out." (Patient 6)
Education	When DFRx Patients expressed learning a new skill or behavior due to the program.	"Well, lettuce that he introduced to me that he let me taste. And it was bitter. And I'm, 'Oh, no, no, I'll stick to my old lettuce.' And then the [med student] said, 'Well, it's in this recipe.' So, I said, really? 'Yeah, this is how you cook it. And this is how you use it.'" (Patient 1)

continued

Table 3 continued

Food Access	Patients able to access foods that they generally could not afford or access.	
Produce Quality	An expression that the CSA produce is of higher quality than produce bought elsewhere.	"If I go to the grocery store to buy these vegetables, I am not going to be buying the ones that [Grower] be [sic] growing and introducing to me." (Patient 1)
Exposure to New Vegetables	An expression that Patients tried a vegetable that they didn't know about before the program.	"I loved it in a great variety, like just stuff that I had never tried before, and really good, lasted a long time. It didn't like rot or anything like that. So, it was really fresh, really good, nutritious produce." (Patient 4)
Increased Purchasing Power	An expression that Patients could buy more or better-quality food because of the program.	"If it's just us, it was always those instant meals or those frozen pot pies because they're cheap. But now we've been able to put money out of the budget and allot for better food like buying fish now. You couldn't afford fish before, you know, that tilapia, like [US]$6 a bag…But when you got to get all these other veggies instead…that makes a difference, you know." (Patient 5)
Difference from Other Programs	An expressed difference between DFRx and other food access programs for people with low income.	"Other types of food programs have boxed items, boxed items and frozen items often have preservatives, salt, sodium products and other chemicals. I can count on the fact that those things are eliminated when I'm getting the food fresh out of the ground." (Patient 6)
Financial Accessibility	An expression that without DFRx, Patients would not be able to afford the food that they now had access to.	"If this program wasn't here, I'd be begging." (Patient 6)
Diet Improvement	Improvements in Patients' diet quality.	
Increased Vegetables	An expression that Patients are eating more vegetables than they did before the program.	"Now we've been having cucumbers in dip, or some of that weird stuff [Grower] gives us. We've been dipping. So, the snacks have changed considerably." (Patient 5)
Other Diet Improvements	A stated dietary change that was not related to vegetables.	"I would say, by getting more exposure to the different types of vegetables … I've expanded … my taste for all these different kind of things too." (Patient 6)
Health Improvement	Improvements in Patient physical and/or mental health.	
Weight Loss	An expression that Patients lost weight while on the program.	"I've lost 55 pounds [24.9 kilograms]." (Patient 1)
Chronic Disease Management	An improvement in how Patients managed a chronic disease using the program.	"So, I've been able to keep a good, you know, glucose levels. I've had a history of high blood pressure. I've been able to decrease the amount of blood pressure medication that I've taken." (Patient 6)
Mental Health and Well-being	An improvement in Patients' mood, mental health disorders, or overall disposition.	"[My physician has] noticed, like, I've had a lot more energy and stuff compared to before. … It just seems like we're less likely just to lay around and slouch." (Patient 5)

continued

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Table 3 continued

Future Directions	Possibilities to improve and/or expand the reach of DFRx.	
No Change	An expression that something about DFRx is working perfectly with no need for change.	"I never felt confused of pickings. It was on full display. The [med students] were on full display with their sample. They were very friendly, very helpful. I have nothing I can add." (Patient 1)
Pediatric Expansion	An expression that children should be eligible for or have access to DFRx.	"I noticed, see years ago when I had WIC[b] with my kid, you couldn't get vegetables. Now my kids [*sic*] have a baby on WIC, and she nurses her. She gets vegetables, fresh vegetables, which is fine, but I guess after they turn five years, there's no more, they don't even give them a link where they could possibly get another program. Would that be a possibility that WIC could like refer them or give them a card or, you know, instead of just saying, 'Well, if you're five, good luck,' you know?" (Patient 5)
More Resources	An expression that more resources are needed for DFRx stakeholders.	"I think more preseason coordination with like education and recipe resources for participants, so that there could be a little bit of … forethought or collaboration of, okay, I'm going to share this recipe on the second week of June when I've got this combination of veggies or share this cooking tidbit or storage tidbit, you know, this week in the season. … I guess I think of it a lot kind of from my former teaching perspective of really planning out the entire year, all the units and how everything scaffolds and builds on itself and finding kind of the right place to put it in but needing to know ahead of time to be able to implement it most successfully." (Grower 2)
Workflow	An expression that the logistics and workflow of the program could be improved.	"Next year, I was going to kind of prescreen before it even started. Just my patients, because I can run stuff in the background. I can run audits so I can figure out who would qualify and stuff like that. And I would even get in touch with them, not prior, but at the earliest convenience and make sure that I get it started." (Prescriber 2)
Communication	An expression that increased communication would be beneficial.	"Maybe an email notification of like the ones you put up might have caught my eye more." (Patient 7)

[a] CSA = community supported agriculture

[b] WIC = Special Supplemental Nutrition Program for Women, Infants, and Children

would change the ways in which they review medical charts and identify Patients to refer before the initial enrollment period started next year. One Prescriber said, "Next year, I was going to kind of prescreen before it even started…so I can figure out who would qualify and stuff like that" (Prescriber 2). Patients modified how they would prepare and store food in their homes. Many Patients spoke of cooking more since being in the program; some were utilizing the recipe resources provided by SDSU Extension, whereas others found recipes online or in recipe books they had at home. Patients also discussed preserving excess produce and herbs to save for the winter months. One Patient and her husband taught themselves how to dehydrate herbs and vegetables. Another Patient was gifted a chest freezer from a friend and was able to freeze excess meals to reheat during the winter.

Education

A certain amount of education was needed, as expressed by the participants, to most effectively utilize the program to its fullest potential. One Prescriber stated that while SNAP participation was one of the proxy measurements for low-income status, many of her patients were eligible for SNAP but not enrolled and she remarked that SNAP enrollment materials for her patients could be helpful. Patients were often unfamiliar with some of the vegetables they received and relied on the Grower and/or the medical students who were involved with sampling to help them understand how to store and prepare the vegetables in their share.

Produce Quality

Patients all said that the vegetables they received from the program were of higher quality than those they would buy at other stores, like Walmart. One Patient stated, "I've never had green peppers so good" (Patient 7). Patients expressed dismay at having to buy lower-quality produce at the grocery store at the end of the CSA season.

Food Access

Patients reported trying vegetables they never had before, such as sprouts, heirloom tomatoes, lettuce varieties, and eggplant. There were also reports of being able to purchase more or better-quality food because of the program, particularly as Patients could stretch their SNAP benefits and buy healthier, more expensive protein foods. Patients expressed that Dakota Food Rx was different from other food assistance programs, like SNAP and emergency foods, because of the increased access they had to fresh foods. For instance, one Grower recounted that a Patient told him that they finally could eat all the tomatoes they could handle. Patients reported that without the program, they would have to buy lower-quality foods or use food pantries. One Patient with a physical disability said, "If this program wasn't here, I'd be begging" (Patient 6).

Diet Improvement

In contrast with our quantitative findings, Patients reported that they were improving the quality of their diet, particularly due to the produce they received. For example, Patient 4 described using the sprouts from her CSA box to top a routine lunch meal of a turkey and cheese sandwich. Another Patient explained how he felt his diet changed:

> Other types of food programs have boxed items. Boxed items and frozen items often have preservatives, salt, sodium products and other chemicals. I can count on the fact that those things are eliminated when I'm getting the food fresh out of the ground. (Patient 6)

Notably, Patients responded that they made dietary changes beyond simply eating more vegetables. One couple stated that they are using less oil because they bought an air fryer while in the program. "Plus," one spouse said, "a lot of the veggies, we won't even fry up anymore since [Grower] showed us so many different ways to cook them that aren't in oil. It's just, it's been amazing" (Patient 5). Other families felt inspired to make other dietary changes while enrolled in Dakota Food Rx, like getting rid of table salt: "I took away the Morton salt…we just had sea salt for cooking" (Patient 7).

Health Improvement

All Patients also reported some improvement in their health or wellbeing. Many Patients reported changes in their chronic conditions, particularly lowering fasting glucose/hemoglobin A1c and lower blood pressure. Some Patients reported no longer needing medicine for their conditions or taking lower doses. These accounts were corroborated by Prescribers and even Growers: "I had one Patient share that they were no longer seeing a specialty doctor for their kidney function. They thought that the higher vegetable diet had made that difference over a couple of years of participating" (Grower 2). Moreover, Patients reported having improved energy and mood since being in Dakota Food Rx. While weight loss was not the focus of this program, one Patient noted losing 55 pounds (24.9 kg) after struggling with excessive weight gain after a traumatic brain injury. She remarked, "[Dakota Food Rx] saved my life because of the depression I have been in over this situation" (Patient 1).

Future Directions

While some participants felt no changes to Dakota Food Rx were necessary beyond continued funding, several opportunities for future iterations of the program were identified. Prescribers, Growers, and Patients all expressed interest in expanding the program to children, due to increasing childhood obesity and food security gaps caused by age criteria in other programs, such as WIC. Patients and Growers indicated that more educational resources for Patients, like recipes, could be compiled and shared by SDSU Extension. One Grower expressed an idea for a Patient-only website where recipes and other resources could be stored. Prescribers and Growers reported wanting changes in the overall workflow of the program, particularly regarding referrals and patient/invoice tracking, respectively. Finally, all participant groups expressed a need for increased communication with project staff at SDSU Extension. The pilot funds for this program were small (<US$50,000) and mostly went to reimbursing Growers and developing marketing and educational materials. Minimal personnel costs were used to support one undergraduate research assistant; the principal investigator's salary was provided in-kind by SDSU Extension. Therefore, the program team was small, and they found it challenging to keep up communications with all program stakeholders.

Discussion

This preliminary evaluation of the Dakota Food Rx pilot indicated several successful impacts of the program, as well as opportunities for improvement and refinement. Both quantitative and qualitative analyses showed promise for Dakota Food Rx to potentially improve Patient household food security and sense of community belonging. Our key informant interviews indicated that Patients reported trying new vegetables, having access to better-quality vegetables, and improving their physical and mental health in a variety of ways. Prescribers, Growers, and Patients overall had positive impressions of the pilot program and had suggestions for improvement that included increased resources and communication, and expanded eligibility criteria, particularly for children experiencing food insecurity and diet-related chronic disease.

Our evaluation found that there was a certain level of "program fit" that Prescribers, Growers, and Patients all must have to benefit from Dakota Food Rx; however, even for participants that did have good fit, there was a certain amount of adaptability required, such as changes in cooking, communication, or workflow. Research has indicated that factors that make consumers with low income more likely to participate in CSA include being female, higher educational attainment, high food preparation self-efficacy (Hanson et al., 2024). One notable barrier reported was unfamiliarity with CSA produce (Hanson et al., 2024). These findings indicate opportunities to educate potential Patients about CSA and provide resources on cooking and storing produce ahead of enrollment, which could help with preparing Patients for developing adaptability as well as overall program retention. Moreover, our results indicated that some Prescribers and Growers seem unaware of the structural barriers that prevent some Patients from participating in PRx, such as time and transportation restrictions (Mydels et al., 2025). Instead, they indicated that Patients lacked "willpower" or "didn't want to help

themselves." Opportunities to train potential Prescribers and Growers on how to better interact with people from low-income backgrounds, like integrating aspects of cultural humility (Stubbe, 2020) in program trainings, could also help with better preparing these partners to be a better fit for the program and could inform the adjustments needed to better serve the Patient population.

A critical aim of our evaluation was to determine the impact of Dakota Food Rx on community belonging and relationship building, primarily among Patients but also other program stakeholders. Social isolation and loneliness are endemic in rural America (Rainer & Martin, 2012), particularly among those with advanced age and chronic illness (Southerland et al., 2024; Theeke & Mallow, 2013), and are associated with poorer health outcomes (Courtin & Knapp, 2017) and physician visits (Gerst-Emerson & Jayawardhana, 2015). Similar to our study, other evaluations of PRx implemented using CSA shares or other locally sourced produce have also demonstrated Patients feeling more socially connected and less isolated (Hileman, 2021; Joseph & Seguin, 2023; Shostak et al., 2025). Owens (2024) posited that social connection may be an unintended, but valued and sought-for effect of PRx for Patients. We further attest that PRx programs that connect Patients to local foodways, as Dakota Food Rx and other CSA-share PRx programs do, foster improved social connections by building relationships between Patients and local farmers, healthcare providers, other PRx actors (e.g., nutrition educators), and even other community members. However, it is important to note that not all customers who engage with local foodways exhibit an improved sense of community, particularly those with low income or belonging to racial and ethnic minority groups (Russomanno & Jabson Tree, 2021).

Another finding of note was that Patients surveyed at the end of the program had higher food security than those at pre-intervention. While a paired test could not be conducted because we had two independent samples, improved food security is a common finding among other PRx programs (Hager et al., 2023; Muleta et al., 2024). Interviewed Patients indicated that Dakota Food Rx provided healthier foods than other food programs they had access to and allowed them to purchase healthy foods that they otherwise could not afford. This, combined with the educational resources provided to Patients, suggests that their food security may have improved via changes in both access to and utilization of food resources. Fewer Patients also reported not using SNAP benefits post-intervention; while causality cannot be inferred, this contrasts with other research indicating that SNAP participation is not generally associated with seasonal changes in food security (Bastian, 2024), as we saw in this study.

Our study had notable strengths. The mixed methods design allowed for a comprehensive process and impact assessment of the pilot program. Questions in the Patient surveys utilized evaluation measures used by GusNIP grantees and a validated rural perceptions scale. Additionally, the key informant interviews gathered input from all three Dakota Food Rx participant types: Prescribers, Growers, and Patients. However, limitations must also be considered. Our results from both the quantitative and qualitative arms were limited by small sample sizes due to low response rates (33% pre-survey, 27% post-survey, and only nine stakeholder interviews) that were not necessarily representative of our entire participant population. Small sample sizes limited our ability to conduct more rigorous analyses (e.g., the changes in SNAP participation from pre- to post-intervention could only be reported descriptively). Rural populations tend to be more reluctant to participate in research than their more urban counterparts due to factors like trust and time commitments (Awuruonye et al., 2024; Morgan et al., 2005). Because this was the pilot program of Dakota Food Rx, and the previous Veggie Rx program had no formal evaluation, there may have been some reluctance to participate in this study due to lack of trust built with the SDSU Extension team. Future project iterations could involve more interaction with Dakota Food Rx participants by SDSU Extension staff to improve rapport and increase evaluation participation rates.

Another limitation of our study was the apparent inconsistency between the quantitative and qualitative findings on the outcome of increased produce intake. Patient interviews indicated that

they did indeed eat more vegetables; however, only five Patients (17% of our enrolled Patients) participated in interviews. Patients who had more favorable experiences with the program may have been more inclined to participate in a research interview. The survey results indicated that there were no changes in vegetable intake. The scale used for the questions we utilized measured the number of times per day or week that each type of vegetable was consumed, as opposed to the serving sizes of the vegetables. Therefore, it is possible that Patients did increase their serving sizes but not the number of their eating occasions. While the questions used were chosen to limit Patient response burden, future assessment with dietary recalls[1] may be needed to ensure valid measurements of vegetable intakes.

Despite the small sample studied, our findings still provide valuable insight into CSA-based PRx programs in rural communities, which are not well represented in academic literature; for example, only 13 of the 108 programs in a PRx field scan used CSA, and only nine were located in the U.S. Plains region (Rodriguez et al, 2021). A comparable mixed methods evaluation of VegRx, a CSA-based PRx near Boston in urban Waltham, Massachusetts, had a similar number of Patients (32), and with all but one completing evaluation surveys, their results indicated positive improvements in food access, vegetable intake, and overall and mental health (Shostak et al., 2025). These quantitative findings suggested that community connections were built among farmers and clinicians; however, patients were not involved in interviews. Notably, while we engaged fewer Patients in our study's quantitative assessment, we reported similar trends in food security status, and qualitative data from Prescribers, Growers, and Patients further showcased the community belonging, food access, and health impacts of a CSA-based PRx in a rural Great Plains state.

Conclusion

The Dakota Food Rx pilot has shown promise for improving the diet quality, food security, social connections, and overall health of its Patients, who have low income and are at risk of diet-related chronic disease. While the program was overall well-received by all stakeholders, there were opportunities for improvement that would include streamlined communication and logistical workflow, as well as additional resources and potential expansion to pediatric populations. As the program continues to expand in size, strategies to increase evaluation participation could be implemented, such as building stronger relationships between SDSU Extension and all Dakota Food Rx participants.



Acknowledgments

We would like to thank Sierra Doherty, Marissa Gasner, Madison Kadlec, Autumn List, Kimberly Maesse, and Jacie Montis for their help with note-taking during the key informant interviews; as well as all Dakota Food Rx prescribers, growers, and patients for being part of the pilot program. Special thanks to Jared Lukens-Black of Budding Moon Farm for his trust and camaraderie in stewarding his Veggie Rx into this larger-scale pilot project.

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[1] Twenty-four-hour dietary recalls are a common method in nutritional sciences to estimate the daily intake of a study population. They are typically structured interviews that have participants give detailed accounts of all the foods and drinks they consumed during a 24-hour period (https://epi.grants.cancer.gov/dietary-assessment-primer/profiles/recall/).

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Journal of Agriculture, Food Systems, and Community Development
ISSN: 2152-0801 online
https://foodsystemsjournal.org

Sustaining mobile produce vending in NYC: Evaluating the future of Green Carts

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Submitted May 1, 2025 / Revised July 31, September 26, and October 30, 2025 / Accepted October 30, 2025 / Published online March 3, 2026

Citation: Fraser, K. T., Ilieva, R. T., Sullivan, J., Greene, J., Mohnani, M.,, Willingham, C., & Cohen, N. (2026). Sustaining mobile produce vending in NYC: Evaluating the future of Green Carts. *Journal of Agriculture, Food Systems, and Community Development*, *15*(2), 355–369. https://doi.org/10.5304/jafscd.2026.152.010

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Abstract

Consumption of fresh fruits and vegetables is essential for preventing diet-related chronic diseases, yet many low-income residents have inadequate diets because their communities face persistent barriers to supplying healthy food. In New York City (NYC), the Green Carts program is a mobile produce vending initiative to improve fresh food access in underserved neighborhoods while supporting immigrant entrepreneurship. This paper presents the findings of a multi-methods evaluation of the Green Carts program and points to a fundamental tension between the program's public health goals and vendors' financial viability. We

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Disclosure

The authors report no financial or personal conflicts of interests.

Funding Disclosure

This study was funded by the NYC Mayor's Office of Economic Opportunity and the NYC Department of Health and Mental Hygiene.

found that Green Carts are an important source of produce for the more than half of customers who buy from them multiple times per week, but vendors earn a median annual income of $20,000,[1] substantially below NYC's living wage. Low electronic benefit transfer (EBT)[2] acceptance limited accessibility for Supplemental Nutrition Assistance Program (SNAP) recipients, and more than half of NYC's public housing developments, home to more than 400,000 low income residents, lack convenient access to Green Carts. Mobile produce vending can meaningfully address urban food inequities, but current economic constraints limit the program's sustainability and impact. We suggest several improvements to help realize its potential, including financial support for vendors, expanded EBT access, and location incentives aligned with equity goals. This program evaluation provides practical insights for other cities seeking to implement mobile vending models to improve public health and provide economic opportunities for local vendors.

Keywords
food access, mobile food vending, Green Carts, public health, food policy, New York City

Introduction

Food insecurity, often driven by inadequate access to fresh produce, poses significant public health challenges, particularly for residents of low-income urban communities. In neighborhoods with high concentrations of poverty, the scarcity of retailers selling nutritious foods creates barriers to healthy eating (Walker et al., 2010). Limited access to and consumption of fresh fruits and vegetables contributes directly to health disparities, as diet-related chronic conditions including diabetes, heart disease, and cancer disproportionately affect economically disadvantaged populations (Benavidez et al., 2024; Centers for Disease Control and Prevention [CDC], 2024).

Cities present unique obstacles to food access, as many residents must rely on public transportation to reach grocery stores and transport food home (NY Health Foundation, 2022). New York City exemplifies these challenges. Approximately 14.6% of its residents experience food insecurity, with significantly higher rates in communities of color: borough-level food insecurity estimates range from 18–31% for Black residents and 20–30% for Hispanic residents (NYC Mayor's Office of Food Policy, 2025). Food affordability further compounds the problem, as 79% of New Yorkers report increasing difficulty affording groceries (Lucas, 2024). These intersecting factors—limited geographic access, transportation challenges, and economic constraints—create a complex NYC food environment where nutritional inequities flourish (NYC Mayor's Office of Food Policy, 2022).

To address inequitable access to healthy food shaped by socioeconomic and racial disparities, New York City introduced mobile produce vending as a policy initiative to intervene in the food retail market and expand access in underserved communities (Danielli et al., 2021; Lucan et al., 2011). In 2008, the NYC Department of Health and Mental Hygiene (NYC DOHMH) and the Mayor's Office of Food Policy (MOFP) partnered to launch the NYC Green Carts program, with technical assistance supported by the Tisch Illumination Fund. The program was designed to increase access to fresh, high-quality produce in neighborhoods where availability and consumption were low. Beyond food access, a central goal was to create entrepreneurial opportunities for vendors, positioning Green Carts as both a public health strategy and an economic development initiative (Fuchs et al., 2014; Leggat et al., 2012). The program offers opportunities for residents to pursue low-cost micro-enterprises while providing a community service (Leggat et al., 2012). Compared to brick-and-mortar retail, mobile vending may offer entrepreneurs advantages such as lower start-up costs and greater flexibility (Lucan, 2019).

The city created 1,000 mobile vending permits specifically for Green Cart vendors to sell whole fresh fruits and vegetables. Vendors receive a license for a specific borough and may operate any-

[1] All currency in this report is in US$.
[2] Electronic benefits transfer (EBT) is the electronic system used to accept SNAP payments.

where within designated police precinct zones identified as having limited access to produce (NYC Health, n.d.-a). Initially restricted to whole produce, the program was updated in 2022 to allow the sale of bottled water, plain nuts, and cut fruits and vegetables (NYC Health, n.d.-a; Office of Disease Prevention and Health Promotion, 2019).

Early evaluations confirmed that Green Carts increased the presence of fresh produce in the target areas, offered competitive pricing, and coincided with more neighborhood stores carrying fresh produce (Farley et al., 2015; Fuchs et al., 2014; Kerker et al., 2014; Leggat et al., 2012). Farley et al. documented sustained increases of 50–69% in the number of retailers selling fresh produce in Green Cart neighborhoods over three years, compared to no increase in non–Green Cart neighborhoods. The presence of carts in areas with commercial activity and pedestrian traffic was also shown to lower prices through increased competition (Breck et al., 2017; Li et al., 2014; Lucan et al., 2011, 2019).

Yet, challenges remain. Studies found that vendors tend to cluster in highly trafficked areas rather than the highest-need zones, with only 7% of carts operating in low-access neighborhoods (Li et al., 2014; Lucan et al., 2011). Other barriers include limited uptake by vendors of EBT machines, which is essential for SNAP users, due to high costs (Breck et al., 2015, 2017; Citizen's Committee for Children of New York, Inc [CCC], 2010;; Fuchs et al., 2014). The financial outcomes for vendors have also raised concerns about program sustainability, as long hours, seasonal demand, and costs for storage and transport constrain their earnings (Brinkley et al., 2013; Browne et al., 2011). Complex multi-agency regulations and fines further discourage participation, particularly among immigrant vendors with limited English proficiency (Koch, 2015). Despite these obstacles, previous research found vendor interest in continuing self-employment and optimism that skills gained through vending could translate to future economic opportunities (CCC, 2010; Fuchs et al., 2014).

This evaluation of the Green Carts program addresses critical gaps in the literature by providing updated data on program effectiveness more than a decade after its launch. While earlier studies documented benefits for neighborhood food environments, much of that work is now dated, with the most recent Green Carts literature published in 2017. Our study, supported by the NYC Office of Economic Opportunity and the NYC Department of Health and Mental Hygiene (DOHMH), assesses how the program functions as both a food access intervention and an economic development mechanism for immigrant entrepreneurs. Specifically, we examine how the program has influenced access to fresh produce in underserved neighborhoods, what disparities persist in reach and utilization, what economic outcomes and sustainability prospects exist for vendors, and what factors contribute to declining vendor participation.

We hypothesize that while Green Carts provide an important mechanism for New Yorkers to access fresh produce, the program's impact may be constrained by insufficient vendor earnings and limited economic sustainability. Although this study focuses on New York City, variations on mobile produce vending have been implemented in other U.S. cities, including Chicago, Boston, and Los Angeles, as tools to improve food access and stimulate microenterprise. Lessons from NYC can inform best practices and policy design in similar urban contexts.

Methods

We conducted a multi-methods evaluation of the Green Carts program over the 14-month period of May 2023 to June 2024. This study assesses several dimensions of long-term effectiveness for food access and economic mobility of vendors, including customer perceptions and patterns of engagement with Green Carts and operational constraints faced by vendors. Throughout the study, we adhered to strict ethical standards in line with federal regulations and the Belmont principles of respect, beneficence, and justice (National Commission for the Protection of Human Subjects of Biomedical and Behavioral Research, 1979). Study procedures included rigorous protocols for informed consent, confidentiality, and the minimization of risk, and researchers adhered to these requirements to ensure the ethical conduct of research. All research protocols involving human subjects were reviewed and approved by the

CUNY Institutional Review Board to ensure compliance with research ethics standards.

Our approach included surveys of both Green Cart vendors and customers. For vendors, we developed a 42-question survey in English, which was then translated into Spanish, Bengali, and Arabic using AI translation services. The translations were then reviewed and corrected by native speakers to ensure accuracy. The vendor survey was built using the Qualtrics online survey platform. We surveyed a convenience sample of Green Cart vendors across four NYC boroughs over a six-month period. We used previously reported Green Cart location data to seek out vendors during standard business hours. Multilingual research assistants approached vendors at their carts and invited them to participate in the survey. We also recruited vendor survey participation via text message using a contact list of vendors provided by the DOHMH. Trained research assistants administered surveys by phone and in person, or the surveys were self-administered by vendors via mobile devices or paper submissions. To incentivize participation, vendors were compensated with a $50 Visa gift card. After data collection, we exported the data from Qualtrics and conducted analysis using Stata statistical software to prepare descriptive statistics.

For customers, we developed a 25-question survey in English and Spanish. The customer survey was also built using Qualtrics. We surveyed a convenience sample of Green Cart customers at five locations in the Bronx, Brooklyn, and Northern Manhattan over a six-month period. These surveys were researcher-administered in-person using iPads or self-administered via personal mobile devices, with participants receiving a $25 Visa gift card for their time. After data collection, we exported the data from Qualtrics and conducted analysis using Stata statistical software to prepare descriptive statistics.

To gain deeper insights into the program's history and operations, we conducted two sets of interviews. We spoke with key stakeholders who were involved in the initial development and implementation of Green Carts, using a 9-question interview guide. These interviews were conducted in English via Zoom and lasted approximately 60 minutes each. We also interviewed wholesale produce distributors, using a 13-question guide that was piloted before use. These interviews were also conducted in English via Zoom and lasted approximately 30 minutes each. All interviews were audio-recorded, transcribed, and analyzed using standard qualitative methods, including predetermined and emergent coding techniques to identify key themes. Two independent researchers reviewed and systematically coded the transcripts. The coded data were then collaboratively examined to ensure consistency and cohesion, facilitating a detailed thematic analysis.

To complement our primary data collection, we conducted a secondary analysis of historical data. We submitted a Freedom of Information Law (F.O.I.L.) request to the NYC DOHMH for data on Green Carts from 2013 to 2023. The resulting datasets included information on permits, inspections, violations, planned vending locations, and applications. We analyzed this data using SPSS to prepare descriptive statistics and examine historical trends. Additionally, we extracted and compiled relevant data from NYC Food Metrics reports spanning 2012–2022 (NYC Mayor's Office of Food Policy, 2012; 2013; 2014; 2015; 2016; 2017; 2018; 2019; 2020; 2021; 2022). We also conducted geospatial analysis using ArcGIS to examine the distribution of Green Cart locations in relation to public housing developments and other points of interest. This multifaceted methodology allowed us to triangulate findings from various sources, providing a robust evaluation of the Green Carts program from multiple perspectives. This methodological framework could serve as a template for evaluating mobile vending initiatives in other metropolitan areas.

Results

We surveyed 200 Green Cart customers at five locations in three boroughs (Tables 1 and 2). Just over half (51%) reported shopping at Green Carts at least two to three times per week, and 22% had patronized the same cart for more than five years. However, only 15% reported purchasing more than three-quarters of their produce from Green Carts.

Cost and convenience were the primary motivators for shopping at Green Carts, cited by 33%

Table 1. Green Cart Customer Survey Participant Demographics (*N* = 200)

Demographics	Total % (*n*)
Sex	
Male	36 (70)
Female	60 (117)
Non-binary/Third gender	2 (3)
Prefer not to say	3 (6)
Age	
18–24	16 (32)
23–39	33 (65)
40–54	28 (56)
55+	23 (45)
Did not provide	1 (2)
Race/Ethnicity	
Hispanic	74 (144)
Native American Indian or Alaska Native, Native Hawaiian or Other Pacific Islander	7 (13)
Asian	6 (11)
Black or African American	17 (33)
White	19 (37)
Other*	27 (51)
Among other, self-described as Mestizo/a	7 (14)
Prefer not to say	16 (31)
Annual household income (US$)	
Under $20,000	56 (109)
$20,001–$40,000	25 (49)
$40,001–$60,000	9 (18)
$60,001–$80,000	4 (7)
More than $80,000	5 (10)
Number of people at home customer shops for	
0–1 people	12 (23)
2 people	15 (30)
3 people	25 (49)
4 people	27 (53)
5 or more people	19 (38)
Currently receive food assistance such as SNAP or WIC	
No	64 (127)
Yes	27 (54)
Not sure	9 (17)

*22 respondents who selected "other" race identified as Hispanic.

and 20% of customers, respectively. Most purchases were made in cash (90%), while 13% of customers reported using SNAP/EBT. Household income data showed that 80% of respondents earned less than $40,000 annually, and 27% reported receiving food assistance. Knowledge of the Green Carts program varied: 64% correctly identified it as a city initiative to improve produce access, while 36% were aware that carts were limited to designated areas.

Despite offering financial incentives and employing research assistants trained to conduct outreach in three primary vendor languages, we struggled to recruit vendors for this study due to many immigrant entrepreneurs' reluctance to speak

Table 2. Green Cart Customer Shopping Habits and Preferences, Based on Customer Self-Reporting (*N* = 200)

	% (*n*)
Green Cart shopping frequency	
Once per day or more	13 (26)
2–3 times / week	38 (76)
Once per week	24 (47)
2–3 times per month	13 (25)
Once per month or less	13 (26)
Length of time shopping at Green Cart	
Less than 1 year	45 (90)
1–2 years	22 (44)
2–5 years	11 (22)
More than 5 years	22 (44)
Percentage of total fruits and vegetables	
0–25%	28 (56)
16–50%	38 (75)
51–75%	20 (40)
76% or more	15 (29)
Average amount spent at Green Carts each	
$5 or less	13 (25)
$6–10	29 (57)
$11–20	26 (52)
More than $20	33 (66)
Payment method for Green Cart purchases	
Cash	90 (179)
Credit or debit card	14 (28)
SNAP / EBT	13 (26)

with researchers given the current political climate. Surveys were completed with 21 vendors across four boroughs, with the Bronx most heavily represented (67%). We recorded the location of each surveyed vendor during the survey recruitment process. Green Cart locations of surveyed vendors are depicted in Figure 1, overlaid on previously reported planned vending location data obtained from the NYC DOHMH, demonstrating the breadth of reach and representation from diverse Green Cart vending zones. Vendors reported working an average of 44 hours per week across 5.3 days, and 75% had been vending for at least five years. Median annual income from Green Carts was $20,000, representing a range of 67–74% of total household income.

Monthly profits showed clear seasonality (Table 3). Earnings ranged from $921 to $1,823 during peak months between March and September, compared with $631 to $793 during off-peak months. Based on reported hours worked, this translated to average hourly earnings of $6.40 to $10.40 during peak months. Most vendors (57%) purchased produce from Hunts Point Terminal Market, a wholesale food distribution center located in the Bronx that supplies over 60% of NYC's fresh produce, while smaller numbers of vendors sourced from membership stores like Costco or BJ's Wholesale Club (14%) or restaurant suppliers such as Jetro or Restaurant Depot (14%). Fruits were identified as the most popular item sold (95%), followed by fresh vegetables (68%).

When asked about their motivations for vending, 58% of vendors cited autonomy as a business owner, while 21% emphasized control over their schedule. Vendors also described significant barri-

Figure 1. Map of Surveyed Green Cart Vendors [in Yellow], Overlaid on Green Cart Precincts and Markers of Unique Vendor Permit Location Data Obtained from the New York City Department of Health and Mental Hygiene (NYC DOHMH)

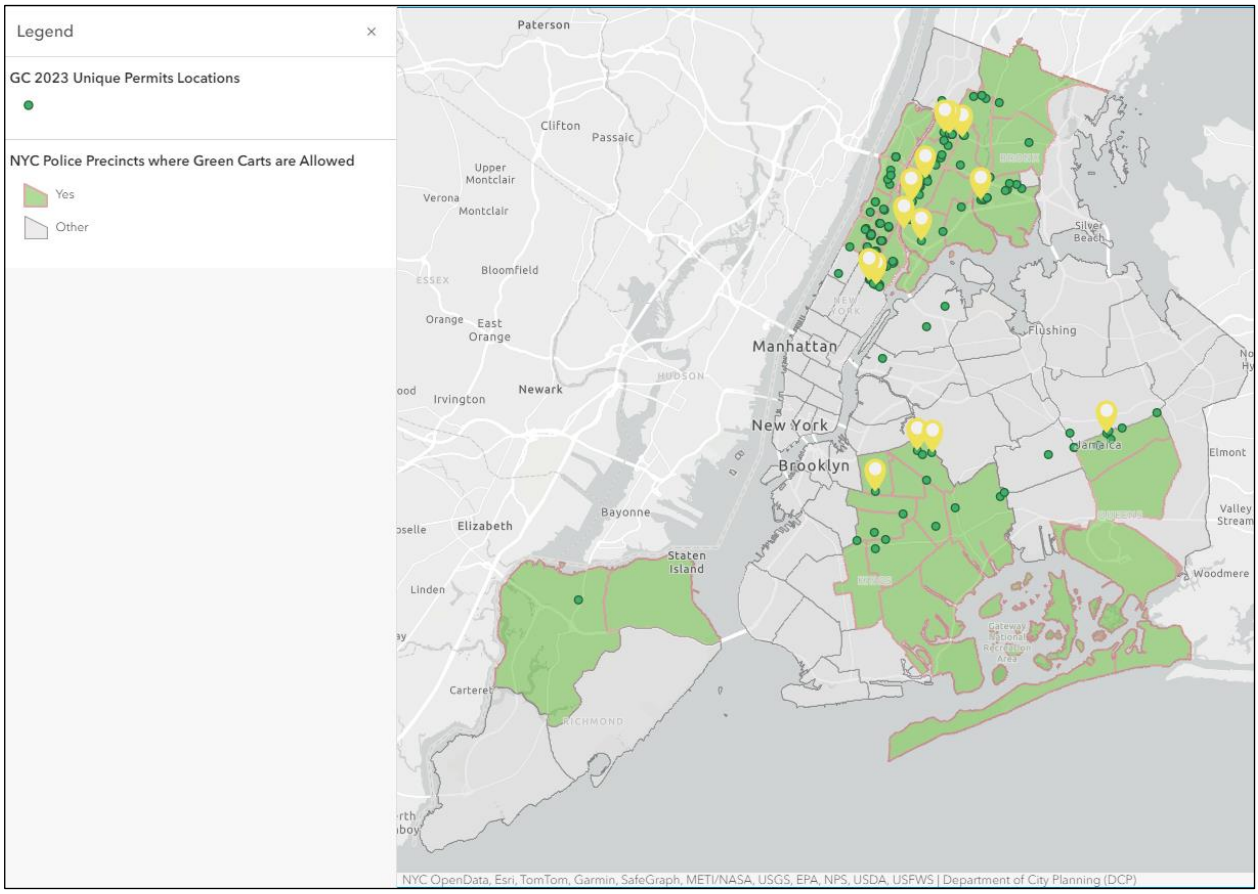


Table 3. Average and Median Monthly Profit Reported by Green Cart Vendors (*N* = 10)

Profit (US$)	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Average	631	641	921	1,621	1,812	1,742	1,823	1,123	1,143	793	793	783
Median	650	650	1,000	1,100	1,050	1,000	1,050	900	900	900	800	800

ers. Permit waiting times were reported by 73%, and 36% found the application process confusing. In addition to being asked about the program's design, vendors were asked for feedback about the physical design of the carts, which are guided by specifications created by the city. Vendors were asked to rate various elements of Green Cart design; weather protection was consistently rated as the weakest aspect of cart design, with 68% indicating it was unacceptable or required improvement.

To contextualize our analysis of NYC Health Department data related to the Green Carts program, we first outline the process by which prospective Green Cart vendors apply to participate in the program. They do so by joining a borough-specific waiting list that requires a valid mobile food vending license issued by the NYC Department of Health. Once selected from the wait list, the vendor receives a permit application packet and must submit a completed application within 30–60 days. Required documentation includes a clearance letter from the Office of Administrative Trials and Hearings, certifying that the vendor has no outstanding fines (which can take up to four weeks); a current New York State sales tax certificate; proof of workers compensation or an exemption; and a commissary/storage agreement for the cart (an agreed-upon indoor location where carts can be stored when they are not in active use). After submission, the vendor schedules a cart inspection and must acquire or build a compliant cart, obtain a green cart permit (fee of $75), and maintain a valid mobile vending license (also $75, renewed biennially) The process typically takes several months, often constrained by wait-list delays, document procurement, inspection scheduling, and commissary arrangements (NYC Health, n.d.-a.)

Table 4. New York City Green Cart Active Permit and EBT Acceptance Rates, 2012–2022

Year	No. of Current Active Permits	No. of Active Permit Holders Accepting EBT	% EBT Acceptance
2012	450+	28	~6.2%
2013	490+	90+	~18.4%
2014	450+	110+	~24.4%
2015	364+	112+	~30.8%
2016	320	110	34.4%
2017	315	32	10.2%
2018	286	19	6.6%
2019	266	15	5.6%
2020	248	10	4.0%
2021	243	8	3.3%
2022	196	6	3.1%

EBT = Electronic benefits transfer, the eletronic system used to process payment via SNAP benefits.

Analysis of NYC Department of Health data for 2013–2023 revealed a decline in Green Cart program participation.[3] Active Green Cart permits peaked at more than 490 in 2013 but fell to 196 by 2022 (Table 4 and Figure 2). Trends in payment methods also shifted. EBT acceptance increased to 33.4% of vendors in 2016 but subsequently declined to 3.1% by 2022, a change possibly related to changes in EBT regulation or in EBT terminals, although this study did not explicitly ask vendors about their motivations for accepting or not accepting EBT.

Permit application data showed that most approvals (87.9%) were completed within six months of submission, while 6.4% take between six and 12 months. Data were not available at a

[3] While we acknowledge the potential impact of the COVID-19 pandemic on the Green Carts program and the experience of Green Cart vendors, careful review of the data indicates that 2019–2020 metrics did not deviate substantially from those of earlier and later years of the program.

Figure 2. NYC Green Cart Active Permit and EBT Acceptance Rates, 2012–2022

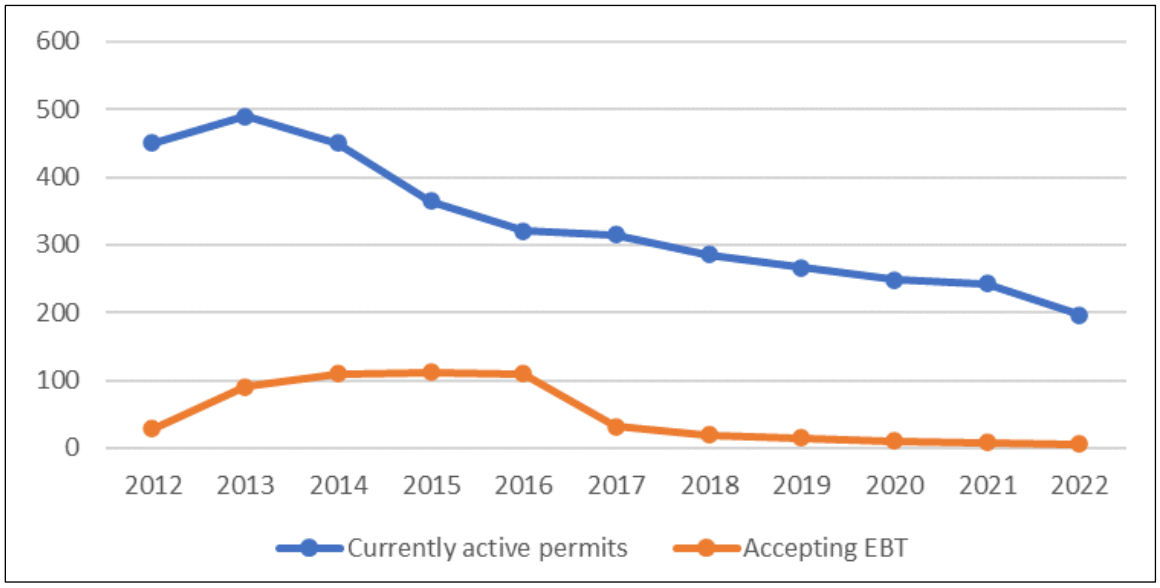


Table 5. Green Cart Violations Paid, Total for All Time (2013–2023) and Most Recent Year (2023)

	2013–2023	2023
Number of violations	3,495	286
Average violation payment (U$)	$100.20	$32.20
Standard deviation in violation payments (U$)	$238.50	$127.90
Range of violation payments (U$)	$0–$2,115	$0–$1,030
Total (U$)	$350,365	$9,210

more granular month-by-month level. Violation records between 2013 and 2023 indicated that only 1.9% of violations were coded as "imminent health hazards," while approximately half were categorized as "miscellaneous." More than one-fifth (20.7%) of all violations were ultimately dismissed or withdrawn. Fines varied widely, ranging from $0 to $2,115, with an average payment of about $100 (Table 5).

Geospatial analysis highlighted differences in cart distribution relative to need. More than half (56%) of New York City public housing developments were located outside a 10-minute walking distance of a Green Cart vendor. Instead, carts were more frequently located near transportation hubs and areas of high pedestrian and commercial activity (Figure 3).

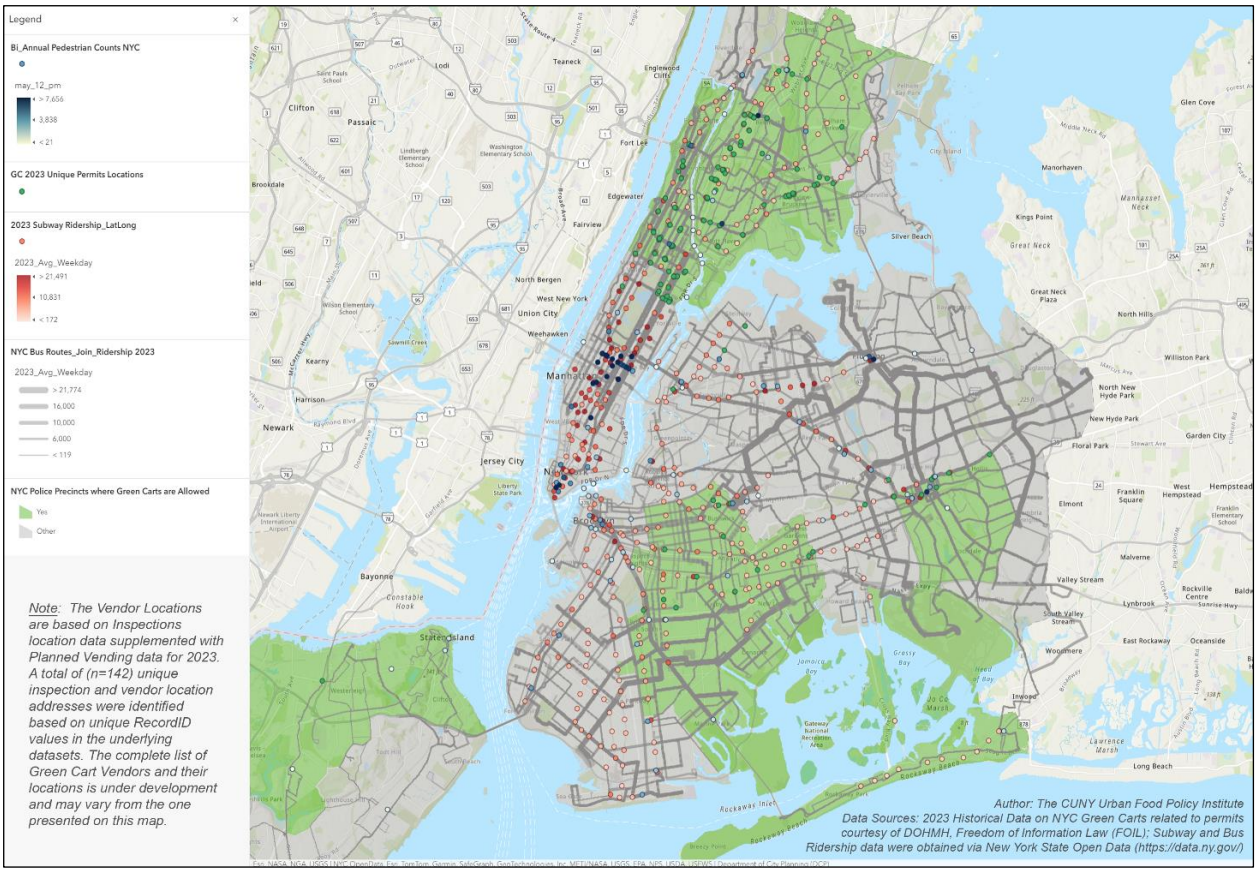
Discussion

Our evaluation of the NYC Green Carts program highlights both its continued relevance in improving fresh produce access in underserved communities and the significant challenges vendors face in pursuing mobile produce vending as a sustaining income source. While findings are specific to NYC, many of the operational and policy challenges, such as regulatory complexity, inconsistent customer demand, and difficulties with EBT adoption, are shared across cities attempting to scale food access through mobile vending. Thus, lessons from NYC may be transferable to other localities with similar structural conditions.

Green Carts in Context

The Green Carts program operates along with other food access initiatives in New York City, joining efforts by organizations such as City Harvest, GrowNYC, United Way NYC, the NYC Department of Health, and others. While Green Carts offer a daily, vendor-based retail model for fresh produce in underserved areas, initiatives like City Harvest's Mobile Markets provide scheduled, free distributions often paired with nutrition educa-

Figure 3. New York City Green Carts (2023), and Pedestrian Traffic, Bus, and Subway Ridership (2023)



tion. Similarly, GrowNYC's Greenmarkets and Fresh Food Box programs expand fresh food availability, while NYC Health Bucks and SNAP/EBT integration efforts along with Groceries2Go and United Way NYC's Connect2Food initiatives support the affordability of fresh produce and purchasing power for low-income residents. These programs complement one another, increasing the visibility and accessibility of healthy foods in low-income neighborhoods. By aligning with these initiatives, Green Carts contribute not only to immediate produce access but also to broader shifts in neighborhood food environments, such as prompting nearby bodegas to stock fresh fruits and vegetables. However, the program's potential remains constrained by declining vendor participation, limited EBT access, limited cart design, lack of technical and administrative support for vendors, and regulatory challenges that may hinder vendors' profitability and long-term sustainability.

Economic Sustainability

The most striking finding is the limited profitability of Green Carts, despite the program's goal of improving economic outcomes for immigrant entrepreneurs, which represents the biggest barrier to program growth and impact. Our study documents that vendors earn far less than NYC's median income of $79,713 (U.S. Census, 2023), indicating that Green Cart vendors support the program's food access goals far more than the program supports immigrants' entrepreneurship and social mobility. Effectively, Green Cart vendors are subsidizing this public health program through below-market earnings for its vendors.

With median vendor earnings significantly below NYC's median household income, financial constraints are likely a key factor in the programs' declining vendor participation. Past research suggests that Green Carts may offer produce at lower prices than alternative local retailers (Fuchs et al.,

2014; Lucan, 2019), and our study confirms that affordability is a primary motivator for customers, supporting the programmatic goal of increasing fresh produce access for low-income New Yorkers. However, despite their competitive pricing, vendors face economic sustainability challenges similar to those documented by Rosales (2013), likely due to inconsistent demand, seasonal fluctuations in sales, and broader economic constraints and administrative barriers.

Declining Program Participation

The number of active Green Cart permits has declined significantly, from over 490 permits in 2013 to just 196 in 2022. While Ali et al. (2021) reported absences, closures, and limited availability among fresh fruit and vegetable vendors, including Green Cart vendors, during the height of the COVID-19 pandemic in 2020, NYC Health Department data did not reflect significant changes in permit trends during this period. This broader contraction threatens the program's ability to maintain consistent food access for residents who rely on Green Carts as a key source of fresh produce. Seasonal variations in earnings, lack of weather protection, and administrative barriers contribute to the declining vendor base, indirectly reducing the program's potential health impact.

EBT Access Barriers

Another concerning trend is the dramatic decline in EBT acceptance among vendors. Previous studies have demonstrated that EBT usage increases customer spending on fresh produce (Breck et al., 2015, 2017), yet our data show that only 3.1% of vendors accepted EBT by 2022. This drop may be due to the complexity or cost of setting up EBT payment systems, advances or changes in EBT technology, transaction fees, lack of technical support for vendors, lack of perceived demand, or a desire by vendors to operate an all-cash business. This is an area that warrants future research.

Given that 80% of customers surveyed for this study reported an annual income under $40,000 and 27% receive food assistance, the low uptake of EBT among Green Cart vendors likely limits the program's potential impact on low-income households' purchase and consumption of fruit and vegetables and general dietary habits. The decline in EBT acceptance since 2016 represents a missed opportunity to enhance food access for SNAP recipients who are vulnerable to chronic diseases. Expanding and simplifying EBT acceptance, as was financially supported in the early days of the program (Breck et al. 2015), could increase vendor revenue while improving food access for low-income residents, dually supporting the program's primary goals. Policy interventions such as technical assistance for EBT registration, reduced transaction fees, or city-sponsored support for card terminals could help address this challenge.

Geographic Coverage and Cart Design

Beyond economic constraints, cart design emerged as a major concern for vendors, particularly with respect to weather protection and display space. These challenges have direct implications for sales, as poor visibility or inadequate shelter may discourage potential customers and may also discourage vendors from selling at all in poor weather. A related issue is the geographic coverage of Green Carts. Prior research has suggested that Green Carts may contribute to broader improvements in the food retail environment by increasing fresh produce availability (Kerker et al., 2014; Leggat et al., 2012). However, our findings indicate that gaps remain in reaching some of NYC's most food-insecure populations, despite vendors being limited to selling in specific Green Cart zones (designated by specific police precinct) that have low access to produce While vendors are limited in their vending location selection by their borough-specific license and the designated Green Cart police precincts, vendors have a high degree of flexibility to vend anywhere within those areas.

Our study and others suggest that vendors prioritize selling in locations with high foot traffic near transportation and areas of commerce rather than in more residential areas farther from public transportation. For example, our spatial analysis revealed that over half of NYC public housing developments are beyond a 10-minute walking distance of a Green Cart, despite many developments being located within "high-need" areas. This suggests the need for targeted expansion efforts, potentially through incentive programs that

encourage vending in underrepresented areas. An increase in available cart storage locations, and transportation support for carts, would also expand the geographic reach of the program.

Regulatory Burden

Additionally, bureaucratic and regulatory barriers appear to strain vendors. While enforcement is necessary to maintain health and safety standards, our analysis shows that fewer than 2% of violations posed an imminent health hazard, half were coded as "miscellaneous," and nearly 21% of historical mobile produce vending violations were dismissed. These data raise concerns about the efficiency, effectiveness, and fairness of regulatory oversight and current enforcement practices. Variability in violation fines may contribute to financial uncertainty for vendors, particularly given their reported low profit margins. Simplifying the permit process (e.g., by increasing locations for cart inspections throughout each borough) and reducing noncritical violations (i.e., violations for failure to comply with regulations that do not pose an imminent health risk) could empower vendors and allow them to focus on growing their businesses.

Recommendations for Program Enhancement

Our findings suggest that revitalizing the Green Carts program will require a multipronged approach that incorporates both public and private channels.

Financial and Technical Support for Vendors

Offering grants or subsidies directly to Green Cart owners for permit fees, start-up capital for new carts, and start-up capital for food purchased could support vendor success. Facilitating wholesale purchasing agreements and providing business training, technical assistance, communication campaigns, and more regular updates from the city on changes in vendor regulations could enhance vendor success. Additionally, interagency support from other NYC agencies could increase cart storage capabilities, business support, or tax incentives.

Expanding EBT Acceptance

Offering grants to cover the start-up costs for expanding EBT accessibility could support broader participation. The city could implement EBT onboarding assistance, offer incentives for vendors who accept EBT, or subsidize the costs of EBT terminals. The city could also offer coupon-style incentive programs (e.g., NYC Health Bucks[4]) to customers to encourage use of EBT at Green Carts.

Strategic Expansion of Green Carts

Targeting vendor placement near public housing developments and other high-need areas through incentive programs could increase food access where it is most needed. Grants to community-based entities could also support personnel to offer assistance for commissary expansion, distribution and transportation, and cart storage for vendors.

Reducing Bureaucratic Burdens

Offering grants to nonprofit and community-based entities to support personnel time for technical and in-person administrative assistance could reduce bureaucratic barriers. This support could include help with applications and ongoing administrative requirements, as well as network support (such as WhatsApp group facilitation) for troubleshooting bureaucratic issues.. At the city level, streamlining the permit application process, reducing noncritical violations, and offering regulatory support for vendors could encourage greater participation. In addition to a more streamlined application process and regularized waitlist schedules, providing vendors with technical assistance on how to navigate the application and renewal process would further strengthen the program and set it for successful continuation and expansion in the coming years. While online portals and forms are available in multiple languages, there may be a gap in the extent to which these vendors, who are often first-generation immigrants, can have reliable access to technology and the resources otherwise made available to the public via the public websites related to the program.

[4] "Health Bucks are $2 coupons that can be used to purchase fresh fruits and vegetables at all NYC farmers markets and farm stands" (NYC Health, n.d.-b, para. 1).

Integrating Green Carts into a Broader Fresh Food Strategy

A "Fresh NYC Initiative" could integrate Green Carts with farmers markets, community supported agriculture (CSA) programs, and other fresh food access strategies, such as those offered by community-based organizations (e.g., City Harvest Mobile Markets, GrowNYC Greenmarkets, NYC Health Bucks and Groceries2Go, United Way's Connect2Food, and others).

Enhancing Consumer Awareness and Demand

To maximize the public health impact of mobile produce vending, demand-side strategies must complement supply-side reforms. Many surveyed customers were unaware of the Green Carts program's purpose or geographic constraints, and SNAP/EBT usage remained low despite high eligibility. A citywide outreach campaign leveraging multilingual advertising, community organizations, and healthcare providers could raise awareness of the program and promote the nutritional and economic benefits of shopping at Green Carts. Public messaging should emphasize SNAP/EBT acceptance (where available), competitive pricing, and the carts' role in supporting immigrant entrepreneurship. Additionally, integrating Green Carts into nutrition incentive programs (e.g., Health Bucks, Double Up Food Bucks) and partnerships with local clinics, WIC centers, and schools could further boost utilization by low-income households. These efforts could be bolstered by distributing culturally relevant recipes, cooking demonstrations, and digital tools (e.g., SMS location alerts or a Green Cart map app). Aligning consumer-facing efforts with vendor support would help drive consistent foot traffic and foster more sustainable demand across neighborhoods.

Study Limitations

While our study offers valuable insights into the Green Carts program, several limitations should be acknowledged. One notable constraint is the sample size and representativeness of our vendor survey, which included only 21 participants. To that end, our findings may not fully capture the experiences of all vendors, particularly given the high level of diversity in this group. Future research should aim to incorporate a broader vendor perspective through a more participatory action research approach that strengthens vendor contribution and engagement to improve generalizability. Another limitation is the cross-sectional nature of our data collection, which provides only a snapshot of Green Cart operations and customer behaviors. As a result, we cannot establish causal relationships between Green Cart access and produce consumption.

Longitudinal research tracking customer dietary habits over time would be beneficial in assessing the program's long-term impact on food choices and nutrition. Additionally, our use of convenience sampling for both customer and vendor surveys may introduce selection bias. While our findings align with prior research, future studies could enhance rigor by employing randomized or stratified sampling approaches to ensure a more representative sample of both vendors and customers. Finally, our study primarily focused on vendor experiences and operational challenges, rather than direct health outcomes associated with Green Cart usage. While access to fresh produce is a key factor in improving dietary health, we did not measure whether Green Cart availability has led to increased fruit and vegetable consumption among customers. Future research should explore these health impacts related to opportunities to increase access to nutritious foods, perhaps through dietary assessments or studies linking Green Cart usage with broader public health indicators.

Conclusion

The Green Carts program remains a small but vital component of NYC's efforts to improve healthy food access in underserved communities; however, financial, logistical, and regulatory challenges may limit its potential impact on access to and consumption of fresh produce, economic mobility, and public health. Addressing these barriers through policy interventions, vendor support, and programmatic improvements could significantly enhance the program's sustainability and impact. By expanding access to fresh produce while ensuring economic viability for vendors, the Green Carts initiative can continue to serve as a model for urban food access programs nationwide.



Acknowledgments

This study was made possible with the contributions of Green Cart vendors, customers, and stakeholders and community partners who supported this study by participating in surveys and interviews. Thank you to the NYC Department of Health and Mental Hygiene and to the dedicated team of bilingual CUNY Urban Food Policy Institute research assistants who supported data collection and analysis.

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Journal of Agriculture, Food Systems, and Community Development
ISSN: 2152-0801 online
https://foodsystemsjournal.org

Culturally appropriate food in local food systems and associated health impacts among immigrants living in high-income countries: A scoping review

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Submitted July 11, 2025 / Revised September 19 and October 28, 2025 / Accepted October 29, 2025 / Published online February 19, 2026

Citation: Zheng, L., Ge, G., Wen, S., & Bruce, A. (2026). Culturally appropriate food in local food systems and associated health impacts among immigrants living in high-income countries: A scoping review. *Journal of Agriculture, Food Systems, and Community Development*, *15*(2), 371–401. https://doi.org/10.5304/jafscd.2026.152.008

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Abstract

While health research typically centers on nutritional value and clinical health outcomes, research on food (in)security among immigrants emphasizes the crucial need for culturally appropriate food, necessitating a holistic approach that accounts for food's cultural and social meanings. Immigrants' participation in community-based food production and preparation, such as through immigrant-led farming and gardening, highlights the potential for inclusive local food movements to advance cultural food security. Understanding the health impacts of access to preferred local foods among immigrants is also essential to guide evidence-based public health interventions. Thus, a scoping review was conducted to synthesize current evidence that examines the alternative food networks, or AFNs, that facilitate access to locally grown, culturally appropriate food for immigrants from low/middle-income countries living in high-income countries

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Author Note
Zheng's dissertation proposal served as the basis of this article.

Disclosure
The authors note no conflicts of interest.

Funding Disclosure
This work was not funded.

and the associated health impacts. Three databases and Google Scholar were searched for studies published between 2000 and 2025, resulting in a total of 267 articles, of which 21 were eligible for this review. Results of the synthesis indicate that so far, access to culturally appropriate food is largely supported through non-market–based strategies such as home or community gardening and foraging, rather than other access points such as farmers markets. While many studies reported positive impacts on diet, exercise, mental and social well-being, their predominantly descriptive designs made it difficult to determine the impact of culturally appropriate food on immigrants' dietary patterns or food security. From a food sovereignty perspective, our understanding of immigrants' access to culturally appropriate food remains incomplete. Greater attention to immigrant foodways within AFNs is critical for advancing inclusive local food movements and designing interventions that promote cultural food security and health equity.

Keywords
immigrants, refugees, diet, culturally appropriate foods, food security, food access, alternative food networks, local food systems, dietary acculturation

Introduction

Globally, nearly two-thirds of international migrants lived in high-income countries in 2019 (United Nations, 2020), making their food-related experiences highly relevant to research on food security and health equity. Because they face linguistic, social, and economic barriers in accessing food in their new food environments, immigrants[1] face a higher risk of food insecurity compared to citizens born in the host country (Liu et al., 2024; Sharareh et al., 2023). Despite the central role immigrant communities play in the food system labor force (Meierotto & Som Castellano, 2020; United Nations Network on Migration, n.d.), they have long reported difficulties in accessing fresh, high-quality, and culturally appropriate food after arrival (Berggreen-Clausen et al., 2022; Lanham et al., 2022; Lee & Lee, 2024; Zheng, Alam, et al., 2025). Immigrants also experience dietary acculturation, the process by which immigrants adapt to new food environments, often resulting in shifts toward typical Western dietary patterns that are high in fat and low in fruits and vegetables (Satia-Abouta et al., 2002). While post-immigration dietary changes are complex and influenced by factors such as age at immigration, education, and admission status (Okafor et al., 2014), structural barriers such as food cost, time constraints, and transportation access likely impact these nutrition transitions (Berggreen-Clausen et al., 2022). These patterns contribute to existing health disparities, as evidenced by elevated risk for obesity, diabetes, and cardiovascular diseases among immigrants (Agyemang et al., 2024; Berkowitz et al., 2016; Mulugeta et al., 2018). Despite these structural issues, food security initiatives in the Global North often fail to meaningfully consider the foodscapes and foodways of immigrants (Bonnevera, 2025).

The concept of food sovereignty offers a broad vision and framework for research and practice to address immigrant communities' lack of access to culturally appropriate food. Food sovereignty is defined as "the right of peoples to healthy and culturally appropriate food produced through ecologically sound and sustainable methods, and their right to define their own food and agriculture systems" (Declaration of Nyéléni, 2007, p. 1; La Via Campesino, 2008). This concept goes beyond food security to emphasize the cultural importance of food and traditional foodways and farming systems, broadening the scope to a community's autonomy over their food choices (Minkoff-Zern et al., 2024). Food sovereignty movements emphasize restoring traditional foodways and farming systems to reduce community reliance on highly processed and nutritionally poor foods (Jernigan et al., 2023). In the context of immigrant communities in high-income countries, food sovereignty brings attention to structural issues such as lack of access to land, and wage disparities that limit immigrants' ability to access culturally appropriate food.

Seeing food sovereignty as part of the food

[1] Throughout this paper, the term *immigrants* is used broadly to refer to foreign-born individuals. When studies specifically examined *refugees* or *asylum seekers*, we retain the authors' terminology to reflect those populations specifically.

security agenda (Clapp, 2014), we argue that it is important to study the intersection of food access and food production. While culturally appropriate food as a concept remains poorly standardized, here we interpret it as "a dynamic and negotiated process" (House et al., 2024, p. 863) to help leverage immigrants' agency in dietary acculturation and provide a more "bottom-up" (House et al., p. 874) view of food system governance. For this study, we adopt a working definition of cultural appropriateness as "the qualification of particular food as appropriate to eat, in a particular manner, in a particular context" (House et al., p. 875), with an emphasis on its cultural significance. Given the calls for greater attention to the cultural importance of food, scholars have started to examine foodways and advocate for culturally appropriate food in clinical and community settings (Crusan et al., 2025; Nemec, 2020; Song et al., 2010). While the lack of access to culturally appropriate food among immigrants has been well-recognized in food security discussions, the public health literature offers limited investigation into strategies that may address these needs.

Recent initiatives have explored access to culturally appropriate food through alternative food networks (AFNs). AFNs typically involve short supply chains with one or no intermediary between producers and consumers, and are positioned as alternatives to highly industrialized, corporate-dominated food systems (Edwards, 2016; Gori & Castellini, 2023; Kessari et al., 2020). AFNs provide a potential strategy to advance food sovereignty for immigrant communities. For instance, Adekunle et al. (2011) found that immigrants of Afro-Caribbean descent are willing to pay a premium for ethnic vegetables that are high in quality and flavor, indicating a promising opportunity for local food systems. In parallel, some community gardens and farmers markets initiatives have supported immigrant farmers and gardeners through training support and land access initiatives (e.g., Grubbström & Joosse, 2021; Harvest Against Hunger, 2021). These efforts reflect growing recognition of immigrants' nutritional and agrarian knowledge in the context of resettlement and climate change (Brons et al., 2020; Klocker et al., 2018; Mazar & Mares, 2020). They also help respond to critiques of cultural "whiteness" in the local food movement and exclusivity within AFNs, such as farmers markets (Alkon & McCullen, 2011; Guthman, 2008; Slocum, 2007).

Despite the growing interest in exploring cultural considerations for sustainability and health, research on immigrant foodways, foodscapes and health have largely remained siloed, limiting a holistic understanding of their interconnected impact on food security and food systems transformation. Previous review studies have established the relationship between community garden participation and health among vulnerable communities (Burt et al., 2021; Malberg Dyg et al., 2020; Onyango et al., 2025; Ramburn et al., 2023). However, the narrow focus on community gardens in urban agriculture may obscure nuanced market-based activities, such as community-supported fisheries (Young et al., 2023), and emerging professional development programs to support immigrant farmers in sustainable agriculture (Koshere, 2018; Ochieng & Ajayi, 2023; Rasul, 2019). Moreover, while studies on dietary acculturation (e.g., Lanham et al., 2022; Mycek et al., 2020; Okafor et al., 2014) and consumer preference for ethnic foods exist (e.g., Goto et al., 2016; Govindasamy & Puduri, 2011), they have not been synthesized to examine the potential health benefits of locally grown, culturally appropriate food. Therefore, to guide inclusive food policy planning and public health interventions, an important step is to synthesize what is known about immigrants from low/middle-income (L/MI) countries living in high-income countries regarding their access to culturally appropriate food through AFNs and the associated health implications.

To address these issues, we conducted a scoping review to map and characterize the existing evidence on the accessibility of culturally appropriate food in local food systems and its associated health impacts among immigrants from L/MI countries living in high-income countries. This review also aims to identify gaps in research and provide implications for future policy and research. The research question guiding our review is: What does the available evidence show about food access through AFNs and the health impacts of locally grown, culturally appropriate food among immigrants from L/MI countries living in high-income countries?

Methods

The study follows the methodological framework outlined by Arksey and O'Malley (2005) and further developed by Levac et al. (2010). A scoping review protocol was registered with the Open Science Framework on March 30, 2025 (Zheng, Ge, et al., 2025), in line with best practices to enhance transparency of reporting (Tricco et al., 2018). In summary, the study has five key phases: (a) identifying the research question, (b) identifying relevant studies, (c) study selection, (d) charting the data, and (e) collating, summarizing, and reporting the results. This paper follows PRISMA Extension for Scoping Review guidelines (Tricco et al., 2018).

Identifying Relevant Studies and Study Selection

As described in the registered scoping review protocol (Zheng, Ge, et al., 2025), we performed a literature search of peer-reviewed articles in PubMed, Web of Science, PsycINFO, and Google Scholar to identify relevant studies on food access through AFNs and health impacts of locally grown, culturally appropriate food in high-income countries. The search strategy was developed in consultation with a librarian at the University of New Hampshire. Our specific search strategy was detailed in the scoping review protocol (Zheng, Ge, et al., 2025; see also Appendix Table A1) and included keywords such as "culturally significant food" and "alternative food networks." The search strategy defined a search period between 2000 and 2025 to capture recent migration patterns, food system localization, and the rising discussion of cultural appropriateness. Eligible criteria for article inclusion were:

(a) Original studies published between January 1, 2000, and March 13, 2025, examining locally grown, culturally appropriate food and its health impacts (e.g., dietary intake, mental well-being) among adolescent and/or adult immigrants (including refugees, asylum seekers, permanent residents, naturalized citizens, etc.) living in high-income countries based on the World Bank classification;
(b) Study populations included immigrants (either exclusively or as part of the study population) for whom results were reported separately by at least one of the following: race, ethnicity, and region or country of origin;
(c) Study participants were identified as people originating from lower and middle-income countries;
(d) Study results included information about locally sourced, culturally appropriate food in regional and local food systems; and
(e) Study designs were quantitative, qualitative, or mixed methods.

Studies were excluded based on these criteria: (a) the study did not specifically report results for immigrants among multiethnic populations, (b) the study was published in a language other than English, (c) the study did not report on health impacts, and/or (d) the study did not report on local food sources.

Title/abstract and full-text review were conducted using Covidence (Covidence.org, Melbourne, Australia). Covidence enabled independent screening, duplicate removal, resolution of reviewer disagreements, and tracking of exclusion reasons. Title/abstract and full-text review were completed in a team-based approach, with two reviewers independently assessing each study (LZ, GG, and/or SW). Any conflicts were resolved by the leading investigator (LZ). No critical appraisal was carried out because scoping reviews that aim to provide an overview of the evidence do not usually include this step (Munn et al., 2018).

Charting the Data

A Google Form was created to organize the data extracted from all the included studies. The following information was extracted from each article: author name(s), year of publication, title of the article, objective(s) or aim(s), study location, study design, data collection methods, study sample characteristics, food access through AFNs, and key outcome contributed to the study. Two team members (LZ, GG, and/or SW) completed independent blinded data extraction, and the results were compared to improve accuracy. Disagreement between reviewers was discussed and resolved by a third team member.

Collating, Summarizing, and Reporting the Results

First, we tallied the temporal and geographical distribution of the studies. The charted data on demographics and study outcomes were summarized in tables. To help synthesize key findings on health impacts, we adopted the World Health Organization (WHO)'s definition of health, which states: "Health is a state of complete physical, mental, and social well-being and not merely the absence of disease or infirmity" (WHO, n.d.). Drawing on this definition, we organized the reported health impacts into four overarching categories: diet, physical activity, mental outcomes, and social outcomes. In alignment with the "food as medicine" philosophy (Academy of Nutrition and Dietetics, n.d.), we further classified the use of edible plants for therapeutic purposes under diet outcomes.

A total of 267 results were identified in the initial search, of which 8 duplicates were removed. During title and abstract screening, 259 records were reviewed; 221 were excluded based on the criteria above and one was identified as a duplicate, resulting in 37 studies eligible for full-text screening. In full-text screening, 16 studies were excluded, leaving 21 studies that met the inclusion criteria (Figure 1, next page). Appendix Table A2 summarizes the included studies across the charted dimensions described above, providing the foundation for the results that follow.

Results

The 21 studies included in this review were published between 2003 and 2024. Between one and four studies were published each year, with a small increase over time (Figure 2).

Table 1 provides an overview of study aims, design, locations and country of origin of participants for each study in the review.

Study Design, Approach, Location, and Participants

Of the 21 included studies, 16 used qualitative methods, including two critical case studies (Table 1). The remaining five used a mixed-methods approach. Data collection methods in the qualitative studies included interviews, observations, focus groups, and archival records. Quantitative data in the mixed-method studies were collected through survey tools such as the Food Frequency Questionnaire (FFQ) (Gichunge et al., 2016; Park et al., 2011), Refugee Health Screener (Gangamma et al., 2024; Minkoff-Zern et al., 2024), and the United States Department of Agriculture (USDA) Food Security Survey (Minkoff-Zern et al., 2024).

Figure 3 maps the study locations by country. Geographically, nearly half of the included studies were conducted in the United States, followed by Australia. All other countries were represented by only one or two studies, spanning Europe and Asia.

Figure 2. Frequency of Publications Examining Locally Grown, Culturally Appropriate Food Published between 2003 and 2024

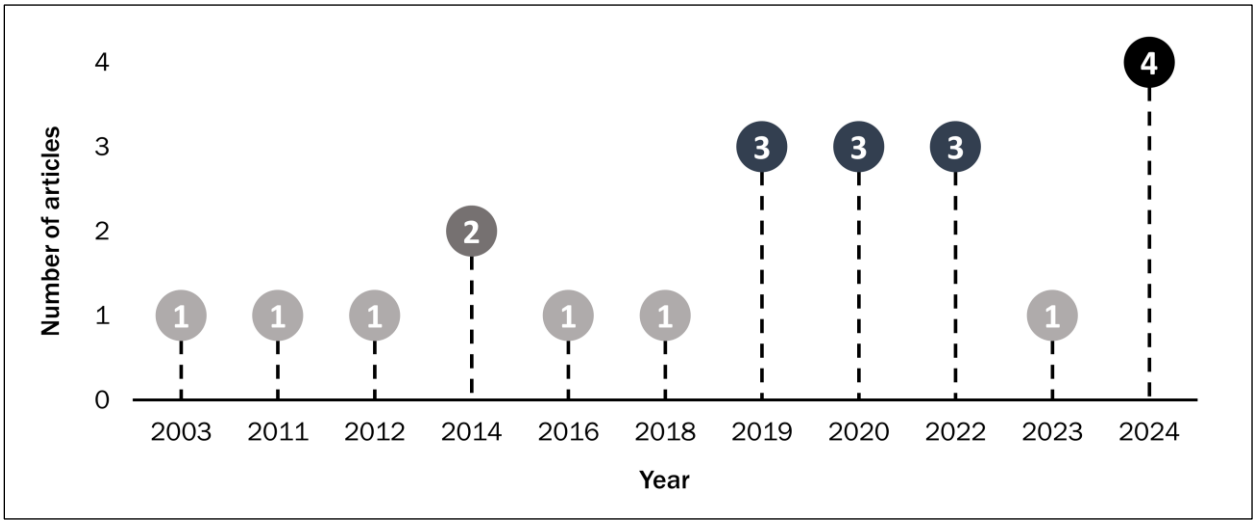
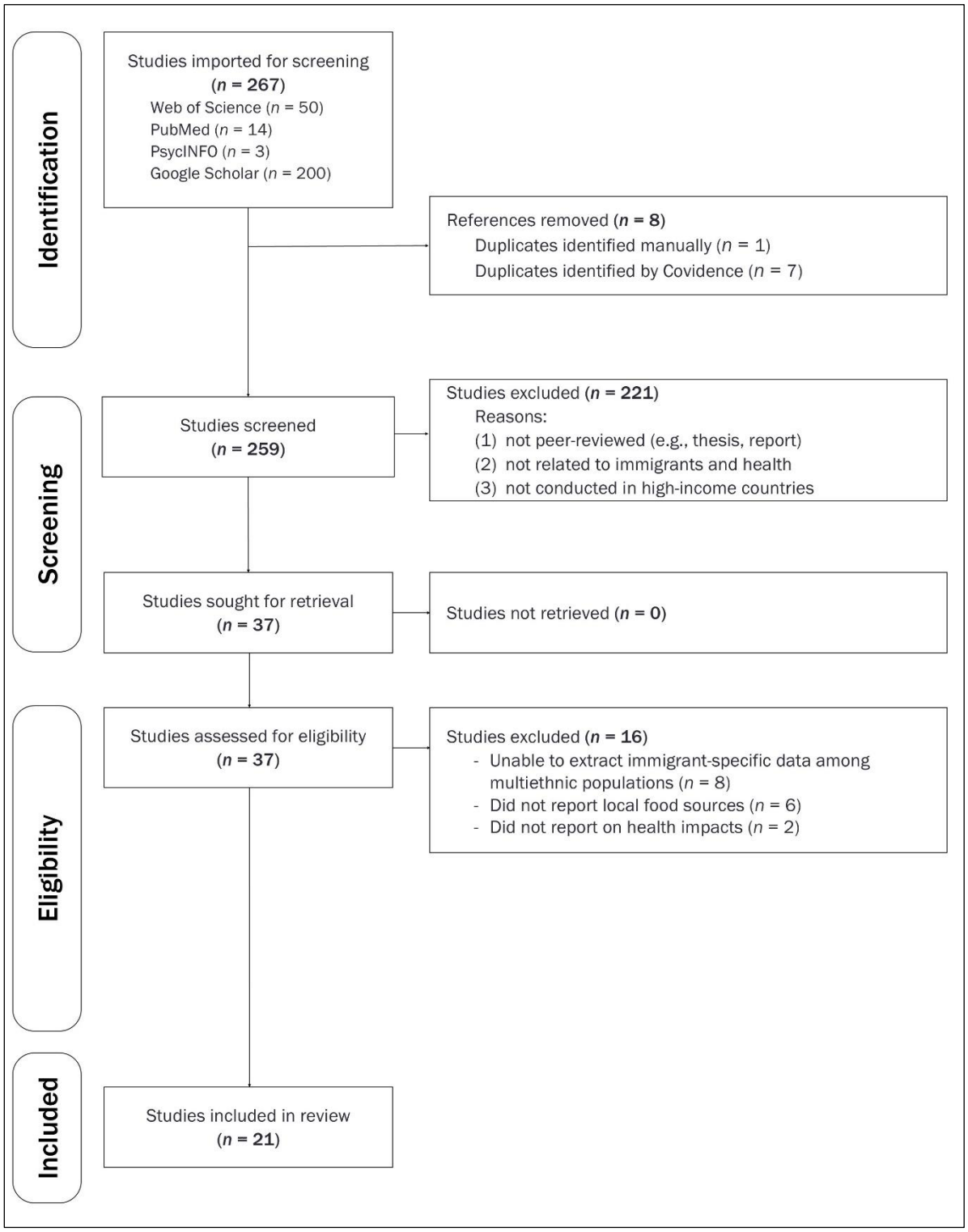


Figure 1. PRISMA Diagram for the Literature Review



PRISMA: Preferred Reporting Items for Systematic Reviews and Meta Analyses

Journal of Agriculture, Food Systems, and Community Development
ISSN: 2152-0801 online
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Table 1. Studies that Evaluated Food Access through Alternative Food Networks and Health Impacts of Locally Grown, Culturally Appropriate Food among Immigrants in High-Income Countries (*n* = 21)

Authors, Year	Aims/Objectives	Country of origin	*N*[a]	Host country	Study Design	Data collection methods
Alkon & Mares, 2012	To investigate on-the-ground processes through which food sovereignty articulates with the work of food justice and community food security activists.	Mexico, Peru, Honduras, El Salvador, Guatemala, Cuba, Nicaragua, and Ecuador	*N* = 46	United States	Qualitative (Ethnographic research)	Participant observation, ethnographic interviews, and archival research
Bloom et al., 2018	To understand the potential for immigrant and refugee communities to maintain the health benefits of traditional food production and preparation practices in acculturation. To identify needs to expand and strengthen bridging social capital between immigrant and refugee communities and Cooperative Extension.	Nigeria, Egypt, Somalia, South Africa, and Burma	*N* = 13	United States	Qualitative (CBPR)	Asset mapping and community meetings, evaluative interviews
Brons et al., 2020	To understand how inclusiveness regarding healthy and sustainable food works within a multi-ethnic urban context.	Syria	*N* = 26	Netherlands	Qualitative (exploratory)	In-depth semi-structured life-history interviews, participant observation
Charles-Rodriguez et al., 2023	To provide relevant and timely feedback to inform program adaptation and development on a community garden for immigrants.	Bhutan, Mexico, Sudan, India, Congo, Eritrea and Pakistan	*N* = 14	Canada	Qualitative (CBPR)	Surveys, focus groups and semi-structured interviews.
Corlett et al., 2003	To determine species raised by Hmong immigrants and their nutritional composition. To explore ways community gardens function in Hmong social and family life. To examine gardens as urban landscape features.	Laos	*N* = 18	United States	Mixed method	Interviews and garden checklists
Dinh, 2024	To explore migrants' motivations for foraging and the dynamics of co-creating environmental and culinary knowledge in new socio-ecological milieus.	Vietnam	*N* = 36	Japan and Germany	Qualitative	Semi-structured interviews and participant observations
Gangamma et al., 2024	To examine whether gardening influences mental health, food security, and economic well-being.	Bhutan, Syria, Somalia, Sudan, Burundi, Congo, Cuba, and Nepal	*N* = 29	United States	Mixed method (cross-sectional, descriptive, concurrent)	Semi-structured interviews and surveys
Gichunge & Kidwaro, 2014	To examine the role of gardening as a component of resettled African refugees' food environment.	Burundi, the Democratic Republic of Congo and South Sudan	*N* = 13	Australia	Qualitative	In-depth interviews, demographic survey

continued

Journal of Agriculture, Food Systems, and Community Development
ISSN: 2152-0801 online
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Authors, Year	Aims/Objectives	Country of origin	N[a]	Host country	Study Design	Data collection methods
Gichunge et al., 2016	To examine the association between household availability and consumption of traditional African vegetables among resettled African refugees residing in Southeast Queensland, Australia.	Burundi, Congo and Rwanda	*N* = 71	Australia	Mixed methods (cross sectional sequential explanatory)	In-depth interviews, survey (including a FFQ)
Gingell et al., 2024	To explore key roles in refugee-background communities to understand why they were important and how they facilitate cultural food security.	Sudan, Syria, Bhutan, Cambodia, and Afghanistan	*N* = 5	Australia	Qualitative	Interviews
Goralnik et al., 2022	To describe the refugee and immigrant community gardening experience in three urban gardens with high refugee and immigrant enrollment.	Burma, Bhutan, Congo, Haiti, Kenya, Malawi, and Nepal	*N* = 11	United States	Qualitative	Observations and interviews
Guo et al., 2022	To explore if and how access to seeds and seed systems enables refugee gardeners to grow essential crops, which might be otherwise difficult to obtain, to produce foods reminiscent of their homelands.	Bhutan	*N* = 30	United States	Qualitative	Semi-structured interviews
Harris et al., 2014	To explore how involvement in a community food garden supports African humanitarian migrant connectedness with their new country.	Not specified	*N* = 12	Australia	Qualitative (single critical case study)	Semi-structured interviews
Head et al., 2019	To understand how different groups of people understand broader human–environment relations, albeit in a context where food growing is something they have in common.	Burundi, Democratic Republic of Congo, Afghanistan, Vietnam, and Tonga	*N* = 30	Australia	Qualitative	Semi-structured interviews
Hughes, 2019	To understand the social and cultural factors that influence food choices in an unfamiliar environment.	Myanmar	*N* = 12	Australia	Qualitative (focused ethnography and PAR)	Semi-structured interviews
Lucas, 2020	To learn about the benefits and challenges of community gardening in the context of a garden for immigrants and refugees.	Not specified	*N* = 14	Canada	Qualitative	Semi-structured interviews
Minkoff-Zern et al., 2024	To bring a comprehensive food sovereignty framework to the research on immigrant and refugee gardening and to add a nuanced and necessary perspective on how to address the related issues of forced displacement, mental health, and food security.	Bhutan, Syria, Somalia, Sudan, Burundi, Congo, Cuba, and Nepal	*N* = 29	United States	Mixed method (cross-sectional, descriptive, and concurrent)	Semi-structured interviews and surveys

continued

Authors, Year	Aims/Objectives	Country of origin	*N*[a]	Host country	Study Design	Data collection methods
Park et al., 2011	To better specify the role of Hispanic immigrants' beliefs about, and preferences for, healthy foods in linking food access to dietary patterns.	Mexico, the Dominican Republic	*N* = 28	United States	Mixed method (convergent)	Survey (FFQ) and interviews
Sandoval & Rodine, 2020	To investigate the relationships between immigrant integration and agricultural, environmental sustainability.	Mexico	*N* = 14	United States	Qualitative (critical case study)	Interviews
Strunk & Richardson, 2019	To understand how urban gardens are used and experienced by residents and city officials.	Not specified	*N* = 27	United States	Qualitative	Interviews, field notes, and participant observation
Tareau et al., 2022	To improve the state of general knowledge on contemporary Haitian phytotherapies. To better understand how plant-based practices adapt and change in different urban, migratory, legislative, and climatic contexts.	Haiti	*N* = 18	France (French Guiana)	Qualitative	Semi-structured interviews

Abbreviations: CBPR: community-based participatory research; FFQ: Food Frequency Questionnaire; PAR: participatory action research.
[a] Results presented in this table represent the individual foreign-born immigrant participants only.

Figure 3. Country-Level Distribution of Study Locations in the Included 21 Studies



Across the 21 studies, participants included refugees, immigrants, asylum seekers, and seasonal workers. Sixteen studies explicitly involved participants with forced migration. Most participants were adult women. Agrarian experience varied widely, ranging from lifelong farming to limited or intergenerational exposure through family members. Among diverse migrant groups, Bhutanese and Burundian participants were included across multiple host countries. North American studies most often focused on Latin American, Bhutanese, and African participants. Australian studies featured African and Southeast Asian groups. European studies were more geographically targeted, such as those on Syrians in the Netherlands (Brons et al., 2020). The study that spanned Japan and Germany focused on Vietnamese migrants (Dinh, 2024). In French Guiana, a study explored the experiences of Haitian migrants (Tareau et al., 2022). Additional sociodemographic profiles for each study are presented in the Appendix (Table A2).

Food Access Through AFNs

Food access through AFNs (Appendix Table A3) was composed of both market and non-market-based options. Most studies investigated gardening practices (n = 19). Market-based sources included farmers markets (Alkon & Mares, 2012; Gichunge et al., 2016; Park et al., 2011), livestock markets (Park et al., 2011), farms (Brons et al., 2020; Gingell et al., 2024), slaughterhouses (Brons et al., 2020), and ranches (Sandoval & Rodine, 2020). Non-market-based sources included home gardens (Bloom et al., 2018; Brons et al., 2020; Gangamma et al., 2024; Gichunge & Kidwaro, 2014; Head et al., 2019; Hughes, 2019; Minkoff-Zern et al., 2024; Tareau et al., 2022), community gardens (school-based or urban) (Alkon & Mares, 2012; Bloom et al., 2018; Charles-Rodriguez et al., 2023; Corlett et al., 2003; Gangamma et al., 2024; Gichunge & Kidwaro, 2014; Goralnik et al., 2022; Guo et al., 2022; Harris et al., 2014; Head et al., 2019; Lucas, 2020; Minkoff-Zern et al., 2024; Strunk & Richardson, 2019), a nonprofit incubator farm (Bloom et al., 2018), and foraging sites (Dinh, 2024; Tareau et al., 2022).

Health Impacts

Studies included in this review covered four dimensions of health impacts: diet, exercise, and mental and social well-being. From a holistic public-health perspective, these health findings are summarized together in the Appendix (Table A3) for each study. Each outcome is described in greater detail below, and an overview of the frequency of each outcome is provided in Table 2.

Diet Outcome

All included studies (n = 21) reported findings on diet that are related to food access, food intake,

food quality, and/or food security. Length of stay was reported to affect diet outcomes. For example, compared to short-term migrants, long-term Syrian migrants were more likely to grow culturally important plants at home and visit local farms for specific products (Brons et al., 2020). Similarly, other sociodemographic factors may influence diet-related behaviors; for instance, elderly Hmong women grew more plants in the garden for food and medicinal purpose than younger women (Corlett et al., 2003). The impact of migration status, however, was unclear due to the participants' mixed immigration backgrounds and the absence of a comparative study design.

Food access: Access to plants with medicinal benefits was prominent (Charles-Rodriguez et al., 2023; Corlett et al., 2003; Dinh, 2024; Tareau et al., 2022). This underscored migrants' unique health strategies and a holistic understanding of food and health. Gardening mainly provided access to fresh and culturally familiar vegetables and herbs that are expensive or hard to find. One study showed that Bhutanese refugee gardeners extended their access by freezing some of their harvest and eating parts of the plant not commonly eaten in their home countries (Guo et al., 2022). In addition to traditional food, immigrant gardeners adapted their foodways by growing local foods, such as pumpkin and strawberry (Harris et al., 2014), and re-appropriating native plants in host countries for phytotherapy (Tareau et al., 2022). Besides fresh produce, a few studies found that immigrants sourced dairy and meat products locally (Brons et al., 2020; Park et al., 2011; Sandoval & Rodine, 2020). For example, meat products from Mexican-immigrant owned ranches was preferred to make cultural foods such as "chicharrónes" (marinated pork and crispy pork skin) (Sandoval & Rodine, 2020).

Food intake: While garden-grown produce improves access to culturally appropriate food in a

Table 2. Overview of the Health Outcomes of Locally Grown, Culturally Appropriate Food in All Included Studies (*n* = 21)

Authors, Year	Diet outcome (*n* = 21)	Exercise outcome (*n* = 6)	Mental outcome (*n* = 7)	Social outcome (*n* = 14)
Alkon & Mares, 2012	x			
Bloom et al., 2018	x	x		x
Brons et al., 2020	x			x
Charles-Rodriguez et al., 2023	x	x		x
Corlett et al., 2003	x		x	
Dinh, 2024	x	x		x
Gangamma et al., 2024	x		x	x
Gichunge & Kidwaro, 2014	x	x	x	x
Gichunge et al., 2016	x			
Gingell et al., 2024	x			x
Goralnik et al., 2022	x	x		
Guo et al., 2022	x			x
Harris et al., 2014	x		x	x
Head et al., 2019	x	x	x	x
Hughes, 2019	x		x	
Lucas, 2020	x			x
Minkoff-Zern et al., 2024	x		x	
Park et al., 2011	x			
Sandoval & Rodine, 2020	x			x
Strunk & Richardson, 2019	x			x
Tareau et al., 2022	x			x

cost-effective manner, its impact on food intake was found to be neutral. Of the three studies that explored self-reported food consumption changes, two indicated that participants received insufficient produce from their gardens to affect the intake of fresh fruit and vegetables in their overall diet (Bloom et al., 2018; Charles-Rodriguez et al., 2023). Farming experience and limited ownership of land and garden space were identified as barriers to immigrants' food self-sufficiency through gardening. For example, Bloom et al. (2018) reported that only Karen refugee participants with extensive farming skills were able to achieve food self-sufficiency on a nonprofit incubator farm. At the same time, market access was shown to improve diet quality; a statistical analysis showed that the presence of a farmers market within the neighborhood was associated with higher servings per day of fruit, vegetables, and juice, and the presence of a farmers market and/or a livestock market was associated with increased servings per day of meat (Park et al., 2011).

Food quality: The quality of locally produced food is highly appreciated and preferred, as participants described it as fresh, organic, safe, chemical-free, and good tasting. Foraging wild plants seasonally exemplifies a cultural preference for freshness (Dinh, 2024). Hazara participants living in Australia considered fruit and vegetables from their gardens to have a better flavor (Head et al., 2019). Similarly, food from Mexican-immigrant owned rural ranches was considered fresh and organic (Sandoval & Rodine, 2020).

Food security: Food security was explored at the household and community level. When measured by USDA's Adult Food Security Survey Module, household food security among gardeners was found to be not significantly different from that of non-gardeners (Minkoff-Zern et al., 2024). Perceived community food security improved when immigrants started to harvest and distribute culturally appropriate food and share seeds and agroecological knowledge across social networks (Bloom et al., 2018; Gingell et al., 2024; Guo et al., 2022).

Exercise Outcome

The benefit of increased physical activity level was only associated with two food acquisition activities: gardening (Bloom et al., 2018; Charles-Rodriguez et al., 2023; Gichunge & Kidwaro, 2014; Goralnik et al., 2022; Head et al., 2019) and foraging (Dinh, 2024). None of the studies measured physical activity quantitatively. The perceived exercise benefits were particularly emphasized among Vietnamese foragers (Dinh, 2024) and the Bhutanese community (Charles-Rodriguez et al., 2023).

Mental Outcome

All seven studies that reported mental health outcomes indicated an indirect positive relationship between garden-produced, culturally appropriate food and mental well-being. Two studies reported happiness (Harris et al., 2014; Minkoff-Zern et al., 2024) and another three showed reduced mental distress (Corlett et al., 2003; Gangamma et al., 2024; Gichunge & Kidwaro, 2014). The remaining two studies concluded that there were overall mental benefits without specifying specific aspects (Head et al., 2019; Hughes, 2019).

Social Outcome

Fourteen of the 21 included studies had information pertaining to social and community well-being outcomes. Except for two studies that explored market-based food sources (Brons et al., 2020; Sandoval & Rodine, 2020), all studies discussed the impact of gardening (n = 11) and foraging (n = 2). Common themes related to social outcomes included community sharing, social connectedness, and belonging. By sharing seeds, knowledge, and food across social networks (e.g., friends, food bank), immigrants were able to strengthen their social connectedness and exercise their agency in this community sharing processes (Bloom et al., 2018; Charles-Rodriguez et al., 2023; Dinh, 2024; Gangamma et al., 2024; Gingell et al., 2024; Guo et al., 2022; Harris et al., 2014; Head et al., 2019; Lucas, 2020; Strunk & Richardson, 2019). Better integration into host countries through community garden participation was another notable social outcome (Gichunge & Kidwaro, 2014; Lucas, 2020). However, the social impact of gardens was constrained by the lack of ownership of

land and space, as well as individuals' work schedules and other obligations, such as parenting (Charles-Rodriguez et al., 2023). At the community level, ethnic food needs motivated the establishment of informal and formal small-scale sustainable agriculture businesses among immigrant communities (Gingell et al., 2024; Sandoval & Rodine, 2020). Immigrants also supported local farmers and butchers by purchasing niche products, such as Syrian labneh and special meat cuts for kibbeh and kebab (Brons et al., 2020).

Discussion

The purpose of this scoping review was to examine access to locally grown, culturally appropriate food through AFNs and the resulting health impacts for immigrants living in high-income countries. The 21 studies highlight a paucity of research from countries other than the U.S. and a noteworthy lack of investigation on market-based AFNs. Studies focused on diet and social outcomes; less than half of the included studies reported exercise and mental health outcomes.

The strong representation of Australia and U.S.-based studies in the review aligns with the discussions focused on cultural appropriateness in these two countries, as identified in a global systematic literature review (House et al., 2024). The popularity of gardening, particularly community gardens, as a means of accessing culturally appropriate food is not surprising, given its affordability and autonomy (Meenar & Hoover, 2012). In contrast, food foraging practices and immigrants' engagement in collective and small-scale enterprises in AFNs are underexplored. The review found limited evidence of localizing culturally appropriate food access through market-based models. As demonstrated in the case of ranchitos (Sandoval & Rodine, 2020), it may be possible that sales through informal markets exist, but they would be difficult for scholars to study and report. This gap between market- and non-market-based models likely reflects the challenges that immigrant farmers face in entering the agricultural sector in their host countries. Immigrant farmers face even greater structural barriers than those well-documented for new and beginning farmers, including land access, social capital, and technical support to get established (Ackoff et al., 2022; Minkoff-Zern, 2019; Smithers & Sethuratnam, 2013). Therefore, the intersection of food access and food production is essential for understanding and addressing ways that the barriers to land access for displaced people impact their dietary acculturation and associated health outcomes.

Dietary outcomes in this review were related to fruit, vegetables, herbs, dairy, and meat. While community gardening offers promising access to culturally appropriate food, its effect on dietary intake at the household and community levels may be limited. This finding is consistent with a systematic review by Burt et al. (2021), which found a neutral impact of community garden participation on diet. Scholars have noted limited year-round production capacity and unstable financial support as barriers to sustaining gardens, raising concerns about the long-term contribution of urban agriculture projects to community food security (Meenar & Hoover, 2012). In this review, some groups with extensive agrarian knowledge, such as the Nepali Bhutanese refugee gardeners (Guo et al., 2022), were found to participate more actively in local food provision. However, the descriptive design of these studies makes it difficult to determine if intergroup differences and causal relationships exist. Encouragingly, a nascent body of research indicates a positive relationship between ethnic produce and health. For example, a cross-sectional study found that exposure to ethnic produce was significantly associated with increased overall fruit and vegetable consumption among Latino, Hmong, and white children ($p < 0.01$) (Chen et al., 2015). A pilot study on a culturally specific community supported agriculture (CSA) program, using a pre-post design, reported higher vegetable intake measured via skin carotenoid scores among Asian American adults (Chan et al., 2025). These findings highlight the potential of AFNs to promote immigrant health. Special attention to urban foraging is recommended in dietary research to better address the complex, structural forces that impact immigrant health (Ali et al., 2023). In parallel, future immigrant-focused research is needed to identify opportunities and barriers for expanding engagement in AFNs beyond gardening.

Exercise benefits synthesized in this review

were associated with both gardening and foraging, whereas mental health benefits were exclusively linked to gardening. Physical and mental well-being are critical components of immigrant health, as first-generation migrants have higher odds of physical inactivity (Juárez et al., 2022) and may be at increased risk of mental illness (Close et al., 2016; Das et al., 2025). Although most of the included studies lacked quantitative measures of physical activity and mental health, the findings suggest that gardening and foraging may offer meaningful health benefits.

The summarized social benefits also demonstrate a promising synergy between local food systems and immigrant health promotion. The placemaking efforts in immigrants' social, economic, and cultural interactions through food provisioning highlight the importance of participation in food production to advance food sovereignty for these communities. The control over food production is explicit in our review of gardening-related studies, while the relations of care, trust, and commitment become essential in understanding market-based activities. A study among Somali immigrants confirms the critical role of active stakeholders in the value chain of culturally appropriate food and shows a strong affinity for ethnic food outlets, such as Somali-owned small businesses, in shaping cultural food preference (Adekunle et al., 2022). Indeed, creating clearer pathways for immigrants to participate in alternative food spaces is an often overlooked step toward building a more sustainable and healthier food system (Minkoff-Zern et al., 2020). Moving forward, centering cultural food security would allow food and health activists to move beyond questions of access to a more comprehensive focus on the control over where culturally appropriate food comes from. This shift would require a critical assessment of norms within AFNs and could inspire innovative strategies to promote culturally appropriate food production and consumption through local food systems. For example, some scholars have examined emerging market opportunities for culturally meaningful seeds in the U.S. (Burke et al., 2024).

When accessing culturally appropriate food, *locally produced food* is not the only factor influencing food purchasing decisions and behavior. For instance, Somali refugees in Canada prefer to shop at local Somali stores, particularly when they know the products are imported from their home country (Adekunle et al., 2022). The importance of transnational food networks is also evident in the Haitian diaspora, where Haitian shop owners import dried medicinal plants to meet high community demand (Tareau et al., 2022). Meanwhile, Afro-Caribbean immigrants in the Greater Toronto Area of Canada primarily prefer to obtain vegetables from supermarkets, including Chinese ethnic supermarkets (Adekunle et al., 2011). These examples illustrate that *local* is a culturally situated concept for transnational communities and that cultural appropriateness is dynamic. Reflexivity is critical; scholars and food activists promoting local food movements for public health should be cautious of the "local trap"—the tendency to conflate *local* with ecologically sound and socially just outcomes (Carolan, 2012). To overcome this pitfall, one study posed the following guiding questions to practitioners: "what role do intermediaries play in bringing together local food producers and ethnic food processors? What role might public food procurement for culturally diverse residents (in schools, hospitals etc.) play in the ongoing economic viability of small-scale local producers?" (Landon & Rosol, 2025, p. 938). This shift in focus could create opportunities for immigrant communities and help resist monopoly power in the corporate food regime (Holt-Giménez, 2017, Chapter 1), such as by supporting the development of immigrant-owned farms and businesses. By foregrounding cultural foodways as a counterforce to the commodification and large-scale importation of cultural foods, the discourse on cultural food security will help drive more impactful shifts toward health equity.

Strengths and Limitations

To the best of our knowledge, this is one of the few review studies that synthesizes alternative sources of locally grown, culturally appropriate food and health impacts among immigrants living in high-income countries. In reviewing 25 years of publications, we provide evidence on the relative inclusiveness of local food movements and sustainable agrifood spaces, which helps identify gaps and

pressing issues for food and health activists working to advance food justice. However, despite the broad search terms used, the number of references identified in this screening was relatively small, indicating the possible omission of relevant studies that may have been identified through additional efforts, such as citation chaining. Finally, not all empirical evidence was captured in the review due to the exclusion of non-peer-reviewed publications (conference abstracts, reports, theses, and dissertations) and non-English records. The grey literature that captures grassroots voices and documents local food initiatives could be particularly important in understanding food acquisition experiences among members of immigrant groups. As such, additional insights could be gained by examining global evidence without language constraints and publication bias.

Recommendations for Policy and Research

To increase the potential health impacts of increased access to culturally appropriate food, our findings suggest that future interventions should adopt a more holistic approach and use broader measures of health outcomes. While dietary intake and food security are often prioritized in food initiatives, stakeholders should also consider the physical activity, mental health, and social benefits associated with food production activities, as highlighted in our scoping review. The studies included in this review highlight the significance of cultural food security for both individuals and communities. Future research should address the current knowledge gap of understanding the potential for AFNs to supply immigrant communities with culturally appropriate food. Among immigrant populations, stronger evidence is needed to assess and optimize market-based models, such as produce prescription programs, to support inclusive local food movements and advance food justice. Applying a food sovereignty framework could help center the assets and challenges described by immigrant participants in our review, including access to land, infrastructure, and technical assistance. For instance, interventions and policy support is needed to address structural barriers for immigrant farmers and to improve communities' capacity for participating in market-based AFNs, such as farmers markets, CSAs, and farm stores.

To improve generalizability and the impact of future interventions, researchers are encouraged to incorporate the Reach, Effectiveness, Adoption, Implementation, and Maintenance (RE-AIM) framework, which includes metrics of these five elements (Glasgow et al., 1999). This approach offers practitioners a structured model for supporting immigrants and refugees from different backgrounds as they navigate and adapt to new food environments. Finally, rather than treating dietary outcomes as the "gold standard" indicator of impact, communities, public health departments, and funding organizations should view promoting culturally appropriate food in local food systems as a means to build social capital and community well-being among immigrant communities, thereby advancing a more socially and ecologically sustainable food system.

Conclusion

This review synthesized evidence from a range of studies on food access through AFNs and the health impacts of locally grown, culturally appropriate food among immigrants in high-income countries. The findings point to a predominance of non-market-based strategies, such as home and community gardening for accessing culturally appropriate food. Despite many positive impacts on diet, exercise, and mental and social outcomes, the largely descriptive study designs leave evidence on improvements in food intake and food security inconclusive. From a food sovereignty perspective, our understanding of culturally appropriate food access among immigrants remains incomplete. Given these results, consideration of immigrant foodways in relation to AFNs is key to building inclusive local food movements and designing effective health interventions. Strategies to achieve cultural food security and health equity include supporting immigrant-led gardening and farming initiatives, promoting access to culturally meaningful seeds, and integrating food sovereignty into food security efforts. Additionally, it is important for scholars, food system planners, and policymakers to avoid the "local trap" by recognizing the transnational nature of immigrant foodways.

Acknowledgments

We thank Dr. Semra Aytur and Dr. Maria Carlota Dao for their structural comments on an earlier draft of this paper. We also extend our gratitude to the anonymous reviewers for their insightful feedback that helped strengthen this work.

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Appendix

Table A1. Search Strategy

Database	Search Query
Web of Science	"local*" or "cultur*" or "ethni*" or "ethnocultur*" or "tradition*" (Topic) and "food*" or "crop*" or "produce*" (Topic) and "alternative food network*" or "CSA" or "garden*" or "community supported agriculture" or "farmer* market" or "Community supported fishery" or "CSF" (Topic) and immigrant* or refugee* or migrant* (Topic) and Preprint Citation Index (Exclude – Database) and Article (Document Types) and English (Languages)
PubMed	(Emigrants and Immigrants[Mesh] OR Transients and Migrants[Mesh] OR Refugees[Mesh] OR "Immigrant Communities"[tiab] OR "Migrant Populations"[tiab] OR "Displaced Populations"[tiab]) AND ("Food Security"[Mesh] OR "Food Supply"[Mesh] OR "Food Assistance"[Mesh] OR "Food Sovereignty"[tiab] OR "Food Justice"[tiab] OR "Nutrition Assistance"[tiab] OR "Food Access"[tiab] OR "Food Insecurity"[tiab]) AND ("Cultural Characteristics"[Mesh] OR "Cultural Food Security"[tiab] OR "Culturally Appropriate Food"[tiab] OR "Traditional Foodways"[tiab] or "Ethnic produce" [tiab])
Google Scholar	("ethnic produce" OR "culturally appropriate food" OR "culturally important food" OR "culturally significant food" OR "traditional foodways") AND ("immigrant*" OR "refugee*" OR "migrant*" OR "displaced populations") AND ("local food" OR "locally grown" OR "small farms" OR "regional food system" OR "alternative food networks" OR "direct-to-consumer" OR "community-supported agriculture" OR "CSA" OR "farmers' market" OR "community-supported fishery" OR "CSF") AND ("food access" OR "food security" OR "dietary acculturation" OR "food justice" OR "food sovereignty" OR "nutrition assistance")
PsycINFO	SU(Food Security OR Food Supply OR Food Assistance OR Food Insecurity OR Food Access) AND AB(Immigrants OR Migrants OR Refugees OR Emigration and Immigration OR Transnationalism OR Acculturation) AND AB(Local Food Systems OR Farmers Markets OR Community Gardens OR Urban Agriculture OR Alternative Food Networks OR Community supported fishery OR Garden OR Farm)

Table A2. Studies that Evaluated the Food Access Through Alternative Food Networks (AFNs) and Health Impact of Locally Grown, Culturally Appropriate Food among Immigrants in High-Income Countries (*n* = 21)

Authors, Year	Aims/Objectives	Country of origin	*N*[a]	Study location; Host country	Study design	Data collection methods	Study sample characteristics[b]
Alkon & Mares, 2012	To investigate on-the-ground processes through which food sovereignty articulates with the work of food justice and community food security activists.	Cuba, Mexico, Peru, Honduras, El Salvador, Guatemala, Nicaragua, and Ecuador	46	Seattle, Washington; USA	Qualitative (Ethnographic research)	Participant observation, ethnographic interviews, and archival research	76% Mexican, 7% Peruvian, 4% Honduran, 4% Salvadoran, 2% each Guatemalan, Cuban, Nicaraguan, and Ecuadorian; 80% grew food before migration; most self-reported economic constraints (e.g., inconsistent employment).
Bloom et al., 2018	To understand the potential for immigrant and refugee communities to maintain the health benefits of traditional food production and preparation practices in acculturation. To identity needs to expand and strengthen bridging social capital between immigrant and refugee communities and Cooperative Extension.	Nigeria, Egypt, Somalia, South Africa, and Burma	13	North Carolina; USA	Qualitative (CBPR)	Asset mapping and community meetings, evaluative interviews	Local mosque members: 40% Nigerian, 40% Egyptian, 20% Somalian, 20% South African; 100% women; many highly educated, urban backgrounds with daily market food access; 100% English-speaking; average 10 years in the United States; all but one had children. Burmese (Karen) participants (n = 7): formally resettled refugees; average 5 years in the U.S.; all but one had children.
Brons et al., 2020	To understand how inclusiveness regarding healthy and sustainable food works within a multi-ethnic urban context.	Syria	26	Five cities (Almere, Enschede, Zwolle, Rotterdam, Amsterdam); The Netherlands	Qualitative (exploratory)	In-depth semi-structured life-history interviews, participant observation	73% female; all except one were married with children; most migrated with at least some relatives. Short-term migrants: average stay 3 years; 100% urban residents in Syria; mean age 41; migrated due to the civil war; 36% had university education; 14% employed; 29% lived in a house with a garden. Long-term migrants: average stay 20 years; 83% were rural residents in Syria; mean age 39; migrated due to religious persecution; 25% had university education; 33% employed; all lived in house with a garden.
Charles-Rodriguez et al., 2023	To provide relevant and timely feedback to inform program adaptation and development on a community garden for immigrants.	Bhutan, Mexico, Sudan, India, Congo, Eritrea and Pakistan	14	Lethbridge, Alberta; Canada	Qualitative (CBPR)	Surveys, focus groups and semi-structured interviews.	~75% female; mean age 45; 43% lived >1 year in Canada; 57% immigrants in settlement program; 75% gardened in home countries, 58% in Canada, 27% in transition countries.

continued

Authors, Year	Aims/Objectives	Country of origin	N[a]	Study location; Host country	Study design	Data collection methods	Study sample characteristics[b]
Corlett et al., 2003	To determine species raised by Hmong immigrants and their nutritional composition. To explore ways community gardens function in Hmong social and family life. To examine gardens as urban landscape features.	Laos	18	Sacramento. California; USA	Mixed method	Interviews and garden checklists	100% female; 33% elderly, widowed or separated; 66% younger, all married with ≥5 children on average; mean age: 70 (elderly), 28 (younger); mean plot numbers: 3 (elderly), 2 (younger).
Dinh, 2024	To explore migrants' motivations for foraging and the dynamics of co-creating environmental and culinary knowledge in new socio-ecological milieus.	Vietnam	36	Five cities (Himeji, Kobe, Kyoto, Hannover, Göttingen, Kassei); Japan and Germany	Qualitative	Semi-structured interviews and participant observations	56% in Japan, 44% in Germany; majority in their 30s; men and women (unspecified %); all lived in host country >1 year; many with foraging/farming experience in Vietnam; wide range of occupations.
Gangamma et al., 2024	To examine whether gardening influences mental health, food security, and economic well-being.	Bhutan, Syria, Somalia, Sudan, Burundi, Congo, Cuba, and Nepal	29	A northeastern resettlement city; USA	Mixed method (cross-sectional, descriptive, concurrent)	Semi-structured interviews and surveys	69% Bhutanese, 10% Somalian; mean age 49.1; mean years since resettlement 7.5; 76% married; 72% with children; 21% fully employed; 63% had gardening/farming experience in home country. Gardeners (n = 19): 47% female; 26% employed; 82% dependent on food assistance programs; 37% with gardening/farming experience in home country; 21% in agricultural training; household income $920–1,020/month (last two months). Non-gardeners (n = 10): 50% female; 30% employed; 100% dependent on food assistance; 50% with gardening/farming experience in home country; household income $980–1,080/month (last two months)
Gichunge & Kidwaro, 2014	To examine the role of gardening as a component of resettled African refugees' food environment.	Burundi, the Democratic Republic of Congo and South Sudan	13	South East Queensland; Australia	Qualitative	In-depth interviews, demographic survey	77% female; 46% unemployed; 54% with high school or above education; 42% with annual household income under $30,000 (AUD).

continued

Authors, Year	Aims/Objectives	Country of origin	N[a]	Study location; Host country	Study design	Data collection methods	Study sample characteristics[b]
Gichunge et al., 2016	To examine the association between household availability and consumption of traditional African vegetables among resettled African refugees residing in Southeast Queensland, Australia.	Burundi, Congo and Rwanda	71	Queensland; Australia	Mixed methods (cross sectional sequential explanatory)	In-depth interviews, survey (including an FFQ)	Survey respondents (n = 71): 89% female; 75% Burundian. Interview participants (n = 15): mean age 36.5; 100% with children; 28% employed; 67% had own vegetable garden.
Gingell et al., 2024	To explore key roles in refugee-background communities to understand why they were important and how they facilitate cultural food security.	Sudan, Syria, Bhutan, Cambodia, and Afghanistan	5	Greater Brisbane; Australia	Qualitative	Interviews	All participants held key community food roles supporting access to cultural food: community leaders (n = 2), farmer (n = 1), market stall owner (n = 1), restaurant owner (n = 1).
Goralnik et al., 2022	To describe the refugee and immigrant community gardening experience in three urban gardens with high refugee and immigrant enrollment.	Burma, Bhutan, Congo, Haiti, Kenya, Malawi, and Nepal	11	Lansing, Michigan; USA	Qualitative	Observations and interviews	27% Bhutanese, 27% Malawian, 18% Kenyan, 9% each Burnese, Congolese, and Haitian; 55% self-identified as refugees; majority lived in the United States for 6–10 years; mean community gardening experience 3.8 years.
Guo et al., 2022	To explore if and how access to seeds and seed systems enables refugee gardeners to grow essential crops, which might be otherwise difficult to obtain, to produce foods reminiscent of their homelands.	Bhutan	30	Chittenden County, Vermont; USA	Qualitative	Semi-structured interviews	67% aged 35–54, 17% aged 18–34, 17% aged 55+; 50% women, 50% men; year of U.S. arrival: 7% (2008–2011), 50% (2012–2015), 3% (2016–2019).
Harris et al., 2014	To explore how involvement in a community food garden supports African humanitarian migrant connectedness with their new country.	Not specified	12	City of Logan; Australia	Qualitative (single critical case study)	Semi-structured interviews	Participant characteristics (besides low socio-economic status) not specified. Gardeners ($n \approx 100$) were mostly women with large families (up to 7–8 children); majority unemployed and attending settlement-related classes (English, life, and employment skills).

continued

Authors, Year	Aims/Objectives	Country of origin	N[a]	Study location; Host country	Study design	Data collection methods	Study sample characteristics[b]
Head et al., 2019	To understand how different groups of people understand broader human–environment relations, albeit in a context where food growing is something they have in common.	Burundi, Democratic Republic of Congo, Afghanistan, Vietnam, and Tonga	30	The Sunraysia region; Australia	Qualitative	Semi-structured interviews	Burundian group (*n* = 8): 100% refugees; 100% gardened in Sunraysia; 75% were farmers pre-arrival; 1–5 years in Sunraysia. Hazara group (*n* = 6): 33% refugees, 33% asylum seekers, 33% immigrants; 83% owned farms in home country; 100% gardened in Sunraysia; 0.1–10 years in Sunraysia. Vietnamese group (*n* = 7): 29% refugees, 71% immigrants; 7–25 years in Sunraysia; none owned farms in Vietnam; 100% worked as agriculture laborers and had home gardens in Sunraysia. Tongan group (*n* = 9): 11% seasonal workers, 89% immigrants; 33% still owned farms in Tonga; 100% gardeners in Sunraysia.
Hughes, 2019	To understand the social and cultural factors that influence food choices in an unfamiliar environment.	Myanmar	12	Regional city of Coffs Harbour; Australia	Qualitative (focused ethnography and PAR)	Semi-structured interviews	100% refugees.
Lucas, 2020	To learn about the benefits and challenges of community gardening in the context of a garden for immigrants and refugees.	Not specified	14	Winnipeg; Canada	Qualitative	Semi-structured interviews	Most had prior farming or gardening experience before migration.
Minkoff-Zern et al., 2024	To bring a comprehensive food sovereignty framework to the research on immigrant and refugee gardening and to add a nuanced and necessary perspective on how to address the related issues of forced displacement, mental health, and food security.	Bhutan, Syria, Somalia, Sudan, Burundi, Congo, Cuba, and Nepal	29	Central New York; USA	Mixed method (cross-sectional, descriptive, and concurrent)	Semi-structured interviews and surveys	62% Bhutanese, Nepali, or Bhutanese-Nepali; 10% Asian; 21% African, Tutsi, Somali-Mayou, Somali-Bantu, Hutu, or Black; 52% male, 48% female; 73% aged 40–70; 66% self-identified as gardeners; resettled for 5–17 years (average 10 years).

continued

Authors, Year	Aims/Objectives	Country of origin	N[a]	Study location; Host country	Study design	Data collection methods	Study sample characteristics[b]
Park et al., 2011	To better specify the role of Hispanic immigrants' beliefs about, and preferences for, healthy foods in linking food access to dietary patterns.	Mexico, the Dominican Republic	28	New York City; USA	Mixed method (convergent)	Survey (FFQ) and interviews	100% female; all lived in high-poverty neighborhoods in New York City; mean age 31; average 9 years of education. Mexican group (*n* = 14): 71% grew up in the countryside; 36% from high-rise Tract, 36% mid-rise, 29% low-rise. Dominican group (*n* = 14): 50% grew up in the countryside; 29% from high-rise Tract, 36% mid-rise, 36% low-rise.
Sandoval & Rodine, 2020	To investigate the relationships between immigrant integration and agricultural, environmental sustainability.	Mexico	14	Umatilla County and Malheur County, Eastern Oregon; USA	Qualitative (critical case study)	Interviews	100% Latino ranchito owners; few were unauthorized residents.
Strunk & Richardson, 2019	To understand how urban gardens are used and experienced by residents and city officials.	Not specified	27	Rock Island, Illinois; USA	Qualitative	Interviews, field notes, and participant observation	100% had farming experience in country of origin, planting and harvesting for both market and family subsistence.
Tareau et al., 2022	To improve the state of general knowledge on contemporary Haitian phytotherapies. To better understand how plant-based practices adapt and change in different urban, migratory, legislative, and climatic contexts.	Haiti	18	Cayenne; French Guiana	Qualitative	Semi-structured interviews	100% Haitian; lived in host country from a few months to several years.

Abbreviations: AUD: Australian Dollars; CBPR: community-based participatory research; FFQ: Food Frequency Questionnaire; PAR: participatory action research.

[a] Results presented in this table represent the individual foreign-born immigrant participants only.

[b] The study sought to include: Age, gender, income, marital status, education, household dynamics (having children), gardening/farming experience, length of stay etc. whenever available. Only indicators that were available from the study are represented in the column "Study sample characteristics."

Table A3. Summary of the Food Access Through Alternative Food Networks (AFNs) and Health Outcomes of Locally Grown, Culturally Appropriate Food in All Included Studies (*n* = 21)

Authors, Year	Food access through AFNs	Key outcome contributed to the study
Alkon & Mares, 2012	Neighborhood farmers market, urban garden	**Diet outcome:** In the sample, only four participants were currently growing food in the city, and three additional were growing herbs. Only eight mentioned shopping at the farmers markets, although they had very favorable impressions about the quality and variety of produce available. The use of a market-based system (e.g., farmers market) to provide culturally appropriate and nutritious food limits access due to relatively high costs. A translocal connection motivates producing homegrown food as an alternative to meet food needs.
Bloom et al., 2018	School garden, home garden, local nonprofit incubator farm	**Diet outcome:** Most women participants did not produce enough vegetables either at the school garden or at home to affect their consumption of fresh fruits and vegetables. The fact that food grown at the school garden was distributed at the mosque indicates the potential to increase community food access through gardens. By providing the opportunity to grow culturally specific produce varieties, the Karen participants reported completely relying on produce from the farm. **Exercise outcome:** Participants reported increased physical activity by gardening. **Social outcome:** The Karen community not only shares produce across social networks but also shares seeds and knowledge. Bonding social capital through alternative food production can be an asset and a potential barrier towards community organizing.
Brons et al., 2020	Farm or slaughterhouses, home vegetable garden	**Diet outcome:** Long-term migrants purchased directly at farms or slaughterhouses for specific products (milk, cheese and meat). Home-growing is another prevalent acquisitioning practice among long-term migrants. Almost all of them have at least a grapevine in their backyard to make their culturally important dish dolma or yaprak. In contrast, almost none of the short-term migrants engaged in home-growing. **Social outcome:** Migrants' new practice elements were integrated into existing local provisioning practices (a Dutch farmer including Syrian labneh in their offer).
Charles-Rodriguez et al., 2023	Community garden supported by a food bank	**Diet outcome:** Having access to fresh vegetables for their own consumption motivates community garden participation. However, some reported receiving insufficient produce for take-home self-consumption. **Exercise outcome:** Bhutanese community particularly prioritizes physical activity benefits of gardening. **Social outcome:** Immigrants enjoyed the company of other women and learning from each other and their respective cultures, such as medicinal use of plants and recipes. Participants donated significant amounts of produce they have grown to the food bank that organized the garden program. This brings dissatisfaction with insufficient take-home produce and indicates a lack of ownership over space and produce. Work and life schedule and transportation were barriers to increasing garden participation.
Corlett et al., 2003	Community garden	**Diet outcome:** There are 59 Hmong garden species grown at a site in South Sacramento, of which 38 were for food and 36 for medicine. On average, elderly women grew more plants than younger women. There is greater variety of medical plants grown by elderly women than younger women. By gardening, all the Hmong women accessed fresh, familiar produce for their families. Although many could be purchased at Asian markets, the women consider growing their own to be easier, more convenient, and more economical. **Mental outcome:** Particularly for the elderly, gardening helps combat feelings of overdependence and uselessness.

Authors, Year	Food access through AFNs	Key outcome contributed to the study
Dinh, 2024	Foraging sites (public grounds, woodlands, abandoned fields, interstitial areas, and streams)	**Diet outcome:** All participants collected wild plants for culinary and recreational purposes instead of for commercial use. Participants underscored the medicinal and remedial characteristics of wild plants. Wild plants have seasonal uses. Food provision benefits were prioritized by immigrants and temporary migrants. **Exercise outcome:** Immigrants and temporary migrants appear to prioritize foraging for its practical physical exercise benefits. **Social outcome:** Foraging facilitates transnational community network by exchanging ecological and culinary knowledge on forgeable plants. Social benefits (i.e., helping social networks) were more frequently mentioned among long-term migrants than immigrants and temporary migrants.
Gangamma et al., 2024	Home garden, community garden	**Diet outcome:** Fewer gardeners than non-gardeners reported food shortage and food insecurity. Participants reported access to fresh, organically grown vegetables for their own consumption. **Mental outcome:** Regression analysis shows that being a gardener significantly predicted lesser mental health distress. There is difference in mental health symptoms between two groups. More non-gardeners reported symptoms of anxiety and depression, including body pains (44%), sadness (33%), too many thoughts (56%), faintness and restlessness (44%), reliving trauma (33%) and emotional numbness (33%). **Social outcome:** Many participants reported strengthening of connections with family and the community members with whom they gardened.
Gichunge & Kidwaro, 2014	Home garden, community garden	**Diet outcome:** By having access to a vegetable garden, participants were able to access healthy food and utilize familiar and culturally acceptable food. **Exercise outcome:** Gardening helps engage in physical activity. **Mental outcome:** Gardening helps manage stress. **Social outcome**: Gardening helps integrate into the wider Australian community.
Gichunge et al., 2016	Farmers market, home vegetable garden	**Diet outcome:** Those who engaged in vegetable gardening reported higher availability of traditional African vegetables in the home. Compared to supermarkets and ethnic grocery stores, farmers markets were the preferred food outlet in terms of availability and cost. Participants with vegetable garden access reported that African vegetables were available and accessible at no expense.
Gingell et al., 2024	Farms, home garden	**Diet outcome:** A refugee farmer networked with other community members to identify trusted business connections, and new cultural food sources and suppliers (e.g., seeds). A refugee market owner grew food in her backyard and shared with the community. **Social outcome:** Food spaces, such as the locations where food were grown or sold, created a place where community members could connect and nurture their identity and helped create a sense of belonging.
Goralnik et al., 2022	Urban garden	**Diet outcome:** Participants shared that access to healthy or organic food were important drivers of their garden participation. They discussed the importance of growing and sharing culturally relevant produce and recipes within their own cultural community, especially food that are expensive or hard to find in local stores and/or food that are central to traditional ceremonies or gatherings. **Exercise outcome:** Exercise motivates garden participation.

Authors, Year	Food access through AFNs	Key outcome contributed to the study
Guo et al., 2022	Community garden	**Diet outcome:** Engaging in agriculture in Vermont enhances household food security through enabling access to culturally relevant food and also enhances stability in terms of having access to those food beyond just the growing season (for example, freezing some of their harvest and sometimes modifying their consumption practices by eating parts of the plant not commonly eaten in their home countries). Gardeners try various cultivars in search of flavors and textures, and ultimately, the taste of home (e.g., very spicy chilies, and pumpkins that stir-fry well). **Social outcome:** Gardening provided wellness and social benefits. The gardeners shared seeds and knowledge surrounding seeds with their families and the larger Nepali Bhutanese community.
Harris et al., 2014	Campus-based community garden	**Diet outcome:** Gardeners have harvested crops including traditional food such as cassava and maize, and local food such as pumpkins, bananas, tomatoes, and strawberries. **Mental outcome:** Growing and harvesting crops offers the opportunity for achievement and feelings of happiness and success. **Social outcome:** Sharing food with family, friends and community builds trust and mutual reciprocity, further improving community belonging.
Head et al., 2019	Home garden, community garden	**Diet outcome:** Participants relate to food gardens rather than farms as places of pleasure and close engagement. Hazara participants were growing vegetables, herbs, or both because they valued freshness and considered fruits and vegetables from their own gardens to have a better flavor. Vietnamese participants mainly grew vegetables (e.g., bok choy) and herbs (e.g., lemongrass) that reflected their dietary preferences for food from Vietnam. Two were raising chickens. Some Vietnamese participants wished to grow tropical fruits. **Exercise outcome:** Burundian participants were motivated to grow food in Australia to keep active. **Mental outcome:** Burundian participants were motivated to grow food in Australia to promote good mental health, **Social outcome:** Burundian and Tongan migrants associated growing food with their sense of community and culture.
Hughes, 2019	Home garden	**Diet outcome:** Gardening can provide a means to access traditional food. It may also provide an income (e.g., supplying restaurant). **Mental outcome:** Gardening helps engagement with nature and green space as a form of therapy.
Lucas, 2020	Community garden	**Diet outcome:** Gardening provides access to healthy, culturally appropriate food and saves money. **Social outcome:** Gardening provides opportunities for social interaction, which can help migrants in their adjustment into Canadian society.
Minkoff-Zern et al., 2024	Home garden, community garden	**Diet outcome:** No significant differences in household food security between gardeners and non-gardeners. Gardening provides more control over the freshness, chemical additives, and quality of the food refugees consume. **Mental outcome:** Producing own food makes participants feel connected with their home country and increases their happiness. Having access to healthy and culturally appropriate food through gardening had a direct impact on participants' level of overall perceived health, reflecting a comprehensive notion of sovereignty.

Authors, Year	Food access through AFNs	Key outcome contributed to the study
Park et al., 2011	Farmers market, livestock market	**Diet outcome:** Women of rural origin were more likely to describe diets composed of home-grown food; those from urban settings tended to discuss locally sourced food. Nearly all respondents reported that they routinely buy poultry and (less often) other meats in livestock markets where poultry and small animals such as goats and rabbits can be purchased. The presence of a farmers market within the home neighborhood was associated with consumption of more total servings per day of fruit, vegetables, and juice ($p < 0.001$), and the presence of a farmers market and/or a livestock market was associated with consumption of more servings per day of meat ($p = 0.01$).
Sandoval & Rodine, 2020	Ranchitos (Mexican-immigrant owned small rural ranches)	**Diet outcome**: Ranchitos provide fresh food that is organic and relatively inexpensive. Produce and meat from ranchitos were sold mostly based on networks of family, friends, and acquaintance. Ranchitos provide safe, healthy food and contribute to the buy-local movement. **Social outcome:** Ranchitos help keep money in the community and encourage social capital via their business networks. Ranchitos give immigrants more control over their health, by giving them options for eating healthier and less dangerous produce and meats. The placemaking function of ranchitos is a critical component of creating a sense of community and belonging.
Strunk & Richardson, 2019	Community garden	**Diet outcome:** Refugee gardeners used plots to plant culturally significant plants. No refugee gardeners reported shopping at local farmers markets or selling at markets due to linguistic barriers and difficulty in understanding local regulations. All valued gardening as a way to access cheaper and more culturally significant food than what is available in supermarkets and smaller ethnic grocery stores. **Social outcome:** While sharing garden-produced food with friends and family members is common, there have been social divides within the diverse refugee gardener group.
Tareau et al., 2022	Home garden, foraging sites	**Diet outcome:** The tropical climate, relatively similar to that of Haiti, is critical to herbal self-sufficiency. Home gardens provide access to fresh medicinal plants in French Guiana. Some plant species can fulfill other functions, such as for food and magical potions in particular. Gathering activities mainly target wild species growing along paths or in urban wastelands. Migrants report re-appropriation of native continental species in French Guiana in post-resettlement medicinal practices. **Social outcome:** Herbal medicine is a clear cultural marker in Haitian communities that continue to maintain and perpetuate their Haitian identity.

Journal of Agriculture, Food Systems, and Community Development
ISSN: 2152-0801 online
https://foodsystemsjournal.org

SNAP's Restaurant Meals Program: Understanding drivers and constraints on state adoption and implementation

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Submitted July 29, 2025 / Revised October 27, November 20, December 10, and December 16, 2025 / Accepted December 17, 2025 / Published online March 16, 2026

Citation: Vong, V., Antonacci, C. C., Thomas, A. E., Poirier, L., Mueller, M. P., Wolfson, J. A., & Mui, Y. (2026). SNAP's Restaurant Meals Program: Understanding drivers and constraints on state adoption and implementation. *Journal of Agriculture, Food Systems, and Community Development*, *15*(2), 403–424. https://doi.org/10.5304/jafscd.2026.152.013

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Abstract

The Supplemental Nutrition Assistance Program (SNAP), the largest U.S. nutrition assistance program, provides financial support to Americans with low income to purchase food. However, SNAP benefits cannot be used to purchase prepared foods, including foods at restaurants. The Restaurant Meals Program (RMP), a program under SNAP offices, offers an important opportunity, yet an underutilized strategy, to improve food access and food security for some of the most vulnerable individuals, including older adults, people experi-

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encing homelessness, and those with disabilities, by allowing them to use SNAP benefits to purchase food at participating restaurants. Though introduced as an option for states in 1977, uptake of RMP has been low, with only nine states participating as of 2025. The factors driving or hindering RMP adoption and effective implementation are poorly understood, leaving a critical gap in policy and practice. To fill these knowledge gaps, this study utilized a rapid literature review, followed by key informant interviews with state administrators of RMP and owners of independent restaurants participating in RMP. Key drivers for adoption and implementation of RMP included motivations to champion food access and food security; to connect local restaurants, communities, and cultures; and to stimulate local economies. Conversely, major constraints included onerous administrative processes for both states and restaurants; fast-food chain domination undermining the driver of connecting local restaurants, communities, and cultures; overcoming misconceptions and negative public opinions about the program; and addressing gaps in program evaluation efforts. These findings highlight the multi-level nature of factors, ranging from intrapersonal motivations to broader policy and administrative domains, that require attention for the successful and equitable expansion of RMP, and highlight RMP as an opportunity to promote agency, dignity, and equity in food assistance, particularly for vulnerable groups least able to prepare meals at home. Recommendations include streamlining enrollment, prioritizing independent restaurant participation, improving federal guidance, and investing in program evaluation.

Keywords
SNAP, Restaurant Meals Program, food policy, nutrition program, food access

List of Abbreviations
SNAP (Supplemental Nutrition Assistance Program)
RMP (Restaurant Meals Program)
POS (point-of-sale)
EBT (electronic benefit transfer)

Introduction

In 2023, food insecurity affected 13.5% (18 million) of U.S. households, with rates four times higher among individuals experiencing homelessness or living with disabilities (Berkowitz et al., 2024; Rabbitt et al., 2024). Food insecurity among older adults also remains above pre–Great Recession levels, reflecting a long-standing vulnerability of this population (Ziliak & Gundersen, 2023). The Supplemental Nutrition Assistance Program (SNAP), a federally funded initiative, plays a critical role in addressing food insecurity by providing individuals and families with low income the financial support to purchase groceries. SNAP has broad national reach and importance. In 2023, more than 41 million people were enrolled in SNAP each month on average, and studies have estimated that participation in SNAP reduces food insecurity by up to 30% (Gundersen et al., 2017; Keith-Jennings et al., 2019; Mabli et al., 2013).

Despite SNAP's general success in mitigating food insecurity, barriers to its use exist for vulnerable populations (Keith-Jennings et al., 2019; Mabli et al., 2013). For example, SNAP participation among older adults was below 50% in 2020, and certain stipulations (e.g., work requirements) disproportionately reduce participation for those experiencing homelessness (Gray et al., 2023; Vigil, 2022). Moreover, SNAP-participating households can only use benefits to purchase groceries, not prepared foods that are hot at the time of purchase (U.S. Department of Agriculture Food and Nutrition Service [USDA FNS], 2025a). This restriction adds to meal preparation burdens for many fami-

Authors' Contributions
VV collected the data, analyzed the data, led data interpretation, and led manuscript writing. CCA analyzed the data, contributed to data interpretation, and contributed to writing the manuscript. AET collected the data, analyzed the data, contributed to data interpretation, and contributed to writing the manuscript. LP designed the study, contributed to data interpretation, and edited the manuscript. MPM contributed to data interpretation and edited the manuscript. JAW contributed to data interpretation and edited the manuscript. YM designed the study, oversaw data collection, guided data analysis, contributed to data interpretation and manuscript writing, and edited the manuscript.

Funding Disclosure
This project was funded by the Bloomberg American Health Initiative.

lies, especially as SNAP participants spend about 26% more time preparing at-home meals compared to the general population (Davis & You, 2010). Such regulations also present challenges for individuals experiencing homelessness who may lack access to food storage and cooking supplies and for older adults and those with disabilities who may be unable to safely prepare food at home.

The Restaurant Meals Program (RMP), an extension of SNAP, allows certain SNAP participants to spend benefits on prepared meals at authorized restaurants (USDA FNS, 2025b). RMP became a state-optional program within SNAP as part of the 1977 Food Stamp Act, and is unique among U.S. food assistance programs, such as the National School Lunch Program, due to its focus on populations that may be incapable of storing or preparing food at home: eligible populations include adults over 60, people experiencing homelessness, and those with a disability (Food and Agriculture Act of 1977, 1977). California in the early 2000s became the first state to implement RMP (California Department of Social Services, 2021). As of 2025, nine states participated in RMP: Arizona, California, Maryland, Massachusetts, Michigan, New York, Rhode Island, Virginia, and two counties in Illinois (USDA FNS, 2025b).

RMP holds strong potential to enhance food security among some of the most high-risk SNAP participants. Nevertheless, adoption remains limited, and little empirical research has examined drivers, constraints, and best practices associated with program implementation (Hua et al., 2024). This study aims to address critical gaps in SNAP policy research by:

1. Reviewing existing evidence on RMP implementation and evaluation; and
2. Examining the perspectives of state administrators and independent restaurant owners on factors influencing program adoption, restaurant participation, and outcomes for eligible SNAP participants.

These analyses seek to advance understanding of how RMP can expand its reach and enhance food access among some of SNAP's most vulnerable participants.

Methods

To generate a more comprehensive understanding of RMP implementation and impact, this study utilized multiple methods—a rapid literature review followed by key informant interviews with state RMP administrators and independent restaurants owners participating in RMP—allowing for both breadth of evidence and depth of perspective. A literature search was conducted in October 2023 utilizing databases representing literature from relevant disciplines, including public health, nursing, social sciences, public policy, and nutrition: PAIS, PubMed, CINAHL, SCOPUS, Web of Science, and Hein Online. In addition, a search of grey literature (e.g., press articles, academic papers, institutional reports) using Google Scholar was performed. Search terms included (Restaurant Meals Program) OR (RMP) AND (Supplemental Nutrition Assistance Program) OR (SNAP) AND (Restaurants).

Studies that met the following criteria were included in the review: discussed implementation or evaluation of RMP, published in English, and full-text accessible. Articles were managed using Covidence (Covidence Systematic Review Software). A trained graduate research assistant independently screened titles and abstracts according to inclusion criteria. Full texts were subsequently reviewed to confirm eligibility based on inclusion criteria. Data extraction was organized in Microsoft Excel and captured bibliographical information, study objectives, and reported drivers and constraints of RMP. Following extraction, the research team discussed the literature findings, and the trained research assistant employed a thematic approach to identify inductive patterns related to drivers and constraints of RMP implementation and evaluation. Throughout, questions and ambiguities were discussed and resolved through consultation with the broader research team, ensuring rigor, transparency, and consistency.

To deepen understanding of drivers, constraints, and impacts of RMP participation, semi-structured key informant interviews were conducted with state administrators of RMP and RMP-participating independently owned restaurants (January–April 2024). Participants were recruited using purposive snowball sampling.

Recruitment began in one focal state (Hua et al., 2024) by contacting the state's RMP administrator using publicly available contact information, who then recommended RMP administrators from other states. At the time of recruitment, only three independently-owned restaurants were enrolled in RMP in the focal state, and one had since closed. Therefore, recruitment was expanded to a second state based on the recommendation of an RMP administrator who provided a list of eligible restaurant owners in their state, facilitating subsequent recruitment. Restaurant owners who participated in interviews were compensated with a $25[1] gift card, while administrators were not permitted to accept gift cards.

Guided by the research aims, gaps identified in the literature review, and related work (Hua et al., 2024), state administrators (n = 6) were asked questions about RMP adoption, restaurant participation and communication, and program evaluation, and restaurant owners (n = 2) were asked about applying for and enrolling in RMP and impacts of participation on their business (e.g., customers, revenue). Specific questions can be found in the interview guides, appendices A and B for each key informant group. Interviews were conducted via telephone or Zoom and scheduled for 60 minutes; interviews ranged in length from 45 minutes to two hours depending on participant availability and scope of program implementation.

Interview recordings were transcribed verbatim and uploaded to Taguette, an online qualitative analysis tool. Data were analyzed by two graduate research assistants, following Braun and Clarke's (2021) work on thematic analysis, beginning with data familiarization and detailed memos to identify preliminary codes. Transcripts were then independently coded using inductive codes (e.g., participation requirements, administrative burdens) and deductive codes (e.g., RMP facilitators, RMP restrictions/limitations) related to drivers and constraints to RMP participation. Codes were analyzed for a shared pattern of meaning to identify preliminary themes, which were refined through a recursive process, revisiting the data and codes and discussing with the broader research team to modify, remove, and add codes as necessary. Illustrative quotes were provided to add context and clarify themes.

Results

The initial database search yielded 199 records. In total, 179 non-duplicate articles were screened, and 59 articles were selected for full-text review (Figure 1). An additional 30 articles were excluded after full-text review due to duplication (i.e., the same articles published under different titles or publishers) or brief mentions of RMP without implementation or evaluation details. This resulted in 29 articles included in the final review, of which 21 were news articles, four were policy briefs, two were college papers (one was a masters thesis), and two were law review articles (Table 1).

Drivers Supporting RMP Adoption and Implementation

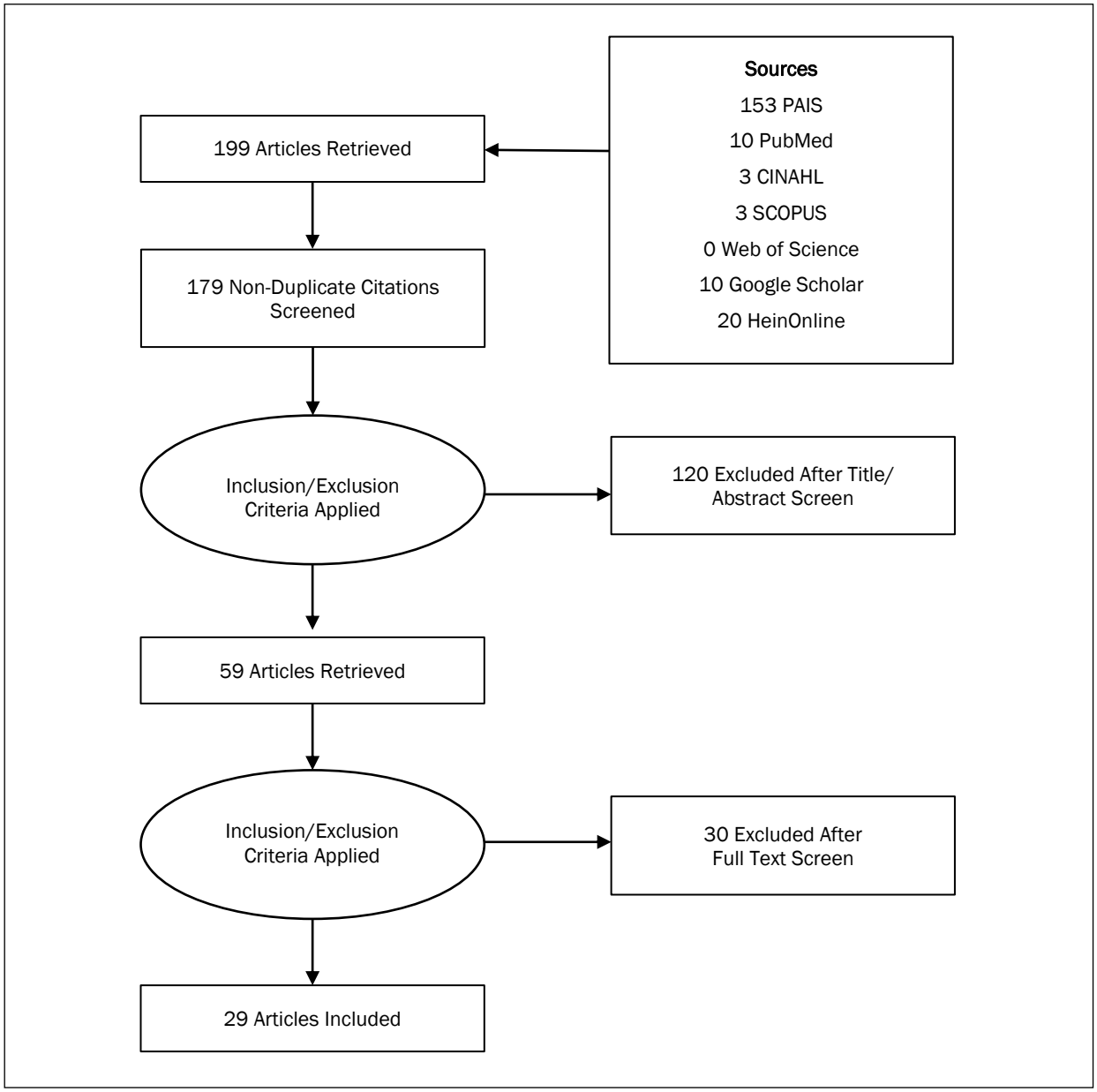
The following sections discuss drivers supporting RMP adoption and implementation, which include championing food access and food security; connecting local restaurants, communities, and cultures; and growing business revenue and stimulating local economies.

Championing Food Access and Food Security

Most articles included in the literature review described RMP as a mechanism for increasing food access and food security while centering participants' dignity and autonomy, a finding echoed by administrators and restaurant owners interviewed for this study (Table 2). Within the reviewed literature, "anti-hunger advocates" (i.e., those working to address hunger and its root causes) were among the most vocal champions of RMP, emphasizing its importance for populations who may face barriers to using SNAP benefits (Alex Padilla: U.S. Senator for California, 2023; Dewey, 2022; Elejalde-Ruiz, 2019; Harris, 2011; Janzer, 2020; Jones, 2011; New York State: Governor Kathy Hochul, 2021; Prah, 2011; Walker, 2016; 2018). These advocates emphasized RMP's role in expanding food access while promoting dignity and autonomy, particularly among

[1] All currencies are in US$.

Figure 1. PRISMA Diagram of Literature Sources and Articles Screened and Included



people experiencing homelessness (Alex Padilla: U.S. Senator for California, 2023; Blum, 2011; Dewey, 2022; Elejalde-Ruiz, 2019; Harris, 2011; Janzer, 2020; Jones, 2011; Kovarsky, 2022; U.S. Representative Jimmy Panetta, 2020; Walker, 2018). News articles similarly emphasized the significant challenges unhoused individuals encounter when seeking hot meals, including being denied entry to restaurants or relying on soup kitchens with limited meal options and operating hours (Elejalde-Ruiz, 2019; Janzer, 2020). In contrast, RMP enabled participating restaurants to welcome individuals experiencing homelessness as valued customers, granting them access to the same amenities (e.g., bathroom facilities) and food choices available to the general public.

The literature review also noted restaurants with anti-hunger missions, including large corporations and independent restaurants, as supporters of RMP for its ability to promote food access and

food security. For instance, news articles and a college paper cited Yum! Brands, the parent company of KFC, Taco Bell, and other chains that devote millions each year to hunger relief organizations, for actively lobbying to expand RMP implementation across states (Blum, 2011; Jones, 2011; Prah, 2011; Robertson, 2020). Likewise, one article featured the California-based food company, Everytable, which pledged to enroll each new franchise in RMP wherever available as part of its Social Equity Franchise Program (Everytable, 2022). Independent restaurant owners cited in news articles also described commitments to addressing food insecurity in their communities as a prime motivator for participating in RMP (Janzer, 2020; Solis, 2023; Walker, 2018).

Findings from the interviews reinforced these themes. Both administrators and restaurant owners emphasized RMP's dignity-centered approach as central to their support for the program. One restaurant owner explained he viewed patrons as "[guests] of our restaurant" (Owner 2) regardless of housing status or payment type. Similarly, a state administrator shared the following sentiment about RMP participants:

> We know that those groups of people have … limited access to cooking facilities, the ability to prepare food, store food, buy food, cook food. So, allowing these populations the autonomy … to make their own decisions about what they want to eat, when they want to eat, how they want to eat is also affirming of them as human beings, people with autonomy, and that matters. (Administrator 6)

Mirroring the influential role of anti-hunger advocates identified in the literature review, advocacy groups were also instrumental in promoting RMP among SNAP administrators interviewed for this study. One RMP administrator credited such organizations as the driving force behind their state's adoption of the program, stating advocacy groups "caught wind of [RMP] and then enlightened us and we got on board" (Administrator 4).

Connects Local Restaurants, Communities, and Cultures

Another key driver of RMP participation identified in both the literature review and interviews was the program's role in fostering connections between businesses and communities (Table 2) (Cohen, 2022; Dewey, 2022; Elejalde-Ruiz, 2019; Janzer, 2020; Solis, 2023; Walker, 2018). Advocates cited in news articles described RMP-participating restaurants as inclusive and safe spaces for social connection, particularly for individuals who might otherwise feel unwelcome in public dining spaces or be unable to afford restaurant meals (Dewey, 2022; Elejalde-Ruiz, 2019). Community connection was particularly salient among owners of locally owned restaurants interviewed for news articles, who saw RMP participation as a way to make their restaurants more financially accessible and, in turn, to engage with a larger share of local residents (Janzer, 2020; Solis, 2023; Walker, 2018). To promote this driver, some states, such as Massachusetts, have

Table 1. Publication Sources of Articles Included in the Review

Article Type (*n* = 29)	Publication Sources
News articles (*n* = 21)	Axios, Chicago Tribune, Columbia Missourian, Courier-Journal [Louisville, Kentucky], Maryland Matters, Next City, Orange County Register, PR Newswire, Public Opinion Newspaper, Restaurant Hospitality, St. Louis Post-Dispatch, Supermarket News, Tribune Content Agency, The Washington Post
Policy briefs (*n* = 4)	Alex Padilla: US Senator for California, Governor Kathy Hochul, MENA Report, US Representative Jimmy Panetta
Dissertations (*n* = 2)	Occidental College, Rochester Institute of Technology
Law review (*n* = 2)	Clearinghouse Review Journal of Poverty Law and Policy, University of Illinois Chicago Law Review

chosen to limit RMP participation to independent restaurants, excluding chain restaurants in order to prioritize local impact (Solis, 2023).

Administrators who participated in interviews echoed the importance of community connection through RMP. Several administrators familiar with Massachusetts' focus on independent restaurants praised this approach, pointing to the state's "extremely robust RMP campaign with restaurants that are owned by women and people of color and local restaurants" (Administrator 1), and expressed aspirations to follow suit. One administrator specifically accentuated the community connection that RMP fosters among older adults "who stay in the house because [they] have less mobility," noting that "being able to take [their] SNAP card and go to a restaurant allows [for] some socialization with others" (Administrator 3).

Another key aspect of community connection, found in both the literature review and interviews, was multiculturalism (Janzer, 2020; Solis, 2023; Walker, 2018). Restaurant owners from diverse cultural backgrounds interviewed in news articles expressed a strong desire to share their food and by extension their cultural heritage with broader segments of their communities through participation in RMP (Janzer, 2020; Walker, 2018). Similarly, interviews revealed that both administrators and restaurant owners sought to ensure that eligible SNAP participants had access to

Table 2. Drivers Supporting RMP Adoption and Implementation

Theme	Description	Illustrative Quote
Championing food access and food security (*n* = 17 articles)	• Greater food access and food security for SNAP participants with limited access to store or cook food • Dignity and autonomy in accessing food and restaurants beyond the charitable food system • Alignment between RMP and restaurants' social missions	"We chose to do the Restaurant Meals Program because it kind of tied in with the Pay It Forward program that we were already trying to do. We were already trying to make it so that people that can't afford a meal … are able to." (Restaurant owner 1) "We identified 20 priority communities…The food insecurities are in some of the deserted towns … farmland towns and things like that … we are really looking to address communities that … have the population that needs the services." (Administrator 3)
Connects local restaurants, communities, and cultures (*n* = 6 articles)	• Restaurants as venues for social connection • Support for local and minority-owned businesses • Promotion of multiculturalism	"Restaurants are connections to community, especially for immigrants that have come to this country that are looking for food from their homeland." (Administrator 1) "The core goal is bringing our food to as many people as possible. So, by participating in the RMP, that opened … the door … to reach out to more people that are income restricted … to allow them to have a taste of our great food." (Restaurant owner 2)
Grows business revenue and stimulates local economies (*n* = 9 articles)	• Support for restaurants during COVID-19 • Economic stimulus in local communities • Growth in restaurant revenue and customer base	"I see the same faces over and over. So that has created a steady revenue from those people that have [SNAP] benefits. Obviously, it looks like to me that they like our food too. But yes, I've seen … the repeated customers." (Restaurant owner 2) "[RMP] is essentially an entirely new revenue stream for restaurants…It supports their business in having more customers and bringing in more money. And in turn, it helps the local community. It helps pump dollars back into the local community." (Administrator 6)

"culturally relevant restaurants within culturally diverse communities" (Administrator 3). RMP administrators in particular recognized the value of culturally diverse restaurants not only as sources of nourishment but also as spaces that reflect and reinforce community identity and belonging:

> Restaurants are connections to community, especially for immigrants that have come to this country that are looking for food from their homeland … Restaurants can be a really good way to kind of link and join communities together. (Administrator 1)

One interviewed restaurant owner, originally from the Dominican Republic, explained that his motivation for enrolling in RMP stemmed from wanting to share his culture with others through food:

> The core goal is bringing our food to as many people as possible. So, by participating in the RMP, that opened … the door … to reach out to more people that are income restricted … to allow them to have a taste of our great food. (Owner 2)

Recognizing this motivation, administrators described efforts to support diverse restaurant owners by making the RMP application process more inclusive and accessible, such as providing materials in multiple languages, such as Spanish and Korean, and offering assistance to non-native English speakers. By lowering administrative barriers, these practices can expand participation in RMP and reinforce the program's potential to celebrate cultural diversity and strengthen community connections through food.

Grows Business Revenue and Stimulates Local Economies

Articles in the literature review emphasized the potential of RMP to grow business revenue for participating restaurants and stimulate local economies (Table 2) (Alex Padilla: US Senator for California, 2023; Carman, 2020; "Charge this meal to Uncle Sam," 2011; Dewey, 2022; New York State: Governor Kathy Hochul, 2021; Janzer, 2020; U.S. Representative Jimmy Panetta, 2020; Walker, 2018). The economic benefit became a prominent driver of RMP expansion during the COVID-19 pandemic, when government officials faced the dual challenge of rising food insecurity and declining restaurant revenues (Carman, 2020; Dewey, 2022; New York State: Governor Kathy Hochul, 2021; Janzer, 2020; U.S. Representative Jimmy Panetta, 2020).

These themes were further affirmed by administrators interviewed for this study; one described the COVID-19 pandemic as a catalyst for their state's adoption of RMP, and another highlighted a sharp increase in program-related expenditures: "peak expenditures for the RMP [were] $30 million plus per month" (Administrator 6) compared to about $9 million per month pre-pandemic. The goal of supporting local economies was found to align with efforts to prioritize independently owned restaurants in RMP; one administrator stated:

> If we have SNAP customers who can use their SNAP benefits at small mom and pop shops, we're hopeful that that would help with the economic impact for local businesses too. (Administrator 2)

Some administrators cited the statistic that "a dollar of SNAP [is] estimated to generate $1.50 in the local economy" (Administrator 1), an observation also referenced once in the literature review by an RMP advocate (Alex Padilla: US Senator for California, 2023). Overall, SNAP's demonstrated economic stimulus effect underscores RMP's capacity to yield wider economic ripple effects.

Although the two restaurant owners interviewed for this study were less financially motivated, both expressed satisfaction in observing noticeable growth in business since joining RMP. One owner noted "at least a 10% increase in sales per week" (Owner 1), attributing additional revenue to greater accessibility and development of a loyal customer base. The other owner expanded on this pattern:

> I see the same faces over and over. So that has created a steady revenue from those people that have [SNAP] benefits. Obviously, it looks like to me that they like our food too. But yes, I've seen … the repeated customers. (Owner 2)

Constraints Limiting RMP Adoption and Implementation

Despite the major drivers supporting RMP adoption, several notable constraints mentioned in the literature review and interviews continue to limit broader adoption by states and participation by restaurants. Constraints include states and restaurants being burdened by an onerous administrative process; the dominance of fast-food chains undermining the driver of connecting local restaurants, communities, and cultures; overcoming misconceptions and negative public perceptions; and gaps in program evaluation, which limit the data needed to encourage RMP adoption.

States and Restaurants Burdened by Onerous Administrative Processes

A primary challenge identified in the interviews was the burdensome administrative process for states to implement RMP (Table 3). Although not widely discussed within the literature review, participants described a lack of dedicated RMP staff within state SNAP agencies. In some cases, newly established RMP programs were managed by a single staff member, with one administrator commenting, "I'd say grow more of me if we're going to grow the program" (Administrator 3). Even states with "many thousands of restaurants" were managed by a "team of five" staff members (Administrator 6). In most instances, RMP staff were also responsible for other aspects of their states' SNAP programs, limiting capacity to effectively administer RMP.

Another major hurdle cited within the literature review and by interviewees was reliance on a manual process to identify SNAP participants eligible for RMP. This approach is both time consuming and error-prone, because of the fluid nature of eligibility criteria which change with life circumstances such as age, housing, and disability status. In the literature review, authors noted that such errors can result in eligible individuals being misclassified and denied access to meals, creating frustration for both SNAP recipients and participating restaurants (Cohen, 2022; Dewey, 2022). Restaurant owners interviewed in the study affirmed these frustrations. One restaurant owner underscored the need for a more efficient and reliable process for determining RMP eligibility:

> I would just want to stress … the frustration that happens when somebody's denied that shouldn't be denied. … There should be a streamlined process whether it's just like a form that they're able to fill out online … that will go to somebody that will look into this and classify them properly. … I've had people come in and say, "I just walked two hours to get here," just so that they can get a hot meal. The disappointment that is on their face when something is declined. (Owner 1)

Additionally, conflicting information from the literature review highlighted confusion surrounding requirements for states to implement RMP. For instance, one news source reported that states must first demonstrate to USDA that RMP's target populations are not "well-served" by the state's broader SNAP program (Dewey, 2022). Other sources, including a news article and a policy brief, claimed states must submit an application to USDA for approval (Carman, 2020; New York State: Governor Kathy Hochul, 2021), while two articles asserted states can simply opt into the program at their discretion (Blum, 2011; Janzer, 2020). Such inconsistencies may contribute to states' hesitation to pursue the program, as the administrative pathway remains unclear.

Similarly burdensome were administrative constraints that restaurants face to apply for and participate in RMP. While these emerged in several news articles and one policy brief from the literature review (Alex Padilla: US Senator for California, 2023; Dewey, 2022; Walker, 2018), the constraints were primarily discussed in interviews, with one administrator citing administrative processes as "one of the main barriers to participation for restaurants" (Administrator 1). Administrators and restaurant owners emphasized that the application

process is burdensome and time-consuming, involving multiple steps. Restaurants first must apply through their state's RMP online system, which requires a completed application plus "all this documentation, you know, the license to do business, all the tax stuff, the social security … it's any government bureaucracy, you know, lots of stuff" (Administrator 4). Once approved by the state, restaurants must complete a second application to the USDA Food and Nutrition Service to become an RMP-authorized restaurant. However, the federal application must be mailed physically, an outdated process that raises both security and efficiency concerns. For example, Administrator 1 explained that a "restaurant doesn't know if that piece of mail they sent is lost somewhere" when sending documents through the mail, and Administrator 5 indicated the lengthy processing time of physical documents: "when it goes to the federal people, 30 to 90 days is how long it takes sometimes."

Even after acceptance into RMP, restaurants face additional administrative burdens, mentioned in both the literature review and interviews, in covering start-up costs. Chief of these is the point-of-sale (POS) devices required to process electronic benefit transfer (EBT) cards, which are the SNAP equivalent of a debit card. News articles and one thesis in the literature review explained that restaurants must either purchase new EBT-compatible devices or pay a third-party vendor to retrofit existing systems (Cohen, 2022; Dewey, 2022; Muckerman, 2023; Prah, 2011; Solis, 2023; Walker, 2018) —an added expense that can cost roughly $75 per month (Walker, 2018). However, an administrator explained that devoted funds from the American Rescue Plan Act of 2021 were available to subsidize EBT-compatible POS systems for the first cohort of participating restaurants in their state, but noted that no such funding would be available for future cohorts.

These layers of administrative burdens have prompted policy responses documented in the literature review. Senators from RMP-participating states introduced the Meals for At-Risk Americans Act, calling on USDA to modernize RMP's infrastructure (Alex Padilla: US Senator for California, 2023). According to the accompanying policy brief, the legislation directed USDA to create a digital application system for restaurants, provide guidance to states interested in launching RMP, improve communication with restaurant and state applicants, and offer technical assistance to restaurants and states (Alex Padilla: US Senator for California, 2023).

Dominance of Fast-Food Chains Undermines the Driver of Connecting Local Restaurants, Communities, and Cultures

Fast-food and quick-service restaurant chains make up the majority of RMP participants, a pattern consistently noted in both the literature review and interviews with program administrators (Cohen, 2022; Dewey, 2022; Healy, 2021; Janzer, 2020; Jones, 2011; Prah, 2011; Robertson, 2020; Walker, 2018). This trend was often framed as a constraint to broader state adoption of RMP, partly because the dominance of chain restaurants was seen as misaligned with the driver for RMP to connect local restaurants, communities, and cultures (Table 3). One news article noted RMP critics calling the program a "handout to fast-food corporations" (Dewey, 2022, para. 22). Many fast-food chains and franchises likely have the infrastructure, staffing, and financial capacity to absorb start-up costs and administrative burdens more easily than independently-owned restaurants (Cohen, 2022; Robertson, 2020).

Large restaurant chains have also been reported to actively lobby for the program. For example, Yum!, the parent company of several fast-food chains, was frequently cited in the literature for its extensive lobbying efforts to expand RMP implementation (Blum, 2011; Boss, 2011; Dewey, 2022; Jones, 2011; Prah, 2011; Rauhut, 2011). While Yum! positions its advocacy as aligned with corporate social responsibility and anti-hunger efforts (Blum, 2011; Prah, 2011; Robertson, 2020), opponents contend the company's actions are primarily driven by financial interests (Boss, 2011; Jones, 2011).

Interviewed participants echoed the tension between the dominance of fast food chains in RMP and the motivation to prioritize local businesses. One administrator articulated the conflict:

> Unfortunately … it's mostly fast food places [that participate] … we would love it and prefer it if this entire list was mostly local restaurants because that's what we really wanted to support coming out of the gate. (Administrator 1)

Several administrators suggested that RMP-participating chain restaurants can create a "blueprint" (Administrator 1) for additional locations for the chain to develop, further contributing to their overrepresentation in the program. The procedural familiarity that chain restaurants possess underscores an informational gap which leaves many smaller, independent restaurants at a disadvantage.

Despite attempts to limit chain participation, one article reported challenges recruiting local restaurants to participate in RMP (Dewey, 2022). A recurring explanation, discussed in both the literature review and interviews, was the limited recruitment efforts undertaken by states. For instance, a college paper described how some local restaurants learned about RMP through signs posted in windows of RMP-participating restaurants stating "EBT accepted here" (Robertson, 2020). Similarly, an administrator recalled when her state implemented RMP, they "didn't do a marketing campaign" (Administrator 4), instead relying solely on word-of-mouth outreach from RMP staff to local restaurants, an approach echoed across most administrator interviews. Additionally, both restaurant owners interviewed also reported learning about RMP informally through word-of-mouth. Given the limited staff capacity devoted to administering state RMPs, proactive recruitment of local restaurants is unlikely to be prioritized.

To overcome these constraints and promote independent restaurant participation in RMP, one administrator suggested allocating state funding to offset start-up costs, such as EBT-compatible POS systems. Not all stakeholders, however, viewed overrepresentation of fast-food restaurants as a constraint to RMP adoption. As highlighted in the literature review, some stakeholders emphasized the role that fast-food restaurants can play in improving food access, particularly in communities where they represent some of the few affordable and accessible food sources (Cohen, 2022; Everytable, 2022; Jones, 2011; Kovarsky, 2022). Reflecting this perspective, one administrator noted that their state's primary goal was to "increase food access first and foremost" (Administrator 6), rather than prioritize participation of certain restaurants over others.

Overcoming Misconceptions and Negative Public Perceptions of RMP

Another set of constraints impeding broader RMP adoption was the prevalence of misconceptions about RMP (Table 3). One pervasive misconception among RMP opponents identified in the literature review was the "paternalistic attitude" (Janzer, 2020, para. 4) that SNAP participants should not be able to use benefits to purchase foods considered unhealthy ("Charge this meal to Uncle Sam," 2011; Boss, 2011; Carman, 2020; Cohen, 2022; Dewey, 2022; Elejalde-Ruiz, 2019; Harris, 2011; Healy, 2021; Jones, 2011; Robertson, 2020; Suntrup, 2022; Walker, 2016; 2018). This concern has mainly played out in debates surrounding the perceived unhealthfulness of menu items at fast-food restaurants, which represent the majority of RMP participants. Some legislators have used this rationale to oppose RMP implementation ("Charge this meal to Uncle Sam," 2011). Similarly, Michigan had adopted RMP but discontinued the program in 2013 over concerns related to the nutritional quality of menu options at their predominantly fast-food restaurant participants (Dewey, 2022; Elejalde-Ruiz, 2019; Healy, 2021), although the state has since re-instated RMP. One administrator articulated the tension between fast-food restaurant participation and health priorities:

> It's nice that we have some of these big chain restaurants that are interested in our program for convenience. … But to be completely honest … we want to be able to offer healthier choices. And sometimes those fast food chains don't have a lot of super nutritious … things that they offer. (Administrator 2)

In response, proponents of RMP have offered other considerations. Some articles in the literature reviewed noted that many fast-food restaurants now offer "better for you" options, such as salads

and grilled chicken, enabling participants to make more nutritious choices (Blum, 2011; Prah, 2011; Robertson, 2020). This message was affirmed by several administrators, who pointed to Subway's participation in RMP as an example of a fast-food restaurant with healthier options, that a "place like Subway sort of has built-in healthy meal options" (Administrator 6).

Additionally, advocates cited in the literature review stressed the importance of personal agency, arguing that SNAP participants, like anyone else, should have autonomy over their own food choices (Blum, 2011; Elejalde-Ruiz, 2019; Janzer, 2020; Prah, 2011; Walker, 2018). Just as individuals not using SNAP are free to choose between healthier and less healthy food options in grocery stores and restaurants, participants in SNAP and RMP should be afforded the same choices (Harris, 2011; Suntrup, 2022). This perspective was generally shared among administrators interviewed:

Table 3. Constraints Limiting RMP Adoption and Implementation

Theme	Description	Illustrative Quote
States and restaurants burdened by onerous administrative processes (*n* = 11 articles)	• Few staff to administer RMP at the state-level and the need to manually identify RMP-eligible SNAP participants • Lack of clarity on requirements for states to implement RMP • Dual application process for restaurants applying to RMP • Start-up costs for restaurants	"[The application] is a two-part thing. So with the state, if I get everything I need it only takes me like one day to approve [a restaurant's application]… Then when it goes to the federal people, 30 to 90 days is how long it takes sometimes." (Administrator 5) "From a staffing…perspective, I think in order for [state] to really expand the [RPM], we're almost going to have to staff an individual that can solely focus on [RPM]…it could become a full-time job." (Administrator 2)
Dominance of fast-food chains undermines the driver of connecting local restaurants, communities, and cultures (*n* = 14 articles)	• Greater resources and less financial risk to participate in RMP • Greater awareness of procedural requirements of RMP via information sharing within a chain or franchise • Challenges recruiting locally-owned restaurants in some states	"Unfortunately…it's mostly fast food places…we would love it and prefer it if this entire list was mostly local restaurants because that's what we really wanted to support coming out of the gate." (Administrator 1) "There's a lot of fast food restaurants that participate…the Jack in the Boxes, Taco Bell…just a lot of fast-food places" (Administrator 4)
Overcoming misconceptions and negative public perceptions of RMP (*n* = 19 articles)	• Negative perceptions of the healthfulness of fast-food restaurant menu options • Misconceptions of RMP as expanding SNAP, increasing benefit amounts, or restricting participants from using benefits at grocery stores	"It's nice that we have…big chain restaurants that are interested in our program for convenience…But to be completely honest…we want to be able to offer healthier choices. And sometimes those fast food chains don't have a lot of super nutritious…things that they offer." (Administrator 2) "It's important to really not communicate [RMP's existence] to everybody [participating in SNAP] because…everybody's not eligible. So we have notices [about RMP]…to clients that are specifically addressed to eligible clients." (Administrator 3)
Gaps in program evaluation limit the data needed to encourage RMP adoption (*n* = 2 articles)	• No formal state-level evaluation data related to restaurants beyond some states tracking the number of participating restaurants • Lack of evaluation data on the reach and impact of RMP on SNAP participants	"As far as evaluation, there's nothing really built into RMP that looks to see how well it's doing…[that's] a really hard metric to…define." (Administrator 1 "We don't have an official program monitoring or evaluation practice…because we don't have the bandwidth at the state level." (Administrator 6

> We're not on the job of telling people what to eat … nutrition and education is super important, but at the end of the day, a meal is a meal and people have rights to eat and choose whatever they desire. (Administrator 1)

Moreover, sources from the literature review described the considerable discretion states have over eligibility requirements for restaurant participants in RMP. In most states, the primary requirement is that restaurants offer discounted or low-cost meals (Dewey, 2022; Janzer, 2020). Other states permitting fast-food restaurants to participate have chosen to prioritize healthier chains (e.g., Subway) or have implemented additional criteria, such as requiring restaurants to offer at least five healthy menu options (Robertson, 2020; Walker, 2016; 2018). Massachusetts, on the other hand, has taken a more restrictive approach by excluding fast-food restaurants from participating in RMP entirely (Solis, 2023).

Another misconception identified in the literature review involves media portrayals that inaccurately depict RMP as an expansion of SNAP, rather than an optional sub-program operating within the existing SNAP framework (Muckerman, 2023; Zokovitch, 2022). Several authors, including both academic and journalistic sources, have sought to correct this by clarifying that RMP neither increases recipients' monthly SNAP benefits nor restricts them to using benefits exclusively at restaurants (Robertson, 2020; Suntrup, 2022). SNAP participants enrolled in RMP continue to receive the same amount of monthly benefits and retain the ability to purchase food at grocery stores (Robertson, 2020; Suntrup, 2022). Moreover, sources in the literature review emphasized that only specific SNAP subpopulations are eligible for RMP, a nuance often lost in public discourse (Harris, 2011; Prah, 2011). An additional identified misconception was that implementing RMP imposes high costs on states. However, multiple news sources have clarified that states with existing programs have relatively low administrative costs, especially after the initial implementation phase (Blum, 2011; Harris, 2011; Jones, 2011; Suntrup, 2022; Zokovitch, 2022). An administrator reinforced this point, sharing that opting into RMP "was relatively cheap, just some administrative costs" (Administrator 1). Altogether, these misconceptions about RMP have contributed to negative public perceptions of the program, particularly among fiscally conservative stakeholders wary of expanding social welfare programs or increasing government spending (Carman, 2020; Suntrup, 2022).

Gaps in Program Evaluation Limit the Data Needed to Encourage RMP Adoption

Results from the literature review revealed a lack of formal data collection or evaluation mechanisms among state RMPs aside from maintaining a participating restaurant list (Table 3) (Cohen, 2022; Robertson, 2020). This observation was corroborated by participants interviewed. For instance, one administrator acknowledged the lack of formal evaluation but was proactive in tracking restaurant participation over time as an indicator of program growth and success, stating that when RMP was adopted in their state in 2021 "we had about 2,500 restaurants on the program. … Now in 2024, we have 4,400 restaurants. … Huge growth, right?" (Administrator 6). Two other administrators said that their states collect and report overall SNAP dollars spent through RMP to USDA, but the data were not analyzed at more granular levels. Another administrator assumed USDA was responsible for program monitoring and evaluation because "the relationship… is stronger between the retailer and the feds than it is between the retailer and the state" and went on to say, "I got a feeling I'm failing the monitoring part" (Administrator 4).

The absence of evaluation data represents a significant constraint to states improving existing RMP and to supporting adoption in additional states. Without robust evaluation data, it remains difficult to understand the program's reach and impact on eligible SNAP recipients. Key questions remain unanswered, such as how many eligible SNAP recipients are participating in RMP, how many are not, and the types of meals bought and restaurants at which SNAP benefits are spent. Generating these insights would be critical for continuous program improvement and to build an evidence base to advocate for RMP expansion nationally.

Discussion

To our knowledge, this is the first comprehensive review of literature related to RMP. The vast majority of sources identified in this review were news articles, and none was a peer-reviewed publication, underscoring the need for scientific investigation of RMP. By synthesizing information from these sources and incorporating insights from interviews with RMP administrators and restaurant owners, this review extends existing literature on food assistance programs by highlighting the multifaceted drivers and constraints influencing RMP adoption and implementation. The primary drivers included championing food access and food security; connecting local restaurants, communities, and cultures; and generating business revenue and strengthening local economies. Conversely, major constraints included a burdensome administrative process faced by both states and restaurants; the dominance of fast-food restaurants undermining the driver of connecting local restaurants, communities, and cultures; misconceptions and negative public opinions about RMP; and insufficient program evaluation efforts. Together, these findings begin to reveal the promise of RMP and critical areas requiring attention for successful and equitable expansion.

This study highlights the unique role RMP can play in enhancing food access and food security among target populations who often face barriers to food preparation and storage. RMP ensures eligible SNAP participants can safely and conveniently access prepared meals, and represents an opportunity to support a dignity-centered approach to food security. This aligns with calls for food assistance strategies that prioritize agency and dignity by creating environments that center choice, reduce stigma, and foster respect. For example, offering client-choice models, minimizing bureaucratic hurdles, and ensuring food assistance is delivered in ways that affirm participant autonomy can improve food security, meet preferences for healthy, perishable foods, and increase self-efficacy to manage diet-related chronic disease (Andriessen & van der Velde, 2024; Herrington & Mix, 2021; Martin et al., 2013, 2016; Remley et al., 2019). Future research should explore how RMP can be more intentionally implemented to affirm the dignity, autonomy, and preferences of participants, while effectively addressing food access needs of the program's intended populations. For instance, research could assess whether program design offers meaningful choice, such as allowing participants to select meals that align with dietary needs and preferences or cultural traditions.

RMP occupies a critical and underexplored space in the food assistance landscape. While preliminary research found RMP improved food security among older SNAP participants in California (Jamal, 2025), research with other RMP target populations and states is lacking. Research could explore RMP's impact on time poverty, the lack of sufficient time to complete necessary responsibilities (Chaudhuri et al., 2021). SNAP participants often cite time as the biggest barrier to preparing healthy meals and devote 26% more time preparing meals than non-participants (Gearing et al., 2021; Davis & You, 2010). Importantly, labor costs of a meal (i.e., time needed to plan, purchase, and prepare food) are not incorporated into the Thrifty Food Plan, on which SNAP benefit amounts are based, likely underestimating the total cost—both time and monetary—of a nutritious diet (You et al., 2022). Households would need to reallocate a significant portion of commuting and/or work hours to food preparation to reach the full cost of a home-cooked nutritious diet (You et al., 2022). RMP could alleviate the labor costs of a meal without requiring time reallocation.

The ability of RMP to strengthen ties between communities and locally owned restaurants aligns with broader food system scholarship emphasizing social and economic values of place-based food access strategies (Deller et al., 2017; Enthoven & Van den Broeck, 2021; Feenstra, 2019; Warsaw et al., 2021), which argues that local food economies can serve as sites of both material support and social connection, particularly among historically underserved populations. As literature sources and interviewed administrators pointed out, every $1.00 of SNAP benefits spent generates approximately $1.50 in the local economy (Canning & Stacy, 2019), which could provide a critical revenue stream for independent establishments in states with RMP. In 2023 alone, SNAP participants redeemed $124 billion in SNAP benefits, with $302

million spent at private restaurants (USDA FNS, 2025c). While this represents a small proportion of total SNAP spending, it points to a meaningful opportunity for economic development, particularly in areas where food options are scarce. Additional research that quantifies and contextualizes economic impacts of RMP could elevate this underexplored driver of program adoption and sustainability.

Despite these benefits of RMP, several challenges hinder broader adoption and effective implementation. Chief among these are the significant administrative burdens encountered by both states and restaurants enrolling in RMP—challenges echoed in prior research, particularly among foreign-born restaurant owners who reported language barriers and difficulty accessing information needed to apply for RMP (Hua et al., 2024). While USDA provides some online resources to interested restaurants (i.e., the online application, information on third-party processors for EBT-compatible POS systems, training resources), they are only available in English and are difficult to locate (USDA NS, 2024a; 2025b; 2025d). Moreover, no publicly available guidance by USDA exists to support states exploring RMP adoption (USDA FNS, 2025b). Such gaps in accessibility and support infrastructure may disproportionately affect smaller, independently owned restaurants and states with fewer administrative resources.

These challenges have drawn federal attention, culminating in the introduction of the Meals for At-Risk Americans Act of 2023, which proposed that USDA provide clearer guidance to states implementing RMP, simplify the application process for restaurants, and offer technical assistance to states and restaurants enrolling in RMP (Alex Padilla: US Senator for California, 2023). Though legislation seems to have stalled, USDA can still implement its recommendations (Alex Padilla: US Senator for California, 2023; Meals for At-Risk Americans Act, 2023). In 2021, USDA partnered with the National Grocers Association to create the SNAP EBT Modernization Technical Assistance Center (SEMTAC), providing technical assistance to retailers to modernize their business and accept SNAP benefits online (USDA FNS, 2023). A similar partnership between USDA and the National Restaurant Association, for instance, could provide information and technical assistance to enable restaurants to participate in RMP.

In addition to administrative challenges, negative public perceptions of fast-food restaurant participation in RMP represent another barrier for state participation. Some critics expressed concerns that allowing SNAP dollars to be spent at fast-food establishments undermines nutrition and public health, a perception that led Michigan to eliminate its RMP in 2013 before reinstating it in 2020 (Dewey, 2022; Elejalde-Ruiz, 2019; Healy, 2021; Low Income Relief, 2025). While results demonstrated some states have focused on expanding food access regardless of restaurant type and healthfulness of food options (Cohen, 2022; Kovarsky, 2022), there is untapped potential to recruit more local, non-chain restaurants into RMP. USDA could support this effort by offering grants to local restaurants interested in joining RMP, as it has done with farmers markets that want to accept EBT (USDA FNS, 2024b). Furthermore, states have authority to shape their RMPs, including defining restaurant eligibility criteria, which some states, like Massachusetts, have leveraged to limit or exclude fast-food participation and prioritize healthier or locally owned small businesses (Solis, 2023). Even so, while debates around the nutritional quality of SNAP-eligible foods are ongoing, recent research has found no significant difference in obesity rates among SNAP participants over 60 in California counties with and without RMP (Jamal, 2025). This finding indicates that while nutrition concerns are valid, they should be weighed alongside the urgent need to improve food access and security among vulnerable populations.

Additionally, despite being an existing option under federal SNAP policy, RMP remains underutilized, emblematic of broader policy-implementation gaps commonly seen in public health, with programs like RMP stalled in a "black box" of unclear or inconsistent implementation (Chriqui et al., 2023). Systematic evaluation of RMP, such as using CDC's Program Evaluation Framework (Kidder et al., 2024), can bridge this gap and dispel misconceptions. For instance, process evaluations

could illuminate start-up and administrative costs for states establishing an RMP, while outcome evaluations could assess program impacts on food security prevalence and diet quality among target populations—both of which could abate concerns related to dietary quality of food offered at RMP-participating restaurants. Ultimately, evaluation data would improve current RMPs and strengthen the case for adoption in more states.

Finally, some have called for expanding RMP eligibility to include college students, a population increasingly recognized as vulnerable to food insecurity (Billings et al., 2021; Gamba et al., 2021; Laska et al., 2021). In 2016, California changed restaurant eligibility requirements to include college campus restaurants but did not expand RMP to college students (Laska et al., 2021; Walker, 2016). In other words, only students participating in SNAP who also meet RMP eligibility criteria would be able to use SNAP benefits at RMP-participating campus restaurants. Therefore, without allowing all college students using SNAP to participate in RMP, its impact on college student food insecurity is likely limited (Billings et al., 2021). Additional research should explore whether extending RMP access to this population could mitigate food insecurity on college campuses.

Strengths and Limitations

To our knowledge, this is the first comprehensive review of RMP-related literature, offering a foundational synthesis of an underexplored area. This study also contributes one of few empirical investigations of RMP, filling an important knowledge gap largely shaped by grey literature. To enhance depth and nuanced richness of the review, we also included qualitative interviews with RMP administrators and restaurant owners.

Several limitations are worth considering. First, many sources included in this review were news articles, some of which contained factual inaccuracies regarding RMP, as discussed in the "Misconceptions" subtheme, as well as biases supporting or opposing RMP. However, given limited publicly available information from USDA about RMP, it is challenging to assess the accuracy of these sources or potential influence on our findings. The impact of this limitation was lessened due to interview data we collected, which triangulated results from the literature. Second, the sample size of qualitative interviews was small, with six administrators from four states and two restaurant owners from one state, due in part to the limited number of active RMPs, small administrative teams devoted to RMP within SNAP agencies, relatively few locally owned restaurants participating in RMPs, and the volatile nature of independently owned restaurant operations. While we captured perspectives across four regions, the small sample size may have excluded valuable viewpoints, particularly from restaurant owners with differing motivations and experiences with program participation, from residents of other regions, from those not enrolled in RMP, as well as from administrators in other states and regions. Finally, while this study highlights the perceived value of RMP in championing food access and food security for eligible SNAP participants, voices of SNAP participants were not represented in the literature or our interview data. Their perspectives and those of independent and chain restaurants represent a critical gap for future research.

Conclusions

This study examined the drivers and constraints influencing restaurant and state participation in RMP. Results highlighted the multi-level nature of these factors, ranging from intrapersonal motivations to broader policy and administrative domains. To strengthen and expand RMP, policy evaluation should be prioritized to bridge gaps between RMP policy design and on-the-ground implementation. Findings from such evaluations, in addition to future research, could then inform policy actions that address key constraints to RMP while investing in the enabling conditions supporting program success. Future research would also benefit from exploring the feasibility, timelines, and cost implications of proposed solutions. Ultimately, encouraging broader RMP adoption could mitigate food insecurity among some of the nation's most vulnerable populations.

Acknowledgments

We would like to thank the participants involved in this study who devoted their time and shared their expertise with our team of researchers.

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Appendix A. In-Depth Interview Guide: State Administrators

Part 1. General Questions

1. What specific factors motivated/led to the establishment of the Restaurant Meals Program in [state]?
2. Who were the stakeholders involved in getting your state's RMP legislation passed?
3. Can you share what the core goal of the Restaurant Meals Program is in [state]?
4. Who is the target audience of the Restaurant Meals Program?

Part 2. Eligibility and Participation

1. Can you talk about how restaurants learn about the program?
2. Once restaurants learn about the program, what is the process they go through to become enrolled?
3. Can you describe the restaurants that are currently participating in the program?
4. What benefits do restaurants gain from participating in the program?
5. How are SNAP recipients made aware of what restaurants are participating in the Restaurant Meals Program?

Part 3. Monitoring and Evaluation

1. Can you provide examples (top 3) of specific measures/indicators that you are currently monitoring and evaluating to track the program's success and impact?
2. Can you tell me about any formal or informal processes to monitor and evaluate these measures/indicators?
3. What are any challenges or concerns related to implementing the program that participating restaurants have raised?
4. Given the progress of RMP so far, what are 1 or 2 areas where you would like to see it improve?

Part 4. Closing Questions

1. What do you think is the impact of the Restaurant Meals Program on food access or food security in [state]?
2. If you had to pick one policy or strategy that you think could advance the impact of RMP, what would that be?
3. Is there anyone else you would recommend we speak with related to implementation of the Restaurant Meals Program?

Appendix B. In-Depth Interview Guide: Restaurant Owners

Part 1. General Questions

1. Can you share what led you to opening this restaurant?
2. Can you share what the core goal of the Restaurant Meals Program is for your business?
3. Who is the target audience of the Restaurant Meals Program?

Part 2. Eligibility and Participation

1. How did you learn about the Maryland Restaurant Meals Program?
2. Can you describe the process of enrolling your restaurant in the Restaurant Meals Program?
3. Given your participation in the program, what changes have you noticed with your restaurant business?
4. What benefits do you gain or expect to gain from participating in the program?
5. Do you let your customers know that you are participating in the Restaurant Meals Program?
6. Can you tell me about the tasks or activities required to ensure the Restaurant Meals Program runs smoothly in your restaurant?
7. Given the progress of the Restaurant Meals Program so far, what are 1 or 2 areas where you would like to see it improve?

Part 3. Closing Questions

1. Is there anything else you would like to share about your experience with the Restaurant Meals Program that we have not had the chance to discuss?
2. Is there anyone else (e.g., restaurant owner) you would recommend we speak with related to the Restaurant Meals Program?

Journal of Agriculture, Food Systems, and Community Development
ISSN: 2152-0801 online
https://foodsystemsjournal.org

Bridging Western and Indigenous epistemologies in an opaque world: Food security and food sovereignty as climate adaptation

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Submitted February 12, 2025 / Revised September 12, November 20, 2025, and January 21, 2026 / Accepted January 23, 2026 / Published online March 24, 2026 / Corrected March 25, 2026, to include fifth author

Citation: Bulger, G., Butler, W., Holmes, T., & Lowrie, K. (2026). Bridging Western and Indigenous epistemologies in an opaque world: Food security and food sovereignty as climate adaptation. *Journal of Agriculture, Food Systems, and Community Development*, *15*(2), 425–442. https://doi.org/10.5304/jafscd.2026.152.036

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Abstract

Food security and food sovereignty represent two similar but distinct pathways for community-led climate adaptation. This study examines how two North American organizations—The Kake Tribal Heritage Foundation (Alaska) and La Organización Boricuá de Agricultura Ecológica (Puerto Rico)—integrate Indigenous Knowledge (IK) and Western Science (WS) to strengthen food systems against climate-related challenges such as extreme weather, supply chain disruptions, and socio-economic inequities. Kake focuses on food security, while Organización Boricuá focuses on food sovereignty. We explore how these community organizations leverage sustainable practices, culturally rooted knowledge, and community engagement to build resilience by integrating IK and WS through these differing approaches. While both groups integrate IK and WS, tensions persist between IK's emphasis on relational, long-term stewardship and WS's empirical, replicable methods. However, these case studies illustrate how food systems initiatives serve as adaptable climate strategies through integrating local and Indigenous knowledge with broader Western scientific environmental frameworks.

Keywords

Indigenous Knowledge, Western Science, food security, food sovereignty, knowledge systems, climate adaptation, community-led initiatives, agroecology, resilience

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Introduction

Climate change continues to accelerate worldwide, affecting 3.3 to 3.6 billion people in increasingly acute ways through extreme heat, unpredictable drought and rain patterns, coastal and inland flooding, wildfires, and vector-borne diseases (Intergovernmental Panel on Climate Change [IPCC], 2023). These changes are especially impactful in rural communities and among socially vulnerable groups. This confluence of factors creates widespread disruptions to food systems, including agriculture, fisheries, and global supply chains that many communities rely on (Bindoff et al., 2019; Ding et al., 2017; Gregory et al., 2005; Tchonkouang et al., 2024). These environmental and logistical disruptions lead to significant economic instability and heighten the risk of food insecurity. While communities dependent on rain-fed agriculture, such as Indigenous communities relying on local sustenance, are at particular risk (Culas, 2012; Sheffield et al., 2014), the cascading effects of climate change are a global challenge. This broad disruption has led to a focus on adapting community food systems to increase resilience to these conditions (Campbell et al., 2022; Worstell & Green, 2017), as well as a growing emphasis on food sovereignty among Indigenous communities (Sowerwine et al., 2019; VanWinkle & Friedman, 2019).

Two food systems frameworks are represented here: food security and food sovereignty. The *food security* framework is rooted in the Food and Agriculture Organization of the United Nations [FAO]'s (2006) four pillars of availability, accessibility, utilization, and stability. It focuses on ensuring adequate supply and economic access to food (FAO, 2006; Food and Agriculture Organization [FAO], 1997). Gunaratne et al. (2021) argue that this model reflects a technocratic and market-oriented logic that prioritizes productivity and trade, often reinforcing structural inequalities and environmental degradation. By contrast, the *food sovereignty* framework emphasizes the rights of communities to define and control their own food systems, linking ecological sustainability, cultural appropriateness, and self-determination (Gunaratne et al., 2021; Nyéléni, 2007). This paradigm thus reframes climate adaptation not as efficiency optimization, but as social and ecological transformation grounded in justice and local autonomy.

Bridging these two food systems frameworks offers a useful lens for understanding how differing epistemologies—Western scientific (WS) and Indigenous Knowledge (IK)—shape responses to climate vulnerability in food systems. While food security frameworks often align with Western scientific approaches, such as emphasizing technical efficiency, measurement, and global governance, food sovereignty aligns more closely with Indigenous Knowledge systems that center relationality, reciprocity, and ecological stewardship. Integrating these perspectives reveals that effective climate adaptation may depend not on privileging one framework over the other, but on creating pathways for co-production of knowledge that combine the empirical rigor of WS with the place-based wisdom of IK (Gunaratne et al., 2021; Nyéléni, 2007).

This research contributes to the conversation about the tensions and synergies between WS and IK as communities seek to adapt to climate change, build resilience, and strengthen food sovereignty and security. We conducted case studies of two community-based organizations that have either begun or increased their food systems work to increase resilience to local impacts of climate change. The village of Kake is experimenting with hydroponic farming techniques, while Organización Boricuá focuses on regenerative agriculture in Puerto Rico. Through our interviews and site visits, we focused on two research questions: What tensions between WS and IK have emerged in addressing food system challenges as part of building climate resilience? What strategies or approaches have helped navigate these tensions? Each has approached this tension in context-specific ways, highlighting the complexity of climate change adaptation strategies and the contributions that multiple ways of knowing can bring to community adaptation efforts.

Ultimately, we found that these communities do not operate within the binary ways the WS and IK frameworks are often theorized about, or about food security and food sovereignty. Both cases demonstrate how local community members selectively weave these frameworks together to meet

their specific ecological, political, and cultural needs. In Kake, hydroponic infrastructure is integrated with stewardship ethics and subsistence practices, resulting in a hybrid WS–IK approach that advances food security while reinforcing cultural continuity. In Puerto Rico, agroecological organizing draws from both ancestral farming knowledge and ecological science, illustrating how food sovereignty can be co-produced through reciprocal relationships between communities and institutions. Together, these examples show how some adaptation strategies emerge in the grey spaces where epistemologies intersect, challenging colonial binaries and demonstrating how food security and sovereignty can complement one another, rather than act in opposition. Our contribution lies in conceptualizing these bridging processes and explicating frameworks for understanding how communities actively negotiate WS and IK to build resilient, culturally grounded food systems.

Literature Review

For decades, scholars have called for the integration of Indigenous Knowledge into the management of land, natural resources, water systems, food systems, and more (Aikenhead & Ogawa, 2007; Ijatuyi et al., 2025; Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services [IPBES], 2019; Souther et al., 2023). These calls have been heeded in projects throughout the world, whether led by community-based organizations, Indigenous tribes, or national governments. However, certain tensions arise when seeking to integrate WS and IK, which are exacerbated in the context of climate change. This review relies on other systematic reviews and key articles to clarify the tensions, identify opportunities for integration, and articulate the challenges posed by climate change to projects seeking to address food security and food sovereignty.

The tensions between IK and WS are rooted in epistemological differences. IK is context-specific, developed over generations of interaction with local environments, and deeply embedded within cultural and spiritual practices (Bohensky & Maru, 2011; Brondizio et al., 2021; Dorji et al., 2024; Mardero et al., 2023). It is passed down through oral traditions and emphasizes long-term observation, relationality with the environment, and adaptive processes that respond to local ecological dynamics (Berkes, 1999; Cajete, 2020; Ford et al., 2020). In contrast, WS privileges quantitative data, hypothesis testing, and the search for replicable and generalizable knowledge, often disregarding place-based observations as subjective or anecdotal (Dentzau, 2019). These differences create a significant divide in how each knowledge system is perceived and valued, with WS historically marginalizing IK by framing it as imprecise or irrelevant (Moller et al., 2004).

Many scholars have long seen the potential value of bringing IK into management and decision-making across sectors such as land stewardship, natural resources, wildfire management, water governance, and food systems, given that all of these domains are grounded in place-based ecological knowledge that is central to Indigenous ways of knowing (Bohensky & Maru, 2011; Dorji et al., 2024). In the realm of food systems, IK plays a foundational role by sustaining traditional foodways that are locally adapted, biodiverse, and ecologically reciprocal. These systems are informed by generations of lived experience and observation, and they rely on seasonal indicators, soil knowledge, seed saving, and intercropping practices (Knorr & Augustin, 2025; Mardero et al., 2023). For over 9,000 years, the milpa system, an Indigenous polycultural agriculture system in Mesoamerica, has continued to provide an adaptive food production model under changing climatic conditions, demonstrating how IK contributes to both resilience and sustainability (Mardero et al., 2023). Reviews emphasize that these foodways are not static; they are evolving hybrid systems that incorporate both Indigenous and scientific insights while resisting the extractive tendencies of industrial agriculture (Brondizio et al., 2021; Dorji et al., 2024). Recognizing the centrality of IK to food system transformation not only offers ecologically viable alternatives to dominant models but also safeguards the cultural heritage and biocultural diversity essential for climate adaptation.

Climate change challenges both knowledge systems. From the perspective of WS, climate models and predictions have become ubiquitous (IPCC, 2023). However, the uncertainty of climate

futures is not easily resolved by WS methods, and the bandwidths of uncertainty widen over time. Climate change is unfolding in ways that challenge assumptions about climate stability, unsettle forecasting methods drawing on past trends, and force the scientific community to adhere to high confidence standards, potentially under accounting for future risks (Herrando-Pérez et al., 2019). Moreover, WS approaches tend to generalize across large scales in the global climate system. Traditionally, this data has tended to struggle to downscale results to local and regional geographies where meaningful adaptation takes place (Colley, 2024).

Meanwhile, climate change inherently challenges local and traditional ecological knowledge systems by destabilizing the long-standing relationships and feedback systems that communities have relied upon for generations. As climate variability introduces new ecological patterns, such as altered precipitation cycles and temperature patterns, the established understanding of local ecosystems can become unsettled, obsolete, or even counterproductive (Dorji et al., 2024; Mardero et al., 2023). These disruptions threaten not only food production systems but also the ontologies and cosmologies through which knowledge is transmitted and legitimized (Brondizio et al., 2021). While IK systems are inherently adaptive and dynamic, scholars have noted that the unprecedented pace and scale of climate change can exceed the capacity of traditional practices alone, necessitating both innovation and selective incorporation of scientific tools (Bohensky & Maru, 2011; Knorr & Augustin, 2025). In this context, communities are increasingly engaged in creating hybrid knowledge systems that blend traditional knowledge with contemporary observations and technologies, such as agroecological forecasting, digital seed exchanges, and participatory scenario planning, to address the uncertainty of emergent climatic regimes (Brondizio et al., 2021; Dorji et al., 2024). However, this evolution of knowledge also raises critical concerns about notions of justice, cultural erosion, and the terms under which integration with WS occurs, especially when these processes are mediated through extractive or externally driven research paradigms (Averett, 2022; Brondizio et al., 2021).

Both IK and WS systems provide valuable insights in the context of climate change, but their differences complicate their potential integration. Observations from IK, such as differences in sea ice distribution, fish abundance, and permafrost thaw, are often based on centuries of lived experience, providing localized data on environmental changes (Belfer et al., 2017; Ford et al., 2016; Kuptana, 1996; Riedlinger & Berkes, 2001). In contrast, WS examines these phenomena through empirical studies that may miss the depth of long-term interaction provided by IK. Daniel Pauly's (1995) concept of the shifting baseline syndrome posits that WS often misjudges ecological baselines by resetting them with each generation of scientists, not taking into account the gradual process of environmental degradation. Scholars like Berkes (1999) and Usher (2000) argue that IK provides localized expertise, enabling communities to detect subtle changes in the environment that WS often overlooks (Belfer et al., 2017). This long-term observational knowledge, embedded in cultural practices and oral histories, offers a temporal depth that complements WS. Oral histories can provide vital ecological data, helping to track climate shifts that extend beyond the temporal scope of WS (Bielawski, 1996). These critiques highlight WS's shortcomings, particularly in ecological sustainability, and support the integration of IK to foster a more ethical and comprehensive environmental stewardship approach.

Integrating IK into WS frameworks remains challenging due to gaps in validation criteria. While WS relies on empirical data and reproducibility, IK is grounded in relational knowledge and lived experience (Bohensky & Maru, 2011; Dentzau, 2019; Dorji et al., 2024). These differences often result in WS marginalizing IK as anecdotal, reinforcing the dominant narratives of scientific objectivity, generalizability, and reproducibility (Bohensky & Maru, 2011; Brondizio et al., 2021). Nadasdy (1999) and Cruikshank (1998) point out that IK is often decontextualized when integrated into WS frameworks, reducing it to isolated facts rather than acknowledging its holistic worldview (Cajete, 2020). This process diminishes the cultural and spiritual dimensions of IK, reinforcing colonial structures that marginalize Indigenous voices in environmental governance (Berkes & Folke, 1998).

Furthermore, as Makondo and Thomas (2018) discussed, institutional barriers prevent IK from being meaningfully included in global climate adaptation strategies. These barriers reflect the dominance of WS in shaping adaptation policies, often sidelining Indigenous contributions (Makondo & Thomas, 2018).

Several frameworks have been proposed to address the enduring epistemic imbalance between IK and WS, as shown in Table 1 below, each offering different pathways to knowledge integration. Among the most community-oriented is the Two-Eyed Seeing framework (Bartlett et al., 2007), which emphasizes mutual respect and relational accountability in bringing together Indigenous and Western knowledge systems. Rather than synthesizing them into a singular epistemology, Two-Eyed Seeing promotes viewing the world through both lenses simultaneously, retaining the integrity of each.

Expanding on this, Knowledge Co-Production processes, such as that developed by Yua et al. (2022), provide a structure for multistakeholder collaboration grounded in inclusivity, power-sharing, and mutual learning. These approaches are particularly relevant in climate adaptation and food systems research, where knowledge must be both locally grounded and scientifically credible. Similarly, Tsosie et al.'s (2022) Six Rs framework—respect, relationship, representation, relevance, responsibility, and reciprocity—offers ethical guidelines for research with Indigenous communities, helping to prevent extractive partnerships and to center Indigenous agency.

Relational Approaches, as outlined by Chan et al. (2016), prioritize reciprocity, trust, and long-term relationship-building, foundational components for legitimizing IK within climate adaptation processes. Adaptive Co-Management (Armitage et al., 2008) focuses on iterative, decentralized gov-

Table 1. Frameworks to Integrate Indigenous Knowledge (IK) and Western Science (WS)

Framework	Description
Two-Eyed Seeing	Emphasizes learning to see from one eye with the strengths of Indigenous Knowledge and from the other with the strengths of Western Science, fostering mutual respect and relational understanding as the foundation for collaboration.
Knowledge Co-Production	A dynamic and inclusive process that brings together diverse knowledge holders to collaboratively define problems, methods, and outcomes, enabling context-specific and equitable solutions across scales.
Six Rs	A normative framework rooted in Indigenous scholarship that centers respect, relationship, representation, relevance, responsibility, and reciprocity as guiding ethics for research and engagement.
Relational Approaches	Grounded in the idea that knowledge and adaptation emerge through sustained relationships and trust, emphasizing human-environment interdependence and local capacity-building.
Adaptive Co-Management	Integrates learning-by-doing with decentralized governance, enabling communities and institutions to iteratively respond to ecological and social change through shared authority.
Weaving Knowledge Systems	Intentionally connects Indigenous and Western epistemologies through relational processes that honor cultural protocols and uphold Indigenous agency in decision-making.
Social-Ecological Systems (SES)	Examines the interconnectedness of human and natural systems, emphasizing resilience, feedback loops, and cross-scale governance for adaptive sustainability.
Multiple Evidence Base	Recognizes multiple, equally valid forms of evidence, from scientific data to experiential and Indigenous knowledge, and seeks their complementarity in policy and practice.
Post-Normal Science (PNS)	Addresses complex, high-uncertainty problems by expanding who counts as an expert and incorporating diverse values and perspectives into the scientific process.

ernance that is well-suited to complex, dynamic systems such as food systems and water networks. Weaving Knowledge Systems (Martin & Mirraboopa, 2003) builds on this by explicitly privileging Indigenous voices and cultural protocols in the co-creation of knowledge, reinforcing sovereignty and ontological pluralism. All these frameworks have some level of epistemological overlap, focused on synthesizing two methods of analysis.

At broader scales, a set of more macro-oriented frameworks offer complementary tools. The Social-Ecological Systems (SES) framework (Ostrom, 2009) provides a diagnostic approach for understanding interactions between ecological and institutional systems. The Multiple Evidence Base (MEB) approach (Tengö et al., 2014) facilitates cross-scale dialogue by treating diverse knowledge systems as equally valid forms of evidence. Finally, Post-Normal Science (PNS) (Funtowicz & Ravetz, 1993) promotes inclusive, participatory research under conditions of uncertainty, opening space for Indigenous perspectives in global climate governance. Together, these frameworks reflect a maturing recognition that bridging IK and WS requires more than technical inclusion; it demands relational, institutional, and ethical commitments to co-production, sovereignty, and justice.

While barriers remain in integrating WS and IK, particularly in knowledge creation and power dynamics, the literature increasingly recognizes the benefits of utilizing both systems for effective climate change adaptation and for addressing failures of the industrialized food system to improve food security or food sovereignty. As the global community continues to confront the realities of climate change, integrating IK and WS may be essential in crafting adaptive strategies that are both locally relevant and globally informed. Multiple frameworks have been proposed to foster respectful and complementary integration, ensuring that both knowledge systems contribute meaningfully to climate resilience strategies. However, what is less well understood is whether these models are equally applicable or practical to people working to address food security and sovereignty in the context of climate adaptation responses. Our research aims to add to this dialogue on the challenges and opportunities of integrating WS and IK in developing climate adaptation strategies for food security and food sovereignty.

Methods

Our research seeks to understand how practitioners working for food security or food sovereignty as a climate adaptation strategy navigate tensions and seek integration of IK and WS. We approached this work by identifying our cases from a larger research project (Holmes et al., 2025) where community-based organizations were working to address food insecurity and food sovereignty in a diversity of contexts using a range of approaches. The cases, the Kake Tribal Heritage Foundation in Alaska and Organización Boricuá, allow for comparison of different programmatic approaches and contexts for addressing food insecurity and sovereignty issues. For data collection, we reviewed program websites and publicly available program documents, including grant applications and reporting documents. We conducted one-to-two-hour interviews with 14 respondents (three from Kake, 11 from Boricuá) from the cases to delve more deeply into specific programs. Finally, we conducted a three-day site visit to Puerto Rico to meet with Organización Boricuá staff members, travel to program sites, conduct interviews with staff and community members, and engage in informal conversations in context.

Our interviews covered the program's operational mechanisms, funding, governance, policy impediments, successes and challenges, and scaling. The tensions and integration of IK and WS emerged in different ways in both cases and became a central theme of our ongoing data collection efforts. Our data analysis involved reviewing program documentation of all programs, as well as interview transcripts and notes from observations and informal conversations. The project team met, on average, 1.5 times per month throughout the data collection and analysis process, which consisted of two years of working together. Team members independently reviewed transcripts and project documents to identify emerging themes across cases. In our review, co-authors independently identified knowledge systems as a core challenge facing these projects. As a team, we began having cross-case discussions among those

involved directly in data collection for each case to compare and contrast alignment with our emergent analysis. We focused our analysis on data pertaining to how these different groups navigated tensions between different knowledge systems as they arose. We continued monthly group discussions to cross-reference our respective reviews of the data, where we began to draw out key themes related to knowledge systems and their use in developing and implementing climate adaptation projects to build food security and sovereignty. Through these team meetings, we developed our cross-cutting themes, which we elaborate on in our discussion section.

Case Studies

To explore how community-based organizations navigate the complexities of climate adaptation and knowledge integration, this section presents two distinct case studies: the Kake Tribal Heritage Foundation in Alaska and La Organización Boricuá de Agricultura Ecológica in Puerto Rico. While Kake primarily utilizes a food security framework and Organización Boricuá that of food sovereignty, both cases illustrate how local practitioners negotiate the tensions between Western Science and Indigenous Knowledge. Through a review of these diverse contexts, we examine the context-specific strategies used to build local resilience, the "grey spaces" where these differing epistemologies intersect, and how contrasting strategies were ultimately selected.

The Village of Kake

The village of Kake, one of the homes of the Tlingit people in Southeast Alaska, is a small community of approximately 470 residents on Kupreanof Island. The island is dominated by the Tongass National Forest and makes up part of the archipelago composing the Alaskan panhandle (U.S. Census Bureau, 2025). Historically, Kake's food system has been deeply rooted in the community's traditional knowledge, which revolves around the sustainable use of local resources such as fish (salmon, halibut, herring), shellfish (gumboots and clams), land mammals (deer, moose, and grouse), and berries (Personal interview, anonymous member of the Kake Tribal Heritage Foundation Interview, October 27, 2023). This Tlingit geographic and cultural knowledge is passed down through generations, where places are not purely physical locations, but hold historical, spiritual, and social importance. They are deeply connected to the Tlingit cultural identity and spiritual relationship with the land (Thornton, 2008, p. 36). IK systems, like those in Kake, are based on long-term lived experiences, oral traditions, and practices adapted to the local environment over centuries. They offer a nuanced understanding of ecological balance, ensuring sustainable harvesting practices and careful stewardship of resources (Personal interview, anonymous member of the Kake Tribal Heritage Foundation Interview, October 27, 2023).

As climate change accelerates and disrupts local ecosystems, Kake faces new challenges that strain this traditional knowledge. Increasingly unpredictable weather patterns, warmer water temperatures, and shifts in seasonal cycles affect the availability and quality of the natural resources upon which the Tlingit have traditionally relied (Personal interview, anonymous member of the Kake Tribal Heritage Foundation Interview, October 27, 2023). For example, salmon, a cornerstone of the community's diet, face barriers to spawning as stream temperatures rise (Crozier et al., 2021), while clams and gumboots can become toxic in warmer waters (van der Fels-Klerx, 2012). The people of Kake have experienced these impacts directly: "As the waters get warmer and warmer, the level of toxicity has been rising at a high rate lately" (Personal interview, anonymous member of the Kake Tribal Heritage Foundation Interview, October 27, 2023), leading to restrictions on clam consumption to protect health. Various berry crops, including blueberries, salmonberries, and blackberries, are impacted by drought and excessive rainfall, resulting in reduced harvests in drought years and moldy crops in overly wet years (Mucioki, 2024; personal interview, anonymous member of the Kake Tribal Heritage Foundation, October 27, 2023).

Due to these disruptions, imported foods have played an increasingly significant role in the Kake food system. Imported foods are brought into Kake through two avenues: through a seaplane and a barge. While the seaplane has maintained consistent schedules, the cost of transporting goods is

exceptionally high at around US$1.00 per pound. This fee turns a US$10 case of water into a US$35 financial hardship (Personal interview, anonymous member of the Kake Tribal Heritage Foundation, October 27, 2023). While far more affordable, the barge has faced repeated interruptions, sometimes leading to fresh produce arriving spoiled (Personal interview, anonymous member of the Kake Tribal Heritage Foundation, October 27, 2023).

These disruptions have created uncertainty and stress in the food systems that the people of Kake rely on, with one resident noting, "We've noticed a dramatic change over the past 15 years—it's definitely a lot different than when I was my kids' age" (Personal interview, anonymous member of the Kake Tribal Heritage Foundation, October 27, 2023). While traditional knowledge offers insight into managing these resources, the scale and rapid pace of these changes present unprecedented challenges that traditional methods alone may struggle to address. In response to these challenges, an external consultant to the tribe recommended applying for grant funding to add capacity to their adaptation efforts, thus leading to a US$100,000 grant, the largest the foundation had ever procured (Personal interview, anonymous member of the Kake Tribal Heritage Foundation, October 27, 2023). This was funded through the Climate Resiliency program of the First Nations Development Institute, an American Indian nonprofit that has funded over US$100 million in grants since 1993, covering a range of thematic areas, including climate change, language, and agriculture. This funding helped facilitate the foundation's acquisition of a hydroponic system, a controlled environment system for growing plants in a nutrient-rich water solution, instead of growing crops in soil exposed to the elements (U.S. Department of Agriculture [USDA], 2025). This allowed foundation leaders and volunteers to grow green leafy vegetables year-round for distribution directly to community members who face challenges in regularly obtaining healthy foods.

The hydroponics system represents a Western, technology-driven approach to food security and was initially met with skepticism from some members of the community. It took months to receive the equipment and weeks to obtain training and install the system; then, a few short weeks later, the results of growing lettuce in the system began to become apparent. The system was installed in a community facility and overseen by staff and volunteers of the Tribal Foundation. It served primarily as a demonstration project that could be expanded for more substantial production in the future. Some community members viewed the technology as "too artificial" (Personal interview, anonymous member of the Kake Tribal Heritage Foundation, October 27, 2023). It was a stark departure from their experience relying on their natural ecosystems. In a community where "everything's completely natural, we eat what grows out of the ground or what we fish or pick the berries or [hunt] deer or moose," the introduction of a system that produces vegetables in a matter of weeks seemed unnatural and disorienting to some (Personal interview, anonymous member of the Kake Tribal Heritage Foundation, October 27, 2023). Despite this initial community consternation, the project began gaining acceptance as lettuces began to grow. According to our interviewees, as community members witnessed the practical benefits of the hydroponic system, such as the ability to grow fresh vegetables across all seasons, they began to reconcile the traditional with the new.

The project's leaders are keenly aware that they must balance maintaining the cultural integrity of the community's traditional food system while slowly integrating new Western technologies (Personal interview, anonymous member of the Kake Tribal Heritage Foundation, October 27, 2023). The hydroponic system is not intended to be or seen as a replacement for Kake's traditional food system. It is seen as a complementary tool that can help mitigate the risks posed by climate change (Mucioki, 2024). This is evident in a traditional agricultural training project at the local school, where students are learning how to establish and manage local farms tied to the growing season of the island (Personal interview, anonymous member of the Kake Tribal Heritage Foundation, October 27, 2023). These simultaneous efforts by different organizations on the island align behind the shared goal of decoupling dependencies on industrial food systems supply chains and strengthening capacity for self-reliance.

As the project progressed, the Kake Tribal Heritage Foundation continued educating the community regarding the risks of climate change and the benefits of adopting new adaptive strategies (Personal interview, anonymous member of the Kake Tribal Heritage Foundation, October 27, 2023). The hydroponic system is not solely about growing vegetables; it is also about preparing for a future where climate disruptions severely impact traditional food sources. The foundation's leaders see the project as part of a broader strategy to improve self-reliance and resilience in the face of climate change. The hydroponics project fosters greater food security, even while deviating from a more traditional food system. However, the leaders recognize the need to involve community members as they introduce new elements into their food system. In this way, Kake's hydroponic system represents a critical step into the intersection of WS and IK, aiming to offer a pathway toward climate resiliency while respecting the community's cultural heritage.

La Organización Boricuá de Agricultura Ecológica de Puerto Rico

The colonial history of Puerto Rico, from Spanish rule in the 16th century to a U.S. territory over the last century, has laid the groundwork for a dependency on external resources, particularly in food production (Garriga-Lopez & Ginzburg, 2023). Prior to this colonial shift, Puerto Rico's agricultural practices were largely self-sustaining, with Indigenous (Taíno) and later Afro-Caribbean communities developing agricultural systems that were in harmony with the island's natural environment (Taíno Society, 2018). However, as industrialization took hold through initiatives like Operation Bootstrap in 1947, the island shifted to a model prioritizing export-driven, industrialized agriculture (Ayala & Kennedy, 2021). This, in turn, left Puerto Rico heavily reliant on food imports, which made up 85% of its food supply by the 1980s (Caban, 1989). This shift not only disrupted traditional agricultural knowledge but also increased the island's vulnerability to external shocks, as demonstrated during the COVID-19 pandemic when the number of families experiencing food insecurity on the island increased by 16,000 (Ostolaza et al., 2021).

In this context, Organización Boricuá, founded in 1989, has worked to reclaim food sovereignty through agroecology, a framework that intertwines WS with IK. In contrast to industrial farming, agroecology emphasizes biodiversity, sustainability, and the integration of local knowledge systems with ecological science (Wezel et al., 2020). According to one of the project organizers, their methods, which draw on ancestral agricultural practices such as diversified cropping and soil health management, are proving more resilient in the face of climate change. He points out that after Hurricanes Irma and Maria made landfall in 2017 as category-five storms, conventional monoculture farms using chemical inputs and monocropping were devastated, while agroecological farms sustained minimal damage:

> In the communities that we are at, where we've put into practice these systems, we didn't have any damage to the topsoil. … We saw conventional farms that are heavy on external inputs, like chemical inputs, chemical fertilizers, and herbicides, and they do monocropping. They lost everything because they didn't have a diverse nature; it doesn't work. (Personal interview, anonymous member of Organización Boricuá, July 6, 2023)

Farmers within Organización Boricuá note that tensions exist between the approaches to technology and ecological practices. Indigenous farming methodologies used by the farmers often emphasize traditional ecological knowledge and practices developed over millennia. In contrast, Western methodologies frequently rely on modern technologies and practices that may not consider ecological ramifications. One example is the use of herbicides and pesticides by larger global farming companies in Puerto Rico to eradicate weeds and pests. These chemicals, the farmers explained, always seep into fertile land and water systems, negatively affecting crops and water filtration for months (Personal interview, anonymous member of Organización Boricuá, July 6, 2023). Indigenous, holistic approaches supporting biodiversity include organic composition, crop diversification, or the introduction of beneficial insects that naturally prey

on the pests in contrast to the toxic chemical approach.

The introduction of genetically modified organisms (GMOs) and other experimental practices by Western farmers, subsidized and incentivized by the government to farm on large, fertile land, is another recognized conflict. Agribusinesses are allowed to experiment with various crops, using GMOs, without the consent of local farmers. Farmers who value traditional methods and sustainable practices often resist these practices (Personal interview, anonymous member of Organización Boricuá, July 6, 2023; Martínez Mercado, 2017). These policies enacted by the government have not only conflicted with IK but have also caused concerns about health consequences and long-term environmental impacts (Ramos, 2019; Personal interview, anonymous member of Organización Boricuá, July 6, 2023).

Beyond these technology tensions, farmers perceive that government policies have historically displaced rural and farming communities. The farmers indicated that multinational agricultural agrochemical corporations (such as Bayer, Syngenta, and DuPont), along with government policies, perpetuate dependency on specific types of seeds and agricultural practices. Foods produced on the island are bound for export while processed foods fill island stores. Local farmers try to resist this corporate dominance, contesting the role of multinationals in prolonging unsustainable food practices. Organización Boricuá engages in policy advocacy, builds community networks, promotes education and awareness-building, and seeks to resist land grabs and resolve land tenure and access conflicts.

Despite these tensions, there are synergies between Indigenous Knowledge and Western Science that incorporate both traditional ecological knowledge and modern techniques in agricultural practices. Agroecology itself represents a Western, scientifically validated approach grounded in Indigenous farming practices. While this form of agricultural practice can be seen as a form of resistance to mainstream Western industrialized monoculture, Western Science and technology provide insight and support to the Indigenous techniques. Farmers participating in Organización Boricuá use traditional agricultural practices and collaborative approaches such as resource sharing, partnerships with local organizations, and the continuous exploration of refined techniques in farming. However, these techniques are intertwined with other techniques that have helped the Indigenous systems to become climate resilient. One farmer mentioned using plastic structures to create small greenhouses, which helps protect crops from adverse weather conditions. Others use cistern water catchment systems to better manage water resources and adapt to weather variability, such as addressing water shortages during summer months, which have recently begun to plague farms more often (Personal interview, anonymous member of Organización Boricuá, July 6, 2023). The union of Western methodologies with their current practices provided technological and practical solutions.

Ultimately, the work of Organización Boricuá exemplifies how IK and WS can complement each other, particularly in the realm of climate adaptation. By blending traditional practices informed by IK with technologies and practices informed by WS, the organization is helping to create a more resilient and self-reliant Puerto Rico. However, this process is not without challenges, as it requires constant negotiation between competing worldviews and knowledge systems, all in a context of ongoing colonial dynamics and environmental crises.

Discussion

The case studies of the village of Kake and Organización Boricuá reveal that, while food security and food sovereignty are often theorized as distinct or even oppositional paths, in practice, they function as complementary strategies for climate adaptation. This section moves beyond the individual narratives of these organizations to analyze how they collectively navigate the epistemological tensions between Western Science and Indigenous Knowledge. By examining the context-dependency of these efforts and the frameworks that support knowledge integration, we illustrate that resilient food systems are built not by prioritizing one knowledge system, but through relational processes that integrate both empirical rigor and place-based wisdom.

Context Dependency and Climate Change

Scholars of Indigenous ways of knowing recognize that IK is context-dependent, based on the place, traditions, cultures, and stories of the Indigenous peoples who have lived in particular regions for generations (Bohensky & Maru, 2011; Dorji et al., 2024; Brondizio et al., 2021). This place-based ecological knowledge, sometimes referred to as Traditional Ecological Knowledge (TEK), is foundational to many Indigenous Knowledge systems. Our cases align with this perspective, particularly in relation to food systems. However, the context of climate change and colonial capitalist systems has led to changes that challenge this foundational knowledge and traditional foodways. The tensions that arise in our cases mirror many of those that are identified in the literature, such as conflicting epistemological assumptions and worldviews (Bohensky & Maru, 2011; Brondizio et al., 2021; Dorji et al., 2024; Tengö et al., 2014). Some of the tensions in our cases also demonstrate how climate change exacerbates challenges to both WS and IK.

For example, in Kake, IK has contributed to a rich understanding of the ecological systems that contribute to local food sources. The traditional food system was tied to knowledge of ecological systems, seasons, and cycles that allow for hunting of game and seafood, and gathering of fruits in particular. Meanwhile, the industrial food system fostered a dependency on weekly barge shipments of processed foods and produce to supply the shelves of the local grocery. Supply disruptions during the COVID-19 pandemic demonstrated to the people of Kake that their over-reliance on the industrial food system made their food security less resilient and undermined their food sovereignty. However, turning to local food sources proved challenging, as the ecological reality was shifting in the face of climate change. Seasons are changing, food sources are becoming uncertain and unpredictable, and, in the case of the clams, a traditional food source is becoming toxic as waters warm. In seeking food security in Kake, the Kake Heritage Foundation has sought new food-producing technologies and approaches to adapt to this changing context, one that blends IK and WS traditions.

Agroecology in Puerto Rico is not just an agricultural movement; it is also a tool for sovereignty and resilience, particularly in the aftermath of colonialism and climate disasters. After Hurricane Maria, agroecology became a lifeline for many communities, enabling them to rebuild sustainable food systems in the face of government neglect and infrastructural collapse (Gies, 2018). The failures of the industrial food system in the face of such a high-intensity disaster emphasized the value of Indigenous Knowledge to build resilience. Agroecology is rooted in ecological principles and informed by Indigenous and local practices. It emphasizes natural processes and ecosystem services over a reliance on synthetic inputs and technological advancements characteristic of industrial agriculture. These technologies, initially designed for highly mechanized industrial systems, do not intrinsically align with agroecological systems, which prioritize biodiversity, ecological balance, and social equity (Zeng et al., 2023). Still, scaling up the agroecology approach has proven challenging, both in terms of overcoming the power of corporations in shaping land tenure and agricultural inputs, and in controlling seed, and in dealing with the land and labor-intensive agroecology processes. Furthermore, other resilience responses, such as building solar farms, compete for the available land, creating tensions between different sets of needs, including energy demands in the food system.

Food Security and Food Sovereignty

Distinguishing between food security and food sovereignty is useful when examining how WS and IK epistemologies differently conceptualize adaptation, resilience, and justice in food systems. Food security has been institutionalized as the dominant global framework through government agencies, philanthropic funders, and policy metrics, by emphasizing technical solutions, market efficiency, and the quantitative assessment of supply and demand (FAO, 1997, 2006). As Gunaratne et al. (2021) argue, this framework reflects a Western technocratic worldview that prioritizes productivity, trade, and economic growth, often at the expense of local autonomy and ecological sustainability. In this model, food is treated as a commodity whose "security" depends on international markets, technological inputs, and state regulation

rather than on community control or cultural integrity. In contrast, food sovereignty, as articulated in the Nyéléni Declaration (2007) and championed by La Via Campesina, reframes food as a right grounded in ecological stewardship, local knowledge, and self-determination. It is explicitly a collective and relational concept, emphasizing the ability of communities to define their own agricultural systems, protect biodiversity, and sustain culturally appropriate practices through reciprocal relations with land, water, and nonhuman life (Nyéléni, 2007; Wittman, 2011).

Rather than viewing these frameworks as oppositional, the two case studies illustrate how they can function in tandem through the bridging of WS and IK. Kake's hydroponic agriculture project, for instance, aligns with a food security approach by addressing logistical and climatic constraints on year-round food availability in a remote and rapidly shifting community. Yet its design, implementation, and monitoring processes are deeply rooted in local values of stewardship and intergenerational knowledge transfer, reflecting IK principles of relationality and adaptation to place (Lenart, 2022). By integrating hydroponic technologies with traditional ecological knowledge—such as seasonal cycles and water use ethics—Kake demonstrates that WS and IK can co-produce contextually appropriate innovations that strengthen both physical and cultural resilience.

In contrast, Organización Boricuá pursues a food sovereignty pathway grounded in agroecology and community governance. Its regenerative farming initiatives emphasize autonomy, soil regeneration, and collective seed stewardship, prioritizing local control over inputs, decision-making, and land management (Carrasco-Torrontegui et al., 2021). While less reliant on formal scientific infrastructure, Organización Boricuá's approach also engages with WS ecological research, drawing on data on soil carbon, crop diversity, and rainfall patterns to enhance sustainability. Through these collaborations, the organization exemplifies the principles of knowledge co-production and the "Two-Eyed Seeing" framework (Bartlett et al., 2007), in which scientific and Indigenous ways of knowing operate in parallel and inform each other. The result is not a rejection of WS but a reframing of it as a partner in a pluralistic epistemological landscape that centers cultural sovereignty and ecological resilience.

Both cases reveal that whether pursuing food security or food sovereignty, effective climate adaptation depends not on privileging one epistemology over the other, but on building bridges between them. Kake's success in blending hydroponic innovation with local stewardship, and Boricuá's use of agroecology to resist dependency while engaging with ecological science, both demonstrate that WS and IK can complement each other when grounded in mutual respect and shared goals. As Gunaratne et al. (2021) argue, climate adaptation must move beyond binary framings toward integrative systems of knowledge. Climate change, while challenging both WS and IK in different ways, presents an opportunity for integrating these knowledge systems to more effectively respond to climate impacts. In this light, whether pursuing food security or food sovereignty, WS and IK can be bridged through participatory governance and relational science to support more resilient, equitable, and sustainable food systems.

Relationships for Integration

What stands out in our cases is that the knowledge conflicts of IK and WS are navigated most effectively through interpersonal relationships that cut across Indigenous and Western colonizing cultures. In Kake, the tribe did not lead the charge to hydroponics. Rather, it was a Western climate scientist who identified this potential solution to a recognized need for food security. She had both the analytical skills to make the case and the technical skills to both procure and manage a grant, the largest the Kake Tribal Heritage Foundation had ever obtained. The approach was in many ways unfamiliar to the tribal members—the grants and reporting process, the technology of hydroponics, growing food throughout the year in a climate with a seasonally limited growing season, and more. But they had a prior relationship and trusted their partner, who guided the grant-making and implementation of the project. They collectively navigated the tensions due to a trusted partnership and strong relationship after years of working together on another climate change data science project. It had less to

do with reconciling competing knowledge systems than navigating uncertain and conflicting terrain together with a friend.

In Puerto Rico, Indigenous farming practices are more community-oriented, as local farmers support each other through regular social interactions, such as 'La Promesa' celebration, which recognizes teachers, historical stalwarts in the farming community, and successful crop growers from the previous year. At the beginning of each year, farmers from Organización Boricuá participate in La Promesa. Through music, socialization, food, and spiritual activities, a sense of community and solidarity is concretized among the farmers. Through this process of building solidarity, farmers working with the organization recommit to the agroecology approach and find ways to navigate tensions between their approach and industrial farming systems.

Frameworks for Practice

In our literature search, we identified nine frameworks that aim to reconcile tensions between IK and WS. What our cases demonstrate is that among the frameworks for integrating IK and WS, those that focus on relationships, community-building, and trust-building appear to be more effective when seeking to build food security and sovereignty in the context of climate change.

The work undertaken by Kake exemplifies the relational and trust-centered frameworks of *Two-Eyed Seeing*, *Relational Approaches*, and *Knowledge Co-Production*, embodying the principle of viewing the world "through both eyes." They aim to balance the IK of ecological cycles with WS tools for sustainable food production. This process has strengthened local adaptive capacity by integrating local food production through Western scientific methods, enabling the community to produce healthy and "natural" food, as well as new technological methods of production (Riedlinger & Berkes, 2001; Ford et al., 2020). Through iterative collaboration and shared authority, Kake demonstrates *Adaptive Co-Management* in practice, where trust and relational accountability form the foundation of effective cross-epistemic food system adaptation (Armitage et al., 2008; Bartlett et al., 2007)

Organización Boricuá's work in agroecology manifests multiple knowledge-bridging frameworks, most prominently *Weaving Knowledge Systems*, *Six Rs*, and *Knowledge Co-Production*, thus integrating ancestral farming techniques with scientific methods of soil regeneration and biodiversity management. Their diversified cropping and seed preservation practices exemplify *Weaving Knowledge Systems* (Martin & Mirraboopa, 2003), prioritizing Indigenous voices and cultural protocols in the co-creation of knowledge. This collaboration has produced empirically validated approaches to soil health that also sustain cultural continuity and community autonomy. The *Six Rs* framework (Tsosie et al., 2022) is reflected in Organización Boricuá's ethical commitments to respect, reciprocity, and responsibility for the land, principles embedded in their struggle for food sovereignty and resistance to extractive agribusiness models (Altieri et al., 2015). Together, these practices embody a relational and justice-oriented model of climate adaptation grounded in ecological and cultural regeneration

Additionally, for Organización Boricuá, their work is centered on agroecology, an agricultural framework that intentionally weaves together IK and WS. The organization's methods, such as diversified cropping and soil health management, are rooted in ancestral practices while also being scientifically validated for their resilience to climate shocks. These approaches embody the *Weaving Knowledge Systems* framework and are a clear example of *Knowledge Co-Production*, where traditional methods are proven effective through empirical observation. Furthermore, their efforts to protect agricultural land and prioritize food sovereignty over technological fixes for renewable energy reflect the core principles of the *Six Rs* framework, emphasizing respect and responsibility for the land and community. Our site visit in Puerto Rico highlighted this commitment to relational approaches; we saw firsthand how the organization's work is deeply embedded in the land and culture, fostering a sense of biocultural heritage that stands in stark contrast to the extractive, capitalist models of industrial agriculture.

These overlapping and at times competing frameworks typically have strengths that work to accomplish a range of goals, from constructing

new methods of participatory research and community engagement to concerns regarding multi-level governance. None of these frameworks is wholly unique or distinct, having borrowed and built upon the most effective elements of the frameworks that came before it. When utilizing these frameworks as an analytical tool in practical, community-driven work, those most applicable can lead communities toward better pathways for building knowledge systems.

We also recognize that in the context of climate change, uncertainties, emergent challenges, and changing contexts are central to the experience of people working to address longstanding challenges to food security and food sovereignty. In many ways, the improvisational and relational responses are those that gain traction in these cases. It is not necessarily a systematic analysis of many variables or the development of a strategic plan. Rather, it is well-meaning, determined, and capable people, working together with others who bring different skills, competencies, and perspectives to the table, filling gaps and making progress together that makes the difference. Thus, trusting relationships allow participants to navigate tensions and discomfort together as they work through their differences and come to depend on each other to develop understanding and make progress.

Conclusion

The long-standing binary between food security and food sovereignty—and, by extension, between WS and IK—cannot be separated from the histories of colonization and imperialism that produced it. These global systems of power institutionalized hierarchies of knowledge, positioning WS as universal, objective, and modern, while rendering IK as local, subjective, and antiquated (Shiva, 1988; Smith, 1999). This epistemic asymmetry was central to colonial expansion: it justified the displacement of Indigenous food systems, the commodification of land and seed, and the imposition of technocratic agricultural models. The global "food security" paradigm, though well-intentioned, still reflects these colonial logics of extraction and control, emphasizing productivity, efficiency, and external expertise. By contrast, "food sovereignty" has emerged as a decolonial counter framework rooted in IK systems that center reciprocity, ecological balance, and self-determination (Nyéléni, 2007; Wittman, 2011).

However, the world in practice is far more complex than this theoretical binary suggests. The dichotomy between WS and IK, so sharply drawn in theory, rarely holds in communities navigating the lived realities of climate change. The case studies of Kake and Organización Boricuá demonstrate that effective adaptation occurs not at the poles but in the spaces between. Both cases illustrate how communities historically marginalized by colonization are reclaiming agency by blending WS and IK in ways that reinforce cultural integrity while enhancing adaptive capacity.

In this light, bridging frameworks such as *Two-Eyed Seeing*, *Knowledge Co-Production*, and the *Multiple Evidence Base* take on both methodological and political importance. They are not simply tools for community collaboration, but mechanisms for unsettling the hierarchies that have long separated WS and IK. These frameworks invite an orientation that values complementarity over competition. Recognizing that the world is neither binary nor neatly ordered, but instead textured and relational, allows for a more honest engagement with how knowledge is produced, shared, and applied. By embracing the spaces where WS and IK intersect, food systems can be both scientifically robust and culturally grounded, capable of addressing not only the technical dimensions of climate adaptation but moral, historical, and relational ones as well.

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Journal of Agriculture, Food Systems, and Community Development
ISSN: 2152-0801 online
https://foodsystemsjournal.org

Community strategies for strengthening food autonomy and *buen vivir* in a Nasa Indigenous Reservation, Colombia: A community-based participatory research (CBPR) approach

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Submitted June 21, 2025 / Revised October 27 and December 13, 2025 / Accepted December 15, 2025 / Published online March 11, 2026

Citation: Cano-Bedoya, S. M., López-Ríos, J. M., Cruz-Rodríguez, L., Calderón-Farfán, J. C., & Finscue-Pete, L. N. (2026). Community strategies for strengthening food autonomy and *buen vivir* in a Nasa Indigenous Reservation, Colombia: A community-based participatory research (CBPR) approach. *Journal of Agriculture, Food Systems, and Community Development*, *15*(2), 443–457. https://doi.org/10.5304/jafscd.2026.152.012

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Abstract

The growing problem of hunger and food insecurity remains a persistent global challenge. In Colombia, the Department of Huila, an administrative region located in the southwest of the country, exhibits high levels of food insecurity and malnutrition among its Indigenous population, a process linked to land and ancestral traditions that are part of the concept of food autonomy. This study aimed to describe the community strategies co-constructed by the Nasa Páez Indigenous

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See disclosures on next page

Reservation to strengthen food autonomy and *buen vivir* (good living) within their territory. Using a qualitative community-based participatory research (CBPR) approach, the study was conducted in two phases. The approach to the community phase involved presenting the proposed study during a community assembly, forming a community coalition, and agreeing on methodological aspects. The diagnosis and strategy formulation phase included documentation review, participatory meetings on buen vivir and food memory, Circles of the Word (talking circles), and visits to the *tul* (traditional household garden). These activities facilitated the co-construction of community-led strategies to strengthen food autonomy. The community coalition established five strategies: the recovery of native seeds, the implementation of demonstration *tul*, the development of a Nasa cropping calendar, the installation of water filters, and a cross-cutting component focused on ongoing support, awareness-raising, and training. These strategies were grounded in the cosmovision, traditional knowledge, and practices of the Nasa people and took into account the local community's capacities. Ultimately, these community-led strategies helped lay the foundations for strengthening food autonomy and buen vivir, highlighting the value of the participatory process and the community's capacity to self-organize around food practices. This study offers valuable insights for strengthening participatory approaches to Indigenous food sovereignty.

Keywords
Indigenous peoples, community-based participatory research, food autonomy, food sovereignty, Colombia, traditional knowledge

Conflict of Interest Disclosure
The authors have no conflicts of interest to disclose.

Funding Disclosure
This article was made possible with research funding from the Ministry of Science, Technology and Innovation of Colombia (MINCIENCIAS), through Call 896 of 2021 for strengthening regional health research capacities, under the project "Strengthening Food Autonomy to Improve the Nutritional Status and Well-being of Pregnant and Breastfeeding Women and Children Under 5 in the Nasa Páez Indigenous Reserve, Huila, 2022–2024."

Introduction and Literature Review

The problem of hunger continues to grow and poses an ongoing global challenge. After remaining relatively stable since 2015, the prevalence of undernourishment around the world rose from 8% to 9.3% between 2019 and 2020; since then, the food-insecure population has increased each year (Food Security Information Network [FSIN] & Global Network Against Food Crises, 2024). These trends in hunger and food insecurity show discouraging results and setbacks in achieving targets 2.1 and 2.2 of the Sustainable Development Goals (SDGs) for 2030 (Food and Agriculture Organization of the United Nations [FAO] et al., 2024).

Although hunger is a global issue, food insecurity is particularly acute in regions such as South America and Africa (FAO et al., 2018). It disproportionately affects the most vulnerable populations, including Indigenous communities (FAO et al., 2021), who often have limited resources to meet their basic needs, experience low and unstable incomes, and face restricted access to essential services such as healthcare, education, and nutritious food.

According to the most recent National Survey of Nutritional Status (ENSIN), conducted in 2015, the nutritional indicators for Colombia's Indigenous population reveal a deeply concerning situation. Inequities based on the ethnicity of the head of household are especially evident. In households headed by someone of Indigenous ethnicity, the prevalence of food insecurity reached 77%, which is 22.8 percentage points above the national average and 24.7 percentage points higher than in households without ethnic affiliation (Instituto Colombiano de Bienestar Familiar [ICBF], 2015). Among Indigenous children under five years of age, the prevalence of stunting was 29.6% (mirroring the 2010 rate of 29.5%) and considerably higher than the prevalence of 10% observed among non-Indigenous children under five that same year. Similarly, the prevalence of global malnutrition (low weight-for-age) among Indigenous children under five was 7.2%, compared to 3% in the general population (. More recent data from 2023–2024 indicate that this population continues to experience the highest prevalence of acute malnutrition, with 2.31 cases per 100 children, surpas-

sing all other ethnic groups (Instituto Nacional de Salud [INS], 2025).

Upon reviewing figures on the food and nutrition situation in Huila, a survey conducted to assess the impact of the COVID-19 pandemic on food and nutrition security revealed that 42.8% of the 455 surveyed households reported moderate to severe food insecurity (Centro Latinoamericano para el Desarrollo Rural, 2021). This indicates that four out of 10 households in Huila reduced the quality and quantity of their food. Alarmingly, 8% of households faced severe food insecurity, indicating a risk of hunger.

In 2022, the Department of Huila's Nutritional Status Bulletin reported that the areas with the highest prevalence of stunting were the western zone, with an average of 11.73%, and the southern zone, with a prevalence of 9.41% (Gobernación del Huila, 2022). Notably, eight of the municipalities in these regions have the largest concentrations of Indigenous populations.

The Nasa Páez Huila Indigenous Reservation, situated in the western part of the department, constitutes the study population for this research. Originally from the municipality of Páez in Cauca, this community was resettled following the 1994 overflow of the Páez River. In 2018, the Indigenous Reservation recorded a stunting prevalence of 39.7% among children under five, an alarming figure that exceeded the 2018 departmental rate for Huila (8.4%) and the 2014 national statistic for Indigenous populations (38.4%) (Calderón-Farfán et al., 2018). These figures serve as evidence of the precarious food and nutritional conditions faced by Indigenous communities, highlighting the urgent need to develop and strengthen strategic actions.

For Indigenous peoples, in particular, food is deeply connected to the land and their ancestral traditions, which are linked to their physical, communal, and spiritual well-being. However, these practices and food systems have been altered and threatened by a range of factors. These include territorial dispossession and loss; unchecked industrialization; large-scale food production driven by neoliberal policies; the commercialization of ultraprocessed foods; deforestation, water scarcity, and pollution; the exclusion of Indigenous knowledge from food policy frameworks; migration and urbanization; and the impact of armed conflict (Calderón-Farfán et al., 2023). These processes have significantly eroded and weakened the sovereignty and preservation of people's ancestral knowledge.

Although the Indigenous communities acknowledge the advances made by the national government in public policies aimed at ensuring adequate food security, the Food First Information and Action Network (FIAN, 2013) indicates that these efforts are rooted in a discourse that fails to represent them and renders them invisible. These measures fall short of affirming their collective human right to autonomously manage their own food processes in accordance with their traditions, customs, and practices.

In response, the Indigenous movement has embraced the concept of food autonomy as a fundamental right that entails comprehensive control over the food cycle, from seed production and reproduction to land access and stewardship over water and territory (Gómez, 2010; Millán, 2008; Zuluaga, 2019). Food autonomy encompasses the revitalization of ancestral farming techniques and native crops, including ecological and organic agriculture, the recovery of native seeds and plant varieties, and the redefinition of women's roles in food autonomy, enabling them to pass on their knowledge to future generations.

From this standpoint, this research adopts the definition of food autonomy developed by the Regional Indigenous Council of Cauca (CRIC) and the Regional Indigenous Council of Huila (CRIHU) in Colombia:

> The strategy of resistance by Indigenous peoples to the country's socio-political crisis, capitalist consumerist tendencies, and globalization policies ([e.g.,] free trade agreements, transgenic seeds). (Consejo Regional Indígena del Huila & IPS-I CRIHU, 2018, "Food Autonomy," para. 2)

This definition emphasizes the value of traditional crops, the recognition of traditional food preparation, the revival of food practices, and the preservation of family harmony through household

food production for self-consumption, avoiding the use of agrochemicals and monocultures, resisting the influence of media (visual marketing of products), and limiting reliance on external aid (external food programs). In this context, community-led resistance initiatives have gained relevance, such as the call from the National Indigenous Organization of Colombia (ONIC) to implement and strengthen the territories' strategies for food autonomy and sovereignty, grounded in their own identity, as an opportunity to return to their origins and reclaim traditional practices.

This study enriches the literature on CBPR and Indigenous food sovereignty by documenting a process of community reorganization around food autonomy in Colombia. It shows how established frameworks are locally adapted and strengthened through the intercultural co-production of knowledge and the revitalization of ancestral agroecological practices among the Nasa Páez people. Taking place between 2023 and 2025, these processes are embedded within broader historical trajectories of displacement, cultural resilience, and resistance that continue to shape Indigenous struggles for food sovereignty.

Accordingly, the objective of this article is to describe the community strategies developed and implemented by the Nasa Páez Indigenous Reservation to strengthen food autonomy and buen vivir in their territory.

Applied Research Methods

This study was guided by a critical social epistemological paradigm, an approach that seeks to question, relativize, and transform prevailing societal structures while proposing alternatives for change and improvement. Within this paradigm, the researcher assumes a self-reflexive and self-critical position regarding the conditions that hinder fair, dignified, and equitable social development (Cifuentes-Gil, 2011). From this epistemological perspective, the subject of study is recognized as a holder of valuable knowledge who often has been excluded from a leading role in scientific inquiry (Carabante-Muntada, 2011). Under this approach, the original constructs of the participants (emic) deserve the same consideration and importance as those produced by the researcher (etic).

The research team was composed of members of the Nasa Páez community and academic researchers from the University of Antioquia and the Surcolombian University. The Surcolombian University has maintained a consistent research presence in the territory, leading participatory and community-based initiatives that have fostered trust and intercultural dialogue over time. One author is a resident of the region and has participated as a facilitator in agroecological and intercultural education workshops. This positionality facilitated trust and dialogue while requiring constant reflexivity regarding all of the authors' dual roles as researchers and participants. The co-construction process was guided by mutual respect and collective decision-making in each research stage.

In line with this framework, a qualitative study was conducted using a community-based participatory research (CBPR) approach. This methodology enables research to be conducted in close collaboration with community members, actively involving them in all stages of the research process. The primary aim of CBPR is to deepen understanding of social phenomena while integrating the knowledge produced into interventions, policies, and social transformations that enhance the health and quality of life of the community (Israel et al., 1998; 2006).

The diagnostic and formulation process for the community strategies was developed in two phases, described below.

Phase I. Approach to the Community

This phase focused on initiating contact with the community, consulting with its members, and preparing activities to develop the research project. During this phase, the following activities were carried out: (a) presentation of the project to Indigenous authorities and community members during a community assembly, (b) formation of the community coalition, and (c) coordination of methodological, operational, and logistical aspects with the Indigenous *Cabildo* (community council), the highest governing body within the community. The community coalition, a specific strategy of the CBPR approach, comprises individuals from the community who work together to address local needs and find solutions

to the problems using their own resources and capacities.

The coalition included representatives from the Indigenous *Cabildo*, the Colombian Institute of Family Welfare's Own and Intercultural Modality Program (ICBF, n.d.), teachers, youth groups, parents, Indigenous authorities, and knowledge holders from the Indigenous Reservation. The continued presence and support of this group of community researchers ensured the acknowledgment and integration of ancestral knowledge and practices throughout the research process. The inclusion of interpreters also facilitated effective communication between Spanish and *Nasayuwe* speakers, the Indigenous community's native language.

Phase II. Diagnosis and Formulation of Community Strategies

The first part of this phase aimed to identify traditional knowledge and practices related to food autonomy within the Indigenous Reservation. The following activities were conducted:

- Documentation review on food and nutrition practices: A review of both gray and scientific literature on food autonomy among the Nasa Indigenous peoples, with a focus on the Nasa Páez Huila Indigenous Reservation.
- Four meetings on buen vivir and food memory: These gatherings aimed to recover ancestral knowledge related to food, traditional agriculture, and nutrition, following the Nasa agroecological calendar. Traditional methodologies included communal pots, knowledge dialogues, Circles of the Word around the *tulpa* (a three-stone fire), territorial tours and harmonization, and *mingas* (collective work gatherings) for preparing food and ancestral medicine.
- Two Circles of the Word with grandmothers, mothers, and women leaders of the Indigenous Reservation: These sessions focused on discussing the community's food and nutrition situation from their knowledge, practices, and perspectives. Each session lasted approximately one hour and involved 20 women.
- Visits to the *tul*: Using participant observation and semi-structured interviews, the research explored food autonomy at the household level, addressing topics such as food supply, preparation practices, and hygiene and sanitation conditions.

Once the ancestral practices of the community on the Indigenous Reservation were identified, community strategies to strengthen food autonomy were co-constructed. To achieve this, the findings related to ancestral practices were presented at a community assembly with the participation of parents, youth, knowledge holders, traditional authorities, and representatives of the Indigenous *Cabildo*. Approximately 250 inhabitants of the territory attended this meeting.

After this meeting, four participatory sessions were held with different population groups from the Indigenous Reservation (each consisting of 20–25 participants). These sessions served as collaborative spaces for the co-construction of lines of action and educational strategies to strengthen food autonomy. It should be noted that these strategies were developed through active participation in community spaces, including rituals, assemblies, and mingas of thought and work with community representatives. These strategies were developed by integrating knowledge, practices, and participatory dynamics across the board, and are detailed in the results section.

For information analysis, analytical tools from Strauss and Corbin's (2002) grounded theory were used. This inductive methodology enabled the identification of emerging categories and themes that naturally arose from the research context without being constrained by pre-existing theoretical frameworks. Community members also contributed their insights and participated in validating the findings.

The study was classified as presenting more than minimal risk in accordance with Resolution 8430 of 1993 issued by Colombia's Ministry of Health. To mitigate potential risks, continuous community participation and adherence to local norms were ensured. The project also adhered to international ethical standards, including those outlined in the Nuremberg Code and the Declara-

tion of Helsinki, thereby upholding the principles of respect for persons, beneficence, non-maleficence, and justice.

Beyond formal ethical approvals, this study required ongoing reflection on the power dynamics inherent in collaborative research. The process of co-designing and co-authoring with community members involved negotiating different epistemic positions and ensuring that community voices guided decision-making at each stage. Authorship was conceived as a collective expression of shared knowledge production, aligning with the CBPR principle that research should benefit and represent the community as an equal partner.

Results

In the Nasa Páez Indigenous Reservation in Huila, the community coalition established five strategies to strengthen food autonomy: the recovery of native seeds, the implementation of demonstrative *tul*, the development of a Nasa cropping calendar, the implementation of water filters, and a cross-cutting component focused on ongoing support, awareness-raising, and training. Collectively, these strategies, rooted in the Nasa people's worldview and aligned with their local capacities, aim to improve nutritional status and strengthen buen vivir, thereby contributing holistically to the community's food sovereignty.

Recovery of Native Seeds: Re-sowing What Is Ours

This community strategy was focused on rescuing native seeds. The community's forced relocation following the 1994 flooding of the Páez River resulted in a significant loss of agro-food and cultural wealth. Many native seeds were either replaced by commercial hybrids to meet market demands or were simply lost, undermining both food autonomy and the transmission of cultivation knowledge associated with these seeds. As a Reservation health promotor noted,

> My dad used to keep the corn in big *totumas*. He'd shuck it, cover it with a bag, and even add some medicinal plants so the seeds wouldn't spoil until it was time to plant again. That way of preserving products is fading; you hardly see it anymore.

In addition, the primary economic activity in the Indigenous Reservation is coffee cultivation, which has further limited the diversity of traditional crops. This monoculture-based production model has displaced ancestral agricultural practices, increasing dependence on external food sources and accelerating the loss of native seeds, affecting the links with the territory. As one Indigenous community leader explained,

> What's happening now is that a lot of people are using their land just to grow coffee. And with this whole coffee monoculture thing, it's like, "If I've got coffee, I've got money to go to the store." That's the mindset that's taking hold.

The community proposed recovering seeds of corn, bulb onions, cilantro patimorado, bush beans, and common garlic. This activity was carried out during the National Day of Indigenous Children and Adolescents, when these seeds were distributed to families for sowing in their tul. The recovered seeds originated from the ancestral Nasa territory of Tierradentro, Cauca (municipality of Páez), where traditional varieties of these crops are still preserved by local families. As a predominantly agricultural people, the Nasa practice polyculture adapted to diverse thermal floors and are recognized as a maize-based culture (ICBF & Universidad de Antioquia [UdeA], 2025). The recovery of native seeds serves as an act of cultural reaffirmation and resistance to industrial and market-driven processes, while reinforcing food autonomy and the reconstruction of the collective and territorial memory of the Nasa people.

Finally, this community strategy recognizes that seed availability is essential. Thus, before considering building a greenhouse or planting in it, it is essential to prepare the seeds to be grown in this space; that is, to have the seeds available to be planted. These seeds generally come from previous harvests, which have been stored in plastic containers by community members and kept planted, with seeds being recovered from that harvest.

Implementation of Demonstration Tul: Spaces for Memory and Life

The tul is a traditional agricultural system used by the Nasa people for cultivating various native crops, including corn, potatoes, cassava, other vegetables, fruits, aromatic herbs, and medicinal plants (Calderón-Farfán, Dussán-Chaux et al., 2021; Calderón-Farfán, Rosero-Medina, Pedrozo-Peñafiel et al., 2022). It is the primary mode of self-sufficient food production, sustaining local economies and cultural traditions through the production of chemical-free food.

According to participants, tul plays a fundamental role in transmitting knowledge from older to younger members of the community and strengthening family ties. In family and community tul, teaching processes are carried out through practical exercises, observation, and the integration of all community actors in the different tasks performed.

However, in the Indigenous Reservation, people report that several families have stopped cultivating their own food and are more dependent on buying it in markets and supermarkets. Some households also lack sufficient land for farming. In response, the establishment of a pilot tul was identified as a crucial strategy to promote food availability and, by extension, food autonomy. A member of the Reservation *Cabildo* said,

> Well, for us, the tul is the foundation of buen vivir, because it's thanks to the generosity of the land that we have food and can nourish our families.

With the intention of strengthening tul as spaces of living and collective memory, three mingas were organized to build two pilot tul at the ICBF's Own and Intercultural Modality Program and the *Kue Dsi'j* Ethno-Educational Institution. Community mothers, parents, cultural facilitators, administrative personnel, and human resource coordinators actively participated. Each plot was cleared of weeds to prepare it for cultivation. Then, organized planting beds were created to arrange the crops, making it easier to plant, care for, and monitor them.

Then, a harmonization ceremony called *Ritual Mayor de Çxa Puç* was conducted in both plots, guided by the community's spiritual leaders. At the heart of the ceremonial space, the traditional rhombus symbolizing the territory was placed and adorned with multicolored flowers, representing the joy of spiritually reuniting with those who are no longer on the earthly plane.

After a welcoming message, the purpose of the ritual was reaffirmed: to honor departed loved ones and invoke harmony and balance, which are essential to the community's social fabric. The spiritual guides carefully prepared the ritual elements (sacred plants and symbolic offerings) destined for Mother Earth and ancestral spirits.

The central moment of the ritual involved giving offerings: each participant stepped forward to present food that reflected the tastes of those being remembered, as well as plants symbolizing their deep connection with nature. Finally, candles or lights were lit, each one representing a loved one, concluding the ceremony in an atmosphere of remembrance, reflection, and spiritual connection.

The demonstration tul are a fundamental part of the region's traditional setting for strengthening food autonomy. In this project, the tul are reinterpreted as long-term educational spaces that foster early, sustained engagement with agroecological knowledge, cultural identity, and relationships with Mother Earth. Through continuous participation in these spaces, children and youth from Kue Dsi;j develop both practical skills and a sense of vocation related to food systems and land stewardship. This process has translated into concrete outcomes: in recent years, several graduates from the educational institution have chosen to pursue agricultural and related fields at university, inspired by their formative experiences in the tul.

Development of a Cropping Calendar: Nasa's Passage of Time

The cropping calendar was developed from community knowledge and wisdom. To create it, information was gathered through in-depth interviews, Circles of the Word, and participatory workshops, allowing for the direct collection of agricultural knowledge, perceptions, and practices from key community stakeholders.

The calendar reflects the Nasa people's understanding of time, organized around four central rit-

uals, ancestral and cultural knowledge, agroecological and climatic patterns specific to the territory, and lunar and solar cycles relevant to agricultural activities. An early childhood program facilitator explained,

> There are certain moon phases for planting specific crops. For example, onions, cassava, and plantains are planted during the waning moon. That's something the community has to keep in mind, because if you don't, the whole planting can fail.

A community validation process of the calendar followed, during which representatives and Indigenous authorities from each rural hamlet participated. In this phase, the planting, maintenance, and harvesting cycles were adjusted to ensure that the final version of the calendar accurately reflected the territory's specific conditions and needs.

The construction and implementation of the Nasa cropping calendar promotes food autonomy, as it is intrinsically tied to cultural planting, harvesting, and food preservation practices. It supports the preservation of the community's food heritage, ensuring the continued availability of traditional and culturally significant foods. Moreover, the calendar strengthens the cultural identity and self-determination of the community by promoting the use and transmission of ancestral knowledge and encouraging the participation of community leaders and members in decision-making related to food production. It also helps improve agricultural practices and outcomes, drawing on ancestral knowledge to guide cultivation cycles and adapt to environmental changes.

Implementation of Community Water Filters: Building Health and Well-Being

This strategy addressed access to clean and safe water, recognizing it as essential to community health and nutrition. The initial steps involved identifying and assessing local water sources, as well as promoting appropriate solid waste management practices. The community also engaged in awareness-raising activities on the sustainable use of water, emphasizing its vital role in life through participatory activities such as role-playing and hands-on learning.

The second step involved establishing a partnership with *Diversa*, an organization that promotes community co-creation and low-cost, innovative, and sustainable solutions to local challenges. Three participatory workshops were held with this organization: in the first workshop, participants learned to construct homemade water filters using locally available materials such as cotton, charcoal, sand, and gravel; in the second workshop, participants explored the concept of pH and water quality using a natural indicator made from purple cabbage; and in the third workshop, participants received training in basic microbiological water analysis, including the construction of a handmade microscope using accessible materials. As a practical outcome, a water filter was constructed using low-cost technology at one of the Community Child Care Units (UCA) operated by the ICBF, which provides comprehensive early childhood care. The system consists of two phytoremediation tanks, a nature-based technology that filters water through planted beds to reduce turbidity and retain heavy metals such as lead. As an educational facilitator said about the workshops,

> Thanks to this experience, we realized how important it is to implement different ways of treating water and also to take care of and protect our water sources in our territory. We picked up new knowledge and also strengthened what we already knew about key concepts related to water.

The purpose of this initiative was to purify the water used in food preparation for young children, ensuring healthier and safer dietary conditions. In this way, constructing a water filter using community resources also served to strengthen food autonomy in the reserve, with improving water quality for consumption being the main objective.

Ongoing Support, Awareness-Raising, and Training: Sharing Words, Constructing Knowledge

This cross-cutting component complemented all the strategies described above. A series of theoreti-

cal and practical workshops on agroecology was delivered. The workshops also emphasized the use of local resources for producing organic fertilizers.

Follow-up visits were conducted every two months over one year (2024–2025) by community agricultural technicians to monitor and provide assistance for household *tul*. These visits helped to evaluate effectiveness in terms of planting and production; identify progress, strengths, needs, and opportunities for improvement; and foster knowledge exchange among families, thereby promoting collective learning. A household father commented,

> This experience really helped us build and reinforce our knowledge about agroecological practices. We learned how to make organic and liquid biofertilizers, and we got tools to help control pests and diseases, which is so important for taking care of our crops and the land.

The above highlights the fundamental importance of ongoing support, awareness-raising, and training as core components for achieving food autonomy. These processes strengthen the community's capacity for sustainable food production and environmental stewardship, making optimal use of local resources and knowledge to ensure long-term sustainability. While measurable improvements in nutritional status will require longitudinal assessment, the participatory process has already demonstrated tangible social achievements, such as increased community participation, the revitalization of ancestral practices, and the emergence of local leadership in advancing food autonomy initiatives.

The following discussion contextualizes these findings within broader debates on Indigenous food sovereignty and participatory research.

Discussion

The results presented here reflect the processual success of community engagement and methodological collaboration rather than quantifiable nutritional improvements, which would require longer-term evaluation. Future longitudinal research should therefore explore how these participatory processes translate into measurable health and nutritional outcomes, providing deeper insight into the long-term impacts of community-led strategies for food autonomy and buen vivir.

The strategies implemented in the Nasa Páez Huila Indigenous Reservation have made a significant contribution to the strengthening of food autonomy, buen vivir, and community health. This process is not limited to food, as it is grounded in healthcare, encompassing the care and preservation of physical and spiritual health, as well as the restoration of harmony with Mother Earth (Calderón-Farfán, Rosero-Medina, & Arias-Torres, 2022). It also involves recovering native seeds; securing access to land and water; exercising the freedom to exchange, distribute, and commercialize; and preserving and revitalizing culture and traditional ways of life and production (La Vía Campesina, 2022).

The recovery of native seeds is of vital importance, functioning as a symbolic and political act that ties to the territory and promotes the development of its identity. At the same time, it serves as an act of resistance against neoliberal processes rooted in the Green Revolution: strengthening of external food or large-scale food production, monocultures, heavy use of agrochemicals, hybrid and transgenic seeds, and a shift away from community-centered economic practices (Forigua-Sandoval, 2020; Otero, 2013).

Moreover, seeds represent the foundation of Indigenous food production, impacting both the economic sustainability of families and their spiritual relationship with the land (Calderón-Farfán, 2014; Calderón-Farfán, Torres-Soto et al., 2021). Native seeds are central to preserving continuous reproductive cycles; they provide sustainability by adapting to local conditions, reducing input costs, and strengthening food sovereignty. Their conservation enhances resilience to external shocks, fosters agrobiodiversity, and mitigates the effects of climate change (García-López et al., 2019; Teixidor-Toneu et al., 2023). Hayden and Hayden (2025) further emphasize that seed recovery is crucial not only for maintaining genetic diversity but also for highlighting the essential role of women in preserving genetic diversity, as well as their role in preserving knowledge and traditions in Indigenous societies.

For the Nasa people, preserving the tul is essential for producing healthy food and preventing illness while also providing a viable economic alternative that supports family livelihoods (Calderón-Farfán, Rosero-Medina, & Arias-Torres, 2022). Beyond their productive function, tul are pedagogical, spiritual, and symbolic spaces. They are the heart of family and community life and a symbol of the Nasa buen vivir. The ancestral heritage is also found in the tul (Pencue-Rivera, 2021). As Delormier and Marquis (2019) argue, tending vegetable gardens is an essential practice for maintaining native seeds and contributing to the revitalization or restoration of culture, identity, well-being, governance, and Indigenous food systems.

The conservation of vegetable gardens is not only foundational for sustaining traditional agricultural knowledge and local food systems but also for the preservation of these systems (Duthie-Kannikkatt et al., 2019). The conservation of vegetable gardens represents a claim to the right to self-determination (Huambachano, 2018), positioning communities in an active struggle to protect biodiversity, native species, and ancestral knowledge (Heywood, 2011; Holt-Giménez & Patel, 2010; Kuhnlein, 2015).

Cropping calendars are important for collectively systematizing knowledge about agricultural cycles, seasonal timing, and climate conditions specific to the territory. As a tool, the calendar facilitates production planning while also strengthening the epistemological autonomy of the Indigenous Reservation by acknowledging the value of its own forms of knowledge. Previous studies have highlighted the importance of cropping calendars for rural families despite the influence of productivist approaches promoted by development institutions. Knowledge and know-how practices are highlighted in this process as they enable communities to adapt to their unique geographic and climatic conditions, serving as guiding frameworks for crop production systems (Apaza-Ticona et al., 2021). Moreover, they hold socio-communal significance, integrating agricultural cycles with community festivals and Indigenous rituals (Broda, 2013).

The community water filters that were implemented represent a concrete example of how innovation can be integrated into community-led processes using participatory, low-cost methodologies adapted to the local context. Framed in a social innovation approach, these processes underscore the need to implement change through innovative procedures and methodologies that provide alternative, context-specific solutions to common challenges.

In this regard, phytoremediation has been widely studied and implemented in diverse contexts as a sustainable water treatment strategy. For instance, constructed wetlands have demonstrated the capacity to remove between 70% and 90% of heavy metals and nutrients while operating at 30–50% lower costs compared to conventional treatment plants. Constructed wetlands are further characterized by low operational costs, minimal energy requirements, and reliance on naturally regenerating plant systems, which align with the principles of ecological design and community adaptability. Their maintenance typically involves the periodic harvesting of plants and occasional removal of accumulated solids, tasks considered manageable for community-based management. The materials used in constructed wetlands, such as native wetland plants, gravel, and sand, are locally sourced and cost-effective, enhancing their suitability for participatory environmental solutions (Wentzell, 2025).

This initiative encourages interaction among local leadership, community knowledge, and technical expertise, fostering experimentation and active learning and facilitating communication among community members, scholars, and government institutions (López-Pabón & Guerrero-Escobar, 2021).

The cross-cutting component of ongoing support, awareness-raising, and training emerges as a foundational axis for ensuring the sustainability of the other strategies. These spaces foster reflection, collective learning, and knowledge exchange.

This strategy is based on the importance of recognizing, transmitting, and revitalizing the community's ancestral knowledge in connection with their territory and land-based practices. In this regard, this study highlights the need to strengthen the transmission of ancestral knowledge and practices, which have been eroded over time, to children and new generations. These processes must

be rooted in principles of solidarity, fraternity, harmony, joy, love, and integral respect (Chaté-Tumiñá, 2013).

Similarly, research conducted in Indigenous communities in Oregon and California underscores the collective desire to regain access to native foods and resume customary practices, emphasizing the importance of knowledge transmission in the preservation of culture (Sowerwine et al., 2019) through strategies such as food preservation and food preparation workshops (Delormier & Marquis, 2019). From this perspective, it is necessary to revisit history and promote awareness and education through participatory research. This is a pathway to decontaminating minds, reframing understandings, and fostering deeper recognition and appreciation of what is inherently one's own. The most tangible evidence of this reclamation is the good food: the food grown in vegetable gardens, which our grandparents taught us to grow and consume (Chaté-Tumiñá, 2013).

Finally, recent international studies have documented similar participatory approaches to Indigenous food autonomy and agroecological revitalization. For instance, research with First Nations communities in Canada (Price et al., 2022), Māori food sovereignty movements in Aotearoa/New Zealand with the Kai Atua project (Smith & Hutchings, 2024), and Native Hawaiian food systems (Antonio et al., 2021) highlight the interconnections between cultural resurgence, self-determination, and sustainable food production. Situating the Nasa experience within this broader comparative context underscores both the shared principles and the distinct sociocultural trajectories shaping Indigenous food autonomy worldwide.

Beyond confirming findings from previous studies, this work aligns with recent Latin American and global research that recognizes culture as an integral dimension of community-based participatory research and Indigenous food sovereignty. Current studies emphasize that successful CBPR processes are those that integrate ritual, agroecological, and intergenerational dimensions of knowledge, acknowledging the inseparable links between spirituality, territory, and collective well-being. Consistent with these perspectives, our findings illustrate how intercultural and community-driven methodologies can strengthen food autonomy while respecting and revitalizing local cultural practices. Overall, the lessons drawn from this participatory process contribute valuable insights for advancing future research and for guiding practice in Indigenous and rural contexts.

Conclusions

Practices of food autonomy are essential to the spirituality, territorial preservation, and collective work of the Nasa Indigenous community. In this sense, food autonomy emerges as a cross-cutting element that is fundamental to strengthening community identity and sustainability.

The community-based participatory research process described here demonstrates how collaborative methodologies can effectively support Indigenous communities in co-designing culturally grounded strategies for food autonomy and buen vivir. In the case of the Nasa Páez Huila Indigenous Reservation, food autonomy is not only a means to improve living conditions but also a vital expression of spirituality, territorial preservation, and collective work. The strategies co-constructed through this process reflect a holistic and comprehensive approach that interweaves cultural, social, spiritual, territorial, and health dimensions. Rather than evidencing measurable outcomes, this paper highlights the methodological and relational achievements that make such transformations possible and sustainable within Indigenous contexts.

Taken together, these strategies promoted the construction and reinforcement of intercultural and participatory approaches aimed at consolidating fairer, more sustainable, and culturally grounded agrifood systems. These processes were centered in the territory, where it is relevant to recognize the voices, leadership, knowledge, and proposals of Indigenous communities as key actors in their own development, autonomy, and self-determination processes.

In addition to the above and based on our findings, we propose the following recommendations for future research, policy, and practice related to food systems:

- For research:
  - Prioritize community-based participatory

research (CBPR) methodologies that recognize Indigenous Peoples as knowledge holders and active co-researchers.

- For policy:
  - Develop and support public policies that guarantee Indigenous food autonomy and sovereignty, including legal protection of native seeds, land tenure, and culturally appropriate food education.
  - Adapt food and nutrition policies to local contexts, drawing inspiration from Indigenous worldviews, values, and practices.
- For practice:
  - Strengthen intercultural education and agroecological training in Indigenous communities, with particular attention to young people and women, who play key roles in preserving traditional knowledge and food practices.
  - Promote intergenerational knowledge exchange to sustain and revitalize ancestral agroecological practices.



Acknowledgments

We would like to express our deep gratitude to the Nasa Páez Huila Indigenous Reservation, its community members, and traditional authorities for their knowledge, guidance, and support throughout this process. Their contributions were essential to the development of this work.

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Journal of Agriculture, Food Systems, and Community Development
ISSN: 2152-0801 online
https://foodsystemsjournal.org

Nourishing connections: An arts-informed approach to illuminating community food values

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Submitted April 8, 2025 / Revised July 30 and November 6, 2025 / Accepted November 10, 2025 / Published online February 25, 2026

Citation: Zollinger, R., & Owen, G. (2026). Nourishing connections: An arts-informed approach to illuminating community food values. *Journal of Agriculture, Food Systems, and Community Development*, *15*(2), 459–477. https://doi.org/10.5304/jafscd.2026.152.011

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Abstract

This pilot study explores a novel arts-informed methodology to examine perceptions of nourishment and strategies for building a sustainable local food system. In collaboration with a food policy council and an art museum, researchers employed a hybrid "Draw and Reflect" method, combining visual art and verbal reflection. The approach allowed participants to express personal meaning through drawing in a low-stakes way, while their verbal reflection provided a deeper understanding of their artistic intentions and thoughts. Findings reveal that nourishment is a multifaceted concept encompassing not only food and drink, but also social, cultural, and environmental connections. Key themes emerged around community cohesion, environmental stewardship, and local economic development—attributes that are essential to nourishment and to resilient food systems. This methodology offers valuable insights for research and for community organizations by engaging the public in discussions about complex issues, capturing collective visions and informing decision-making.

Keywords

arts-informed research, draw and reflect, food systems, nourishment, resilience

Study Background, Context, and Rationale

A food system is a range of processes involved in producing food for human consumption. The system includes growing, processing, distributing, eat-

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Funding Disclosure

This work was supported by the National Oceanic and Atmospheric Administration's Climate Adaptation Partnerships / Regional Integrated Sciences and Assessments program through grant NA17OAR4310288 with the Climate Assessment for the Southwest at the University of Arizona.

ing, and disposing of food, as well as the outcomes of these processes, such as food security and environmental impacts (Ericksen, 2008). Conventional food systems generate high volumes of food supplies and rely on large-scale agricultural production and industrial processing to distribute food through global networks and long-distance supply chains. Local food systems, however, typically operate at smaller local or regional scales, shortening the distance between the various system components (Hendrickson et al., 2022).

Although conventional food systems tend to produce higher quantities of food, evidence increasingly suggests that local and regional food systems play important roles in food security, economic health, and social connectedness (Blay-Palmer et al., 2020; Ruben et al., 2020). Shorter supply chains are integrated with community and economic development (Gillespie et al., 2007; Gross, 2011). Local and regional food systems cultivate civic agriculture by connecting consumers with their food sources, fostering knowledge and engagement in food production, and strengthening community resilience (Bellante, 2017; Lyson, 2005; Moore et al., 2015). Enhanced capacity for local processing and distribution contributes to rural economic development (Swenson, 2011). In addition, urban and community gardens (Mello et al., 2017), farm-to-school initiatives (Janssen, 2017), and protection of traditional foodways can help address local food insecurity and bolster agrobiodiversity and food justice (Coté, 2016; Reese, 2019).

The COVID-19 pandemic, with crises such as global supply chain disruptions (Mahmood et al., 2024), outbreaks in meatpacking plants (Taylor et al., 2020), and increased reliance on food assistance benefits (Wu et al., 2025), exposed serious weaknesses in conventional food systems. More local food systems contributed to relief and recovery efforts by connecting people to local producers, supporting farm-to-institution programs, and supporting community food banks and mutual aid operations (Bornstein et al., 2024). Due to factors like interpersonal relationships, short travel distances, and innovative distribution models, local food systems were sometimes able to quickly respond to rapidly changing political and social conditions caused by the pandemic (Owen et al., 2021; Thilmany et al., 2021). As consumers and businesses show growing interest in local food systems, it is important to increase understanding of community priorities in building resilient local food systems.

Since 2021, researchers at the University of Arizona have collaborated with members of the Pima County Food Alliance (PCFA), a local food policy council in Tucson, Arizona, to develop community-based priorities for building a sustainable local food system that is resilient to future environmental and social risks (Bellante et al., 2022). Collaboration has involved multiple kinds of community engagement activities, most notably interviews and focus groups with 15 local organizations and over 100 individuals representing different parts of Tucson's food system (Bhakta et al., 2024; Gildersleeve et al., 2024). The council has sought additional ways to engage the broader community in conversations about the food system and gather insight into addressing issues such as food insecurity and food access. One idea that emerged was to incorporate art and artmaking into conversations to encourage more public engagement. PCFA invited us to develop an arts-informed research method to systematically engage the public in visioning components of a resilient local food system.

This paper reports on a pilot study in Tucson of a novel arts-informed research methodology to investigate perceptions of nourishment and how they might inform building a resilient food system. We chose to emphasize the concept of nourishment, rather than nutrition, food security, or food systems. Nourishment is one outcome of a well-functioning food system in which all people have access to food. However, while often tied to food, the concept and application of nourishment can extend beyond nutrients to include a wide range of things that are necessary for growth, health, and overall well-being. Because local food systems often extend beyond the basic provisioning of food, constructing prompts based on nourishment rather than nutrition offered a more flexible entry into people's visions of well-being.

Arts-informed research and collective artmaking practices can encourage broader public participation, evoke deep perspectives or emotions, and create a visible record of collective vision (Barone

& Eisner, 2011; Cole & Knowles, 2007; Dossa, 2019; Furman et al., 2019; MacGregor et al., 2022). Our findings suggest that this method is a promising avenue to engage the public in discussions of complex issues, to understand these issues from more holistic viewpoints, and point to future applications and approaches.

Research Design and Development

Arts-Informed Research

We employed an arts-informed methodology to enhance and expand our qualitative inquiry into perceptions of nourishment, as the arts offer a distinct way of seeing and knowing. Research using the arts intends to extend beyond conventional modes of communication and explore ambiguity and nuance through emotive and affective experiences as well as imagination and intellect (Barone & Eisner, 2011; Cole, 2015; Finley, 2007). Arts-informed research uses alternative creative processes or representational forms of inquiry to advance research and create new understandings of the complexity and diversity of human experience (Cole, 2015). While qualitative inquiry has traditionally favored verbal methods, the multisensory ways in which humans experience and know the world cannot be sufficiently communicated through a single modality. The arts offer ways to provoke and express that which may otherwise be implicit and ineffable (Barone & Eisner, 2011; Cole & Knowles, 2007). An arts-informed approach brings together the systematic rigor of conventional qualitative methods (e.g., interviews) with the creative and imaginative possibilities of art forms and processes (e.g., drawing) to create the potential for substantial new knowledge (Cole, 2015; Cole & Knowles, 2007).

The integration of art into community-based participatory research offers a host of advantages, including broadening participation (Collier & Perry, 2023; Furman et al., 2019), evoking nuanced perspectives and feelings around challenging topics (Dickson, 2021; Mantler et al., 2024), inviting a broad spectrum of knowledges and experiences (Dossa, 2019; Drolet et al., 2018), and collaborating and co-creating a community vision (MacGregor et al., 2022; Trout et al., 2022). Accordingly, this approach recognizes the breadth of varied, complicated, and subtle knowledges held by individuals and communities and attempts to more authentically represent and reflect lived experiences. Overall, as Cole states, arts-informed research is an "explicit attempt to make a difference through research" (2015, p. 22), connecting people through accessible, evocative, embodied, and empathetic means.

Moreover, arts-informed methods can aid in enlarging the social imagination, which has been described as the sharing of stories within a community (Greene, 1995). Asserting that all people possess the ability to tell stories of the human condition, Greene suggests that many sorts of dialogue are key to reshaping our imaginations toward a "more fulfilling social order" (p. 5). Stories give voice to personal perspectives and the particularities of the everyday, or the community "local knowledge" (p. 68). Similarly, Arendt proposes understanding of the evolution of people's objective and worldly interests toward the subjective in-between that she calls the intangible but no less real "'web' of human relationships" (1958/2018, p. 183), a web which produces stories, a "living reality" (p. 184) revealing the nature of both its subjects and their greater contexts. Arendt suggests that artworks are one way these stories may be made visible or tangible, and in doing so reveal more about the ever-changing social and political networks that shaped them.

An arts-informed approach also aligns with other epistemologies that emphasize relationality and inspire alternative perspectives of knowing beyond cognition. For example, an Indigenous research paradigm recognizes knowledge as situated within relationships, including "interpersonal, intrapersonal, environmental and spiritual relationships, and relationships with ideas" (Wilson, 2008, p. 74). An East Asian perspective offers a holistic understanding of the elements of everyday life and belief systems as deeply interconnected (Yigang & Qianli, 2011), and the African philosophical worldview of *Ubuntu* centers the essence of being human with our connections to the natural environment and spiritual worlds (Ewuoso & Hall, 2019; Seehawer, 2018). Other cultural art practices similarly resonate with place- and food-based

knowledges, communal memory, and aesthetic symbolism, such as Indigenous storywork (Archibald, 2008), Southeast Asian performance rituals of Wayang Kulit and Ramayana (Richman & Bharucha, 2021; Yousof & Khor, 2017), and Afro-Caribbean muralism (Braziel, 2022). As further evidenced by rich traditions and emerging practices of artmaking and craft within non-Western cultures and diasporic communities, such as muralism (Braziel, 2022; Healey, 2024; Latorre, 2018), dance (Kabir, 2014; Mabingo, 2019), ceramics (Arnold, 2018; Zhou & Sangiamvibool, 2025), weaving (Ariss, 2023), and many others, the affective, creative, and multimodal possibilities of artistic expression and representation lend themselves readily to ways of knowing that prioritize the relational dimensions of people's experiences and that include emotional, embodied, and cognitive aspects of meaning-making and knowledge.

A Method of Draw and Reflect

While drawing is a common research method for investigating the perceptions of children (Agarwal et al., 2021; Bland, 2018; Literat, 2013; Nomakhwezi Mayaba & Wood, 2015; Tatham-Fashanu, 2023), it is infrequently used with adults, despite the process offering the same valuable data, such as nonlinear conceptualization, access to memories, thoughts, and feelings, reflexivity, and creative non-verbal expression (Luraschi, 2020; Odhiambo, 2020; Reason, 2018). As a flexible mode of communication that generates countless ways of expression, drawing provides an approachable entry point into artmaking, even among those who do not consider themselves to be artists or artistic. Following a collaborative drawing activity with an invitation to participate in a semi-structured interview allows participants to reflect on their creative process, verbally clarify their intentions, and explain their drawings in relation to prompts. This approach echoes other arts-informed methods that involve drawing, such as Draw and Write (MacGregor et al., 1998), Draw, Write, Tell (Angell & Angell, 2013; Angell et al., 2015), and Draw, Write, Reflect (Sharafizad et al., 2020).

The procedural order of visual and verbal methods matters. A study of women in academic careers concluded that conducting an artmaking activity first is "more likely to result in an authentic representation of the topic of investigation" (Sharafizad et al., 2020, p. 449). Drawing first and interviewing second emphasizes art as both a process and a catalyst toward deeper understanding. As a study on emotional impact amid organizational change found, this sequence affords participants opportunities to capture their raw, initial thoughts and frame their own experiences uninfluenced by further dialogue with researchers (Kearney & Hyle, 2004). Because images are open to interpretation (Weber, 2014), participants' verbal clarification minimizes researcher subjectivity. In terms of validity and reliability, the combination of methods produces multiple data streams that can reinforce one another. However, just as art can transform understanding, research rooted in art must also be appraised differently than traditional qualitative research methods. Barone and Eisner (2011) proposed that the success of research involving the arts is to be found not in systematic validation, but in persuading others to look again at the world and experience it differently.

Methods

This pilot study occurred at a free, public event hosted by an art museum in May 2024 in Tucson, Arizona. On the third Thursday of each month, the museum opens in the evening and invites the public to enjoy music, food, and art, and learn about community organizations. PCFA was invited to this event to share information about the organization's work and to conduct the pilot study in conjunction with University of Arizona researchers.

Inspired by the potential of arts-informed research to elucidate individual and community values around sustainable food systems, we engaged participants through a hybrid method of Draw and Reflect, consisting of a collaborative art activity and a semi-structured interview. Participants were asked to draw in response to two prompts about nourishment on a shared canvas: (1) What nourishes you? (2) What nourishes our community? As participants drew their responses to either or both prompts, their contributions filled small portions of a larger canvas to eventually yield a colorful, collaborative envisioning of individual and community

nourishment. After drawing, participants were invited to answer questions about their artwork, nourishment, community, and the local food system.

The drawing prompts and interview questions were collaboratively developed between University researchers and members of PCFA. Overall, 16 people participated in the pilot study. Two opted to write their answers to the interview questions after drawing, while the other 14 agreed to a recorded interview. Written answers and interviews were transcribed for analysis, and digital photos of each individual artwork were attached to the corresponding transcript. Interviews and artworks were compiled into Atlas.ti for analysis. Text and imagery of the drawings—most drawings (75%) included text as part of the response—were visually analyzed using an inductive coding approach; that is, the codes and findings emerged from the dataset. We (the authors) iteratively developed the codebook through dialogue about emerging themes and concepts. We both coded the entire dataset and resolved any analytic discrepancies through discussion.

After data analysis, we presented initial findings to members of PCFA to solicit additional feedback about the process and findings. We inquired about how this kind of public engagement activity could support PCFA's efforts to connect with the community and how the information acquired through the study might inform their work in the local food system.

Findings

In the following section, we discuss the methodological and thematic findings of the visual and verbal data. Methodological findings reveal differences in representation when expressed through visual and verbal modalities, while thematic findings emphasize the complexity in perceptions of nourishment.

Demographics

Of the 16 people who participated in the study, ages ranged from 10 to 72 years, with a median age of 43.5. All were current Tucson residents, with residency ranging from 2 to 42 years, with a median residence time of 11 years.

Visual Analysis

When people think about nourishment and what nourishes them, it is clear that the concept of nourishment expands beyond food and beverages. While food and nutrients represented a common theme, other themes of nourishment arose, including nature and the environment, people and society, spirit and emotion, and connections to place. Images of food and drinking water appeared in 37.5% of drawings, represented by fruits, vegetables, and food crops. Nature or environmental themes appeared in most of the drawings (81.3%), represented by plants, animals, weather, and natural landscapes. Themes involving people and society appeared in 62.5% of drawings and were represented through depictions of relationships, connection, and cooperation. Emotions appeared in 50% of drawings and were represented through hearts, smiley faces, and compassion imagery. Place-based markers appeared in 37.5% of drawings such as desert plants or local landmarks. Place-based images were double-coded, meaning that they were coded for one other theme as well. For example, a saguaro cactus—an iconic Sonoran Desert plant—was coded as a place-based marker and as nature or environment.

Interview Analysis

In interviews, participants were asked to describe their drawing and what it meant to them. By comparing the above visual analysis to what participants expressed, we can assess how closely our interpretations as researchers align with participant intentions. Food and drinking water appeared in 37.5% of participant interviews, the same percent as the visual analysis. Nature or environmental themes were discussed in only 56% of descriptions, as compared to 81.3% in the visual analysis. People and society-related themes were discussed in 68.7% of descriptions, compared to 62.5% of drawings. Spirit and emotion only arose in 31.3% of descriptions, compared to 50% in the visual analysis. One reason for this outcome was that a smiley face was interpreted as happiness (an emotion) when participants attached the image to society or people, rather than as an emotion. Place-based markers increased to 50% in people's descriptions, from 37.5% of drawings. Some

people referenced local organizations or community groups in their description that were not apparent in the drawing.

Figure 1 shows the comparative frequency of themes as they arose in visual and verbal analyses. The illustrative imagery for each theme was drawn from exemplars of participants' drawings and use of visual symbols and corresponds to the categorization of the visual expression or verbal description; for example, hearts for spirit and emotion, and mountains and storm clouds for nature and environment.

Describing Nourishment

After describing their artworks, participants were asked questions about nourishment as a concept, personal forms of nourishment, and community forms of nourishment. Because the art activity contained two prompts, many people's responses reflected notions that combined personal and community nourishment. In describing nourishment, people articulated its interconnectedness and multifaceted qualities, strongly emphasized relationships with people, places, and things, and described natural and local elements as significant sources of nourishment.

Figure 1. Illustrated Bar Chart Comparing the Frequency of Themes in Visual and Verbal Analyses

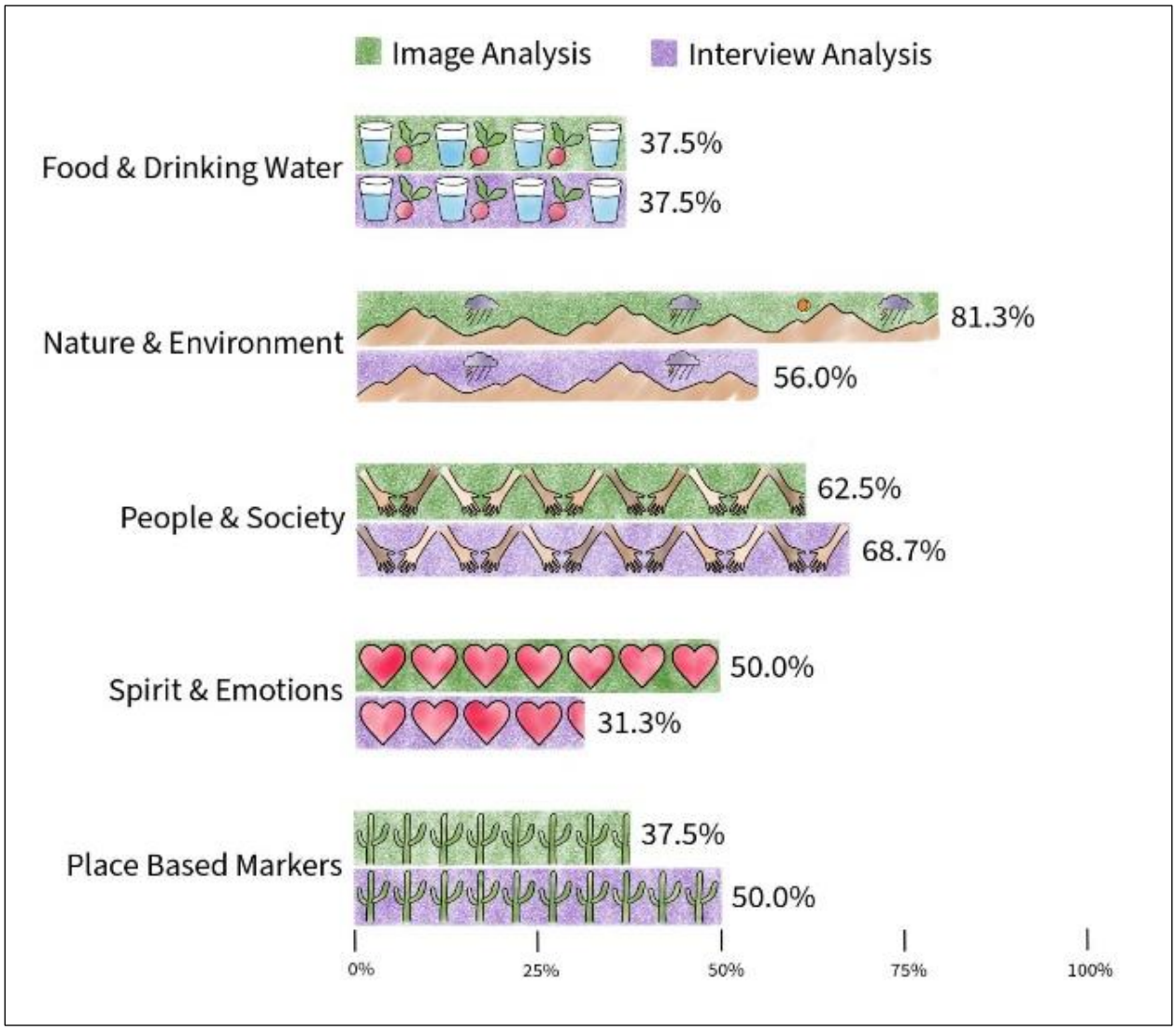


Image by the authors.

Connection as a Means of Nourishment

Participants described bonds or relationships with other people, places, plants, and animals as integral to feeling nourished. This type of connection can be cultivated by partaking in community activities, engaging in formal and informal learning opportunities, and sharing mutual experiences. For example, participants described joining organized activities such as dance classes and cultural events, volunteering with community gardens, food banks, or other social organizations, and learning through museum visits, attending seminars, and other educational programs. Others identified experiencing connection through events or moments shared with others, such as savoring the distinct aroma of the summer monsoon. One participant (B), who drew blue raindrops falling on soil, discussed her lifelong experience anticipating and experiencing the monsoon: "The smell of the rain in the desert, it's something that really stays with you. It connects people … and everything comes to life" (Figure 2).

The theme of connection was often described as a sense of belonging or identifying as part of something larger. Nearly half (7) the participants noted the significance of community for nurturing this sense. When asked what community means or feels like, one participant (J) responded, "It makes me feel like I'm part of something and not just part of myself." Other descriptions of belonging included feeling at home, feeling validated and supported, learning to move collectively, sharing experiences, setting roots in place, and having the ability to rest. Being part of something larger also meant making space for others and providing support. As one participant (G) shared, the importance of community is "finding a place where you can feel at home and where you can make others feel at home."

Another form of connection was described as reciprocity. Closely linked to belonging, participants described how relationships were nourished through giving and receiving and how investing in care and support for others was also a way to nourish oneself. Reciprocity was described as trusting in community support. As Participant B shared, reciprocity was "being able to take a break and come back knowing that others are going to carry it on while you're resting." Self-awareness, communication, and cooperation were crucial aspects of reciprocity.

Others emphasized that connection is about having a relationship that, as Participant J explained, "goes beyond … the immediate human to human relationships. … It's about thinking of

Figure 2. Participant B's Drawing of Monsoon Rain in the Desert



yourself in relation to others including the more than human." Participant M described her drawing of an avocado seedling, sun, and phoenix as representing a long-term, more than human relationship with the exchange of multiple benefits (Figure 3):

> I have this avocado plant that I've been growing for a few years. It doesn't really nourish me right now but one day it will. And it also nourishes my soul. So I take care of him, I talk to him. His name's Buddy. Then I drew a sun, giving him life and warmth. And then in the sun, I drew a phoenix to symbolize the circle of life and death, kind of. That sort of spiritual energy nourishes me.

Overall, meaningful connections between participants and elements and entities within their communities played a key role in feelings of nourishment. As participant K summed up, community meant a "feeling of belonging, a feeling of camaraderie, fulfillment, elements of giving and taking, and being concerned with the betterment of others, and not just myself." Another participant (L) reflected on the tendency of contemporary habits to distance and isolate people, explaining that his drawing of interlocking rings and a series of hearts intended to show that, for him, connection was synonymous with nourishment.

Nourishment as Holistic, Diverse, and Multifaceted

Participants described nourishment as encompassing more than the intake of food and water. While nutrients were acknowledged as basic needs and were popular in visual depictions, participants' discussions and artworks indicated that nourishment is more multifaceted, complex, and holistic. Participant N stated that nourishment "can be social, spiritual, financial, physical, within food, but also finding the things that make you feel happy, feel joyful, and bring a net positive energy." Another participant (B) described nourishment as "an extra layer" on top of food, one tied to "community and tradition" and "pleasure and joy," but stressed that it is nevertheless a basic need. Participant M felt that nourishment is "not only something that's good for my body, but something that's good for my soul."

Key feelings of nourishment included a sense of joy or happiness, fulfillment, and deep satisfaction. Participant A shared that while her initial sense of nourishment was a literal, food-based

Figure 3. Participant M's Drawing of Her Avocado Plant, Sun, and Phoenix



experience, upon reflection through her artmaking she felt her creativity and connection to the community to be essential to her overall fulfillment and happiness. Others similarly noted that feeling satisfied, whole, or complete was derived from a variety of sources that extend beyond the physical domain. Participant K, in sharing the components of her artwork, explained that nourishment is made up of "things that make me feel full, whether it's in my heart, or my belly, or my head, things that make me feel both at once settled, and also very vibrant and alive."

A final feature that emerged from participant descriptions was the continuous and cumulative nature of nourishment. Insights underscored the significance of enduring interactions, connections, and community in providing nourishment. Participant D explained:

> When I think about nourishment and community, [I think of] cumulative things, of doing … things that make me feel connected that are not necessarily, like, a one-off festival, but [that] there's a continuity that I really value.

In this sense, nourishment was described as enduring traditions of community, culture, and place.

*Nourishment **from** and **for** Nature*

Images of nature and natural elements were the most common visual elements depicted (81.3%), and participants often mentioned nature in interviews (50%). Analysis revealed that when people discussed nature and environmental elements, they often described personal or cultural relationships with nature. Two distinctions emerged in the ways participants portrayed nature in terms of nourishment: as a resource for humans, and as a collective of more-than-human entities that have purposes beyond human interests.

For some participants, nature provided a space for interpersonal connection. Participant H, discussing her drawing of water and fish, remarked, "I feel outdoors and nature is really helpful not only to yourself, but to our community as well … it gets people out there and talking to each other and talking about things and building friendships and connections." Participant E expressed a similar sentiment: "You can't be in this place and not really think about the natural beauty of it, and I think that brings a lot of people together." Participant I, who identified as a recent transplant to the area, shared his observation that efforts to protect land and wildlife bring people together in ways that are nourishing for all species.

Others considered natural resources in relation to sustainability and conservation efforts. For example, Participant G drew a prickly pear cactus to symbolize the desert scenery and its role as an Indigenous food source, centering local natural resources and resilience in an arid climate. Participant N drew a faucet, glass of water, and a water molecule-turned-heart to express her concern with access to clean water for all people, explaining that "it's really important for everyone to have access to something that sustains and nourishes all of us." Others expressed concern for dwindling or mismanaged water supplies and the subsequent impacts on plant and animal life. A participant mentioned gardening as a sustainable way of connecting to the earth and people. Sustainable practices were also described as having value beyond human well-being. As Participant I emphasized:

> There are so many different ways to use food that do nourish the life around us. … Just the practice of general recycling. And I don't mean the recycling for the bin, I mean recycling for life, to keep the plants growing and keep the ecosystem healthy.

These responses demonstrate how participants viewed nourishment as deeply intertwined with environmental stewardship and care for the broader ecosystem.

Native plants and animals were central to some participant descriptions of nourishment. Participant A, who drew blooming saguaro cacti, explained, "I do love local plant life, not so much as food for me but as food for animals. I love saguaros … and it's saguaro blooming season right now. So watching the bees and the birds, that's nourishment to them." Participant J, who drew laurels of mesquite tree branches, pods, and pollen, described her daily relationship with the mesquite trees in her yard, observing their seasonal changes

and the animals that visit them. "I kind of gravitated toward my mesquite. … If I'm thinking of nature, like who is my teacher right now, it's the mesquite" (Figure 4).

Others described how weather patterns were important for nourishing the local environment. Participant L shared:

> My mind immediately goes to the monsoon or weather. I think of this type of nourishment as the monsoon season coming to ultimately a pretty dry place. My mind just kind of went to the weather … that's interesting. Yeah, nourishment *of* nature.

Similarly, Participant B described the annual arrival of the monsoon as "celebratory" and as an event that connects all desert dwelling life.

Nourishment and Connections to Place

Beyond local flora, fauna, and weather, participants frequently referenced other local elements in relation to nourishment, including landmarks, community organizations, local restaurants, traditional foods, and long-standing cultural practices. These place-based elements were described as assets, and participants intimated their own connections to these elements. For example, Participant E shared how the "sense of the city and its energy and its sense of community" was a source of nourishment.

Figure 4. Participant J's Drawing of a Mesquite Tree



Participants emphasized the importance of diversity within their community, recognizing representation of different backgrounds, perspectives, and epistemologies as an overall strength. Participant B explained how she felt connection:

> People coming together in interdisciplinary ways, each bringing their own strengths to things, and creating something much more rich and diverse than you would get if you're more siloed. Tucson is really good at that, at really bringing multigenerational and people from all kinds of backgrounds.

Similarly, participant N credited the city of Tucson for teaching her about community: "It has shown me how so many different types of people can come together and show their strengths and provide for each other, support one another, and bring about community betterment."

Several participants identified themselves as recent transplants or short-term residents, and learning about the local natural environment and community. Participant D, for example, admitted feeling culture shock upon arrival but learning more about the weather, land use, and gardening has helped her feel more comfortable and to appreciate the area. Participant G attributed the desert environment as stimulating her awareness of place in a way she had not previously felt:

> I came from a very green, wet, moist place when I moved here. And then I was suddenly faced with a totally different way of living, and having to get used to all sorts of different environmental factors. I think that tied me a lot more to place than I may originally have been, because I was forced to have such a drastic shift in my environment and community. So thinking in that way, a place can kind of impact how you see yourself and how you see the world.

Others spoke of their realization and appreciation that the specific conditions of place engender different kinds of knowledge, approaches, and forms of conservation for natural resources, wildlife, and cultural practices.

Discussion

Our findings contribute to a growing body of research that shows how arts-informed and creative research approaches allow people to express their experiences and perspectives in new ways and contribute greater understanding of complex problems (Dickson, 2021; Drolet et al., 2018; Furman et al., 2019; Mantler et al., 2024). The art activity discussed in this pilot study afforded an opportunity to test combined methods of inquiry about nourishment within a community-based research approach. Findings point to two main areas with implications for conducting arts-informed research and supporting local food policy.

Arts-Informed Research

An arts-informed approach offers the potential to engage participants through multiple modalities and advance research in new ways. This section discusses findings and considerations for instrumentalizing art as a method of engagement.

Necessity of Multiple Forms of Inquiry

A method that combined artmaking with interviews revealed important distinctions regarding creative expression and modalities of communication. Comparative analyses of visual and verbal data suggest variations in the content represented and the frequency of thematic topics. In visual analysis of the artwork, researchers did not always interpret meaning or representation in the drawings as intended by participants. Therefore, the post-drawing interview is a necessary component to arts-informed inquiry in order to clearly understand participants' meanings in their drawings. For example, images depicting nature appeared in 81.3% of drawings but were mentioned in only 50% of verbal descriptions. Similarly, symbols of emotion appeared in 50% of drawings but were only mentioned in 31.3% of verbal descriptions. One explanation for this difference may be the use of iconic and symbolic imagery, such as saguaro cacti, landmarks, smiley faces, or hearts. Icons and symbols are shorthand for concepts, ideas, or feelings (Geertz, 2000). While they generally do not hold inherent meaning, they can be used to communicate broadly held notions or feelings such as connection to place, happiness, love, and so forth. When asked to elaborate upon their perspectives, some participants may have found it unnecessary to fully describe the iconic or symbolic meaning embedded in their artwork, presuming these to be self-evident and commonly understood. However, a large percentage of the drawings (75%) also included text, which suggests that many participants wanted to clarify the intention of their imagery, or felt that the combination of image and text more closely communicated their aims.

Variations in the visual and verbal data, stemming from different modalities, may offer distinct benefits to both the participant and the researcher. For the participants, the familiarity and flexibility of drawing means that the activity can feel low-stakes and enjoyable, allowing them to express themselves with personal style and meaning. Speaking about their drawing allows the participant to clarify their intentions and elaborate on elements or thoughts that may not be immediately apparent. For instance, Participant A noted that she had conceived of creativity as part of what nourishes her but felt that this was not obvious in her drawing. Talking about her art assured her that this important aspect was communicated and recorded, similar to ways that many participants incorporated writing into their drawings.

For the researcher, drawing opens a pathway for connecting with the participants, as their drawing becomes a starting point for a conversation. A participant's explanation minimizes researcher bias in interpreting the drawing and positions the researcher as a listener to their creative process and perspective. Deployed in combination, drawing and verbal reflection cross-validate the salience of the findings and together illuminate subtleties and nuances that would likely be overlooked by one method alone.

Art Informs Interview, Interview Informs Art

The act of drawing may influence how a person

responds to a research prompt. Converting thought into image uses different cognitive processes than verbalizing a response. Allowing research participants time on their own to draw freely in response to a prompt may encourage them to think more deeply about the research topic. Likewise, following the drawing activity with an interview suggests an important aspect about the artmaking process. While interview questions probed further and more pointedly than the art prompts—asking participants about community, place, and the local food system in addition to explaining their art—it is possible that talking about their drawings helped participants generate deeper insights into what they drew and why. When given guiding questions to reflect upon and verbalize their intentions, participants may realize more about the roots of their artmaking than they would through drawing alone. Participant L illustrated this connection, by drawing an interlocking chain and hearts to symbolize interpersonal relationships, later recognizing through his verbal reflection that the monsoon, as the "nourishment of nature," was also central to his understanding of nourishment. This points to the value of the creative process and the role of multimodal communication in unlocking implicit knowledge.

Creating a Collective Artwork

Finally, we found that integrating an art process into qualitative inquiry yielded more than a visual catalog of participants' drawings or an enhancement of interview data. Rather, the activity of making art together initiated an intersubjective process, or dialogue, among participants as well as with the researchers. During the public event at the museum, we observed people engaging not only with the prompts, but with each other and each other's expressive contributions on the canvas. People appeared to enjoy and take inspiration from other drawings, at times even echoing compositions and representations of ideas or elements in creating their own visual expression (Figure 5). The shared canvas became a site for dialogue that occurred person to person, person to artwork, and artwork to person, across time. In this sense, the medium and the outcome of the work is the collective conversation that emerged from the interactivity of making art together. The iterative process allowed ideas to build on one another, creating a richer, more layered representation of collective knowledge and priorities, reflecting what Greene (1995) described as the social imagination. While our data collection and analysis focused on individual contributions and perspectives, we contend that the data were shaped by the intersubjectivity of the art process and reflect otherwise intangible connections of human relationships (Arendt, 1958/2018). Measuring the precise significance of such an effect is difficult, if not impossible, and would otherwise contradict the point of involving an art process in the study.

Informing Food Policy and Community Programs

The ongoing collaboration between PCFA and University researchers has centered on understanding local priorities for building a sustainable local food system that is resilient to forms of environmental and societal risk. This section describes potential applications of our research to inform local food system development.

Several of the main characteristics of nourishment that emerged from our dataset also point to key characteristics of resilience, or the ability to withstand and recover from shocks and stressors, such as natural disasters, economic downturns, and political unrest. For example, participants' descriptions about connection as a form of nourishment, exemplified by a strong sense of social cohesion, inclusion, and community, are also important components of a resilient society (Aldrich, 2017; Matthews et al., 2020). A sense of belonging, reciprocity, and trust can serve to facilitate cooperation and collective problem solving (Arana & Wittek, 2016).

Another significant theme of nourishment focused on the health and well-being of the natural environment, and the ecosystem services that nature provides for human society. Participants discussed the need to use environmental resources sustainably, to help maintain ecosystem function for human and nonhuman life. Resilient practices also tend to conserve resources and consider environmental and ecosystem health, including water and air quality, soil health, and biodiversity (Mallick et al., 2025).

Figure 5. The Collective Artwork Composed of Participants' Drawings



A third key theme of nourishment described people's connection to place through public involvement, attending community events, and supporting locally owned businesses, all of which are also important characteristics of resilience. Joining local initiatives through volunteering and attending festivals and other cultural events can help build relationships and increase feelings of well-being (Coren et al., 2021). Small businesses and locally owned operations can support community resilience through creating jobs, circulating wealth within the community, and fostering a sense of place (Adekola & Clelland, 2020; Gibson-Graham et al., 2013). As participant K noted, "It makes sense for us to invest in the place that we live. And so that means eating things that are grown by people here and trying to support their livelihood as they support us and having delicious things that are nourishing for us."

When applied to building a local food system, these themes of nourishment and resilience might take the form of (a) strengthening local food economies through farmers' markets, food cooperatives, and local farms, as well as businesses and restaurants that source locally grown food; (b) supporting community-led initiatives like community gardens and home gardens; (c) attending festivals and events, often tied to the unique qualities of a place and its cultural traditions; (d) implementing sustainable farming practices that promote biodiversity, soil health, and water conservation; (e) reducing food waste and promoting resource recovery through composting, anaerobic digestion, and other innovative approaches; and (f) promoting overall community well-being through access to healthy and culturally appropriate food, safe housing, recreational opportunities, and social support.

PCFA Reflections on the Method and Applications for Use

In March 2025, the authors presented findings from this pilot study to three PCFA steering committee members. We sought their feedback on our methodology and analysis, and explored potential future applications of this arts-informed approach within the organization.

PCFA members discussed how this method facilitated collective meaning-making and exchange. Unlike survey or interview research methods that prioritize individual responses, they thought this arts-informed approach encouraged participants to see and respond to others' contributions. One member reflected on how the art fostered dialogue and collective effect: "If what we're talking about is collective action and advocacy, there's something to that in how people's ideas converge and influence each other" (R. Leih). The interactive component of this method helps surface not just individual perspectives but also shared visions for the future.

Because the approach captures collective visions as well as individual perspectives, it can serve as a strategic planning tool for organizations seeking to align their work with community priorities. One clear application is the potential for gathering broad community insights and translating them into PCFA priorities and action items. As an organization serving Pima County, PCFA strives to be responsive to community needs. Members viewed this method as a creative and structured way to capture shared experiences, concerns, and aspirations about food, agriculture, and sustainability. One member noted how the study "expands our minds about different ways that we can engage people. It moves in the direction we want to go, in terms of more equitable community engagement" (S. Thompson). PCFA members shared their plans to implement a variation of this method at an upcoming community event.

Another application identified by PCFA members was to gather public sentiment on current issues and communicate it to local policymakers. As one member noted, "People talk about how a lot of elected officials want to hear stories and not necessarily see graphs" (R. Leih). PCFA members discussed how installations that combine audio or written statements from the artists with their drawings could create compelling stories for policy advocacy, observing that "one of our roles could be to make the connection between the stories that are emerging from this and connect it to policy decisions" (S. Thompson).

PCFA members brainstormed ways to present this work to policymakers, suggesting displays in city or county buildings. One member offered, "We could do a focused presentation where we pull individual images and corresponding text from the interviews to make a case for different policies that we're trying to push forward" (S. Thompson). Another member proposed using the canvas's imagery to create a community-based "mural project based off of this research" and "make it a permanent item at a park." She explained that a mural could help bridge the community with policymakers "by inviting folks who represent a district or neighborhood [and] bringing leadership or decision makers to a community event" to create the mural (B. Fealk).

Beyond policymaking, PCFA members emphasized how the visual nature of this work makes findings easily shareable with wider audiences, including the public and other community organizers. One member suggested using the visual output of this work for PCFA's social media campaigns. Another member noted that "social media is often a huge entry point for people to engage in policy advocacy," adding that this strategy could grow membership and "broaden the engagement of people…[who] see themselves as potentially part of PCFA moving forward" (R. Leih).

A final application involved the idea of translating community voices into artistic representations. PCFA members recognized the canvas itself as a valuable collection of community insights, but noted how the overall visual richness of the "canvas alone could be overwhelming" (R. Leih). Just as verbal data needs analysis and synthesis, they thought that creating a visual summary of the canvas would help communicate its key messages. PCFA members noted that these summarized visuals could be used to spark further discussions about food system policy and local programs to address community needs.

Conclusion

This study was an exploration of a novel arts-informed method to evoke and capture people's perspectives of nourishment in relation to food systems. The artistic process, facilitated by drawing and a community event, permitted people to express themselves creatively, while the interview portion provided opportunities for reflection and clarification. The combination of visual and verbal responses from participants suggested that nourishment encompasses physical, emotional, and spiritual dimensions of people's lives, and pointed to the need for food advocacy and policy to attend to more than simply the provision of nutrients and to support social, cultural, and ecological relationships. Overall, the arts-informed research process demonstrated promising accessibility and applicability for investigating complex topics through community engagement.

The outcomes of this pilot study suggest there is further opportunity to advance the utility of arts-informed methods in the service of building a resilient local food system and beyond. Future research could explore the impact of incorporating art processes in qualitative methods and comparatively examine differences in engagement with complex topics such as nourishment and food system values through conventional, creative, or hybrid modalities. Additionally, developing questions or prompts focused on specific food- or place-related issues could provide greater insights to local policymakers and advocacy organizations working to shape more effective food system programs and policies. It should be noted that a larger sample size involving a broader diversity of community members could reveal a clearer picture of people's perspectives, as well as a more granular understanding of the effects of current food policy and issues on people's lives.



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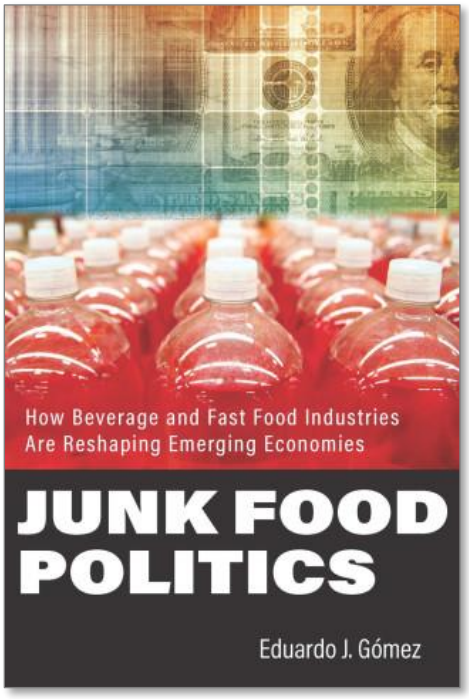
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Journal of Agriculture, Food Systems, and Community Development
ISSN: 2152-0801 online
https://foodsystemsjournal.org

Public health and food systems in emerging economies under corporate influence

Book review by
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Review of *Junk Food Politics: How Beverage and Fast-Food Industries Are Reshaping Emerging Economies*, by Eduardo J. Gómez. (2023). Published by Johns Hopkins University Press. Available as hardcover, audiobook, and eBook; 408 pages. Publisher's website: https://www.press.jhu.edu/books/title/12450/junk-food-politics

Submitted February 22, 2026 / Published online March 8, 2026

Citation: Jouzi, Z. (2026). Public health and food systems in emerging economies under corporate influence [Book review]. *Journal of Agriculture, Food Systems, and Community Development*, *15*(2), 479–481. https://doi.org/10.5304/jafscd.2026.152.035

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Noncommunicable diseases such as obesity and type 2 diabetes have become among the most serious public health challenges of our time, especially in developing countries and emerging economies. Many governments have implemented nutrition education and awareness campaigns, but rates of obesity and diabetes continue to rise. In *Junk Food Politics: How Beverage and Fast-Food Industries Are Reshaping Emerging Economies*, Eduardo J. Gómez asks a clear and urgent question: why do these diseases increase despite stated government commitments to control them?

Gómez argues that the dominant explanation is incomplete. Public discussion often frames obesity as a consequence of lifestyle change, modernization, or poor individual choices. In contrast, this book shifts attention from personal behavior to political and economic structures. The rise of diet-related diseases is not only about what people choose to eat. It is also about how global trade, investment regimes, and state-level decisions shape food environments. Gómez shows that noncommunicable diseases are connected to the political economy of food systems.

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Gómez situates the expansion of ultra-processed food within the broader wave of economic liberalization that reshaped many emerging economies after the 1990s. Market reforms and trade agreements reduced barriers to foreign investment and opened markets to multinational corporations. At the same time, regulatory pressures in North America and Western Europe pushed companies to seek new markets. Slowing sales, soda taxes, and growing public scrutiny made emerging economies attractive sites for growth. As import restrictions declined and retail sectors modernized, global food and beverage firms scaled rapidly across Latin America, Asia, and Africa. These shifts coincided with urbanization, income growth, and social programs that increased purchasing power. Weaker marketing restrictions and governments willing to partner with industry for development objectives further facilitated this shift. Expansion reflected regulatory pressures in advanced economies and market opportunities within emerging markets. In countries such as Brazil, cash transfer programs expanded consumption without parallel investment in strong nutrition regulation. The result was not simply economic development, but construction of food environments increasingly saturated with ultra-processed products. Gómez's point is not that modernization automatically produces poor diets, but that liberalization without regulatory safeguards creates structural opportunities for corporate expansion.

Using case studies from India, China, Brazil, Indonesia, Mexico, and South Africa, Gómez identifies several common industry strategies despite differences in political systems. One important strategy is direct political engagement. Corporations lobby policymakers, participate in regulatory committees, and sometimes benefit from revolving door employment between government and industry. They also fund research and academic institutions, which can shape how nutrition problems are defined and discussed. Through these mechanisms, companies gain access to policy spaces and influence regulatory debates. Another strategy involves policy framing. Industry actors often emphasize exercise and physical activity instead of focusing on dietary regulation. They promote narratives of individual responsibility, suggesting that obesity results from personal choices rather than structural conditions. At the same time, they resist clear definitions of junk food, creating ambiguity that delays regulation and weakens enforcement.

Corporate social responsibility programs play an additional role. Companies sponsor school exercise initiatives, support women entrepreneurship schemes, and partner in anti-poverty or anti-hunger campaigns. These activities increase corporate legitimacy and present firms as development partners. In some cases, companies expand aggressively into remote regions where health services are scarce. The example of Nestlé boats delivering branded products to isolated communities in the Amazon illustrates how commercial expansion can reach even the most vulnerable populations. In certain markets, sugary drinks are priced lower than bottled water, which further shapes consumption patterns among low-income groups.

Governments, according to Gómez, are not simply passive actors. They operate within political and economic constraints. Partnerships with multinational firms can offer visible short-term achievements, such as investment inflows, job creation, and economic growth. Where poverty reduction and development are urgent priorities, collaboration with industry may appear attractive. However, many countries face institutional weaknesses, including limited enforcement capacity, fragmented regulatory authority, and inadequate conflict of interest rules, that reduce the effectiveness of public health regulation.

Policy responses therefore follow a familiar pattern. Governments prioritize education and exercise initiatives, while marketing restrictions and fiscal measures remain limited or contested. Soda taxes and labeling reforms have been introduced in some countries, yet structural transformation of food environments remains partial. The health consequences are significant. The increase in obesity and type 2 diabetes is particularly severe among children and low-income populations. Rising disease burdens place additional strain on health systems. Gómez also describes feedback loops that make reform more difficult. As health costs increase, governments may rely further on industry partnerships for funding and program delivery.

Corporate legitimacy deepens, and regulatory change becomes politically harder.

Gómez's analysis resonates with the food politics tradition associated with scholars such as Marion Nestle, who documented industry influence on nutrition policy in the U.S. (Nestle, 2019). Gómez extends this lens to emerging economies, situating similar dynamics within processes of economic liberalization and institutional constraint. While the book offers a compelling account of corporate influence across diverse contexts, some counterexamples receive limited attention. Chile's comprehensive food labeling and marketing law, including front-of-package warning labels and restrictions on sales in schools, was associated with significant reductions in purchases of products high in sugar, sodium, and saturated fat during its first phase of implementation (Taillie et al., 2021). A deeper examination of these cases could have further clarified the institutional factors that enable more successful reform.

Junk Food Politics reframes the rise of noncommunicable diseases as a problem rooted in political and institutional structures rather than individual choice. The book advances a persuasive argument that meaningful reform requires confronting the incentives, alliances, and power relations that shape regulatory environments. In doing so, Gómez encourages a more holistic approach to food system reform, that moves beyond individual behavior and addresses the power relations embedded in global markets. As governments commit to improving population health yet struggle to implement effective regulation, the book offers a timely contribution to debates on global health governance and food systems transformation.

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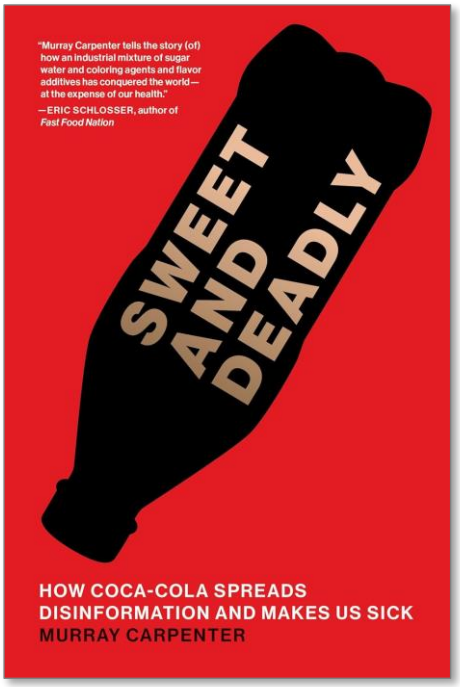
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Journal of Agriculture, Food Systems, and Community Development
ISSN: 2152-0801 online
https://foodsystemsjournal.org

The dark side of soda

Book review by
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Review of *Sweet and Deadly: How Coca-Cola Spreads Disinformation and Makes Us Sick*, by Murray Carpenter. (2025). Published by The MIT Press. Available as hardcover, paperback, Kindle, and audiobook; 344 pages. Publisher's website: https://direct.mit.edu/books/book/5934/Sweet-and-DeadlyHow-Coca-Cola-Spreads

Submitted Januaray 6, 2026 / Published online February 25, 2026

Citation: Cullers, A. (2026). The dark side of soda [Book review]. *Journal of Agriculture, Food Systems, and Community Development*, *15*(2), 483–485. https://doi/org/10.5304/jafscd.2026.152.015

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In *Sweet and Deadly: How Coca-Cola Spreads Disinformation and Makes Us Sick*, journalist Murray Carpenter investigates how Coca-Cola used science, marketing, and political influence to obscure the health dangers of its products and protect profits at the expense of public health. Focusing primarily on the decade 2010–2020, Carpenter documents how the company aggressively countered growing scientific evidence linking sugar-sweetened beverages (SSBs) to obesity, diabetes, cardiovascular disease, and other chronic illnesses. The result is a sobering account of how one of the world's most recognizable brands built and defended a global image based on deception, misinformation, and corporate power.

Carpenter begins by tracing the history of Coca-Cola and its rise to cultural dominance. The brand's logo is recognized worldwide, even in non–English-speaking countries, making Coke one of the most successful consumer products in history. Like the tobacco industry before it, the soda industry understood that its products were addictive and

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harmful. Yet, Coca-Cola successfully framed itself as a symbol of happiness, refreshment, and togetherness. This positive image allowed the company to deflect early concerns about sugar, health, and disease for decades.

The core of Carpenter's argument is built around four major strategies Coca-Cola used to suppress damaging scientific evidence and mislead the public. First, as research in the early 2010s increasingly demonstrated the biological harms of SSBs, Coca-Cola shifted the public conversation away from nutrition and toward "energy balance." Under the guidance of its chief scientist, Rhonda Applebaum, the company funded industry-friendly studies that emphasized a lack of physical activity rather than sugar consumption as the primary driver of obesity. Coke financially supported prominent researchers and created the Global Energy Balance Network (GEBN), which promoted the idea that "calories in, calories out" mattered more than the quality of those calories. In 2015, the exposure of Coke's financial ties to GEBN revealed the extent to which corporate funding had distorted scientific messaging.

Second, Carpenter details Coca-Cola's role in fighting soda taxes through well-funded political campaigns. The American Beverage Association—of which Coca-Cola is a leading member—spent millions to defeat local soda tax initiatives, particularly in California. Using tactics similar to those of the tobacco industry, the association threatened state leaders with costly ballot measures unless soda taxes were blocked at the local level. This aggressive lobbying effort successfully delayed or prevented public health legislation in many areas.

Third, Carpenter discusses lawsuits brought against Coca-Cola, including a case filed by two African American pastors who argued that the company targeted Black communities with deceptive marketing. These communities already experience disproportionately high rates of diabetes, heart disease, and stroke. Evidence presented in the book shows that Black children see significantly more soda advertisements than white children, illustrating the deliberate nature of these marketing strategies.

Fourth, the book exposes how Coca-Cola built relationships with respected professional organizations to gain credibility and silence criticism. The company donated millions to groups such as the Academy of Nutrition and Dietetics and the American Academy of Family Physicians. In return, these organizations often avoided taking strong public positions against sugary beverages, while Coca-Cola gained visibility at professional conferences and influence in policy discussions. Carpenter argues that these partnerships gave the company a powerful shield against public scrutiny.

One of the most disturbing aspects of *Sweet and Deadly* is its documentation of how long the health risks of sugary drinks have been known. As early as the 1940s, scientists were raising concerns about excessive sugar consumption. Over the following decades, evidence only grew stronger, yet Coca-Cola consistently worked to challenge, distort, or distract from this research. Carpenter demonstrates that the company's campaigns were not isolated incidents but part of a highly organized, long-term strategy to shape public perception and policy.

The book also highlights the unequal burden of Coca-Cola's practices on communities of color. Targeted advertising, higher consumption rates, and limited access to healthier alternatives have intensified the impact of chronic disease in these populations. Carpenter makes clear that this disparity is not accidental, but the result of deliberate marketing decisions based on profit at the expense of public well-being.

Despite declining soda consumption by 2020 and growing public awareness, Carpenter concludes that the harm done by decades of disinformation cannot easily be undone. Juice drinks, energy drinks, and other sugar-sweetened beverages continue to rise in popularity, often under the false impression that they are healthier alternatives. Had Coca-Cola been forced to act transparently earlier—through warning labels, advertising restrictions, sugar reduction, and widespread soda taxes—the global burden of chronic disease might be significantly lower today.

Sweet and Deadly is a powerful and unsettling exposé of corporate influence over public health. Carpenter skillfully weaves together investigative journalism, internal documents, court records, and scientific research to reveal how deeply Coca-Cola shaped health narratives for its own benefit.

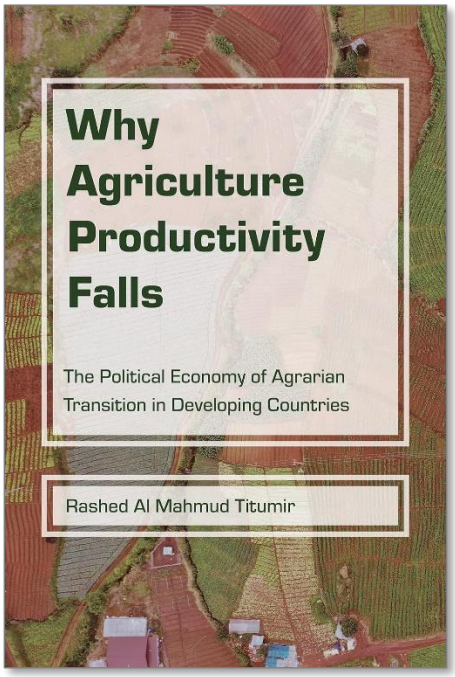
The book ultimately argues that Coca-Cola's manipulation of science rivals that of the tobacco and opioid industries and has contributed to preventable illness and death on a massive scale.

For readers interested in nutrition, public health, corporate ethics, or social justice, *Sweet and Deadly* is both eye-opening and deeply troubling.

Journal of Agriculture, Food Systems, and Community Development
ISSN: 2152-0801 online
https://foodsystemsjournal.org

A political dissection of agrarian development in developing countries: A case from Bangladesh

Book review by
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Review of *Why Agriculture Productivity Falls: The Political Economy of Agrarian Transition in Developing Countries*, by Rashed Al Mahmud Titumir. (2023). Published by Purdue University Press. Available as hardcover, paperback, and Kindle; 232 pages. Publisher's website: https://docs.lib.purdue.edu/purduepress_ebooks/68/

Submitted December 4, 2025 / Published online February 10, 2026

Citation: Sharma, M. (2026). A political dissection of agrarian development in developing countries: A case from Bangladesh [Book review]. *Journal of Agriculture, Food Systems, and Community Development*, *15*(2), 487–489. https://doi.org/10.5304/jafscd.2026.152.022

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Rashed Al Mahmud Titumir's *Why Agriculture Productivity Falls: The Political Economy of Agrarian Transition in Developing Countries* raises a profound question: why has agricultural productivity in many developing countries slowed or stagnated despite decades of Green Revolution technologies and neoliberal globalization? The author's central claim is that productivity in developing countries is shaped less by factor endowments and "efficient" markets than by social property relations, political settlements, and non-market accumulation. Taking Bangladesh as the empirical case, the book shows how smallholder-dominated agrarian structures experience short-run output growth when capital-biased technologies and clientelist institutions prevail, but are locked into long-run stagnation and environmental degradation. The argument moves between neoclassical, Marxist, and neopopulist perspectives. On the one hand, Titumir engages neoclassical and new institu-

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tional economics, which stress market (re-)allocation, property-rights reform, and (supposedly) scale-neutral technology. On the other, he draws heavily on Marx, Brenner, Wood, and political-settlement theory[1] to foreground class power, "politically constituted property," and nonmarket processes. He explicitly distinguishes between market accumulation and non-market accumulation (primitive accumulation), arguing that "there are at least two dimensions of nonmarket processes[:] … primitive accumulation and the operation of the political settlement" (p. 26). These are not residual complications to an otherwise well-functioning market order. They are, in fact, the main drivers of land misallocation, disinvestment, and, ultimately, productivity decline.

A key conceptual note is to consider land as a political asset and store of value, rather than just a factor of production. Titumir argues that in developing countries, "land is treated as savings rather than an investment" (p. 3). Buyers are often non-farm actors using remittances or business income, not cultivators seeking to raise yields. At the same time, smallholders face capital and technology constraints, while the available technologies, such as high-yielding varieties (HYV) and hybrid seeds, mechanization, groundwater irrigation, chemical fertilizers and pesticides, are scale-neutral in practice. Small farms can show high land productivity in the short run through intensive family labor and "self-exploitation," but they are structurally disadvantaged when it comes to big investments and risk management. Migration and remittances deepen this pattern: land is mortgaged or sold to finance migration, then repurchased as a savings asset, which decouples ownership from productive use.

The empirical heart of the book lies in four villages that embody different shapes of urbanization, climate risk, migration, market access, and primitive accumulation. Srimantapur (Comilla), the "village between two cities," shows high yields and intensive input use under extreme land fragmentation. Farmers are "hyper-productive" but ecologically vulnerable. Char Lakshmi (Noakhali), a disaster-prone char land that is formed through the natural process of sand deposition due to flows of rivers, exemplifies low productivity and aggressive land-grabbing, with khas land[2] and newly accreted chars captured by politically connected elites through what Titumir calls "networked power and land accumulation" (pp. 124–128). Bara Pakhia (Tangail) is a village of migrant workers where remittances structure land markets, producing absentee landlordism without a corresponding productivity surge. Dastika (Bogra) is a semi-urban, diversified economy where agriculture remains largely subsistence-oriented and nongovernmental organizations (NGOs) themselves emerge as large landowners, contributing to new forms of primitive accumulation.

Together, these cases demonstrate that what Titumir terms "market failures sustained by power asymmetries … [where] diseconomies of scale that affect small farmers, and unstable property rights" have "led to low growth of output and productivity" (p. 4). Methodologically, the book draws on a mixed-methods design. Village-census surveys document landholdings, tenancy, input use, cropping patterns, credit, and political affiliations. Qualitative interviews and ethnographic observations explore how households understand land, risk, and power. This is complemented by simple field experiments and national statistics. Titumir uses descriptive statistics, cross-tabulations, and stylized models (e.g., expressing productivity as a function of land, labor, capital, and technology, and land prices as a savings asset) to ground his propositions.

The book's main contribution is to reframe the agrarian question under conditions of smallholder dominance, capital-biased technology, and clientelist states. It challenges both neoclassical optimism that removing market distortions will lead

[1] A political settlement theory underscores that the distribution of power among elites and social groups shapes the formal and informal "rules of the game" and institutionalization in rural and agrarian settings (Gray 2019). Titumir uses this theory to explain that productivity decline in countries like Bangladesh is not solely technical but also a consequence of political settlements and institutional arrangements that favor factions, which benefit at the expense of productivity growth in the short run.

[2] In South Asian context, Khas land is government-owned land that is meant for redistribution to landless or marginal farmers.

land to the "most productive" users and neopopulist faith in smallholder-led development. Land is becoming more fragmented "through demographic processes" while "smallholding agriculture [is] increasing as opposed to the concentration of land" (p. 3), yet aggregate productivity remains arrested. At the same time, the "common underlying feature in all the villages is political settlement" (p. 4): factional politics, donor-state entanglements, and rent-seeking "syndicates" condition who gains access to land, credit, and technology, and on what terms. Breaking out of the "sub-optimal productivity growth trap," Titumir argues, "requires a steep change in land consolidation" (p. 4) and reforms that confront these political structures directly.

There are, however, important limitations of the book. Despite its general title, the empirical basis is purposefully chosen from four villages in Bangladesh. The specific nature of land politics, demographics, socio-economic properties, and party–bureaucracy networks may not transfer easily to other settings and may be insufficient to generalize the context to "developing countries" as a whole. Empirically, the study focuses on breadth over depth. The employment of formal modelling is a useful heuristic, but the book largely overlooks the micro-econometric methods. Further, the book is stronger in its diagnostic approach than in offering solutions. The text can be dense and occasionally repetitive, especially in revisiting the critique of neoclassical and neopopulist approaches. Some readers may wish for sharper and clearer distinctions between different dimensions of "productivity" (yields, profitability, labor productivity, or total factor productivity).

Despite these caveats, *Why Agriculture Productivity Falls* is a significant contribution for scholars and practitioners interested in agrarian political economy. The book is fitted for readers with a background in agricultural economics, rural agrarian studies, or political economy. Graduate students and researchers, particularly those interested in South Asian land politics, will find it a useful resource. Policy-makers can also draw lessons, though these are often implicit. The book's strength lies not in offering quick fixes, but in dissecting the interaction of land, power, technology, and political settlements to explain agricultural productivity in countries like Bangladesh.

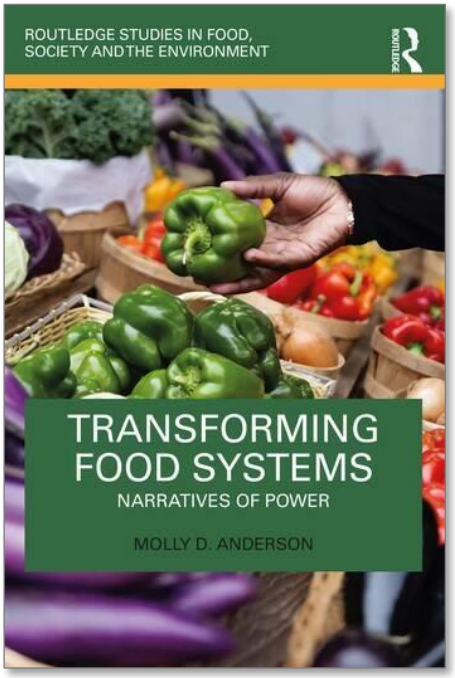
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Journal of Agriculture, Food Systems, and Community Development
ISSN: 2152-0801 online
https://foodsystemsjournal.org

Deconstructing the narratives that frame food system transformation

Book review by
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Review of *Transforming Food Systems: Narratives of Power*, by Molly D. Anderson. (2024). Published by Routledge. Available as paperback, hardcover, and eBook; 282 pages. Publisher's website: https://www.routledge.com/Transforming-Food-Systems-Narratives-of-Power/Anderson/p/book/9781032196671

Submitted December 28, 2025 / Published online February 19, 2026

Citation: Manitius, C. (2026). Deconstructing the narratives that frame food system transformation [Book review]. *Journal of Agriculture, Food Systems, and Community Development*, *15*(2), 491–493. https://doi.org/10.5304/jafscd.2026.152.020

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Narratives hold power. The stories we tell ourselves about the food system—what it is, what it ought to be, and who has the power and agency to change it—shape our conception of what's possible. In *Transforming Food Systems: Narratives of Power*, Molly D. Anderson explores the most common narratives around food system transformation and deconstructs the theories and assumptions underlying them. Drawing on her decades of scholarship and advocacy, she demonstrates the power of narratives by exploring how they show up in contemporary food systems discourse and the influence of such narratives on actionable change.

Anderson organizes her book into five parts and 11 chapters. In the opening part, she defines what "food system transformation" means to her. First, she argues that the goal should be to achieve a regenerative food system: one that goes beyond merely sustaining the status quo to actively restoring ecosystems and communities. Second, she argues that achieving this goal requires a deep reorientation of social values to be focused on fairness and the public good rather than individual profit. Throughout the rest of the book, each narrative of food system transformation is assessed

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against whether or not it aligns with this vision.

Part two sets out what narratives are and why they matter. Anderson defines a narrative as a course of action with a beginning, middle, and end, which is used by humans to make sense of and provide meaning to their experiences. She then argues that narratives create and reinforce different perspectives on problems and solutions. She demonstrates this by setting out two "meta-narratives" in the food systems discourse—food as a commodity vs. food in the commons—arguing that these narratives involve fundamentally different views of the value and purpose of food. She finished the section using system diagrams to show how power flows through the food system both narratively and visually. For example, she maps the interplay of different actors and how their power can reinforce or counteract each another.

Having set out the conceptual foundation, part three forms the core of Anderson's analysis: a typology and examination of common narratives of food system transformation. She distinguishes between narratives that do not require structural change (e.g., sustainable intensification and international summits) and those that do (e.g., food democracy and agroecology). Anderson deconstructs each narrative by laying out its implicit or explicit theory of change and underlying assumptions, showing they are far from value-neutral. She then demonstrates how these narratives present themselves in the discourse, using examples from interviews, literature, the media, speeches, and her own first-hand accounts. Ultimately, she argues that from her perspective, only the more radical narratives (namely, food sovereignty) can deliver on the goal of a regenerative food system.

From there, Anderson moves her analysis to actors in the food system, exploring who has the power, agency, and accountability to lead transformative change. She ultimately argues that civil society is best positioned to do so, but that involving multiple actors will increase the likelihood of success as different actors balance and reinforce each other. The sheer quantity of examples included in this section make it information-dense at times, but the sources included can serve as a valuable resource guide for readers seeking to learn more.

In part four, Anderson uses case studies to explore how the competing narratives identified in part three play out in practice. For example, she shows how disagreements surrounding the Committee on World Food Security over the involvement of the private sector and civil society in policy-making stem from differing narratives around the sources of the problem and which actors are best positioned to bring about change. The wealth of examples included in this section is both a strength and a challenge, as readers may find themselves wishing for a clearer through line to guide them through. The final part ties the book together, arguing that achieving transformative change first requires shifting the dominant cultural narrative about what food is and what it is for. Only once we leave behind the idea of food as a commodity do we have any hope of achieving regenerative food systems.

Anderson's work stands out for its synthesis and scope. To my knowledge, this is the first attempt to comprehensively map the full landscape of narratives within the food systems discourse. For newcomers, it provides a helpful orientation to the various perspectives shaping global debates. For those already embedded in them, it provides an interpretive framework for critically assessing their own work and understanding sources of contention. All readers will emerge better equipped to discern the assumptions and power relations shaping today's food system debates.

There is, however, one limitation to Anderson's analysis. While she speaks to the different problem definitions that actors may have, she presupposes that all actors within the food system want to change it. In doing so, she does not account for the self-interest that may be driving actors towards certain narratives precisely *because* they cannot deliver on her goal of transformative change. For example, an owner of large assets who stands to lose from deep structural change may push forward the sustainable intensification narrative because it protects their wealth and power, which are their more fundamental goals. These underlying motivations may therefore lead certain narratives to gain traction not because they are more likely to be effective, but because they are useful to those in power who benefit from the sys-

tem as it is today. Incorporating this broader political economy dimension would have sharpened Anderson's analysis and deepened the book's explanatory power.

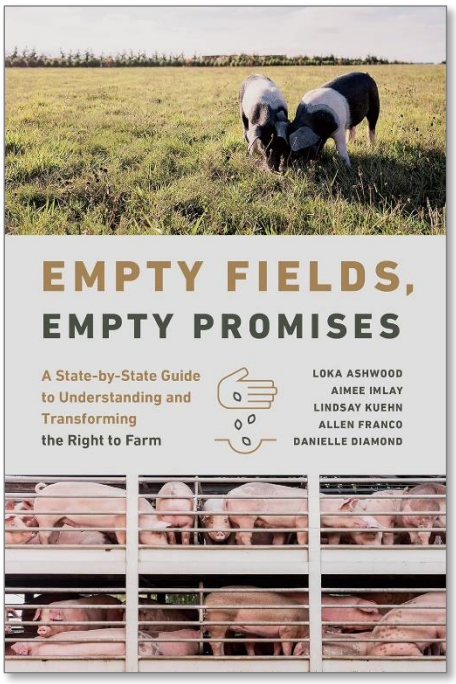
Ultimately, *Transforming Food Systems* serves as both a diagnosis and a call to action. Anderson persuasively argues that meaningful change will not be found in new technologies or international declarations, but through deeper changes in our values and the stories we collectively believe about what is possible. Her book's lesson is clear and compelling: to transform our food system, we must first transform the narratives of power that sustain it.



Journal of Agriculture, Food Systems, and Community Development
ISSN: 2152-0801 online
https://foodsystemsjournal.org

Right-to-farm laws: Legal shields of Big Ag

Book review by
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Montana State University



Review of *Empty Fields, Empty Promises: A State-by-State Guide to Understanding and Transforming the Right to Farm*, by Loka Ashwood, Aimee Imlay, Lindsay Kuehn, Allen Franco, and Danielle Diamond. (2023). Published by The University of North Carolina Press. Available as paperback and hardcover; 304 pages. Publisher's website: https://uncpress.org/9781469674599/empty-fields-empty-promises/

Submitted December 9, 2025 / Published online February 10, 2026

Citation: Ebel, R. (2026). Right-to-farm laws: Legal shields of Big Ag [Book review]. *Journal of Agriculture, Food Systems, and Community Development*, *15*(2), 495–497. https://doi.org/10.5304/jafscd.2026.152.018

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In the 1970s and 1980s, U.S. agriculture faced its worst crisis since the Great Depression. Dire finances due to collapsed land and commodity prices forced almost a third of farms nationwide to close, negatively affecting rural economies beyond farming (Barnett, 2000). During this period, right-to-farm (RTF) state laws were enacted to protect farmers from nuisance lawsuits resulting from agricultural practices, such as complaints about noise or odor. These laws were promoted to safeguard family farms and slow down the urbanization of rural areas, a trend contributing to the emergence of post-agrarian rural societies in the U.S. (Salamon, 2007). In *Empty Fields, Empty Promises*, authors Ashwood, Imlay, Kuehn, Franco, and Diamond critically examine how far RTF laws have diverged from their original intent and now instead protect large-scale operations, such as concentrated animal feeding operations (CAFOs).

The book is divided into three sections. Section I begins with a compelling case: We get to

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know the Lewis family, long-time residents of White Oak, North Carolina, whose lives changed for the worse when a 14,700-hog CAFO became their neighbor in the 1990s. They sought justice for the loss of quiet at their home and health issues they claim were caused by the close location of the CAFO, only to lose their case because RTF laws supported the CAFO.

We then learn that RTF laws were first enacted in Alabama in 1978, and by the mid-1990s, existed in all 50 states, fundamentally changing private property rights in the U.S., as the "constitutional right to the enjoyment and use of land became subject to protections of agriculture" (p. 3). Next, the authors discuss two shortcomings of RTF laws, inherent since their inception and likely to prompt a negative view from a food systems and justice perspective: (1) RTF laws make no distinction between small family farms and industrial operations such as CAFOs; and (2) the agricultural practices these laws are protecting, and thus their applicability, remain vague. Accordingly, in several states, RTF protects meat processing and even mining. In 1995, a Mississippi paper mill successfully applied RTF defense to avoid liability for allegedly discharging dioxin sludge, after a court classified its timber-derived products as a crop (p. 6).

The section ends with assessing the outcomes of all 197 RTF cases nationwide through 2021. While CAFOs won 69% of cases (fully or in part) as plaintiffs or defendants, sole proprietor farmers only succeeded in 41%, including in zero of nine cases as the plaintiff (p. 9). If anyone imagines that RTF laws could protect urban farmers from neighbors who complain, the book dispels that hope: In a California case, poultry farmers were denied RTF defense because their 80 acre operation was labeled "weekend" farming (p. 14).

Section II provides brief chapters on each state's RTF laws, covering their history, application, impact, and attorney fees, contrasting them with the number of family farms in the respective states, which has drastically declined in the past four decades in the majority of states. Farms in 30% of states are immune from nuisance lawsuits if, for example, they use a new but potentially polluting technology, if their size changes (30% of states), or even if they switch to a different commodity (26% of states). Once in operation for a year, farms in 48% of states are strongly protected by RTF laws, which supersede local governance in 62% of states.

There are a few curious state laws:

- Florida (p. 70) offers no explicit protection of farmland from urban development, despite RTF law being promoted as doing so.
- Indiana's RTF law (p. 95) protects mining.
- New Hampshire (p. 158): Agritourism is included in the definition of agriculture and thus protected from nuisance lawsuits.
- Rhode Island (p. 208): Unlike other states, RTF law does not protect farms from nuisance suits if a neighboring property's value is affected by loss of use or enjoyment.

In the concluding section, the authors stress that not a single RTF law explicitly protects family farms. They suggest that accompanying provisions, such as immunity for a farm when it switches from extensive ranching to industrial chicken production, should be reframed to empower rather than weaken rural dwellers, whether farmers or neighboring residents. The authors alternatively suggest an entire abolishment of RTF laws, since their initial goal, the revitalization of rural space, has been clearly missed (if it was ever seriously aimed for). Finally, the authors point out that the constitutionality of RTF laws has never been established, since no case has reached the Supreme Court.

The book's central argument is that RTF laws do not protect homeowners, residents, or farmland from corporate agriculture and encroaching development; instead, they primarily serve industrial operations, giving them an advantage over smaller farms (p. 11). These burdens fall disproportionately on the poorest residents, especially minorities in Southern states—and on the "second-next victims" in what the authors call the Midwest's "midburden," where small and midsized farms are being displaced by consolidation and urbanization, producing new pathways to poverty (p. 23).

At times, the evidence presented is almost too abundant. When the authors note that CAFOs prevail more often than any other sector in RTF cases across the top five "hog states," the significance of

these numbers can be questioned, given that Indiana (the state with most cases) had only seven pro-CAFO verdicts, while some other states had just a single one; in total, the book analyzes only 197 RTF cases. Also, while it is not the authors' intention, uncritical readers might interpret the book's narrative as romanticizing "good" family farms versus "bad" CAFOs, even though smallness does not guarantee environmental or social responsibility, and family farmers do not necessarily reject the idea of expanding into industrial operations.

Those expecting a "page-turner" may not find what they anticipated. Unlike Loka Ashwood's outstanding characterizations of rural America in her previous books, this work, although it includes sociological elements in its case examples, is primarily a fact- and number-heavy analysis of laws that many in the food systems field may be unfamiliar with, placing the book closer to policy analysis than rural sociology.

However, I will assign Section I as a core reading in my food systems courses. RTF is not the root cause of rural desolation or family farm loss. Yet these laws, either never designed to promote rural prosperity or later co-opted by Big Ag, demonstrate how the legal system ultimately serves industrial agriculture, a pattern amplified by large players' access to better lawyers. Because "right-to-farm" suggests the opposite, RTF laws are a clear example of greenwashing (or food-washing). *Empty Fields, Empty Promises* offers a strong, evidence-based, and well-written argument on this point, making it both compelling and valuable for JAFSCD readers.

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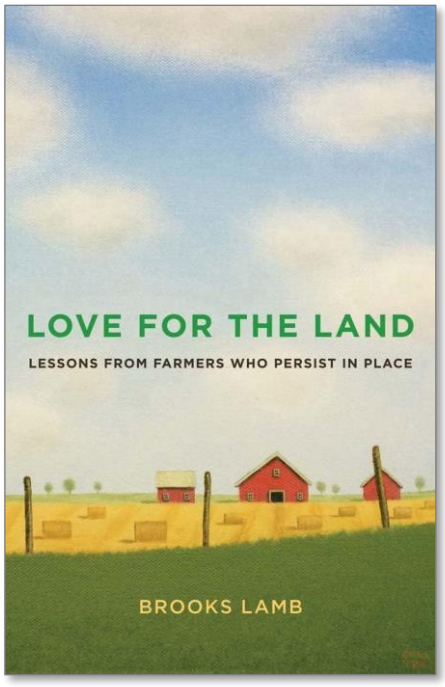
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Journal of Agriculture, Food Systems, and Community Development
ISSN: 2152-0801 online
https://foodsystemsjournal.org

We won't "Get big or get out": The farmers who stayed put

Book review by
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Review of *Love for the Land: Lessons from Farmers Who Persist in Place*, by Brooks Lamb. (2023). Published by Yale University Press. Available as paperback, hardcover, eBook, and audiobook; 288 pages. Publisher's website: https://yalebooks.yale.edu/book/9780300280104/love-for-the-land/

Submitted December 9, 2025 / Published online February 10, 2026

Citation: Ramsey, E. Q. (2026). We won't "Get big or get out": The farmers who stayed put [Book review]. *Journal of Agriculture, Food Systems, and Community Development*, *15*(2), 499–501. https://doi.org/10.5304/jafscd.2026.152.016

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In the U.S., farmland is steadily declining. The number of farms has declined dramatically from a peak of 6.8 million in 1935 to 2.04 million in 2022, and further to 1.88 million according to the 2024 Census of Agriculture (Lacey, 2025). Tennessee reflects this trend. The farmers' persistence in place is a remarkable feat, especially amid long-standing trends in farm loss and consolidation that have reshaped the agricultural landscape.

As a boy who grew up on Tennessee farmland and returned to document the stories of those who stayed, Brooks Lamb offers a moving tribute to agricultural resilience. In this review of *Love for the Land: Lessons from Farmers Who Persist*, I reflect on the importance of these stories and the enduring wisdom they carry. Lamb sets out to preserve the voices of small-scale farmers to reframe persistence as a form of resistance. His goal is not simply to document survival, but to illuminate the emotional, ethical, and imaginative commitments that sustain farmers in the face of erasure.

Love for the Land gathers the stories of farmers in Robertson and Maury counties, Tennessee.

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Brooks Lamb spent time interviewing farmers in both regions—white farmers in Robertson County and Black farmers in Maury County. While their histories and geographies differ, what emerges is a shared ethic of care, commitment, and deep-rooted connection to the land.

This book presents a powerful exploration of the deep and often fraught connection between farmers, their land, and their legacy, by focusing on three core virtues that shape how farmers embody land stewardship: imagination, affection, and fidelity. These virtues are not abstract ideals but lived commitments, expressed through the farmers' actions, relationships, and enduring ties to place. Imagination is presented as an essential quality for farmer-stewards. Lamb describes it as the ability to "visualize what is possible" for the farm and the land, a forward-looking mindset rooted in care and creativity (pp. 6–8). This imaginative vision often stems from ancestral connections to land, particularly for those farmers who inherited the land they grew up on and played on as children (p. 9). It allows farmers to hold a "child-like view of the world" that deepens their connection to the land, enabling them to envision futures beyond extraction or sale.

Affection is the emotional force that sustains commitment to the land. Lamb describes it as "acting on emotion" and "deciding to care for the earth" (pp. 13–14), echoing relational practices common among farmers. He identifies affection as the primary reason farmers persist as "stickers" (p. 93) and stewards, noting that "without imagination, affection cannot arise" (p. 13). This deep love manifests in farmers' refusal to sell—one example being Phillip, who insists that "no price could ever be high enough" because selling would violate an authentic love for the land (p. 93).

Fidelity reflects unwavering dedication to the land, even amid hardship. Lamb frames it as a virtue that marks farmers as good stewards of the land (p. 17). Fidelity fuels persistence and resistance to external pressures, enabling farmers to persist in place. It is demonstrated through farmers' determination to remain, rehabilitate neglected land, and pass on their legacy—especially among minority farmers facing systemic barriers. Their commitment to continue caring for the land, even when it has been disrespected or devalued, speaks to a deeper ethic of stewardship and survival.

Lamb's virtue-based framework offers a compelling lens, and in the book's final chapter, he connects these virtues to broader structural forces. He discusses how imagination, affection, and fidelity can serve as forms of resistance to land loss, racial exclusion, and development pressures. This concluding discussion deepens the book's engagement with policy, race, and power, particularly in relation to the historical and ongoing dispossession of Black farmers—a theme explored in depth by scholars such as Penniman (2018) and White (2018). Lamb's approach resonates with literature on moral economies and agrarian ethics (Bell, 2004), while also contributing to a growing body of work that foregrounds agrarian resistance and place-based justice.

Despite neighboring farmland disappearing around them, and often transforming into sprawling subdivisions, farmers in Maury and Robertson counties persist in place. Lamb establishes that many farmers, particularly those operating on a small scale, are struggling with the rapid disappearance of farmland, driven by housing developments and the expansion of large corporate farms. These farmers are frequently left behind, facing continual pressure to sell from neighbors, developers, and encroaching urban areas. Their decision to remain is not passive but deeply intentional, reflecting a commitment to legacy, stewardship, and resistance to displacement.

Diversity among Tennessee farmers remains low. According to the 2022 Census of Agriculture, the state included 105,222 white producers, compared to just 1,176 Black or African American producers, 351 American Indian/Alaska Native, 221 Asian, 49 Native Hawaiian/Pacific Islander producers, and 798 identifying as more than one race (U.S. Department of Agriculture, National Agricultural Statistics Service, 2022). These stark disparities underscore the significance of Lamb's decision to center the narratives of Black farmers in Maury County—stories that are too often marginalized or omitted in dominant agricultural discourse. His research approach was not only intentional but also relational: by collaborating with a Black historian who helped connect him to local

farmers, Lamb enacted principles of ethical storytelling rooted in participatory and decolonial research traditions (Smith, 2012). These traditions emphasize relational accountability, co-authorship, and the refusal to use extractive knowledge practices—values reflected in Lamb's commitment to honoring lived experience and building trust. This method allowed him to access voices that might otherwise remain unheard, offering a more inclusive and historically grounded portrait of land stewardship in Tennessee.

Lamb's work resonates with a growing body of scholarship that reclaims agrarian life as a site of resistance and ecological care. In conversation with thinkers like White (2018) and Penniman (2018), *Love for the Land* joins a tradition that frames farming not only as survival, but as collective resilience. White's notion of "collective agency" and Penniman's emphasis on land as a site of healing echo through Lamb's portraits of farmers who persist in place despite systemic erasure. His narrative contributes to a broader reimagining of rural futures. It invites us to ask: What does it mean to remain when the land itself is under siege?

Although these farmers are dealing with land disappearing around them, their persistence gives hope to the future of farming and agriculture. Those who remain do more than survive; they steward, resist, and imagine. Their stories, as Lamb shows, are not relics of the past but blueprints for a more rooted and just future.

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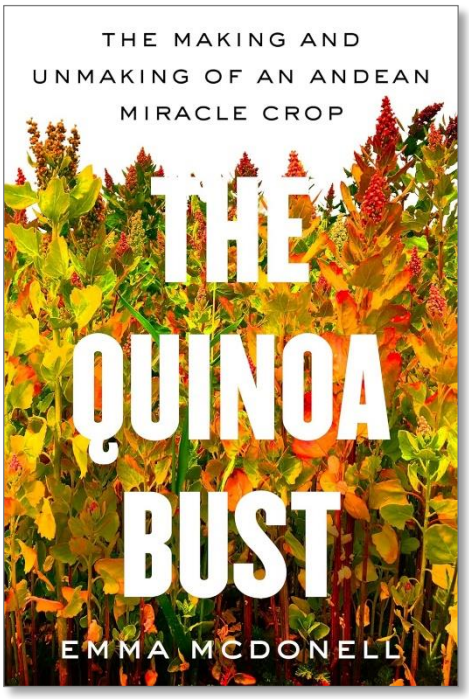
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Journal of Agriculture, Food Systems, and Community Development
ISSN: 2152-0801 online
https://foodsystemsjournal.org

The promise and peril of "miracle crops" as vehicles for sustainable development

Book review by
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Review of *The Quinoa Bust: The Making and Unmaking of an Andean Miracle Crop*, by Emma McDonell. (2025). Published by University of California Press. Available as hardcover, paperback, and Kindle; 328 pages. Publisher's website: https://www.ucpress.edu/books/the-quinoa-bust/paper; DOI: https://doi.org/10.1525/9780520401723

Submitted January 29, 2026 / Published online February 28, 2026

Citation: Goertz, H. (2026). The promise and peril of "miracle crops" as vehicles for sustainable development [Book review]. *Journal of Agriculture, Food Systems, and Community Development*, *15*(2), 503–505. https://doi.org/10.5304/jafscd.2026.152.033

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In *The Quinoa Bust: The Making and Unmaking of an Andean Miracle Crop,* cultural anthropologist Emma McDonell describes the emergence of quinoa as a global commodity, tracing its transformation from a staple crop of the Andean Altiplano to a "miracle food" sold at grocery stores worldwide. Quinoa's transformation is driven by its promise to alleviate poverty among indigenous smallholders in the Altiplano while at the same time addressing malnutrition in urban communities in the region. McDonell charts how these at times contradictory objectives are pursued by a cast of actors along the global supply chain, each projecting and acting on their own aspirations for quinoa. Drawing on deep ethnographic work, she follows farmers, cooperatives, *técnicos* (private extension agents), processors, and buyers in Puno, Peru, over a 10-year period as they navigate the volatile quinoa economy.

While the book's title foreshadows the inevitable *bust* of quinoa, the book presents a much more nuanced accounting of the distribution of impacts

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from quinoa's rise and fall across its many stakeholders. In the book's first section, "Miracle Crop," the actions of local actors are presented against the backdrop of efforts by national governments and international NGOs to promote quinoa as a vehicle for sustainable development. The second section, "Boom," describes the rapid rise of quinoa and its attendant market forces. The boom created "profound changes in [the] livelihoods and landscapes" of farmers in the Altiplano (p. 93), including shifting their production from diverse crop rotations to an intensive monoculture to capitalize on rising quinoa prices, adopting a narrow set of quinoa varieties designed to meet processer and consumer preferences, and struggling to comply with standards and practices imposed by buyers and organic certification. Promoted through the frontline *técnicos*, these changes were grounded in the demand for a uniform quinoa product, which could be aggregated across farms and flow as a single "golden stream" through global markets (p. 123). These agronomic-focused changes were accompanied by socio-cultural changes in the ways in which quinoa was marketed and consumed. Culinary and cultural elites sought to distance quinoa from its origins as an "Indian food" associated with poverty and indigenous heritage, and reinvent it as a miracle food that could be marketed to a global clientele. This framing sought to tap into the narrative-driven "fashion cycles" of food markets that seek novelty and authenticity in food products (p. 57).

The third section describes the "bust" that was spurred by the decentralization of quinoa production and collapse of prices in 2014–2015. Soaring prices brought on by the boom prompted farmers in other parts of Peru, the Andes, and the world to cultivate quinoa, thus completing its transformation into a global commodity. Despite their deep connection to the crop, Andean smallholders were poorly positioned to compete with new, better-resourced producers in the global marketplace. The bust's impact on Andean farmers was exacerbated by the rejection of shipments of Peruvian quinoa by the U.S. Food and Drug Administration in 2014–2015 due to chemical residues. The contamination exposed the challenge of traceability for global commodities and raised questions about the reliability of organic certification. It also undermined the trust built between farmers and buyers that had propped up the supply chain. The uneven fallout from the collapse in prices and rejected quinoa shipments exposed the fragility of that trust as well as the power asymmetry between these groups.

The social and ecological changes brought on by the boom left Andean farmers exposed both to market forces and to a changing climate. Many farmers departed from their traditional production systems, which featured diverse varieties of quinoa, types of crops, and sources of income, to focus on commercial quinoa production. While McDonell offers us glimpses into the impacts on farming communities in Puno, the book does not delve into specific farm-level consequences. It instead relies on *técnicos* and local processers as the central narrators of the story. Frequently born in rural Altiplano communities but educated in Peru's urban centers, *técnicos* served as intermediaries between these two worlds during quinoa's commercialization—translating buyers' demands to farmers and farmers' realities to buyers. This lens neglects some of the inter- and intrahousehold dynamics guiding farmers' decisions, including differences across different generations and genders. We are also not afforded a view of the impacts of quinoa's global commodification on Peruvian consumers, who from the outset were supposed to have benefited from improved access to the nutrient-dense grain. The reader must speculate, or consult other sources, about how global demand has impacted local access to this longtime staple in Peru.

Nevertheless, *The Quinoa Bust* demonstrates the limitations of any crop—miracle or not—to address the complex challenges of marginalized communities. We come to understand that quinoa could not possibly have lived up to the development goals of lifting its traditional producers out of poverty *and* lifting local communities out of malnutrition. It was inevitable that market forces would shift the geographies of production and consumption as quinoa emerged as a global commodity. Similarly, it was inevitable that racial, class, and economic power structures would dictate the accumulation of benefits and risks among participants in the quinoa supply chain.

McDonell draws on James Ferguson's critique of international development in *The Anti-Politics Machine* to describe the "depoliticization" of power structures in Peru (rendering them technical issues requiring technical fixes) and the pursuit of "standardized solutions" to "development problems" that ignore local realities (p. 125). The book also shows the limits of using marketing tools, such as organic certification and origin branding, by smallholders to differentiate their products from commodities and extract greater value. The closing section of the book presents a clear-eyed look at the collective action required to form and maintain a cooperative brand. McDonell makes the case that studies of *existing* brands are biased towards success, since those groups have already overcome startup barriers. The author's critical analysis of these strategies provides timely lessons for development practitioners and policymakers seeking to reimagine foreign assistance in the wake of recent geopolitical changes.

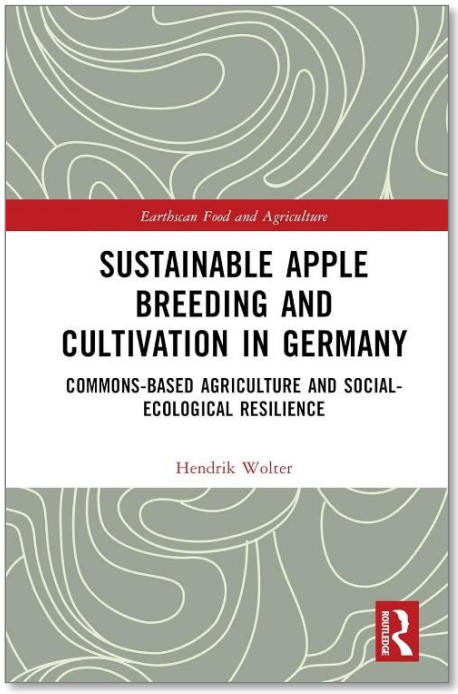
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Journal of Agriculture, Food Systems, and Community Development
ISSN: 2152-0801 online
https://foodsystemsjournal.org

From power trees of the enclosure to the apple trees of the commons

Book review by
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Review of *Sustainable Apple Breeding and Cultivation in Germany: Commons-Based Agriculture and Social-Ecological Resilience*, by Hendrik Wolter. (2023). Published by Routledge. Available as hardcover, paperback, and Kindle; 292 pages.
https://doi.org/10.4324/9781003355724
Publisher's website:
https://www.taylorfrancis.com/books/mono/10.4324/9781003355724/sustainable-apple-breeding-cultivation-germany-hendrik-wolter

Submitted January 5, 2026 / Published online February 19, 2026

Citation: Tumuhe, C. L. (2026). From power trees of the enclosure to the apple trees of the commons [Book review]. *Journal of Agriculture, Food Systems, and Community Development*, *15*(2), 507–509. https://doi.org/10.5304/jafscd.2026.152.023

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Hendrik Wolter's *Sustainable Apple Breeding and Cultivation in Germany: Commons Based Agriculture and Social Ecological Resilience* offers a comprehensive and timely analysis of how fruit breeding systems are intertwined with the ecological, social, and political dynamics of food systems. Wolter argues that apple breeding should be understood not as a purely technical or scientific pursuit but as a social and ecological process embedded in ownership structures, governance arrangements, and market institutions. Drawing on social ecological systems theory, resilience thinking, and commons scholarship, he redefines fruit breeding as a reflection of broader questions about power, equity, and sustainability. His analysis resonates strongly with the four-dimensional agroecology framework developed by the Coopération Internationale pour le Développement et la Solidarité (CIDSE, 2018) which incorporates ecological, social, political, and economic dimensions. In this review, I contend that Wolter's book is an important contribution to the agroecology social movement. The book offers both theoretical depth and practical insight into how collective governance can foster ecological

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resilience and social justice in food systems.

Wolter unfolds four interconnected parts that bridge conceptual discussion and empirical research. He begins with a theoretical framework that integrates resilience, ecosystem services, and commons theory to interpret plant breeding as a complex social ecological system. He argues that the evolution of modern apple breeding in Germany and, by extension, in global fruit production, has been guided less by ecological imperatives than by political and economic choices embedded in property regimes and industrial models of innovation. He critically examines the Distinctness, Uniformity, and Stability (DUS) criteria that define modern breeding standards, demonstrating how these legal requirements promote monocultures, discourage genetic diversity, and deepen dependence on patented or trademarked "improved" plant varieties.

Drawing on transdisciplinary and participatory research, Wolter develops a comparative analysis of three breeding models; corporate, public, and commons-based. He uses data from stakeholder engagement, case studies, and institutional analysis to evaluate each model on the parameters of adaptability, agrobiodiversity, and social organization. His findings reveal that corporate- and state-supported models, characterized by privatization and efficiency driven selection, undermine diversity and long-term system stability. In contrast, commons-based organic breeding, which relies on collective governance, shared local knowledge production, and ecological diversity, performs more favorably on measures of resilience and adaptability. Wolter also identifies the enabling factors that make such systems viable, including participatory decision-making, decentralized funding, and supportive legal frameworks. As quoted below, Wolter examines apfel:gut, a collaborative German initiative dedicated to breeding disease-resistant and climate-resilient varieties of apples and pears:

> In shaping the system-to-be-governed, apfel:gut performs well in integrating diverse ecological and social dimensions, exchanging knowledge and technology, and promoting an eco-centric breeding approach labelled as participatory organic fruit breeding. Both the organization and individual members support the monitoring of diversity and redundancy of fruit varieties to certain degrees. (p. 188)

Wolter's analysis is intellectually rigorous, methodologically sound, and conceptually innovative. By combining ecological, social, and institutional perspectives, he moves beyond traditional agronomic approaches to offer a holistic understanding of plant breeding. The argument that breeding systems mirror the organization of power in food systems is persuasive and well supported by both theory and evidence. The book's comparative framework allows for a nuanced assessment of how different models of breeding either constrain or enable adaptive capacity and social participation.

Nevertheless, certain assumptions deserve closer examination. Wolter's optimism regarding the scalability and sustainability of commons-based governance could further explore the structural barriers that shape farmer agency in the context of globalized markets. The analysis would have been strengthened by a deeper exploration of the political struggles and asymmetries of power that influence who controls genetic resources and whose knowledge counts in agricultural innovation. In addition, while the concept of resilience offers analytical coherence, it risks depoliticizing the structural dimensions of inequality, particularly in relation to intellectual property rights and corporate concentration. His use of the language of ecosystem services, although valuable for bridging ecological and economic perspectives, occasionally reflects a utilitarian logic that some agroecology and food sovereignty scholars critique. Despite these limitations, Wolter's conceptual and empirical synthesis remains an important contribution, particularly for demonstrating how the commons framework can be applied in practical contexts to redesign food system governance.

What distinguishes Wolter's contribution is his ability to connect these theoretical traditions to the concrete realities of fruit breeding and cultivation. Rather than limiting the discussion to abstract principles, he demonstrates how policy design, intellectual property reform, and financial mechanisms can influence the resilience of breeding systems. By sit-

uating breeding within the larger debates on ecological economics and governance, Wolter provides a bridge between critical scholarship and applied policymaking. For practitioners, the work offers a roadmap for designing programs that strengthen agrobiodiversity and community participation; for scholars, it provides an empirical basis for testing theories of commons governance and resilience; and for policymakers, it offers evidence to support reforms that democratize agricultural research and innovation.

Wolter demonstrates that plant breeding is not only a site of scientific inquiry but also a domain of social action where questions of justice, equity, and ecological integrity converge. Although the book could have engaged more directly with the political economy of corporate power and the structural dynamics of global markets, its conceptual clarity and empirical richness make it a landmark contribution. By positioning commons-based governance as a viable pathway toward ecological and social resilience, Wolter offers both theoretical reorientation and a practical agenda for transforming food systems. This work deserves close attention from scholars, policymakers, activists, and practitioners committed to advancing food sovereignty and agroecology.

I find Wolter's work deeply aligned with the transformative principles guiding food systems movements, as in Africa (Tumuhe et al., 2025). His book exemplifies how commons-based governance can restore both ecological diversity and democratic accountability within food systems. The emphasis on collective management, farmer participation, and biodiversity parallels global advocacy for seed sovereignty, farmer-managed seed systems, and the protection of local seed commons from corporate appropriation. By situating breeding within a commons framework, Wolter's analysis echoes my personal conviction that true resilience requires dismantling structural inequities, revitalizing indigenous knowledge, and ensuring that food systems governance remains rooted in local agency and cultural identity. In this sense, the book contributes to a shared global vision where ecological sustainability, social justice, and community sovereignty are inseparable dimensions of the right to food.

As an activist scholar, my campaign for seed sovereignty illustrates the political agency behind Wolter's call for commons-based governance of genetic resources. Wolter's analysis resonates with our struggles in Africa led by the AFSA, which resists the International Union for the Protection of New Varieties of Plants [UPOV] 1991 framework that seeks corporate-aligned seed laws as part of a broader defense of seed commons and farmers' rights (UPOV, 2024). The parallels with Wolter's critique of intellectual property regimes in apple breeding are striking: both highlight how enclosure of genetic material undermines diversity, erodes local autonomy, and weakens adaptive capacity in the face of climate change. I call upon other activist scholars to raise and oppose repressive legal frameworks (e.g., UPOV 1991) through campaigns, policy advocacy, and community seed initiatives, to embody in practice the political transformation that Wolter theorizes, one that reclaims seeds as commons and repositions farmers as active agents in shaping just, resilient, and self-determined food systems.

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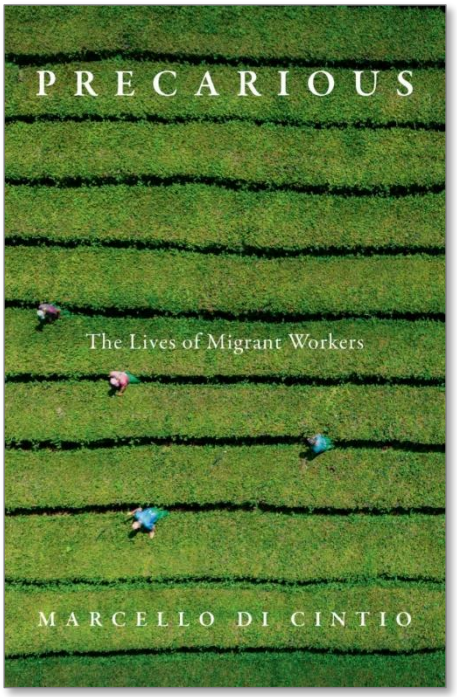
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Journal of Agriculture, Food Systems, and Community Development
ISSN: 2152-0801 online
https://foodsystemsjournal.org

From invisibility to accountability: Rethinking Canada's responsibility toward migrant workers

Book review by
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Review of *Precarious: The Lives of Migrant Workers*, by Marcello Di Cintio. (2025). Published by Biblioasis. Available as paperback and eBook; 342 pages. Publisher's website: https://www.biblioasis.com/shop/new-releases/precarious-the-lives-of-migrant-workers/

Submitted February 15, 2026 / Published online March 8, 2026

Citation: Garneau, J. (2026). From invisibility to accountability: Rethinking Canada's responsibility toward migrant workers [Book review]. *Journal of Agriculture, Food Systems, and Community Development*, *15*(2), 511–513. https://doi.org/10.5304/jafscd.2026.152.034

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In *Precarious: The Lives of Migrant Workers*, Marcello Di Cintio offers a deeply researched and powerfully narrated account of the structural vulnerabilities faced by migrant workers in Canada. Through a combination of investigative journalism, historical analysis, and intimate biographical portraits, Di Cintio challenges dominant narratives of Canadian benevolence and exposes the systemic conditions that render thousands of workers "permanently temporary." At a time when labor shortages and food insecurity dominate public debate, this book provides a timely and necessary examination of the human cost underlying Canada's economy.

The author situates contemporary migrant labor within a long historical trajectory, tracing the origins of the Seasonal Agricultural Worker Program (SAWP) to 1966 and examining the evolution of the Temporary Foreign Worker

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Program (TFWP). He carefully unpacks the bureaucratic architecture that governs migrant employment, including labor market impact assessments (LMIAs), employer-specific work permits, and federal oversight mechanisms. While the extensive use of institutional acronyms may be challenging for readers unfamiliar with immigration policy, the author succeeds in demonstrating how these administrative structures function as instruments of dependency and control. For newcomers to the topic, keeping a reference list of acronyms may enhance readability, but for practitioners and scholars, this technical detail reinforces the book's analytical rigor. A central theme of *Precarious* is the contradiction between Canada's self-image as a humanitarian nation and the realities faced by migrant workers. Di Cintio revisits the United Nations Special Rapporteur's report describing Canada's temporary labor system as a "breeding ground for contemporary forms of slavery" (Obokata, 2024, p. 5) and documents how closed work permits, employer-tied status, and limited mobility constrain workers' ability to report abuse (Obokata, 2024). The author describes this system as a "cruel lottery" in which workers' safety and dignity depend largely on whether they are assigned to a benevolent or exploitative employer.

The book's emotional strength lies in its biographical portraits. Di Cintio presents stories of workers from diverse national contexts, situating their individual experiences within broader political and economic histories. One recurring theme is the painful trade-off between income and family separation, exemplified by a worker's statement: "I will do the suffering, and I will do the distance from my family, because I'll get a better income" (p. 50). These accounts reveal how migration is often a strategy of constrained choice rather than genuine opportunity. Several narratives explore gender and sexual identity, including the story of a lesbian couple and a nonbinary worker navigating gender transition within the context of migration and marginalization. These chapters demonstrate Di Cintio's commitment to portraying the diversity of migrant experiences, and they invite readers to approach the text with openness and empathy. For readers with lived experience in LGBTQ+ communities, these accounts carry particular resonance, underscoring how multiple forms of vulnerability intersect in precarious labor systems. The emotional impact of these stories is considerable; moments of sadness, resilience, and quiet courage are interwoven throughout. For sensitive readers, the book may be difficult at times, yet this discomfort serves an important ethical function: it prevents detachment and reinforces moral engagement.

The COVID-19 pandemic occupies a significant place in the narrative, revealing how overcrowded housing, limited health protections, and economic vulnerability intensified existing inequalities. Di Cintio documents how many workers were deemed "essential" without being adequately protected, reinforcing their perceived expendability within the labor system. These chapters resonate strongly with ongoing debates about workplace safety, public health governance, and employer accountability. One of the book's most compelling contributions is its analysis of migrant invisibility. *Precarious* encourages readers to reconsider everyday interactions and recognize migrant labor as foundational rather than peripheral. From a policy perspective, Di Cintio avoids simplistic explanations based on individual misconduct. Instead, he emphasizes structural failure, arguing that exploitation is embedded in the design of regulations rather than resulting from isolated "bad apples."

Di Cintio suggests that a Canadian prime minister may one day apologize for the treatment of migrant workers, drawing parallels to other historical reckonings, before wryly noting that such an apology would first require acknowledging that migrant workers exist. His final reflection—that "by diminishing the dignity of our most precarious workers, we diminish our own" (p. 309)—offers a powerful moral framework. For readers with professional experience in agriculture, immigration, or public service, *Precarious* may resonate particularly strongly. The book exposes the dissonance between institutional ideals and operational realities, challenging policymakers, employers, and citizens alike to confront uncomfortable truths. It also complements academic research on labor precarity

and financial vulnerability, offering qualitative depth that enriches quantitative and policy-oriented studies.

Overall, *Precarious: The Lives of Migrant Workers* is a meticulously researched, ethically grounded, and socially urgent work. It invites readers to move beyond passive awareness toward informed responsibility. In doing so, Di Cintio contributes not only to public discourse but to the ongoing project of building a more just and inclusive society.



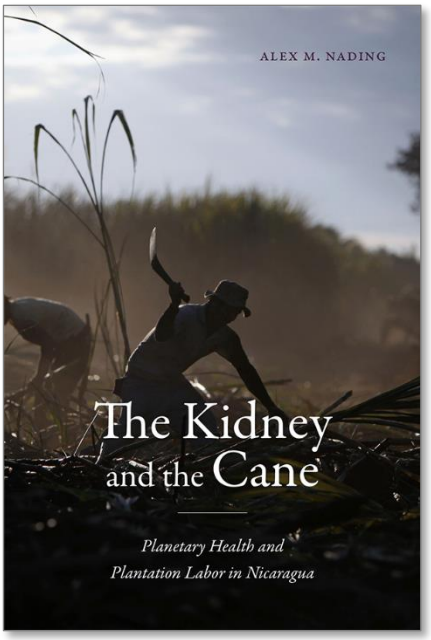
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Journal of Agriculture, Food Systems, and Community Development
ISSN: 2152-0801 online
https://foodsystemsjournal.org

Agro-industry at the center: How do communities on the edge respond?

Book review by
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Review of *The Kidney and the Cane: Planetary Health and Plantation Labor in Nicaragua*, by Alex M. Nading. (2025). Published by Duke University Press. Available as paperback and hardcover; 240 pages. Publisher's website: https://www.dukeupress.edu/the-kidney-and-the-cane

Submitted December 29, 2025 / Published online February 10, 2026

Citation: Cole, D. C. (2026). Agro-industry at the center: How do communities on the edge respond? [Book review]. *Journal of Agriculture, Food Systems, and Community Development*, *15*(2), 515–517. https://doi.org/10.5304/jafscd.2026.152.021

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Alex Nading's second book focuses primarily on the communities that surround a Central American sugarcane operation—yet it spans the local to the global with a masterful combination of participatory observation, archival research, and theoretical reflection. The Asociación Montelimar Benedición de Dios (AMBED) represents around 700 rural Nicaraguan people who identified as "workers, former workers, residents and members of the communities belonging to the Montelimar Sugar Mill" (p. x). The World Bank has massively funded extensions of the sugar mill operation. AMBED registered a complaint to the Bank's Compliance Advisor/ Ombudsman (CAO) which set up negotiations with the company. AMBED creatively brings "knowledge of the ground" to these negotiations for "life supports" for themselves and their communities. Nading characterizes "life support systems" as always temporary, whether they be the agrochemicals, harvesting equipment and irrigation canals supporting sugarcane, the hemodialysis machines supporting those with Chronic Kidney Disease of non-traditional origin (CKDnt) in the sugarcane zone, or "projects addressing the cris[e]s of the Anthropocene"

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(p. xiv). He concretizes the Rockefeller Foundation–Lancet Commission on Planetary Health's emphasis on the earth's life-support systems for human health and well-being. He sensitively analyzes

> how people grapple with life support systems, from legal frameworks like the CAO to irrigation works, to pesticide application regimes, to state-sponsored social security programs, to occupational health measures, to dialysis treatment itself. . . . [He] suggests that a close look at what happens along the unstable edges where life support systems meet might provide insights into the possibilities and limitations of planetary health. (p. xiv)

Nading positions himself "alongside rural Nicaraguans living in the sugarcane zone as an engaged observer" (p. viii), including using research funds to pay for AMBED activities in which he becomes involved. He understands AMBED as part of a social movement of sugarcane workers globally, but without overromanticizing their environmental justice role. As a critical social science scholar, drawing on decades of scholarship on plantation life, he explores "how actions taken in small, seemingly out-of-the-way places, such as the villages that dot the Nicaraguan sugarcane zone, reverberate across the globally dispersed spaces of capitalism and global health" (p. 5). He regards planetary health as still a question, telling a story about it "not as an encompassing condition but as an ongoing, messy, paradoxically very local process" (p. 6), a refreshing contrast to the more usual strident, universalist discourse.

Each of the core six chapters explores how people grapple with a subsystem that is fundamentally designed to support plantation life, the human life of laborers and residents, and the life of the sugarcane monoculture itself. Other involved members of these agro-ecosystems—domestic dogs and rats in the cane, the few remaining forest remnants, hedgerows of trees, and garden vegetables—are unfortunately all classified under the term "non-humans,' perhaps exemplifying a persistent anthropocentrism. Chapter 2 focuses on the occupational health of cane workers and the role of heat stress as the leading accepted cause of CKDnt, exacerbated by climate change. At the same time, he notes that "the systematic push to find ways of continuing to profitably produce sugarcane under conditions of extreme heat was paralleled by efforts of non-workers, particularly women, to make knowledge claims about the slower and more accretive changes in climate wrought by chemically driven cane production" (p. 16). Chapter 3 shifts to an analysis of the vast irrigation network required for growing sugarcane in Central America's Pacific littoral zone:

> For AMBED, waterways were a means of both dividing and connecting plantation and non-plantation space, work and home, and human and nonhuman life. The embankments of irrigation canals, dams and pipes, as well as beaches and riverbeds, turned out to be effective places not just for producing evidence of the impact of sugarcane production on bodies but also for flipping the terms on which CKDnt could be understood—from a disease of agricultural production to a disease of social reproduction. (p. 16)

Among the most pressing concerns for AMBED was herbicide spraying of the cane. Chapter 4 describes "how people in the sugarcane zone worked to make toxicity legible through a variety of media, including the oral sharing of stories and the exchange of videos and photographs on platforms like Facebook and WhatsApp" (p. 17).

Nicaragua's national social security system is a life support system for injured and ill formerly productive workers, but also for sugarcane production—"to rescue the industry from itself" (p. 17), similar to the extensive subsidies to North American agro-industry. "The villages in which sugarcane residents live and die are physically located on the ecological and economic edges of monocrop production systems" (p. 19), similar to many farming contexts where farmers, farmworkers, and their families may live in the midst of fields. Hence ensued messy negotiations on which bodily and ecological conditions count as "working conditions," for social security support (chapter 5). A key outcome of AMBED's mediated settlement

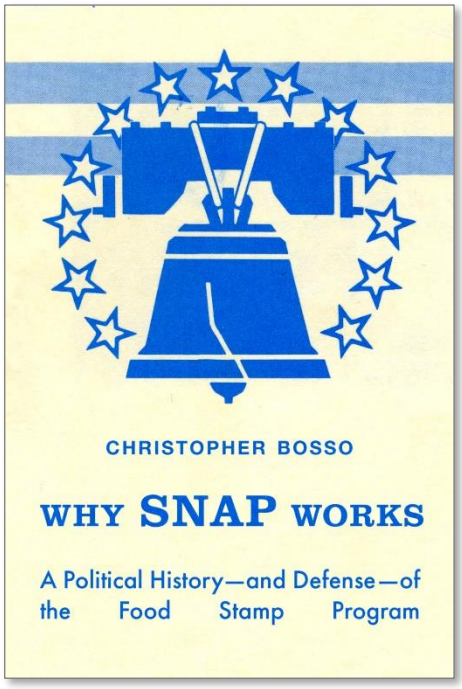
with the Montelimar Corporation was "access to hemodialysis for dozens of former workers with late-stage kidney disease" (p.17). But these necessitate arduous and costly journeys to and from Nicaragua's capital, Managua—similar to the journeys that North American farm residents undertake to access specialized care.

Nading makes a convincing case that "a critical approach to planetary health is that there is no way of returning to a 'before,' when life support systems worked better" (p. 19), and that "planetary health still remains something of an aspiration" (p. 20). Less convincing is his assertion that planetary health "as a grassroots project . . . has already begun, in an unlikely place: on the edge of the sugarcane zone" (p. 20). Other examples globally might better convey a "good news story" for which activist NGOs and environmental justice advocates hope. Perhaps engaging with uncertainty and trying to make sense of the multiple interacting systems composing the whole, rather than focusing on either the center or the edges alone, is a more appropriate stance for many of us who want more health-sustaining change in agriculture and food systems.

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SNAP's "unhappy marriage" to the farm bill

Book review by
Lucy Srour *
University of Vermont



Review of *Why Snap Works: A Political History—and Defense—of the Food Stamp Program*, by Christopher Bosso. (2023). Published by University of California Press. Available as hardcover, paperback, and eBook; 280 pages. Publisher's website: https://www.ucpress.edu/books/why-snap-works/

Submitted Januaray 24, 2026 / Published online February 21, 2026

Citation: Srour, L. (2026). SNAP's "unhappy marriage" to the farm bill [Book review]. *Journal of Agriculture, Food Systems, and Community Development*, *15*(2), 519–521. https://doi.org/10.5304/jafscd.2026.152.031

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The U.S. Supplemental Nutrition Assistance Program (SNAP) once again finds itself in the political hot seat. With cuts enacted under the Trump Administration in the summer of 2025 compounded by the government shutdown just months later—leaving millions of Americans without benefits for weeks—conversations about SNAP are widespread. But how did the program get here?

In *Why SNAP Works: A Political History—and Defense—of the Food Stamp Program*, Christopher Bosso offers exactly that: a chronological account of SNAP's legislative past. He structures his argument around SNAP's longstanding political resilience—rooted in its ties to the farm bill—and ultimately concludes that the program's greatest strength lies in its administrative practicality.

SNAP (formerly known as food stamps) is neither direct food assistance nor direct cash assistance. Administered by the U.S. Department of Agriculture (USDA), eligibility requirements are based on monthly reported income. Eligible individuals receive benefits on an electronic benefits transfer (EBT) debit card that can only be spent on designated food items at participating retailers. Bosso argues that the rules are often contradictory,

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noting, for example, that SNAP dollars can be spent on a box of frozen chicken tenders but not on a Costco rotisserie chicken (p. 178).

As the title suggests, the book is first and foremost a political history. Bosso, a professor of political science and public policy, impressively reviews nearly a century's worth of congressional bills, key legislators, and shifting cultural contexts to trace how SNAP's rules and regulations evolved under successive farm bills.

Drawing on his public policy background, Bosso organizes the first five chapters according to political eras, spanning the presidencies from Eisenhower (1953–1961) to Trump's first term (2017–2021). Only in the concluding chapter does he formally articulate his "defense" of SNAP. He first explains the program's longevity as a function of its political practicality, showing through historical examples how proposals to cut or alter SNAP often sparked political backlash. He further describes SNAP as an "accidental anti-poverty program" (p. 159). Compared to other federally administered welfare assistance, SNAP's lenient eligibility requirements make it a catch-all for vulnerable Americans on the cusp of extreme poverty.

A central theme of Bosso's text is the paradoxical problem of "want amidst plenty" (pp. 25–30). He demonstrates that "plenty"—or the price-deflating surpluses of commodity crops—was the driving concern of SNAP's founding legislators. In Congress, the focus was on helping farmers plagued by low prices, not the millions of hungry Americans that food stamps "accidentally" ended up helping. Bosso suggests, "without the surplus, food stamps never would have existed" (p. 47). This explains why SNAP landed in the purview of the USDA and is funded through the farm bill rather than the Department of Health and Human Services.

Ironically, this mismatch between intent and impact sets the stage for Bosso's foremost argument in defense of food stamps: its political armor. Citing the program's longevity as evidence of its success, he argues that SNAP's inextricable ties to the farm bill have protected it. Although he displays dissatisfaction with elements of the program, dryly noting, "nobody apparently consulted with those the new program was intended to help" (p. 33), he nonetheless presents SNAP's agricultural origins as the reluctant hero of the story.

He attributes the program's durability to its "unhappy marriage" (pp. 110–111) with the farm bill—a bipartisan set of legislation reauthorized roughly every five years—which has historically carried SNAP along with it. Throughout the book, Bosso shows that political debates have largely targeted the program's rules, not its existence. He notes with malaise this resulted in SNAP's treatment as "just another commodity" (p. 103) akin to legislators' use of corn, cotton, dairy, and wheat as bargaining chips in cross-party vote exchanges. But still, he uses these historical anecdotes to bolster his primary argument in support of SNAP's political practicality.

If a political history lesson is what the reader wants, this book delivers with aplomb. But if, like me, the reader is drawn in by the promise of a "defense" of the program, this book will leave one wanting more. I had hoped for stronger evidence that SNAP is truly working, or for deeper exploration of alternatives that policymakers have contemplated over time. Bosso briefly touches on options such as direct cash assistance, direct food aid, or state-level block grants (removing federal oversight), but he swiftly refutes each. His emphasis is on political pragmatism rather than creativity. The book does not misadvertise itself, and perhaps my mild dissatisfaction stems from a harder truth: in just the three years since its publication, his central argument has become more vulnerable.

The government shutdown may have ended before the start of the new year, but the farm bill was not reenacted. Although it was up for renewal this fall, Congress opted for *another* one-year extension. Meanwhile, major changes in eligibility requirements from the omnibus One Big Beautiful Bill Act remain. Bosso's claim of SNAP's impenetrable political armor appears increasingly vulnerable. We now face an administration questioning not just SNAP's rules but its very existence. If federal funding continues to be unreliable, states will have to decide whether to fill the fiscal gap left in its wake.

In states that do choose to step in, can we envision a more effective way to spend the billions

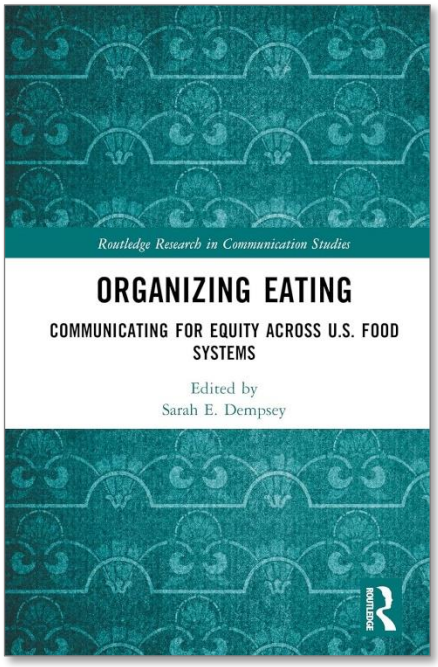
of dollars that previously accounted for two-thirds of all federal nutrition funding? Would housing the program in an agency more directly focused on improving access to healthy, nutritious food better serve those it aims to assist? And what might that look like? Bosso rightly notes that direct food assistance is not the way forward, but what about direct cash assistance? Or further investment in produce-dollar matching programs, such as Double Up Food Bucks, which he points out have demonstrated nutritional benefits (pp. 158–159)?

Bosso defends SNAP on the grounds of its political armor, but now that armor appears compromised. Policy-makers and advocates would benefit from reading this book to deepen their understanding of SNAP's political legacy. They could then use that knowledge to look beyond SNAP's (former) viability as the status quo and critically reexamine its agricultural roots and the precedent they have set for politicians' treatment of food assistance as "just another commodity."

Journal of Agriculture, Food Systems, and Community Development
ISSN: 2152-0801 online
https://foodsystemsjournal.org

Communication and power: A review of *Organizing Eating*

Book review by
Emily Talkow *
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Review of *Organizing Eating: Communicating for Equity Across U.S. Food Systems*, by Sarah E. Dempsey. (2023). Published by Routledge. Available as hardcover, paperback, and eBook; 266 pages. https://doi.org/10.4324/9781003190578.
Publisher's website: https://www.taylorfrancis.com/books/edit/10.4324/9781003190578/organizing-eating-sarah-dempsey

Submitted January 5, 2026 / Published online February 21, 2026

Citation: Talkow, E. (2026). Communication and power: A review of *Organizing Eating* [Book review]. *Journal of Agriculture, Food Systems, and Community Development*, *15*(2), 523-525. https://doi/org/10.5304/jafscd.2026.152.030

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Organizing Eating: Communicating for Equity Across U.S. Food Systems draws together recent research from scholars on organization and communication exploring how to move toward food justice, as edited by Sarah E. Dempsey. It is not coincidental that this book was published in 2023, just a few years after the COVID-19 pandemic. As Dempsey explains in the opening chapter, COVID-19 epitomizes the ways intersectional systematic forms of oppression threaten people's ability to access food, a basic human right. However, exerting power through food did not just start during COVID-19: from post-Emancipation to New Deal legislation, the American legal system uses food both as a mechanism and outcome of power. The authors in this collection illustrate that U.S. society, as a whole, needs to bring equity to the conversation around food, organization, and power to dynamically reorganize our food system.

Dempsey includes a roadmap in the introduction outlining the collection's path. The volume begins with research illustrating the role of state power and policy in shaping the organization of U.S. food systems. After establishing this foundation, the authors dive into research on communication infrastructure and the ways it interacts with organization in food systems. Communication infrastructure is made up of the mechanisms that

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shape who is heard and whose voices are excluded. Food and communication infrastructure are deeply connected, particularly looking at the ways those who experience hunger and poverty are often intentionally omitted from the common discourse. In response to the current inequities within organization and communication in food systems, the final chapters survey alternative structures. The research in this collection spans Detroit to Denver; community supported agriculture operations (CSAs) to cooperatives; corporate regimes to community storytelling; and more. Each article powerfully builds on the last, demonstrating the multifaceted approach needed to achieve food justice in the U.S.

The collection starts by revealing how U.S. policy racializes and individualizes hunger. In early chapters, Adam Pine, Rebecca de Souza, and Kathleen Hunt's research successfully reveals that the "invisible hand of white supremacy" (pp. 58–59) has manipulated U.S. food policy. For instance, the authors explain that mainstream mechanisms to access food, like SNAP or grocery stores, actively reinforce a system that allocates resources through racist means. Food deserts, as an example, are a product of policy and planning. This enables white people to control BIPOC communities' experience with food. After establishing this historical framing of the state's role in exerting dominance over food, the subsequent chapters explore the importance of communication infrastructure.

Organization and communication infrastructure are interrelated and have historically worked to further marginalize vulnerable communities; however, as these authors argue, it does not have to be that way. Currently, the U.S. food system is organized by policy and planning efforts which silo communication infrastructure to predominantly give voices to those with power. Nevertheless, communication infrastructure can be reformed to promote food justice. These mechanisms include forms of collaborative, critical community engagement. Chapter authors Rahul Mitra, Nadia Gaber, Roslyn Bouier, Shea Howell, and Constance Gordon, among others, research what this looks like. For instance, Gordon emphasizes how the current communication infrastructure—particularly the ways policy is discussed and created—does not engage the community. Thus, polysemic meaning tends to fall in line with the discourse controlled by those in power. *Sustainable, inclusive, equitable, accessible*—these words hold multiple meanings. If policymakers aim to create "equitable" reforms, Gordon argues that the community needs to be a part of the conversation understanding what equity means. How does this happen? Infrastructure like translation services, childcare, listening circles, and holding additional meeting times to discuss policy efforts are all examples of critical mechanisms to help make communication more accessible. These authors argue that increased equity within communication streams is a pivotal step toward food justice. Following this discussion, the research shifts to ways marginalized communities have responded to current inequities.

The authors effectively incorporate numerous research methods to explore these alternative structures that respond to current inequities. Through ethnographies, case studies, extended literature reviews, collaborative writing, and interviews, these chapters demonstrate that to study organization in food systems, there is no "one" research methodology to answer every question. Similarly, there is no "one" solution for alternative mechanisms to lead us toward equitable food systems. From coalitional organizing to unionization to cooperatives to regionally attentive organization and beyond, the chapters reveal a multidirectional systems approach. This heterogeneity of structures shows that diverse approaches are essential to dismantling inequitable organization and communication systems. While each chapter focuses on specific aspects of the food system or individual responses to historical challenges, the strength of this book comes from the compilation of the chapters. Each chapter contributes to the last—and as a reader, I can see the power of a diverse approach to reforming communication infrastructure (and therefore policy).

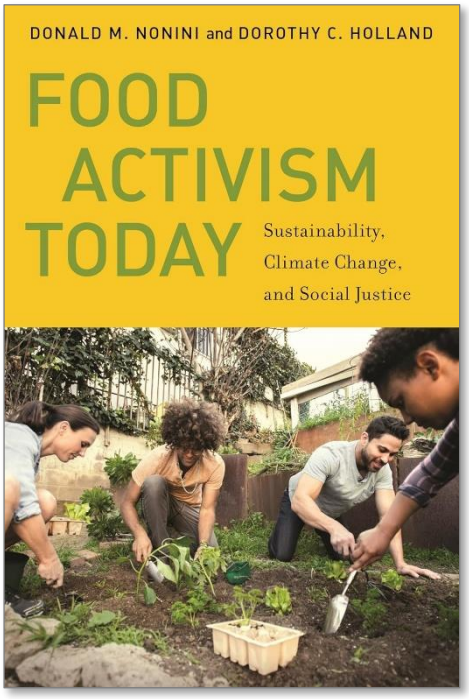
Ultimately, *Organizing Eating* proves that food systems are dynamic and therefore need active, collaborative forms of communication to inform organization. U.S. society as a whole needs to constantly re-examine the current organization, how communication either maintains or challenges power, and what alternative structures arise as a

result of injustices. Organizing can and should be "undone, reconfigured, and remade" (p. 11) as priorities evolve. While this book successfully reaches that conclusion, Dempsey aptly notes a major limitation: the conversation solely examines the United States. This type of critical communication should be explored in all countries and from all different vantage points. Nonetheless, this book successfully takes on a major task to understand the relationship between various structures reinforcing power, alternative responses, and approaches to communication.

Journal of Agriculture, Food Systems, and Community Development
ISSN: 2152-0801 online
https://foodsystemsjournal.org

Food justice and the power of collective action

Book review by
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Review of *Food Activism Today: Sustainability, Climate Change, and Social Justice*, by Donald M. Nonini and Dorothy C. Holland. (2024). Published by New York University Press. Available as hardcover, paperback, and Kindle; 400 pages. Publisher's website: https://nyupress.org/9781479810987/food-activism-today/

Submitted December 10, 2025 / Published online February 21, 2026

Citation: Triefenbach, J. W. (2026). Food justice and the power of collective action [Book review]. *Journal of Agriculture, Food Systems, and Community Development*, *15*(2), 527–529. https://doi.org/10.5304/jafscd.2026.152.019

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Food Activism Today: Sustainability, Climate Change, and Social Justice reports on the authors' research into local food systems in four locales across North Carolina: Watauga and Ashe counties in western North Carolina, Edgecombe and Nash counties in eastern North Carolina, and the cities of Charlotte and Durham. In each, Nonini and Holland focus on activists seeking to improve the equity (justice) and sustainability of those systems in various ways. The authors conclude that, as the site of historical and ongoing racial and class disenfranchisement, economic depression, and a stark urban/rural cultural divide, the state has not seen the successful integration of the local foods movement and small-agricultural advocacy movement that has been more prevalent in other areas of the country.

The book examines what the authors call the corporate industrial food alliance through an interrogation of the neoliberal global regime ("transnational food corporations, the US government, and international trade and financial institu-

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tions" [p. 38] that conspire to disinvest local food economies of choice, agency, and sovereignty), before pivoting to an exploration of possible alternatives to the bleak and fallow future sown by the pursuit of agri-market hegemony over community and ecosystem health.

In the philosophical and practical terrain of food systems transformation in North Carolina and beyond, the authors counterpose rural and urban, affluent and impoverished, farmer and restaurateur. Each case study features the first-hand accounts of multiple stakeholders as well as the authors' own observations about the alliances and conflicts brought about through diverse and sometimes irreconcilable viewpoints. The book excels at expressing the pain and frustration of small farmers who toil for years at growing and producing sustainable, ethical, often organic foods and, far too often, end up losing their lands and businesses to the encroachment of corporate-industrial interests.

The authors contrast the discursive positions of global food conglomerates whose goals are the industrial-scale provisioning of cheap, abundant monocrops across national borders with the often microscale, biodiverse specifics that make up a global patchwork of small farms, each with idiosyncratic goals, methods, and production agendas. Nonini and Holland posit that the privatization of state resources and duties under neoliberalism, allocated to corporate partners, simultaneously cedes public interest to private agendas while restraining the ability of alternative food systems to flourish. At the same time, corporate "food aid" distributed both domestically and internationally provides tax breaks and improved public profiles to the same companies while undercutting small farms' livelihoods through subsidies and artificially low prices.

One highlight of the book is a section that profiles the activities and motivations of several local foods entities operating in the state, from farmers markets to food pantries to advocacy groups. Nonini and Holland alternate narrative reporting on their local ethnographic research with reflections on broader issues affecting the worldwide tableau of producers, merchants, consumers, ecologists, and working people worldwide. These stories indicate the breadth and variety of philosophies and operational structures that interact in local food systems, which they term "diverse community econom[ies]" (p. 103) existing outside of reductive capitalcentric logics. In Charlotte, NC, for instance, local manifestations of the Slow Food movement have combined epicureanism with reform politics, championing the sensual pleasures of fresh local foods produced in just and sustainable ways. Critics of this form of food activism, cite the somewhat elitist nature of an event-driven approach which, they claim, tends to celebrate individual actors and exclude the vast majority of local consumers who are unable to afford such goods and services.

Later chapters expand the authors' framing of food justice to include the moral implications of neoliberal class divisions and the role of dignity within the truly sustainable social relationships that might be engendered by shared experiences of producing, preparing, and consuming food. Rather than some forms of industry-supported charitable distribution, which some study participants argue breed resentment and low self-esteem among minoritized communities, the authors cite examples of equitable, resilience-building initiatives like participatory food banks, community supported agriculture, and outdoor education programs that combat food desertification, nutrient poverty, and chronic scarcity.

The title notwithstanding, there is actually little explicit exposition on climate change throughout most of the book. Rather, the authors position the industrial farming processes that contribute to climate instability as a background force in the discussions and analyses that accompany each case study or portrait. In the book's conclusion, however, the authors propose climate justice as a possible umbrella framework under which food justice activists might join with labor, women's rights, Black Lives Matter, and other movements to form a stronger, more far-reaching coalition through which to combat the neoliberal global agenda. In this section, the authors cast such an intersectional movement in opposition to a toxic alliance of political elites, right-wing extremism, and an unfettered fossil fuel industry pushing both society and the biosphere toward devastating collapse. In this final section, written by Nonini alone, the

author proposes that the concerns and capacities of local food movements as outlined throughout the book represent an actionable framework with the moral and practical momentum necessary to synergize the broad agendas of a worldwide peoples' movement to stave off mass calamity.

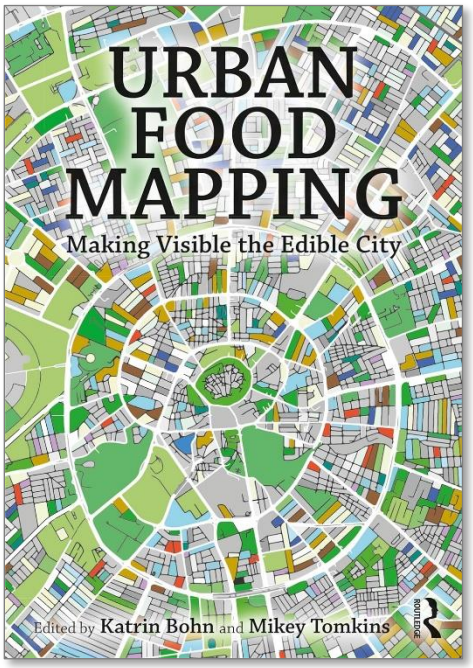
In imagining the possible outcomes of such opposing visions, *Food Activism Today* proposes hopeful solutions to the ecological and social degradation wrought by industrial agriculture within the global neoliberal economic regime. Grounding the book in a study of local food systems in North Carolina provides the authors with a seedbed of conditions from which to extrapolate a set of goals, limitations, and strategic considerations that might enable globally linked communities of producers, consumers, workers, and activists to improve outcomes in health, ecology, and livelihoods. Arriving at a time of particularly unstable international politics and economic upheaval, the book provides an important contribution to the developing discourses around food sovereignty, environmental justice, and the power of collective action.



Journal of Agriculture, Food Systems, and Community Development
ISSN: 2152-0801 online
https://foodsystemsjournal.org

Beyond coordinates: A structured look at food system mapping

Book review by
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Review of *Urban Food Mapping: Making Visible the Edible City*, edited by Katrin Bohn and Mikey Tomkins. (2024). Published by Routledge. Available as hardcover, paperback, and Kindle; 328 pages. Publisher's website: https://www.routledge.com/Urban-Food-Mapping-Making-Visible-the-Edible-City/Bohn-Tomkins/p/book/9781032402819

Submitted December 10, 2025 / Published online February 25, 2026

Citation: Dankbar, H. (2026). Beyond coordinates: A structured look at food system mapping [Book review]. *Journal of Agriculture, Food Systems, and Community Development*, *15*(2), 531–533. https://doi/org/10.5304/jafscd.2026.152.009

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In this era defined by rapid urbanization and increasingly complex, precarious global food supply chains, the essential question of "how we feed ourselves as an urban species" has taken on increased urgency. *Urban Food Mapping: Making Visible the Edible City*, edited by architect Katrin Bohn and researcher Mikey Tomkins, addresses this question by celebrating and systematizing the act of food mapping as an area of research and design practice. The editors assert that mapping is not merely a tool for spatial representation but a necessary methodology for critical inquiry, community empowerment, and, ultimately, effective urban design and policy intervention. This volume establishes urban food mapping as a bridge between the often-abstract theoretical concerns of urbanism and the tangible realities of food systems, offering a rich, multidisciplinary survey that will prove invaluable to scholars and practitioners across the food, planning, and community development sectors.

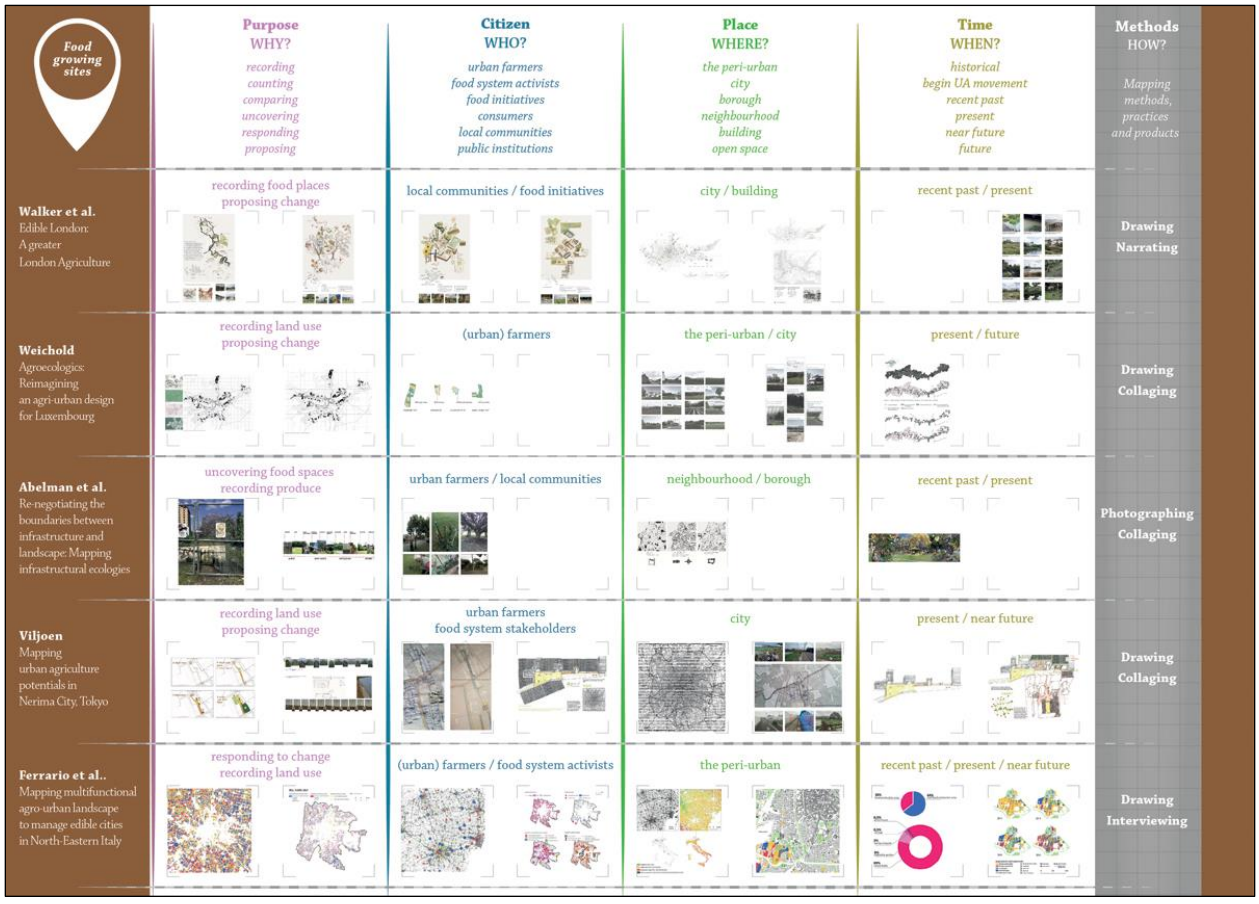
Bohn and Tomkins provide an *urban food mapping matrix* (Bohn & Edwards, 2020) to systematically organize and review urban food maps. This matrix includes five major themes that guide the organization of this book: food growing sites, food system activities, food produce and culture, food networks and resources, and food stakeholders.

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These themes can be categorized into four mapping types that include food maps based on purpose, citizens, places, or time. The matrix is narrowed down to mapping methods, which includes a wide range of methods ranging from drawing to audio recording. Each section is summarized with a visual matrix (see Figure 1).

The book, comprising 25 chapters and over 200 visual mapping images, follows the five thematic sections that delineate the primary subjects of urban food mapping, providing a comprehensive framework for the field. The first section, Food Growing Sites: Reimagining Land Use, focuses on the material potential of the city, exploring how mapping can highlight existing urban agriculture spaces and reveal latent opportunities. For instance, the chapter detailing the mapping of urban agriculture potentials in Nerima City, Tokyo, employs collage mapping to explore how vacant lots could be better integrated into a neighborhood. The second section, Food System Activities: Recording Economies, Patterns and Crises, shifts the focus to flow and vulnerability, detailing how visualization methods can track market dynamics. A case study in this section maps food geographies during COVID-19 in Hannover, Germany, utilizing collaborative auto-ethnographic methods to document shifts in food procurement and distribution during the onset of the pandemic. The next two sections delve into the social and cultural dimensions of food. Food Stakeholders: Proposing Change for Communities emphasizes participatory and political mapping practices, demonstrating how co-created maps empower communities. In one notable effort to map seeds of freedom, the organization Red de Huerteros Medellín used participatory asset and relationship mapping to promote food sovereignty and local knowledge

Figure 1. Example of the Urban Food Matrix



Source: Bohn and Tomkins, 2024, pp. 16–17.

retention. Food Produce and Cultures: Uncovering the Special in the Everyday uses mapping as a form of storytelling, capturing cultural significance through methods like qualitative narrative mapping utilized in work on participative food culture mapping in polarized urban districts to foster inclusion. Finally, Food Networks and Resources: Connecting People and Places examines the infrastructural and relational aspects of urban food. This section showcases projects that map resource sharing, illustrated by a chapter documenting the practice of sharing and mapping historic foodscapes in Lisbon that relies on drawing and listening methods. Throughout these chapters, the editors successfully synthesize contributions from geographers, architects, urban planners, artists, and community activists, solidifying the claim that urban food mapping is a truly interdisciplinary endeavor that demands diverse methods combining theoretical analysis, practical applications, and methodological experimentation.

Bohn and Tomkins' volume is timely reading, particularly for its focus on visualization as a tool for democratic action and cross-sector planning. The book's greatest strength is its embrace of the participatory and political nature of mapping. Many contributions move beyond static cartography to employ dynamic, narrative, and even performative mapping techniques that engage citizens in defining their own food realities, particularly by reframing maps from authoritative documents to instruments of collective knowledge generation. Chapters exploring initiatives like mapping food networks in Delft, South Africa, or visualizing edible spaces in London illustrate the potential of mapping to expose inequities, foster social cohesion, and build localized food sovereignty.

The sheer breadth of global examples and disciplinary approaches presents the book's primary challenge. While the editors succeed in defining "mapping" as an overarching category, the term "map" itself encompasses everything from high-level, GIS-based spatial analysis (such as Bohn's own Continuous Productive Urban Landscape, or CPUL, Opportunity Mapping Method) to highly personal, hand-drawn narratives of a single market visit. While this diversity is enriching, it occasionally leaves the reader seeking greater synthesis or a clearer methodological guide for scaling these disparate, localized efforts into cohesive city- or region-wide food strategies. The book's success in systematizing the field lies less in providing a single unified theory and more in offering a robust, globally sourced taxonomy of contemporary practice.

A specific theoretical contribution is the consistent link drawn between spatial representation and governance. The book clearly demonstrates how making the "Edible City" visible forces food issues into the planning and policy spotlight, often serving as a precursor to securing land rights for urban farming or integrating food infrastructure into municipal master plans. The case studies effectively demonstrate that, without a map, food remains an "invisible" system in the eyes of many planning departments, which has been a historic observation (Pothukuchi & Kaufman, 2000).

Urban Food Mapping: Making Visible the Edible City is more than a compendium of case studies; it is an essential read for the power of visual communication in driving food system change. By defining the "map" as a generative, political, and participatory tool, Bohn and Tomkins have created a foundational text for the emerging field of urban food studies. The volume offers critical insights and practical methodologies for anyone concerned with creating more equitable, resilient, and beautifully designed urban foodscapes.

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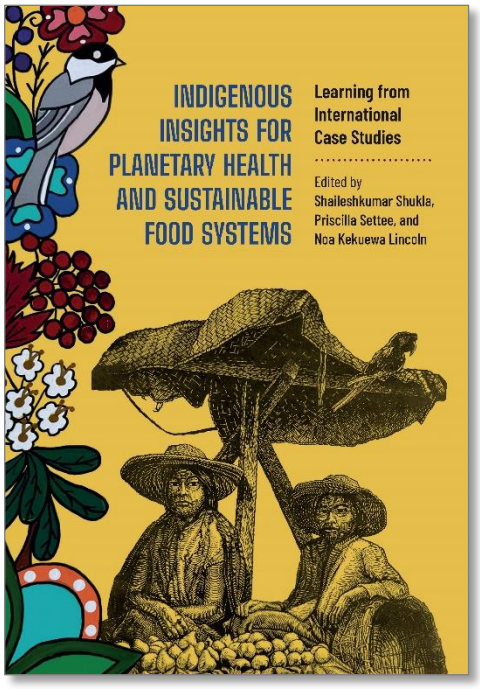
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Journal of Agriculture, Food Systems, and Community Development
ISSN: 2152-0801 online
https://foodsystemsjournal.org

Indigenous food sovereignty in action

Book review by
Jill Fabricius Keith*
University of Wyoming



Review of *Indigenous Insights for Planetary Health and Sustainable Food Systems: Learning from International Case Studies*, edited by Shailesh Shukla, Priscilla Settee, and Noa Kekuewa Lincoln. (2025). Published by Canadian Scholars. Available as print and eBook; 372 pages. Publisher's website: https://canadianscholars.ca/book/indigenous-insights-for-planetary-health-and-sustainable-food-systems/

Submitted January 14, 2026 / Published online March 3, 2026

Citation: Keith, J. F. (2026). Indigenous food sovereignty in action [Book review]. *Journal of Agriculture, Food Systems, and Community Development*, *15*(2), 535–537. https://doi.org/10.5304/jafscd.2026.152.032

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If you are looking for positive news for the health of the planet directly from people across the globe working to reclaim sustainable foodways, authors and editors Shukla, Settee, and Lincoln provide it in *Indigenous Insights for Planetary Health and Sustainable Food Systems*. The book is a compilation of case studies from food advocates, growers, and practitioners, including multigenerational voices and Indigenous scholars, representing rural and urban areas and multiple climate zones, and demonstrating community engagement and decolonized research methods. The overall goal of the authors is to share the knowledge and experience of Indigenous people from across the globe to promote lessons for those focused on sustainable food solutions for the planet.

The book is divided into three sections, Insights, Initiatives, and Innovations, although stories about food integrate all three and there are common threads throughout. Integrative strategies such as knowledge sharing and collaboration between communities are highlighted, with many case studies providing examples of practice. The land is central to every chapter; appreciation, respect, and reverence for Mother Earth are woven through the book. Descriptions of specific actions

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and ceremonies are embedded in each chapter. Several chapters center and lift up the importance of language, highlighted in Chapter 3 with the example of the Bribri word for food, which "cannot be separated from other concepts that are essential to life, such as medicines" (p. 35).

The Insights section sets the stage for Indigenous insights into the health of the planet and sustainable food systems by including several case studies highlighting Indigenous knowledge, actions, and strategies for sustainable food systems. While many readers may already recognize the important role of Indigenous knowledge, others may not, and providing case studies (echoing storytelling methodology) sets the tone for the rest of the book. This section also shines a light on factors influencing the loss of Indigenous foodways and planetary health, particularly the role of Western policies and colonization in decreasing land access, losing cultural knowledge, and restricting ancestral practices such as gathering, growing, processing, preserving, sharing, and consuming Indigenous foods. Figure 4.3 (p. 58) clearly shows how the reclamation of Indigenous foodways and practices can restore food security and planetary health.

The Initiatives section showcases projects in Indigenous communities that offer examples and roadmaps for efforts to support sustainable food systems across the globe. Interestingly, the authors question the use of "food sovereignty" as a separate term from "sustainable food systems," although it is commonly used in work focused on supporting Indigenous foodways. This is due to the impact on tribal communities and the barriers to achieving true food sovereignty in terms of feeding communities. In particular, the barriers to food sovereignty are critical when communities are faced with a lack of ability to grow enough food to support itself due to loss of land base and access to land. The projects discussed in this section are uplifting for those working to support sustainable food systems, providing examples and how-tos from work of Indigenous communities. Many who work in these areas will recognize key features, such as the importance of language, community involvement, multigenerational events, communication, and inclusion, that echo in each chapter.

The Innovations section of the book provides descriptions and examples of novel food sovereignty efforts. This differs from Initiatives by tweaking the lens of the discussion and encouraging us to think creatively, not only thinking outside the box but employing strategies to embrace (or reclaim) Indigenous knowledge to support the health of the planet, including all human and non-human relatives. Tribal community members, respected elders, and Indigenous knowledge-keepers often convey a message similar to what is heard throughout the book: that the knowledge for sustainable food systems exists, but it has been impacted and continues to be restricted by Western/colonial policies, distorting the actual practice of consuming/using/engaging with traditional foods and food systems. There are encouraging stories, such as the inclusion of community members from youth to elders, but clear strategies to sustain the efforts shared in the book are necessary for creating lasting change and positive impacts on the planet. The barriers included by the editors in the final summary are bleak, adding importance to the shared efforts. The case studies shared in the book provide a ray of hope for many who may be disillusioned by years of hard work while seeing little measurable movement on food policy, land rights, consumption of traditional foods, and health outcomes, to reclaim Indigenous knowledge and practices.

The book itself is a testament to decolonized writing, centering community voices and those doing the work. The contributors and editors describe their role in the work as well as their worldview and experience, although there are a couple chapters where the authors do not clearly situate themselves in the narrative, reflecting some limitations in the research and conclusions presented. Nevertheless, if their personal experience is not described fully in a chapter, the author biographies are included at the end of each chapter for reader review. Shukla, Settee, and Lincoln also clearly describe the process of inviting authors (particularly those not often present in scholarly writing) and supporting the writing. This transparency is valuable and necessary in community-based work; reflecting it in the book is a testament to the authors' commitment to supporting Indigenous stories. The writing is straightforward and descrip-

tive, often including Indigenous language. The authors clearly embrace the "learning from international case studies" approach, as they provide a glossary, review questions, and suggested readings and resources at the conclusion of each chapter. While not an overt intent of the book, the research presented in several of the case studies demonstrates community-based participatory research and ethical, culturally grounded methods for engaging with Indigenous partners.

The research and lessons shared in the book are especially timely as we consider the rise in food insecurity, chronic disease rates, malnutrition, health disparities, and extreme weather events and other climate change challenges. The authors show how knowledge-sharing, collaborating between Indigenous communities, celebrating the central role of Indigenous women in food systems, embracing food as medicine, and caring and centering relationships are crucial to a sustainable food system and healthy planet. We must invest the required "time, energy, and responsibility" (p. 245) in these strategies to support a healthy future.

