

Evaluation of a sustainable student-led initiative on a college campus addressing food waste and food insecurity

Kendra OoNorasak,^a Makenzie Barr,^{b*} Michael Pennell,^c Jordan Hinton,^d Julia Garner,^e Cora Kerber,^f Celia Ritter,^g Liana Dixon,^h Cana Rohde,ⁱ and Tammy J. Stephenson^j
University of Kentucky

Submitted October 29, 2021 / Revised January 20, February 22, and June 2, 2022 / Accepted June 7, 2022 /
Published online August 30, 2022

Citation: OoNorasak, K., Barr, M., Pennell, M., Hinton, J., Garner, J., Kerber, C., Ritter, C., Dixon, L., Rohde, C., & Stephenson, T. J. (2022). Evaluation of a sustainable student-led initiative on a college campus addressing food waste and food insecurity. *Journal of Agriculture, Food Systems, and Community Development*, 11(4), 223–237.
<https://doi.org/10.5304/jafscd.2022.114.014>

Copyright © 2022 by the Authors. Published by the Lyson Center for Civic Agriculture and Food Systems. Open access under CC-BY license.

Abstract

Food waste and food insecurity present a troubling paradox found across the globe, in local communities, and on college campuses. The Campus Kitchen at the University of Kentucky (CK) is a student-

led, sustainability-focused service organization in the Feeding America Network that can serve as a local food waste checkpoint in the southeast region of the United States and address community and campus food insecurity through community-building activities. Farm-to-Fork (F2F), a free weekly meal and education program of CK, provides a case study of leveraging existing resources like

^a Kendra OoNorasak, MS, RD, LD, Director of Community Outreach, Department of Dietetics and Human Nutrition, College of Agriculture, Food and Environment, University of Kentucky; Kendra.OoNorasak@uky.edu

^{b*} *Corresponding author:* Makenzie L. Barr, PhD, RDN, Assistant Professor, Department of Dietetics and Human Nutrition, College of Agriculture, Food and Environment, University of Kentucky; 160 Funkhouser Drive, 204 Funkhouser Building; Lexington, KY 40506 USA; +1-859-257-1573; Makenzie.barr@uky.edu

^c Michael Pennell, PhD, Associate Professor and Director of Undergraduate Studies, Department of Writing, Rhetoric, & Digital Studies, College of Arts and Sciences, University of Kentucky; michaelpennell@uky.edu

^d Jordan Hinton, Undergraduate dietetics student, Department of Dietetics and Human Nutrition, College of Agriculture, Food and Environment, University of Kentucky.

^e Julia Garner, BS, Undergraduate nutrition student, Department of Dietetics and Human Nutrition, College of Agriculture, Food and Environment, University of Kentucky.
Julia Garner is now at University of Kentucky HealthCare.

^f Cora Kerber, BS, AmeriCorps VISTA, Department of Dietetics and Human Nutrition, College of Agriculture, Food and Environment, University of Kentucky.
Cora Kerber is now at Tufts University.

^g Celia Ritter, BA, AmeriCorps VISTA, Department of Dietetics and Human Nutrition, College of Agriculture, Food and Environment, University of Kentucky.

Celia Ritter is now at the University of Arizona.

^h Liana Dixon, MPH, Graduate assistant, Department of Health Management and Policy, College of Public Health, University of Kentucky.

Liana Dixon is now at Kentucky Department for Public Health.

ⁱ Cana Rohde, RD, Undergraduate dietetics student, Department of Dietetics and Human Nutrition, College of Agriculture, Food and Environment, University of Kentucky.

Cana Rohde is now at Cedar Lake, Inc.

^j Tammy J. Stephenson, PhD, FAND, Professor and Chair, Department of Dietetics and Human Nutrition, College of Agriculture, Food and Environment, University of Kentucky; Tammy.Stephenson@uky.edu

Funding Disclosure

This work was supported by University of Kentucky Chellgren Center, the Food Connection at the University of Kentucky, and University of Kentucky Student Sustainability Council.

student volunteers, CK infrastructure, and campus partners to address college food insecurity. In this case study, we evaluate the pilot model of CK and its F2F Program. The data gathered consist of the amount of food recovered, the number of meals prepared and distributed, and demographics and behavioral perceptions of college students attending F2F. From August 2018 to December 2019, CK food recovery and meal data were collected and an F2F cross-sectional student survey ($N=284$) was administered twice. The program development, implementation, and evaluation of F2F relies on the social-ecological model (SEM) to capture and highlight the complicated issues of food waste and food insecurity, and the layered approach any initiative addressing such issues must take. Ultimately, F2F highlights how programs such as CK can expand their missions of reducing food waste and food insecurity in communities and on college campuses. CK's economically and environmentally sustainable practices can be built upon to improve the diversion of food waste and use socially inclusive approaches to provide healthy meals and resources to populations experiencing challenges with food insecurity, both on and off campus, as well as educate all those involved. In turn, such an initiative highlights the need to move beyond stopgap measures, such as food pantries, in both community and campus programs targeting food waste and food insecurity.

Keywords

Food Waste, Food Recovery, Universities, Higher Education, Food Insecurity, Social-Ecological Model

Introduction and Literature Review

Food waste and food insecurity are paradoxical global concerns that occur adequate food production to feed the world population (United Nations Environment Programme [UNEP], 2020). Approximately 931 million tons of edible food were wasted in 2019 (UNEP, 2021), while about 2 billion individuals are moderately or severely food-insecure across the world (FAO, IFAD, UNICEF, WFP, &

WHO, 2019). In the U.S., 306 lbs. (139 kg) of food from retail, food service, and households is wasted per capita per year, which is higher than in other countries of similar economic development levels, such as the United Kingdom (UNEP, 2021). Such prevalence of food waste is especially troubling when one considers that 14.3 million Americans were food insecure in 2019. Kentucky, one of the top 10 most food-insecure states in the nation, projected an increase in food insecurity from 14.8% in 2018 to 18.1% in 2020 (Feeding America, 2021). Such an increase is reflected in the findings that one in seven Kentuckians, and one in six Kentucky children, is hungry. The impact of food waste extends far beyond food insecurity alone, accounting for 18% of total methane emissions in the US (U.S. Environmental Protection Agency, 2016). Moreover, global food waste contributes 4.4 Gt of CO₂ emissions per year, with nutrient-dense cereal grains, vegetables, and meats responsible for much of the carbon footprint (Food and Agriculture Organization of the United Nations [FAO], 2015).

Food insecurity is a growing public health challenge that can leave individuals with diminished nutritional status and various forms of malnutrition, including obesity, anemia, wasting, and stunting (FAO, IFAD, UNICEF, WFP, & WHO, 2019). Although nutrient-dense fruits and vegetables could enhance the nutritional status of food-insecure individuals, retailers often discard a high proportion of fruits and vegetables due to commercial quality and cosmetic standards. Furthermore, consumers account for 15–30% of fruit and vegetable food waste via foods that are purchased or acquired but disposed of in the home (Gustavsson et al., 2011). Diverting and reclaiming foods is possible through recovery, an environmentally and economically sustainable solution to food insecurity that involves repurposing high-quality, unused food, and secondary produce from farms, restaurants, and grocery stores. Regionally, such efforts are witnessed in the growth of food recovery organizations and efforts across the southeast, including Glean Kentucky,¹ East Tennessee Gleaners Co-Op,² and Haywood Gleaners in

¹ “Glean Kentucky gathers and redistributes excess fresh fruits and vegetables to nourish Kentucky’s hungry” (Glean Kentucky, n.d.,

North Carolina.³ Importantly, food recovery efforts fall under the federal Bill Emerson Good Samaritan Food Donation Act, protecting donors from criminal and civil liability (Oo et al., 2018).

College campuses are not immune to the issues of food waste and food insecurity, and more researchers, administrators, and students are uncovering and addressing this paradox on their local campuses. Over the past decade, a growing body of literature has revealed alarming rates of college food insecurity. For example, The Hope Center #RealCollege survey found that 39% of approximately 167,000 college students were food-insecure (Baker-Smith et al., 2020); several smaller studies of individual universities and multi-institutional studies reported the prevalence rates of college food insecurity ranging between 15% and 59.5% (Abu & Oldewage-Theron, 2019; El Zein et al., 2019; Payne-Sturges et al., 2017). While published rates of college food insecurity may vary depending on the locations and demographics of higher education institutions, the evidence clearly points to its growing presence on college campuses. This estimated increase in food insecurity potentially can aggravate college students' existing food insecurity, health, and well-being challenges, as the evidence explain the intersectionality of food insecurity, poor psychosocial health, including stress, and academic performance in college students prior to the pandemic (Bruening et al., 2016; Hege et al., 2020; Payne-Sturges et al., 2017).

Additionally, certain populations of college students face a disproportionate risk of food insecurity. Notable disparities in the risk of food insecurity have been noted based on race, ethnicity, gender identity, and sexuality. Students of color, especially Latinx/Hispanic, African American, and Indigenous students, experienced higher rates of food insecurity than white students (Baker-Smith et al., 2020; Martinez et al., 2016). Despite the disparities and prevalence of college food insecurity that

prompt immediate actions, there is a multitude of challenges college students encounter in accessing federal and state safety-net programs, such as expanded Supplemental Nutrition Assistance Program (SNAP) benefits, as they fall into an administrative gap. For example, in 2016, about a quarter of the 5.5 million low-income students at risk for food insecurity could not obtain SNAP benefits due to eligibility issues (U.S. Government Accountability Office, 2018). Along with the issue of food insecurity, food waste has recently experienced more attention on college campuses. In particular, college campuses, especially those with dining halls of the all-you-can-eat variety, have developed initiatives to limit, or at the least study, food waste (Rajan et al., 2018).

One program that is representative of food-waste and food-insecurity reduction efforts is the Campus Kitchen at the University of Kentucky (CK), a nonprofit student-led organization that is a partner agency of God's Pantry Food Bank within the Feeding America network. CK, a former affiliate of the national Campus Kitchens Project, is a student-led service organization founded in the fall of 2014 and housed in UKY's Department of Dietetics and Human Nutrition. CK aims to improve community food security, healthy eating behaviors, and social cohesion by recovering food that would otherwise go to waste; preparing and serving healthful meals using recovered foods; and engaging student and local community groups in educational activities (Oo et al., 2018).

Although there are student-led interventions on food waste and food insecurity across the nation, few studies have examined data and evaluated such initiatives. Since evaluation processes play an essential role in the development, implementation, and monitoring of student-driven food recovery interventions for continuous improvement of programming and pursuing future funding opportunities for such efforts, the current case

"Our mission," para. 1).

² "East Tennessee Gleaners Co-op endeavors to recover food and products that would otherwise go to waste by creating opportunities for our members to work toward their well-being and the well-being of others while also educating our members to make the best use of their work and recovered items" (East Tennessee Gleaners Co-op, n.d., para. 2).

³ "The mission statement of Haywood Gleaners is to engage volunteers and community resources to rescue and distribute surplus food to the food insecure and to promote healthy eating in Haywood County" (Haywood County Gleaners, n.d., "Mission," para. 1).

study aimed to (1) examine CK operations, including food recovery, meal preparation and service, food processing, and distribution of recovered foods with resources; and (2) describe behavioral perceptions of students who utilized CK's F2F free meal program for college students. This case study report shows how the student-led CK organization and its F2F program address the complex layers of the social-ecological model on a college campus. In turn, this case study illustrates the layered and complicated issues of food waste and food insecurity, as well as any interventions, while providing a model for administrators, educators, and scholars from other campuses to consider modifying and adopting on their own campuses to address food waste and food insecurity simultaneously.

Social-Ecological Model

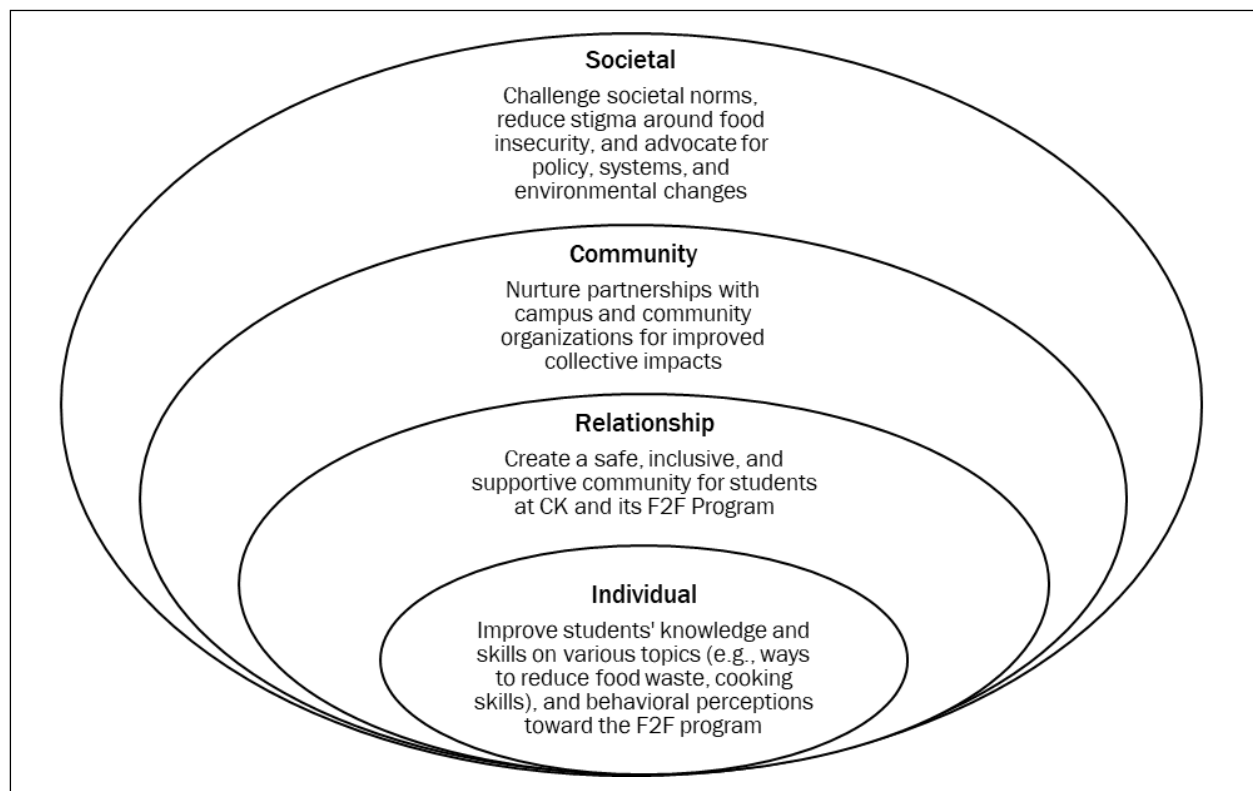
CK's use of the social-ecological model (SEM) in understanding and addressing food waste and food insecurity highlights the multidimensional status of these issues, and the complicated layers involved in

any intervention (see Figure 1). As others addressing food waste have noted, previous interventions have focused on the individual, oftentimes addressing either food waste or food insecurity. The SEM provides a multifaceted approach that reflects the individual in other contexts, forces, and actors, from communities to organizations to policies (Centers for Disease Control and Prevention [CDC], 2022). The SEM utilizes overlapping rings to highlight how factors at each level influence other levels (CDC, 2022). We appreciate how the model captures the overlapping factors involved in understanding and intervening in food insecurity and food waste, reflecting the complex interplay between various factors, including individual, relationship, community, and societal factors.

CK Operations

CK operates entirely through student volunteers with staff oversight at a large, four-year research institution in a medium-sized urban area located in central Kentucky, in the southeast region of the

Figure 1. Application of the Social-Ecological Model in Campus Kitchen at the University of Kentucky (CK) and its Farm-to-Fork (F2F) Program



United States. Typical weekly operations include student volunteer shifts for food recovery, processing to prolong the shelf life of recovered foods, meal preparation, meal-serving, and gardening (see Figure 2).

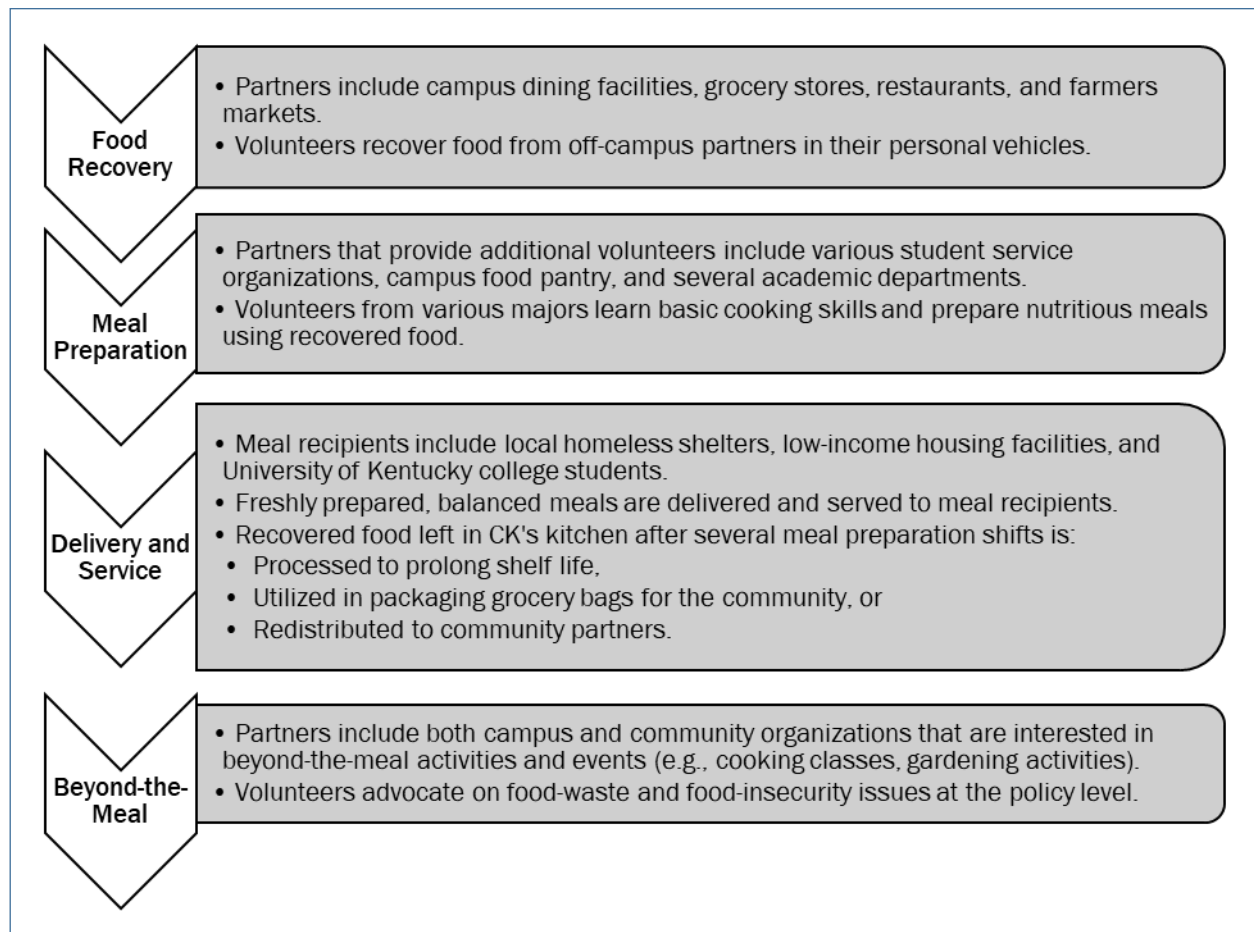
As part of the weekly operations, the environmental impact of food transportation is considered, and CK volunteers recover and deliver the majority of food in their personal vehicles. Volunteers are encouraged to carpool when possible to reduce the environmental impact and reduce any confusion about exact food recovery locations. Recovery from a campus farm once per week requires the greatest travel distance, at 11.2 miles for the round trip. However, several on-campus recovery and delivery shifts, such as those from dining facilities to student dormitories, require no vehicular transportation and instead utilize a large wagon, allow-

ing volunteers to walk rather than drive.

To limit waste, volunteers deliver congregate CK meals in reusable containers when allowed by recipient facilities and serve F2F meals using reusable tableware. Kitchen signs encourage students attending F2F to bring personal Tupperware when taking meals to go, but biodegradable containers and utensils are available. Compost bins are placed near the dish return area for F2F attendees to discard their inedible food or food scraps. All waste is composted using a commercial pulp dehydrator at two campus dining facilities as part of a campus-wide composting initiative (Mills, 2019).

As part of CK's beyond-the-meal programming that targets the individual level of SEM, CK students developed and promoted weekly educational materials and activities based on the time of the year (e.g., cooking class before Thanksgiving,

Figure 2. Campus Kitchen at the University of Kentucky (CK)'s Model, Partners, and Weekly Operations



recipe cards utilizing seasonal produce). Those materials and activities generally are designed around five overarching categories: (1) cooking skills, (2) healthy eating, (3) gardening, (4) budgeting, and (5) sustainable food systems. Among these themes, cooking skills, gardening, and sustainable food systems utilized hands-on activities for students and community members, such as cooking classes, gardening workshops, weigh-the-waste events, and trivia games. Topics were additionally broken down into subthemes to provide a greater educational range.

Educational sessions related to cooking skills included knife skills, healthy meatless recipes, Plate It Up Kentucky Proud recipes utilizing local produce, and a virtual “Tasty Tip Tuesday” series, which provided a series of topics on less common produce and ways to prepare it (e.g., acorn squash or edamame). Educational gardening sessions included garden recovery and beautification, soil nourishment, companion planting, composting, and informational resources for building one’s own kitchen herb garden. Lastly, educational sessions related to sustainable food systems incorporated signage and discussions about reducing daily food waste and use of to-go materials, knowing the origins of the food on your plate, and raising awareness about the campuswide food composting initiative and CK’s work. At every meal service and delivery, hard copies of educational materials are provided to CK’s meal program attendees, and the CK blog and social media platforms also post educational materials.

CK’s Farm-to-Fork Program

In fall 2018, F2F was launched by a group of researchers, including faculty and CK students, as a response to growing awareness of food waste and food insecurity on campus (Oo et al., 2020; Sandar et al., 2019). F2F integrates social, environmentally sustainable, local, nutritional, and educational elements to affect the pillars of sustainability in the University of Kentucky (UKY) student community. This program expanded the work of CK into a free meal program for students by operating as one program within the CK enterprise, using and building on resources and educational materials that have been created for broad CK distribution.

CK volunteers use recovered food to develop and serve an F2F weekly lunchtime meal at a central campus location, which functions as the CK kitchen and the F2F cafeteria. Since community enrichment is critical for CK, F2F wove various CK educational materials, from recipe cards to nutrition information to weekly trivia, directly and indirectly into weekly meals, allowing the larger CK structure to impact the smaller F2F initiative. Although CK is housed in the College of Agriculture, Food and Environment, F2F is available to all students. Initially, the primary goal of the pilot program was to respond to growing concerns over campus food insecurity by utilizing the operations and structure of an established program, such as CK. While F2F attempted to address a gap rather than solve the problem of food insecurity, researchers positioned it as an innovative intervention in the systemic paradox of food waste and food insecurity, while also contributing to a sense of community on campus as diners could eat with others in the cafeteria space (or take a meal to go).

Evaluation of CK Operations

From August 2018 through December 2019, researchers recorded and tallied the total number of volunteers, service hours, and meals served, CK budget data, and the amount of food recovered, distributed, and composted to depict the frequency of the operational data.

The following CK operations data allow for a better understanding of how F2F fits within the broader CK program. During the 18-month period, weekly CK operations consisted of 9–10 recovery shifts, 1–2 processing shifts, 4 cooking shifts, 4–5 meal-serving shifts, and 2 gardening shifts, all of which engaged 25–30 student shift managers, 8–10 student executive committee members, and hundreds of volunteers per semester. During the 18-month period, through the efforts of 500 unique student volunteers who dedicated 4,890 service hours, CK was able to divert 14,990 lbs. (6,800 kg) of food from landfills, 7,308 lbs. (3,315 kg) of which was produce.

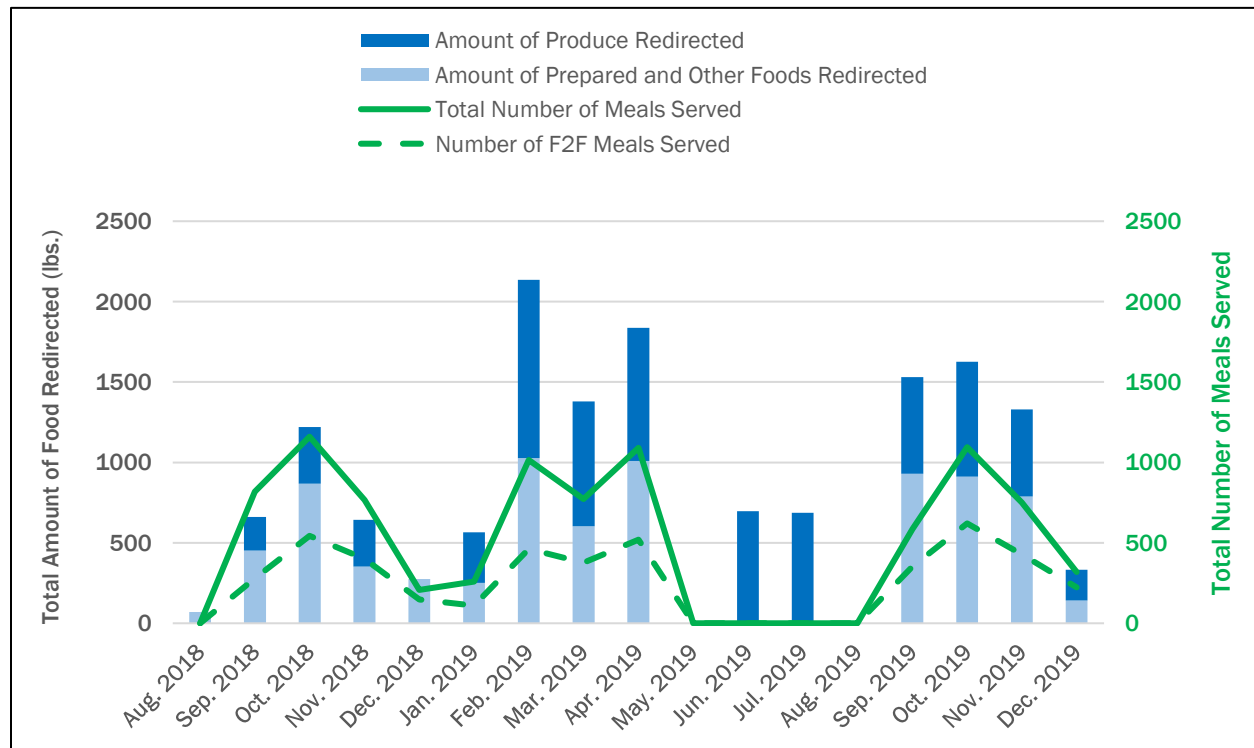
Using those recovered foods, CK provided 8,839 meals along with 5,183 lbs. (2,351 kg) of food and produce to the community. The average cost was US\$5,700 per semester for all CK opera-

tions and the survey research. Of the total meals served by CK, F2F meals for university students for 18 months accounted for 4,465 meals, utilizing approximately US\$6,000, or about one-third of the entire CK operations expenses. The rest of the meals were hand-delivered and served to meal recipients in the community, including a local homeless shelter, low-income housing facilities, and so forth. The only meals served in CK’s kitchen were F2F meals. In terms of recovered food value, 14,990 lbs. of food that CK recovered was estimated to be worth about \$24,284 based on the calculation of US\$1.62/lb. provided by Feeding America (Second Harvest Food Bank of Tennessee, 2021). Additionally, an estimated value of labor contributed by CK volunteers was US\$35,453, calculated from the federal minimum wage of US\$7.25 per hour. Ultimately, by adding those two estimated values of food and labor, CK had an estimated economic impact of US\$59,737 during the 18-month period. This economic impact represents more than triple the amount of the total CK expenses, including survey research.

To provide the data trends in depth, Figure 3 shows the total number of meals prepared based on the total amount of food recovered or redirected, including produce, prepared, and other foods, such as bagels. A portion of the food recovered was utilized in preparing F2F meals and other community meals. The left axis of Figure 3 displays the total amount of redirected or recovered food, and the right axis displays the total number of meals served.

In general, the recovery volume was greatest midsemester, and it was lower at the start and end of the semester and over the summer (see Figure 3). The least amount of food recovered in one month was 71 lbs. (32 kg) in August when students returned to campus and new CK leaders and volunteers were being trained. Conversely, the greatest recovery occurred in February, with 2,135 lbs. (968 kg) recovered during the month. Consequently, the largest volumes of meals served were observed in October of both years and February and April 2019, ranging between 1,015 and 1,160 meals. However, the number of meals served stayed fairly

Figure 3. Prepared and Other Foods Recovered Stacked with Produce Recovered Trended over Total Number of Meals Served and Number of Farm-to-Fork (F2F) Meals Served over an 18-month Period



consistent despite the great increase in the amount of food recovered. Since there was no cooking shift during the summer months, no meals were served.

To prevent recovered food from being wasted, recovered foods left in the CK kitchen after all the meals for the week have been prepared, were frequently processed to prolong their shelf life, packaged into grocery bags, and redistributed to community partners, such as homeless shelters. Table 1 summarizes the number of student volunteers, service hours, and the amount of food used in packaging grocery bags and redistributed to community partners following CK's weekly meal preparation during the 18-month period. Similar to Figure 3, student volunteers and service hours were considerably lower during the summer months and at the beginning and end of each semester. Service hours per month were greatest in October and November 2018 and February and March 2019, ranging between 504 and 787 hours per month. Since Feb-

ruary 2019 was the month with the greatest amount of food recovered and the greatest number of meals served, the amount of food packaged into grocery bags and redistributed to community partners during that month was also the greatest. During the summer months, the majority of food recovered was simply packaged into grocery bags and redistributed to community partners. Composted food totaled 352 lbs. (160 kg) of foods and plate waste in the fall 2019 semester; composting amounts were minimal before that time.

CK operations, including F2F, require minimal cost, with secured funding from internal grants and in-kind donations used to support an outdoor campus garden; student leadership stipends; leadership development, team building, and educational activities; appliance and utility charges; to-go supplies, such as containers and utensils; marketing materials; survey incentives; and supplemental food for well-balanced meals. The average cost for one semester of running student-led CK operations and

Table 1. Number of Student Volunteers, Service Hours, Amount of Food Packaged into Grocery Bags and Redistributed Following Weekly Meal Preparation over 18-month Period

Months	Number of Volunteers	Service Hours	Amount of Food Packaged into Grocery Bags and Redistributed (lbs.)
Aug. 2018	0	0	0
Sep. 2018	185	382	90
Oct. 2018	336	787	0
Nov. 2018	226	530	0
Dec. 2018	36	100	0
Jan. 2019	77	160	15
Feb. 2019	376	677	1034
Mar. 2019	272	504	669
Apr. 2019	168	345	674
May. 2019	0	0	
Jun. 2019	12	12	506
Jul. 2019	17	17	891
Aug. 2019	0	0	0
Sep. 2019	141	282	448
Oct. 2019	248	458	416
Nov. 2019	224	459	363
Dec. 2019	88	177	77

conducting survey research with F2F attendees was approximately US\$5,700. The average cost of F2F per semester was US\$2,000, with approximately US\$500 going toward to-go supplies, US\$1,000 for student leader stipends, and US\$500 on supplemental food expenses.

Evaluation of the Farm-to-Fork Program

F2F Evaluation Survey Measures

The authors developed the F2F evaluation survey to assess student perceptions of the F2F program. The survey tool was pretested by UKY students who did not attend F2F. Survey measures included student demographics and variables of interest (gender, age, race/ethnicity, college major, year in school, living situation, and if they worked for pay), the frequency they attended F2F during the semester (1–3, 4–6, or 7 or more times), if they utilized other food assistance programs or resources (yes/no), and what they learned from the F2F program. Additionally, the survey included 18 Likert-scale questions (1 being strongly disagree to 5 being strongly agree) about how their meal experience with F2F influenced certain areas of their life or behavior, including, but not limited to, forming connections with others, accessing healthful foods, and improving overall perceived food security. Eligibility criteria for students to complete the survey included being 18 years or older, attending the university, and having attended F2F at least once in a given semester. Upon arrival to F2F meals, attending students provided an email address through which they received a recruitment email for the survey at the end of the spring and fall 2019 semesters. To capture a timely evaluation, students attending F2F both semesters were eligible to complete the survey once per semester. As an incentive to complete the survey, participants had an option to enter a drawing for US\$10 grocery gift cards.

The statistical software used for all analyses was JMP (Version Pro 14). The descriptive format displays demographic variables. Researchers analyzed behavioral perception variables regarding personal feelings toward F2F (Likert items) by frequency of attending F2F using the Kruskal-Wallis test to examine differences. Significance was set at

a p -value of <0.05 . University of Kentucky Institutional Review Board approved the study protocol.

F2F Evaluation Survey Results

Of the 629 students attending the F2F lunch program, 45.2% ($n=284$) participated in the program evaluation survey. Students attending weekly F2F meal sessions and completing the survey were predominately white (69.3%), female (69.3%), 18–23 years of age (73.6%), living off campus (77.0%), and undergraduate senior status in college (29.6%) (Table 2). F2F survey respondents represented 68 majors and 14 colleges. Students completing the F2F survey were largely from the College of Arts and Sciences (34.3%) with majors such as biology, psychology, Hispanic studies, and neuroscience.

There was a significant relationship between dining in at F2F and feeling that the program helped facilitate connections with others ($p=0.0225$), as compared to taking food to go. Non-white survey respondents were 61% more likely to utilize food resources than their white counterparts ($p<0.001$, OR=0.39, 95% CI= 0.2–0.7). In terms of what they learned from F2F, more than half of respondents described that they learned more about food waste, ways to reduce food waste, the importance of local food, food-insecurity issues, ways to make healthy meals, healthy recipes, and sustainability.

As shown in Figure 4, those who attended F2F more frequently (7 or more times a semester) responded more positively than others who attended F2F less frequently (1–3 times and 4–6 times) toward the following items of behavioral perceptions regarding F2F (all $p<0.05$).

Discussion

As food waste accounts for significant amounts of greenhouse gas emissions, CK's efforts to redirect food away from landfills prevented 1,244.17 lbs. (564.3 kg) of methane from food decomposition from entering the atmosphere (FAO, 2015). Ultimately, CK and the F2F meal initiative are beneficial from the individual to planet levels. Economically, CK has made an estimated economic impact of over US\$60,000 from utilizing student volunteers to divert food from being wasted, thus ensuring that natural resources used for food production

Table 2. Demographics of Farm-to-Fork (F2F) Evaluation Survey Respondents (N=284)

Variable / Subgroup	n (%)
Gender (n=270)	
Male	67 (24.81%)
Female	187 (69.26%)
Other	16 (5.93%)
Age (n=269)	
18-23	198 (73.61%)
24-29	47 (17.47%)
30 and older	24 (8.92%)
Race/Ethnicity (n=270)	
White	187 (69.26%)
Hispanic or Latino	30 (11.11%)
Black or African American	19 (7.04%)
Asian	14 (5.19%)
Other	20 (7.40%)
Year in school (n=270)	
Freshman	32 (11.85%)
Sophomore	32 (11.85%)
Junior	67 (24.81%)
Senior	80 (29.63%)
Graduate and Professional	59 (21.85%)
College (n=265)	
College of Agriculture, Food and Environment	72 (27.17%)
College of Arts and Sciences	91 (34.34%)
College of Engineering	54 (20.38%)
Other	48 (18.11%)
Living situation (n=270)	
On-campus	62 (22.96%)
Off-campus	208 (77.04%)
Work for pay (n=270)	
Yes	179 (66.29%)
No	91 (33.71%)
Dining location (n=284)	
To-go	98 (34.51%)
Dine-in	186 (65.49%)
Frequency of Farm-to-Fork visits (n=284)	
1-3 times	111 (39.09%)
4-6 times	83 (29.23%)
More than 7 times	90 (31.68%)

^a included nonbinary, those who preferred to self-describe, and those who chose not to disclose.

^b included biracial, multiracial, and those who chose not to disclose.

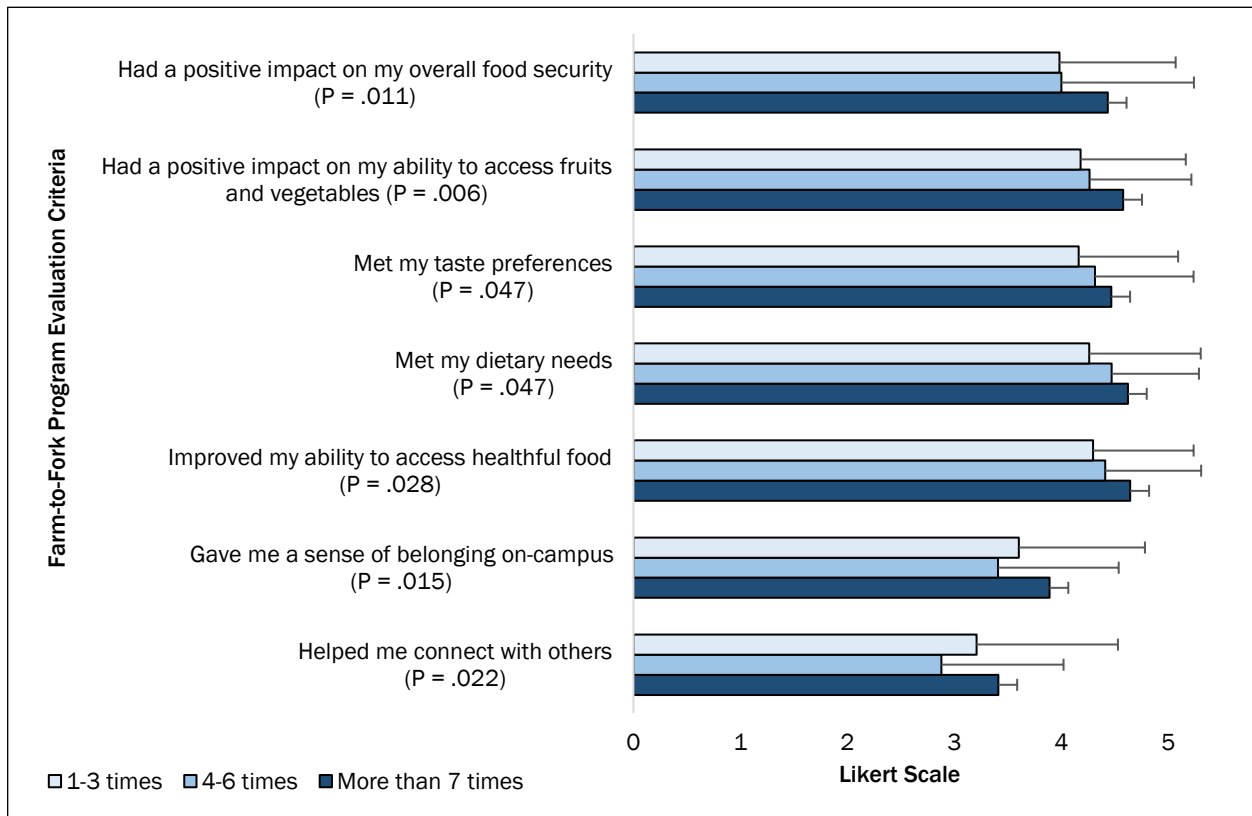
^c included colleges of Communication and Information; Design; Education; Engineering; Fine Arts; Health Sciences; Law; Medicine; Nursing; Public Health; Social Work; and Gatton College of Business and Economics.

are not wasted and contributing to social welfare services in the community.

In comparing CK operations with similar student-led food recovery chapters in the national Food Recovery Network (FRN), FRN chapters on average recover 2,503 lbs. (1,135 kg) of food per semester and engage an average of 83 volunteers per year (Food Recovery Network. 2018 Annual Report, 2017; Food Recovery Network. 2018 Annual Report, 2017). The CK operation is substantially larger than a typical FRN chapter. Excluding recurring volunteers and summer 2019 food recovery data, CK recovered 4,536 lbs. (2,057 kg) of food and engaged 112 unique volunteers per semester on average. While comparing the type of food recipients in the community, CK primarily served college students and low-income housing agencies, including senior residences, while FRN chapters predominately served shelters and soup kitchens (Food Recovery Network. 2018 Annual Report, 2017; Food Recovery Network. 2018 Annual Report, 2017). In this way, CK was able to reach food-insecure populations that may be largely overlooked by similar food delivery programs but who face disproportionate rates of food insecurity nonetheless. Additionally, FRN chapters simply recover and distribute food, whereas CK operations ranged beyond recovery to include food processing, meal preparation for congregate meals, and community-enrichment programs involving nutrition education.

In terms of produce recovery, CK gleaned 1,775 lbs. (805 kg) of produce in summer 2016, which was more than the 1,382 lbs. (627 kg) of produce gleaned in summer 2019 (Oo et al., 2018). Summer recovery in 2019 was much lower partly due to the lack of a stipend-supported summer student fellow whose primary role was to manage volunteer recruitment, training, and engagement as well as interact with community partners and recovery locations to develop and manage a weekly production schedule. Building partnerships is critical for CK's operations, and it targets the community level in SEM. Nonetheless, CK

Figure 4. Likert-scale Ratings on Farm-to-Fork (F2F) Evaluation Criteria by Frequency of F2F Visits (N=284)



recovered more than twice the proportion of produce (48.8%) compared to FRN chapters' typical produce recovery (21.7%) in 2018 (Food Recovery Network. 2018 Annual Report, 2017; Food Recovery Network. 2018 Annual Report, 2017). Comparatively, some college campuses use electronic alert systems to let students know when rescued food is available on campus (Frank, 2020). However, CK and F2F rely on regularly scheduled recovery and delivery rather than an alert system. Scheduled operations allow meal planning based on dietary guidelines, and each meal includes a source of grains, vegetables, fruit, and a choice of meat or plant-based protein. Given that food-insecure individuals do not have consistent access to fruits and vegetables (Baker-Smith et al., 2020), CK was able to provide a significant amount of free nutrient-dense meals and produce bags to campus and city community members experiencing food insecurity.

Additionally, CK provides experiential learning and student development through its leadership

structures, trainings, and hands-on experiences. For example, a team of undergraduate dietetics or nutrition students drafts weekly menus, reviewed by a registered dietitian (RD) in the department, providing students with the opportunity to apply their knowledge outside the classroom and ensure meals meet both caloric and dietary needs of the community. Likewise, student volunteers and leaders of CK are repeatedly learning about food waste and sustainability to utilize best practices in the operations of CK and in their personal routines.

Annually, an average American wastes about 225–290 lbs. of food, with fruits and vegetables accounting for 39% of this waste (Conrad et al., 2018). However, one study on food waste knowledge, attitudes, and behavioral intentions among university students found that students perceived that 65% of food waste occurred upstream of the consumer and that consumer food waste was less than actual consumer food waste, indicating how college students may have downplayed their own contribution to food waste (Alattar et al.,

2020). Several food waste awareness campaigns have been established to educate consumers about the economic and environmental impacts of unnecessary food waste and showcase creative ways to reduce food waste. CK, via F2F and community interaction, provides age-appropriate educational resources on topics including sustainable food systems and best practices to reduce individual food waste. F2F educational materials inform college students of various food system–related practices, allowing them to have a better understanding of and appreciation for where their food comes from, food waste, composting, and ways to reduce to-go material waste in dine-in settings. F2F attendees are also engaged in various hands-on, interactive activities that promote social interaction with peers and target positive behavioral changes to promote less wasteful behaviors. Activities specifically designed for F2F student meals include food-waste trivia questions, table discussion questions, and taste-testing.

Based on survey responses on what students have learned from F2F, more than half stated that they learned more about food systems, including food waste, composting, food-recovery efforts, food insecurity, and healthy meal preparation. Those topics mentioned by respondents were covered in the educational materials and activities provided at F2F, possibly indicating that attendees recognized key messages from those materials. Future studies can explore student learning and development in terms of food systems topics before and after attending such programs.

Lastly, students attending F2F meals more than seven times a semester had significantly more positive perceptions of how F2F impacted their quality of life, including areas such as a sense of belonging on campus and reduced worry over food security, compared to their counterparts who attended less frequently. Such findings support the use of a layered model in understanding how the individual may fit into relationship and community layers, despite the limitations in terms of predictability on students' perceptions of F2F based on the linear regression models. Enhanced belonging and improved food security have been shown to also improve students' retention in postsecondary education and scholarly activity, improving academic

performance (O'Keeffe, 2013). Such findings may offer some support for student services, from dining to housing, that encourage students to get involved and become a part of a campus community.

From educational materials to community dining to meals from recovered produce, the F2F program illustrates the usefulness of the social-ecological model (SEM) in understanding campus and community food waste and food insecurity. An individual utilizing the F2F weekly meal program gains a free nutritious meal, meeting his or her physiological need for food at that moment. Moreover, individuals enter a relationship with fellow diners and student volunteers. Through educational materials and talks from special guests, the individual may recognize relationships even beyond their fellow diners/students. In discussing the roles of dining halls with a marketing director for a large campus dining operation, the director shared that beyond the food, the most important part of a dining hall is the relationships formed from eating together or near others. The commensality reflected in dining halls or the F2F cafeteria proves to be important in forming positive relationships not only with others but also with food-waste and food-insecurity programs. Creating a community structured around sustainable food systems and inclusive practices through F2F is an approach to target the relationship level of SEM.

At the community level, F2F relies on a community of volunteers, staff, and faculty, as well as the campus community, including that of CK. As opposed to the more individual focus of resources such as campus food pantries or coupons for a free meal at the dining hall, F2F highlights the strength of communities in addressing food waste and food insecurity. Specifically, individuals recognize the ways in which food waste and food insecurity are community concerns, as opposed to individual choices. Finally, SEM's societal level asks us to consider and address the broad societal factors sustaining and, in turn, impacting food waste and food insecurity. We might consider policies such as mandatory dining plans, financial aid, and SNAP requirements within the SEM model, particularly at the societal level. While F2F meals represent a straightforward stopgap, limited in their ability to eliminate campus food insecurity completely, the

popularity of F2F provides evidence of a widespread need to address campus food insecurity. Furthermore, programs such as F2F ask those involved to consider the social and cultural norms determining how we understand and discuss food waste and food insecurity. For example, some might ask, “Isn’t being hungry just a part of college?” Addressing this norm proves key in educating others about the impact food insecurity can have on college students and why more needs to be done to move beyond stopgap interventions.

The current study is not without limitations. The total number of volunteers for CK is high due to volunteer data recorded as a simple count of volunteers each day instead of a data count of unique volunteers over time. Likewise, data were cross-sectional from students attending by semester, which does not show longitudinal change. In addition, experiences and perspectives from community and campus partners and student volunteers were not recorded to add more insights into the challenges and successes of CK’s model and the F2F program. Future research should include volunteer data by person and shifts and include unique longitudinal data on CK’s operations and experiences of partners, stakeholders, and student volunteers, to reflect any changes over time.

Additionally, it should be noted that not all foods recovered by CK are redirected or composted. Seeing that most recovered foods brought in by CK are no longer eligible for sale in retail settings, expired foods, damaged packaging, and bruised produce are common among recovered items. Foods most disposed of in the CK operation include molded breads and baked goods, rotten produce, and severely dented canned goods. The Good Samaritan Act states that, while nonprofit organizations may serve any donated food appearing fit for consumption, gross negligence in food service is contestable. For this reason, CK volunteers must dispose of recovered foods that do not meet food-safety standards.


While CK’s operation is not waste-free, two large dining halls on campus have a commercial pulp dehydrator to turn plate waste, unbleached paper towels and napkins, compostable to-go containers, and CK’s inevitable food waste (including prepared food and meats) into compost used by

the university’s campus farm and local farms. During the time of this case study, CK composted approximately 300 lbs. (136 kg) of undistributed, unused, and inedible foods. It is likely that recovery locations such as grocery stores and farmers markets would simply discard any unused foods to a landfill.

Despite some inevitable waste, CK provides an additional checkpoint in the food system that rescues food before it reaches the landfill to create thousands of meals and redirect hundreds of pounds of food donations per semester. CK’s model works well at the University of Kentucky partially due to a large college student population, available resources, and administrative support at the departmental, college, and university levels toward CK’s operations and its F2F program. It is important to consider the volunteer base and resource availability when exploring potential student-led initiatives on food waste and food insecurity. Understanding and being open regarding such limitations also prove useful from an SEM approach; we, and researchers at other campuses, can better witness the limits to certain layers or how certain layers fail to interact effectively around aspects of food waste or food insecurity. Nonetheless, we can also see where policies, such as the Good Samaritan Act, can help or at least intervene in local practices and policies.

Conclusion

This case study with operational and evaluation data highlights one of the few if only, campus meal programs addressing food waste and food insecurity on a college campus. Universities have a unique opportunity to offer service-learning opportunities related to addressing issues surrounding the food system, including food waste and food insecurity. Specifically, on-campus dining facilities and enthusiastic student volunteers assist with gleaning, food preparation, composting waste, and serving meals to the community. This study is supportive of sustainable efforts to reduce food waste while simultaneously addressing food insecurity, supporting the environment, and promoting positive health outcomes through the distribution of healthy meals and beyond-the-meal programming with social cohesion and education. Universities need to take a

multilayered approach to understanding and addressing food waste and food insecurity if they plan to move beyond stopgap measures. While F2F provides a model for addressing the paradox of food waste and food insecurity on college campuses, perhaps it may also spur structural and societal changes that make such programs obsolete, both on campus and in the community. 

Acknowledgments

Authors would like to thank all student volunteers of the Campus Kitchen at the University of Kentucky and all survey participants of the Farm-to-Fork Program.

References

- Abu, B., & Oldewage-Theron, W. (2019). Food insecurity among college students in West Texas. *British Food Journal*, 121(3), 738–754. <https://doi.org/10.1108/BFJ-12-2018-0804>
- Alattar, M. A., DeLaney, J., Morse, J. L., & Nielsen-Pincus, M. (2020). Food waste knowledge, attitudes, and behavioral intentions among university students. *Journal of Agriculture, Food Systems, and Community Development*, 9(3), 109–124. <https://doi.org/10.5304/jafscd.2020.093.004>
- Baker-Smith, C., Coca, V., Goldrick-Rab, S., Looker, E., Richardson, B., & Williams, T. (2020). #RealCollege 2020: Five years of evidence on campus basic needs insecurity. https://hope4college.com/wp-content/uploads/2020/02/2019_RealCollege_Survey_Report.pdf
- Bruening, M., Brennhofner, S., van Woerden, I., Todd, M., & Laska, M. (2016). Factors related to the high rates of food insecurity among diverse, urban college freshmen. *Journal of the Academy of Nutrition and Dietetics*, 116(9), 1450–1457. <https://doi.org/10.1016/j.jand.2016.04.004>
- Centers for Disease Control and Prevention [CDC]. (2022). The social-ecological model: A framework for prevention. (2021). Retrieved from <https://www.cdc.gov/violenceprevention/about/social-ecologicalmodel.html>
- Conrad, Z., Niles, M. T., Neher, D. A., Roy, E. D., Tichenor, N. E., & Jahns, L. (2018). Relationship between food waste, diet quality, and environmental sustainability. *PLOS ONE*, 13(4), Article e0195405. <https://doi.org/10.1371/journal.pone.0195405>
- East Tennessee Gleaners Co-Op. (n.d.). *Learn more: Mission*. Retrieved January 2022 from <https://www.etgc.org/learn-more>
- El Zein, A., Shelnutt, K. P., Colby, S., Vilaro, M. J., Zhou, W., Greene, G., Olfert, M. D., Riggsbee, K., Morrell, J. S., & Mathews, A. E. (2019). Prevalence and correlates of food insecurity among U.S. college students: A multi-institutional study. *BMC Public Health*, 19, Article 660. <https://doi.org/10.1186/s12889-019-6943-6>
- Feeding America. (2021). *The impact of the coronavirus on local food insecurity in 2020 & 2021*. https://www.feedingamerica.org/sites/default/files/2021-03/Local%20Projections%20Brief_3.31.2021.pdf
- Food and Agriculture Organization of the United Nations [FAO]. (2015). *Food wastage footprint & climate change*. <http://www.fao.org/3/bb144e/bb144e.pdf>
- FAO, IFAD, UNICEF, WFP, & WHO. (2019). *The state of food security and nutrition in the world 2019: Safeguarding against economic slowdowns and downturn*. https://docs.wfp.org/api/documents/WFP-0000106760/download/?_ga=2.146193459.68949194.1631555491-564584388.1631555491
- Food Recovery Network. (2018). *2018 annual report*. <https://static1.squarespace.com/static/555b5cf1e4b0864ccf1a0156/t/5c7041d141920266f5dce0ed/1550860780285/FY18+Annual+Report+for+Website.pdf>
- Frank, L. B. (2020). “Free food on campus!?”: Using instructional technology to reduce university food waste and student food insecurity. *Journal of American College Health*. Advance online publication. <https://doi.org/10.1080/07448481.2020.1846042>
- Glean Kentucky. (n.d.). *About us*. Retrieved January 2022 from <https://gleanky.org/about-us>
- Gustavsson, J., Cederberg, C., Sonesson, U., van Otterdijk, R., & Meybeck, A. (2011). *Global food losses and food waste: Extent, causes and prevention*. Food and Agriculture Organization of the United Nations. <http://www.fao.org/3/i2697e/i2697e.pdf>

- Haywood County Gleaners. (n.d.). *About*. Retrieved January 2022 from <https://www.haywoodgleaners.org/about-haywood-gleaners-haywood-county-nc/>
- Hege, A., Stephenson, T., Pennell, M., Revlett, B., VanMeter, C., Stahl, D., Oo, K., Bressler, J., & Crosby, C. (2020). College food insecurity: Implications on student success and applications for future practice. *Journal of Student Affairs Research and Practice*, 58(1), 44–61. <https://doi.org/10.1080/19496591.2020.1726359>
- Martinez, S., Brown, E., & Ritchie, L. (2016). What factors increase risk for food insecurity among college students? *Journal of Nutrition Education and Behavior*, 48(7S), S4. <https://doi.org/10.1016/j.jneb.2016.04.017>
- Mills, M. (2019, September 26). *UK diverts more than 17 tons of material with food waste program* [Press release]. Uknow University of Kentucky News. <https://uknow.uky.edu/campus-news/uk-diverts-more-17-tons-material-food-waste-program>
- O’Keeffe, P. (2013). A sense of belonging: Improving student retention. *College Student Journal*, 47(4), 605–613. <https://www.ingentaconnect.com/content/prin/csj/2013/00000047/00000004/art00005>
- Oo, K., Stephenson, T., Hege, A., Brewer, D., Gamboa, L., Hildesheim, L., Serra, L., Houlihan, J., & Koempel, A. (2018). Gleaning from campus farms: Sustainable approach to reducing waste and addressing food insecurity. *North American Colleges and Teachers of Agriculture Journal*, 63(2), 354–359. <https://www.nactateachers.org/index.php/vol-63-2-apr-oct-2019/2884-gleaning-from-campus-farms-sustainable-approach-to-reducing-waste-and-addressing-food-insecurity>
- Oo, K., Garner, J., Jackson, K., Hinton, J., Kerber, C., Ritter, C., & Stephenson, T. (2020). Farm-to-fork on a college campus: Evaluating impact of free weekly meals on dietary habits and meal planning behaviors. *Journal of Nutrition Education and Behavior*, 52(7S), S8. <https://doi.org/10.1016/j.jneb.2020.04.028>
- Oo, T. N. S. (K.), Hege, A., Pennell, M., Kerber, C., Rohde, C., Dixon, L., & Stephenson, T. (2019). From idea to reality: Addressing college food insecurity with a farm-to-fork initiative. *Journal of Nutrition Education and Behavior*, 51(7S), S5. <https://doi.org/10.1016/j.jneb.2019.05.316>
- Payne-Sturges, D. C., Tjaden, A., Caldeira, K. M., Vincent, K. B., & Arria, A. M. (2017). Student hunger on campus: Food insecurity among college students and implications for academic institutions. *American Journal of Health Promotion*, 32(2), 349–354. <https://doi.org/10.1177/0890117117719620>
- Rajan, J., Fredeen, A. L., Booth, A. L., & Watson, M. (2018). Measuring food waste and creating diversion opportunities at Canada’s Green University™. *Journal of Hunger & Environmental Nutrition*, 13(4), 573–586. <https://doi.org/10.1080/19320248.2017.1374900>
- Second Harvest Food Bank of Middle Tennessee. (2021). *Financial statements, additional information and independent auditor’s report*. <https://www.secondharvestmidtn.org/wp-content/uploads/2021/01/FY20-Financial-Audit.pdf>
- United Nations Environment Programme. (2020, July 13). *How to feed 10 billion people*. Retrieved from <https://www.unep.org/news-and-stories/story/how-feed-10-billion-people>
- United Nations Environment Programme. (2021). *UNEP food waste index report 2021*. <https://www.unep.org/resources/report/unep-food-waste-index-report-2021>
- U.S. Environmental Protection Agency [EPA]. (2016, April 22). *America’s food waste problem*. <https://www.epa.gov/sciencematters/americas-food-waste-problem>
- U.S. Government Accountability Office. (2018). *Food insecurity: Better information could help eligible college students access federal food assistance benefits*. <https://www.gao.gov/assets/700/696254.pdf>