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

Food insecurity coping strategies among households with average dietary diversity and caloric intake scores in rural Uganda

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Submitted June 8, 2025 / Revised July 12, July 31, August 8, August 12, and August 14, 2025 / Accepted August 14, 2025 / Published online September 29, 2025

Citation: Ikendi, S., Owusu, F., Masinde, D., Bain, C., & Oberhauser, A. (2025). Food insecurity coping strategies among households with average dietary diversity and caloric intake scores in rural Uganda. *Journal of Agriculture, Food Systems, and Community Development*, *14*(4), 245–278. https://doi.org/10.5304/jafscd.2025.144.023

Abstract

This study assessed the livelihood education programs (LEPs) of the Center for Sustainable Rural Livelihoods. The center is based at Iowa State University (ISU) and operate in Uganda through the ISU Uganda Program, with the goal of ending hunger in Uganda. We used mixed methods, using surveys and focus groups. The surveys assessed dietary and caloric intake statuses and food access pathways with 454 households (316 LEP partici-

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Author's Note

The first author's graduate thesis (Ikendi, 2019) formed the basis of this article. Similarly, this article is an expansion of the research poster that was presented to the Association for International Agricultural and Extension Education held in Orlando FL, April 22-25, 2024.

Funding Disclosure

The authors are grateful for the financial support provided to conduct this study by the Iowa State University Center for Sustainable Rural Livelihoods, the Department of Community and Regional Planning, and the Graduate Program in Sustainable Agriculture.

pants and 138 nonparticipants). Twelve focus groups conducted with 125 LEP clients explored dietary changes and coping strategies during food scarcity. Overall, 44.1% households had good diets, and 42.5% had acceptable caloric intake. LEP participants were associated with good diets and acceptable caloric intake compared to nonparticipants. Specifically, participation in livestock programs was associated with good diets, and agronomy, postharvest, livestock, and nutrition programs were associated with acceptable caloric intake. Foodstuffs were mainly accessed through home (farmgate) production, especially protein and energy foods, and market purchases for animal-source foods and vegetables. Focus groups identified shifts in consumption from fresh to dried foods like sweet potatoes and cassava flour during scarcity. Consumption of animal-source proteins was low, and foods like meat and fish went off the menu during scarcity periods. Mothers selling their labor in exchange for food or cash, reliance on husbands, use of food reserves, and livestock sales were the main food insecurity coping strategies. Others included profits from small businesses, borrowing, friends, and fruit gathering. These results imply the benefit of participating in LEPs. Efforts to develop postharvest programs for starchy food, in addition to monitoring the adoption of storage practices, will benefit households.

Keywords
agronomy and land use, caloric intake, caloric consumption, coping strategies, dietary diversity, income innovations, livestock integration, nutrition and infant feeding, nutrition education centers, postharvest technologies, water supply and public health, Uganda

Abbreviations
Center for Sustainable Rural Livelihoods of the Iowa State University (CSRL)
Food and Agriculture Organization of the United Nations (FAO)
Food consumption scores (FCS)
Household Dietary Diversity Scores (HDDS)
Iowa State University Uganda Program (ISU-UP)
Livelihood education programs (LEPs)
National Agriculture Advisory Services (NAADS)
Nutrition Education Centers (NECs)
Office of the Prime Minister of Uganda (OPM)
Volunteer Efforts for Development Concerns (VEDCO)
Water, sanitation, and hygiene (WASH)

Introduction

At the end of the Millennium Development Goals (2000–2015), world leaders set a target to achieve zero hunger by 2030 through the Sustainable Development Goals (SDGs; United Nations, 2015). The Food and Agriculture Organization of the United Nations (FAO) and its partners monitor the progress of SDGs annually. FAO et al. (2025) projected a reducation in the number of undernourished, "but 512 million people are still projected to be facing hunger in 2030, of whom nearly 60 percent will be in Africa" (p. xii). Moreover, in the post-COVID-19 recovery period, food insecurity has been exacerbated by global disruptions in production and trade due to the Ukraine–Russia war (El Bilali & Ben Hassen, 2024), climate change (Li et al., 2025), and the foreclosure of humanitarian aid from the United States (Cavalcanti et al., 2025).

In Uganda, our country of study, the global hunger index has consistently ranked Uganda as *serious* in hunger severity (Wiemers et al., 2024), in line with several trend analyses (Akumu et al., 2023; Ogenrwoth et al., 2022). The 2024 census indicated a 46% prevalence of food insecurity (Uganda Bureau of Statistics, 2024). Many factors predict the disruptions in agri-food production. These factors include hydroclimatic hazzards such as landslides (Kempango et al., 2024; Mulabbi et al., 2025; Nahalomo et al., 2024; Nedala, Mugagga, et al., 2025; Nedala, Puja, et al., 2025) and tensions such as political violence (Bhangyi & Rømer, 2025), ethnic conflicts (Kwikiriza et al., 2023), and rebel movements (Kamugisha et al., 2024; Nanfuka et al., 2025). Other factors include production factors such as agrarian land struggles (Asad et al., 2024), non-native pest invasions (Mulema et al., 2025) and diseases, requiring improvements in crop surveillance tools (Nameere-Kivunike et al., 2023), among other interventions.

Improving food production and access requires concerted efforts through public–private

partnerships, and the Ugandan government has responded to these calls. FAO data shows that public spending on interventions promoting food and nutrition has been growing (FAO et al., 2024, p. 80). The Office of the Prime Minister (OPM) and associated ministries, such as health and agriculture, monitor the implementation of several interventions (OPM, 2020). Key drivers to agricultural development are programs through the National Agriculture Advisory Services (NAADS) since 2000 using the farmer-to-farmer extension model (NAADS, 2024), whose model has direct links with the public–private partnership of the sustainable livelihoods program of our study.

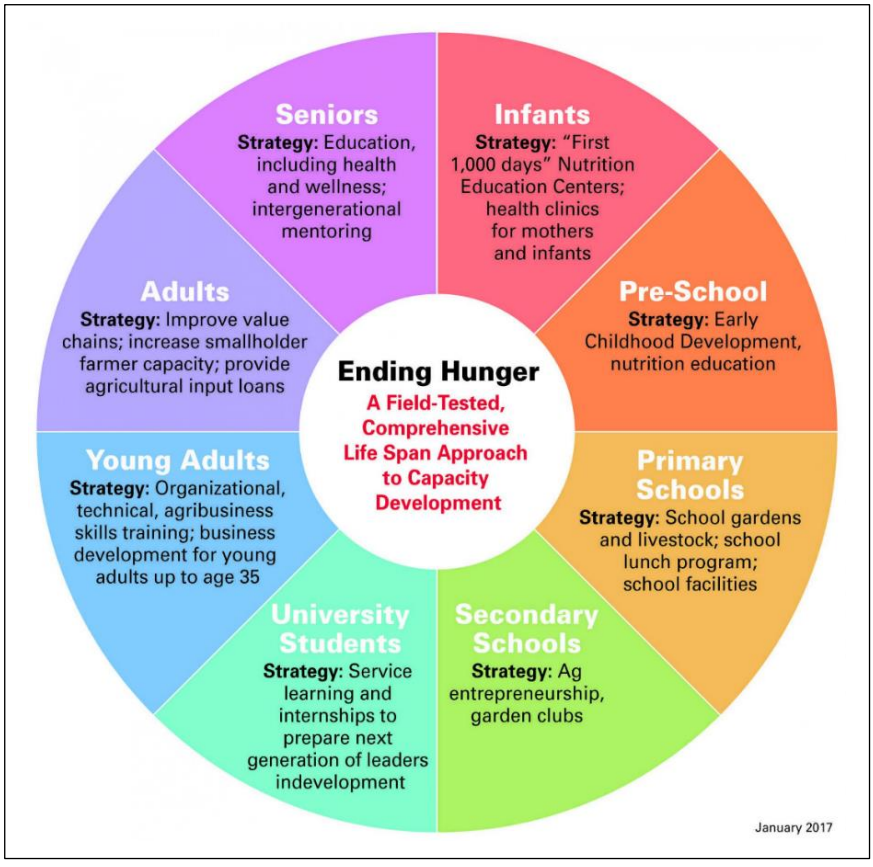
Operationalization of the Sustainable Livelihood Program in Uganda

This study explores the Iowa State University's Center for Sustainable Rural Livelihoods (CSRL) interventions toward ending hunger in rural Uganda. Since 2003, CSRL has operated in tripartite partnership with Makerere University (MAK), located in Kampala, Uganda, and not-for-profit non-governmental organizations, including the Volunteer Efforts for Development Concerns (VEDCO) (2004-2014); and Iowa State University Uganda Program (ISU-UP) 2014 to date (Butler & Acker, 2015; Ikendi & Retallick, 2025). The CSRL/VEDCO phase adopted a farmer-to-farmer approach where food security groups were formed as a model of extension to harness livelihood assets (Masinde, Butler, & Mazur, 2015; Sseguya et al., 2009; Sseguya et al., 2015). Harnessing livelihood assets was in line with the livelihood framework, supporting development organizations to assess the status of community capitals, including social, financial, natural, human, and fiscal capital as an entry for development interventions (Natarajan et al., 2022).

However, in 2014, there was a shift from the farmer-to-farmer extension approach, partly due to presidential suspensions of NAADS in 2007 and 2014 (Rwamigisa et al., 2018). CSRL/ISU-UP designed and adopted a comprehensive human capacity-building approach (Figure 1). This capacity development model touches the lives of all people from pregnancy to seniors through interrelated livelihood education programs (LEPs) (Ikendi, Mwenyi et al., 2025), building their capacities toward sustainable food security (Ikendi, Owusu et al., 2023a) and nutrition security (Ikendi, Owusu et al., 2023b; 2023c).

The LEPs include *agronomy* to improve the knowledge of farmers in soils, crops, and natural resource management and to increase access to quality and diverse crop inputs (Akitwine, 2021;

Figure 1. CSRL/ISU-UP Comprehensive Lifespan Approach to Capacity Building Model



Anderson, 2023; Ikendi et al., 2024; Kwikiiriza, 2022; Tusiime et al., 2019; Tusiime et al., 2020; Wokibula et al., 2024; Wokibula & Westgate, 2016). *Postharvest programs* foster reduction of postharvest losses in schools and communities (Ahimbisibwe et al., 2024; Asimo et al., 2024; Bbosa et al., 2017; Bbosa et al., 2020; Brumm et al., 2021; Ikendi et al., 2024; Mayanja et al., 2018; Tumutegyereize et al., 2022). *Livestock programs* educate farmers on sustainable livestock breeding and management practices to improve their income and consumption of animal-source proteins (Ikendi, Owusu, et al., 2025; Kugonza et al., 2014; Masinde, McMillan, et al., 2015; Semahoro et al., 2018; Walugembe et al., 2014).

Community innovations work to diversify the incomes and assets of mothers and in- and out-of-school youth through crafts, saving schemes, sewing, bookmaking, soapmaking, and school gardens (Ikendi, Mwenyi, et al., 2025; Martin, 2018). CSRL/ISU-UP also provide technical backup to food security support groups to initiate sustainable food and income-generating activities. *Education programs* through global service-learning build the capacity of young program participants using school gardens as outdoor experiential learning laboratories (Ikendi, Mwenyi et al., 2025; Ikendi, Retallick, & Nonnecke, 2023; Ikendi, Retallick, Nonnecke, & Kugonza, 2023; Nonnecke et al., 2015). *Youth entrepreneurship programs* engage youths in managing small to medium businesses to improve their livelihoods (Banige et al., 2024a, 2024b; Duerfeldt et al., 2016; Ikendi, 2022; Ikendi, Mwenyi et al., 2025; Nyarko & Masambuka-Kanchewa, 2025; Orozco & Lukwata, 2025).

Nutrition programs have two components: community nutrition and school feeding programs. A *community nutrition program* addresses nutrition challenges through community-based approaches using nutrition education centers (NECs) for managing acute malnutrition among women and children up five years old (Ikendi, Owusu et al., 2023b; 2023c; Masinde, McMillan, et al., 2015; Winham et al., 2016). The program utilizes locally grown foodstuff such as soybeans, millet, and grain amaranths to make nutrient-dense therapeutic porridge. The program partners with government nurses to provide complementary services such as immunization, HIV counseling, and family planning. Also, the nutrition program enhances school lunches with proceeds from school gardens to reduce hidden hunger in schools (Byaruhanga et al., 2017; Nonnecke et al., 2016; Ssabika et al., 2024). *Public health programs* work to increase access to safe water by drilling boreholes and advocating for community hygiene and sanitation practices (Ikendi, Masinde et al., 2025) and food safety (Nabwiire et al., 2023).

All LEPs regularly assess their impact on food and nutrition security. Program studies have assessed these LEPs on household food security (Ikendi, Owusu et al., 2023a; Sseguya et al., 2018) and nutrition security (Ikendi, Owusu et al., 2023c). However, no studies have assessed their impact on dietary diversity and caloric intake and food insecurity coping strategies. This study was conducted to bridge that gap and support program planning and improvements in ending hunger in rural Uganda. The study compared the dietary and caloric intake status of households by their affiliation with the NECs and participation in the LEPs. Overall, the study had six objectives:

1. Determine the household dietary diversity status and compare to their affiliation with NECs and participation in LEPs.
2. Determine the household caloric intake status and compare to their affiliation with NECs and participation in LEPs.
3. Establish the factors influencing household dietary diversity and caloric intake.
4. Find out the household dietary diversity/food access pathways.
5. Identify changes in food consumption patterns between periods of plentiful food and scarcity.
6. Identify the household coping strategies during food scarcity.

Literature Review

Achieving sustainable food and nutrition security requires multifaceted food production strategies at all levels, both macrolevels—global, regional, and national—and microlevels, in particular, the household (FAO et al., 2025; Swinnen & Barrett, 2025; Wiemers et al., 2024). Food and nutrition security

comprises four core pillars: availability, access, utilization, and stability (FAO et al., 2013). Food security is related to food availability and access, while nutrition security focuses on food utilization within our bodies. Food stability relates to future assurances of food.

Food availability provides proxy indicators of the physical presence of food through farm production, purchase, food aid, gifts, or trade. Food availability is influenced by natural resources like land. Land access and control, especially by women, contribute greatly to food production (Barak et al., 2023; Kangogo et al., 2024; Kakungulu et al., 2025; Kemigisha, 2025; Mukoda et al., 2025). Similarly, trade polices influence food availability by regulating the flow of between countries (Barlow et al., 2020).

Food access relates to the ability to obtain food through production, relief, exchanges, or purchases. Food availability does not guarantee access, especially in the neoliberal economy, where food is a commodity for sale (Bradley et al., 2023a; Canfield et al., 2021). Therefore, household income influences the purchasing power (Ahmad et al., 2024; Kakati, 2025), affecting mostly animal-source foods with higher prices (Paro et al., 2024). Accelerating agrifood trade among women and youth improves food access (Agole et al., 2025; Kironde et al., 2024; Leon-Himmelstine et al., 2021; Namata et al., 2024). Also, investments in livestock enterprises, especially by women (Bain et al., 2020; Colverson et al., 2020; Kakungulu et al., 2025; Nagasha et al., 2024; Waiswa & Jolly, 2021), contribute positively to diets and income.

Food utilization relates to the ability of the body to absorb nutrients from the foods consumed, influenced by its health status and the diet. Also, household cleanliness, especially water and sanitation facilities such as latrines, reduces predisposition to illness like diarrhea (Auma et al., 2024; Ikendi, Masinde et al., 2025; Mabkhot & Piaralal, 2024; Workman et al., 2022). Food availability and access are influential but do not guarantee nutrition utilization. For instance, high income may result in consumption behaviors, such as preference for a hypocaloric diets (low-calorie foods), leading to being underweight, or a hypercaloric diet (high-calorie foods), leading to overweight (Blüher, 2025). Also, consumption of alcohol or fast foods with low nutrient density may affect nutrition utilization (Almoraie et al., 2024; Bradley et al., 2023b).

Food stability looks at sustainable food access, including the lean periods or periods of food scarcity. Ensuring sustainability requires enhancing production and price stabilization (Gahamanyi & Tchouassi, 2025) and improving postharvest technologies (Mayanja & Oluk, 2023; Taku-Forchu et al., 2023), food safety and social programs (Gilligan et al., 2025; Wanyakha & Grudens-Schuck, 2025; Wanyakha et al., 2025), and agricultural insurance (Ceballos et al., 2025).

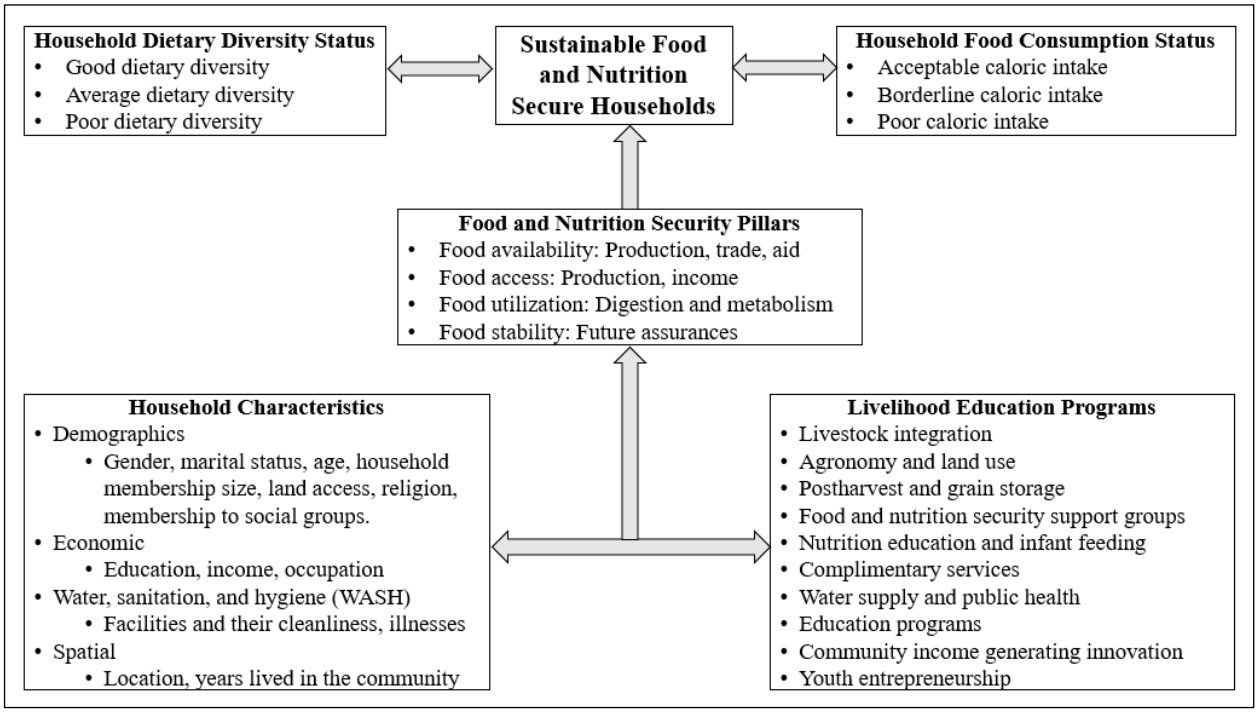
This study focused on food access measured by household dietary diversity and caloric intake (Swindale & Bilinsky, 2006). Dietary diversity is assessed as a 24-hour recall of the foods consumed by the household to give a proxy indicator of whether the household had a good, average, or poor diet on the household dietary diversity scale. Caloric intake is assessed as a seven-day recall of the food consumed to determine the level of food consumption, whether acceptable, borderline, or poor, on the food consumption scale.

A conceptual framework (Figure 2) was designed with a concept of starting from where the communities are (Masinde & McMillan, 2015), assessed through understanding the status of their community capital assets (Natarajan et al., 2022; Sseguya et al., 2009). The framework shows how household characteristics influence household participation in LEPs and collectively influence the food and nutrition security pillars. By the principle of the theory of change, development interventions need to understand the nature of the communities where they operate. Lanou et al. (2021) echoed the vital role of meeting and starting from where people are in promoting behavioral change in food consumption patterns.

Methodology

This study adopted a mixed methods approach. A survey was used to determine dietary and caloric intake statuses and food access pathways; focus group discussions gleaned information on dietary patterns and coping strategies during food scarcity. The study was conducted in the Butansi and Namasagali subcounties of Kamuli District,

Figure 2. Household Dietary Diversity and Caloric Intake Conceptual Framework Design for the Study



Uganda (Figure 3), where the CSRL/ISU-UP implements LEPs to end hunger. The IRB oversight was approved by ISU under IRB number 18-356-1.

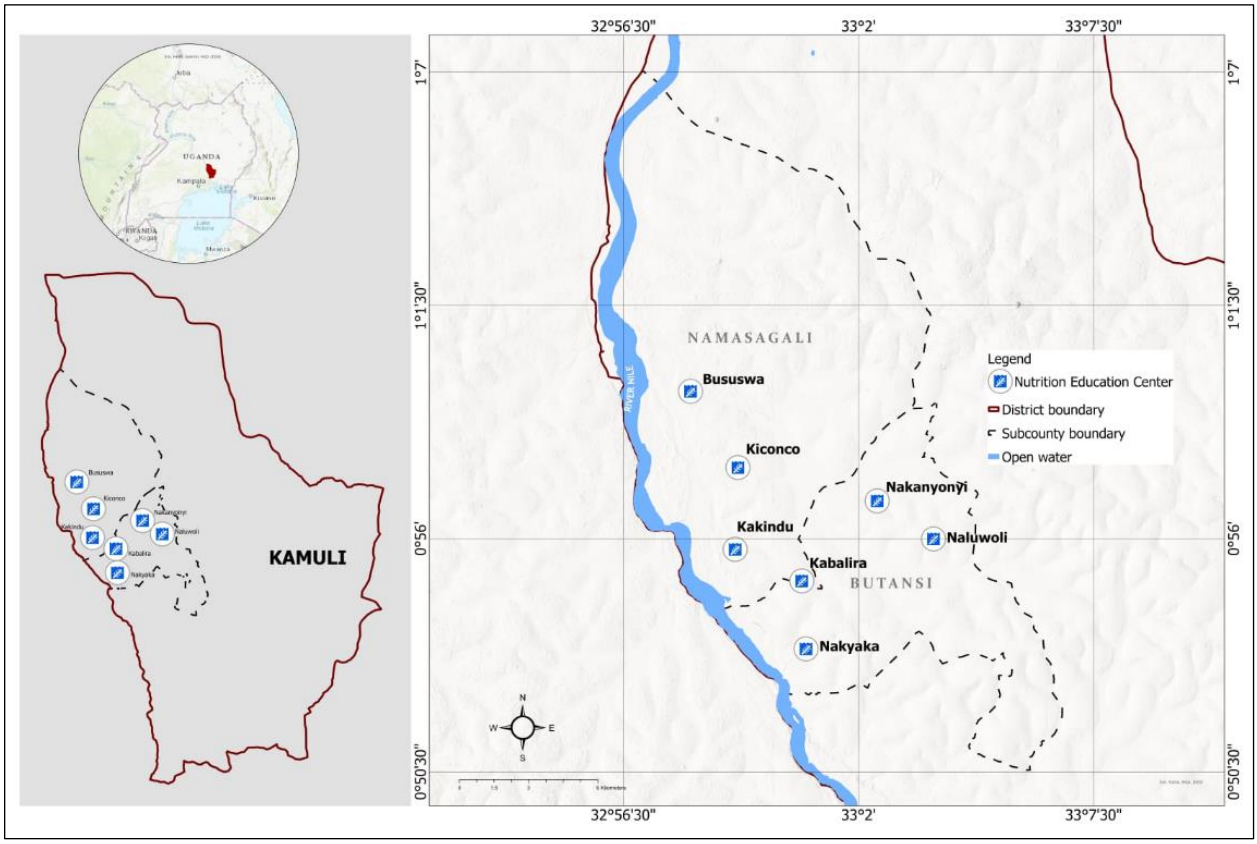
The target population were clients of the NECs or households who had participated in other LEPs, while nonparticipants had never participated in any LEPs. NECs are community-based centers where women and children (≤59 months) at risk for malnutrition are rehabilitated through nutrition therapy of nutrient-dense porridge (Ikendi, Owusu et al., 2023b; Masinde, McMillan et al., 2015). Households (n = 1,503) served by the NECs formed the sampling frame. A representative sample of 306 at a 95% confidence interval was determined and randomly drawn.

The community-based NEC trainers assisted the research team in identifying the NEC participants, and 82.7% (n = 253) were accessed and interviewed. We sought to compare an NEC household to a non-NEC household within a quarter-mile radius. Non-NEC households (n = 201) were also interviewed, giving us 454 households in the survey. However, among the 201 households, 63 households had participated in other LEPs, and these households were labeled *participants: non-NEC clients*. The rest, 138 households, were labeled *nonparticipants*.

Data Collection, Analysis, and Interpretation

In data collection, affiliation to the NECs and participation in LEPs were determined by dichotomous "yes" or "no" questions. Then, a food frequency questionnaire (Appendix A) was adopted to collect data on household-level food consumption in a 24-hour recall to assess dietary diversity using the Household Dietary Diversity Scores (HDDS) and a seven-day recall to assess caloric intake using the Food Consumption Scores (FCS) metrices (Swindale & Bilinsky, 2006). Respondents were asked to describe the household foodstuffs eaten within 24 hours and during the last seven days. Each food was marked as either 0 (*not consumed*) or 1 (*consumed*). Participants also indicated how each food was accessed: 1 = grown/reared, 2 = bought, 3 = exchanged, 4 = loaned, 5 = gift, and 6 = food aid. For HDDS, foods are grouped into 12 food groups: cereals, vegetables, legumes/pulses, roots/tubers, fruits, meats, seafood, eggs, dairy products, sugar, fats/oils, and miscellaneous, like

Figure 3. Map of Study Areas of Butansi and Namasagali Subcounties in Kamuli District



salt. Each group was assigned a multiplier index of one regardless of the number of foods consumed. Dietary diversity was determined by adding all scores generating 12 points maximum. A three-score cluster was generated and interpreted as: 0–4 (*poor*), 5–8 (*average*), and 9–12 (*good*) dietary diversity.

For FCS, foods are grouped into eight categories with their multiplier indices: main staples (2), legumes/legumes (3), vegetables (1), fruits (1), meats/fish/eggs (4), dairy products (4), sugar (0.5), and oils (0.5). Each foodstuff consumed was multiplied by its respective index. Caloric intake was determined based on the total score and interpreted in three clusters: 0.0–21.4 (*poor*), 21.5–35.0 (*borderline*), and >35.0 (*acceptable*) caloric intake. We then assessed the likelihood associations and differences in dietary diversity and caloric intake between households with their affiliation to NECs and LEPs using Chi-square and ANOVA, respectively, using SPSS version 30.

Factors Influencing HDDS and FCS

Binary logistic regressions were used to assess the association between dependent variables (HDDS and FCS) and selected household-level independent variables: spatial, demographic, socioeconomic, water and sanitation, and production factors (Appendix B). Variables were categorized into dummy variables: HDDS (0 = poor/average, 1 = good dietary diversity), FCS (0 = poor/borderline, 1 = acceptable caloric intake), and independent variables, for instance, education (0 = primary or less; 1 = post-primary education). Before running the binary logistic regressions on HDDS and FCS as categorical/dummy variables, linear regressions were run as continuous variables against the independent variables to test for multicollinearity and key statistical indicators of Tolerance Value (*TV*) and Variance Inflation Factor (*VIF*; Leech et al., 2007). Nineteen independent variables were run, and five were dropped for lack of conformance to TV and/or TIF. The final model for HDDS had

an adjusted R^2 of 0.108 and *TV* of 0.892 (*TV* = $1-R^2$; Appendix C), and FCS had an adjusted R^2 of 0.147 and *TV* of 0.853 (Appendix D). Both models conformed to VIF, which is supposed to be ≥1 but ≤2.5, and ran at 0.05 and 0.1 significance, considered due to reductions in variables' prediction power due to categorizations (Menard, 2000).

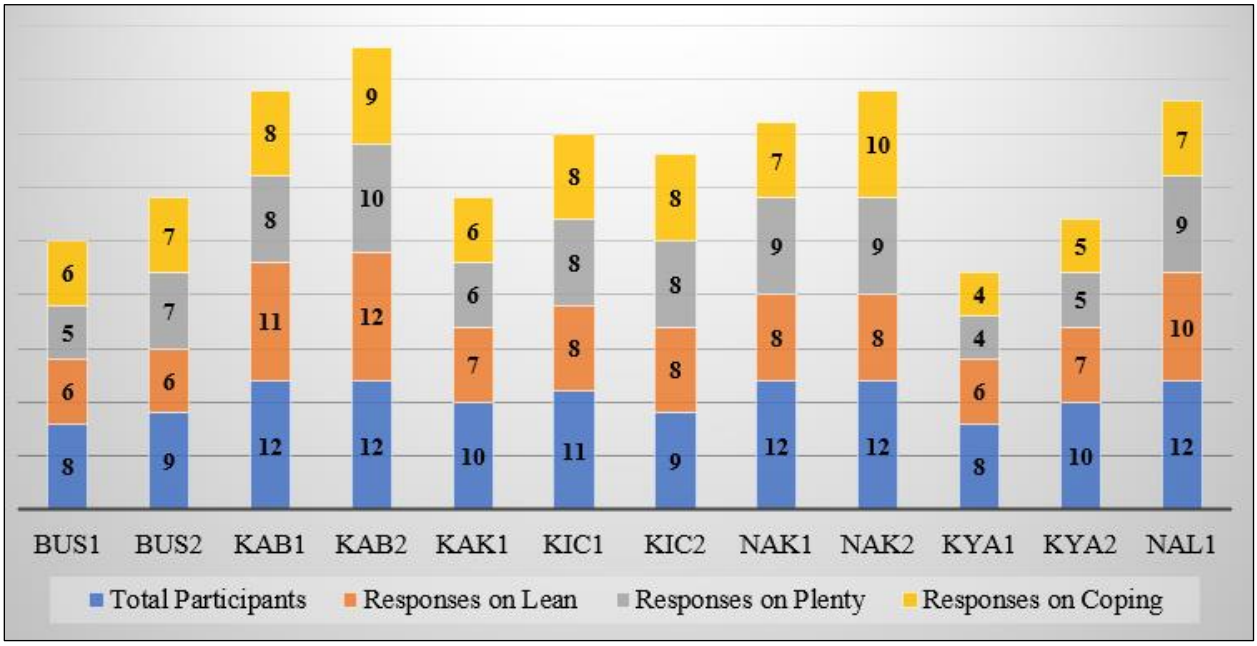
Food Consumption Patterns and Coping Strategies

We conducted 12 focus group discussions in our broader study with 125 NEC mothers. This article extracted responses from two questions. Question 1 asked, what foods are commonly eaten in your household during seasons of plenty and scarcity? Five marks were given to the most consumed foods, descending to one mark for the least consumed. Question 2 asked, during food scarcity, how does your household cope with the situation? (see Figure 4).

Our inquiries through focus groups were grounded in social constructivism, informed by the belief that knowledge is socially constructed and that its meaning emerges inductively (Crotty, 1998). Four members, including three research assistants and the lead author, conducted the discussions. The research assistants asked questions, managed recorders, and transcribed responses. The lead author asked probing questions and wrote field memos used in triangulation and discussions to improve data trustworthiness (Lemon & Hayes, 2020). The four members spoke Lusoga, the native language, easing data collection in a natural flow of conversations focused on the study goal (Rossman & Rallis, 2017). After the discussions, written responses were typed into Microsoft Word. The lead author cross-checked for clarity between the typed documents of each group and their audio recordings and cleaned the data where necessary.

The process of cross-checking went along with preliminary transcriptions, which were done word by word while actively listening to the audio and following written notes, noting the relay time in a member's response and between members. This relay time potentially signified a change of themes, need for clarification, and/or discomfort (Brinkmann, 2022). After transcribing, we fully engaged in dialogues with our data, reading the transcripts line by line, continuously triangulating with the field memos. In that process, we sought to recognize and classify commonalities across the experiences of mothers and perspectives that appeared distinct among them and wrote analytic memos to reflect on emerging unique ideas (Mihas, 2021).

Figure 4. Respondents on Changes in Food Consumption Patterns and Coping Strategies



Themes emerged inductively as we closely read the transcripts (Saldaña, 2024). We then used continual comparisons amongst the themes to determine the predominant ones related to negotiating their distinctiveness and look-alike responses within groups and among them. Frequencies for each theme were generated, and their results are presented with verbatim excerpts to illustrate the "details, emotions, and textures of social relationships" (Rossman & Rallis, 2017, p. 172) about the food insecurity coping strategies.

Positionality and Reflexivity

Reflecting on our positionality was key in the research process to control for any personal bias that would influence both the data collection process and interpretation of the findings (Savolainen et al., 2023; Yip, 2024). Specifically, the lead author is a native of Kamuli district, where the study was carried out. This study was conducted as part of their graduate school thesis, and especially as an impact evaluation of the CSRL program, where the lead author worked as a graduate assistant for monitoring and evaluation. This insider-outsider relationship had the potential to influence the results; however, much support was provided by the graduate committee through guidance and formal examination of the thesis. Moreover, during the focus groups, the lead author specifically took the role of managing the focus group dynamics to ensure everyone spoke, asked probing questions, and wrote methodological field memos, and three trained research assistants led the questioning process. Reflexively experiencing the data collection processes, leading the transcription, and theming ensured rigor and trustworthiness, along with peer debriefing, both as a supervised graduate student and with the co-author during the writing of this manuscript. The guidance and contributions made by the team, moreover, who were all familiar with livelihood programs in an international rural setting, improved our interpretation of the study results.

Results

Results are presented based on specific objectives, including determination of the statuses of dietary diversity and caloric intake to the NECs and participation in LEPs; logistic regression assessing the factors influencing the dietary and caloric intake; food access/dietary diversity pathways; and household coping strategies during lean periods.

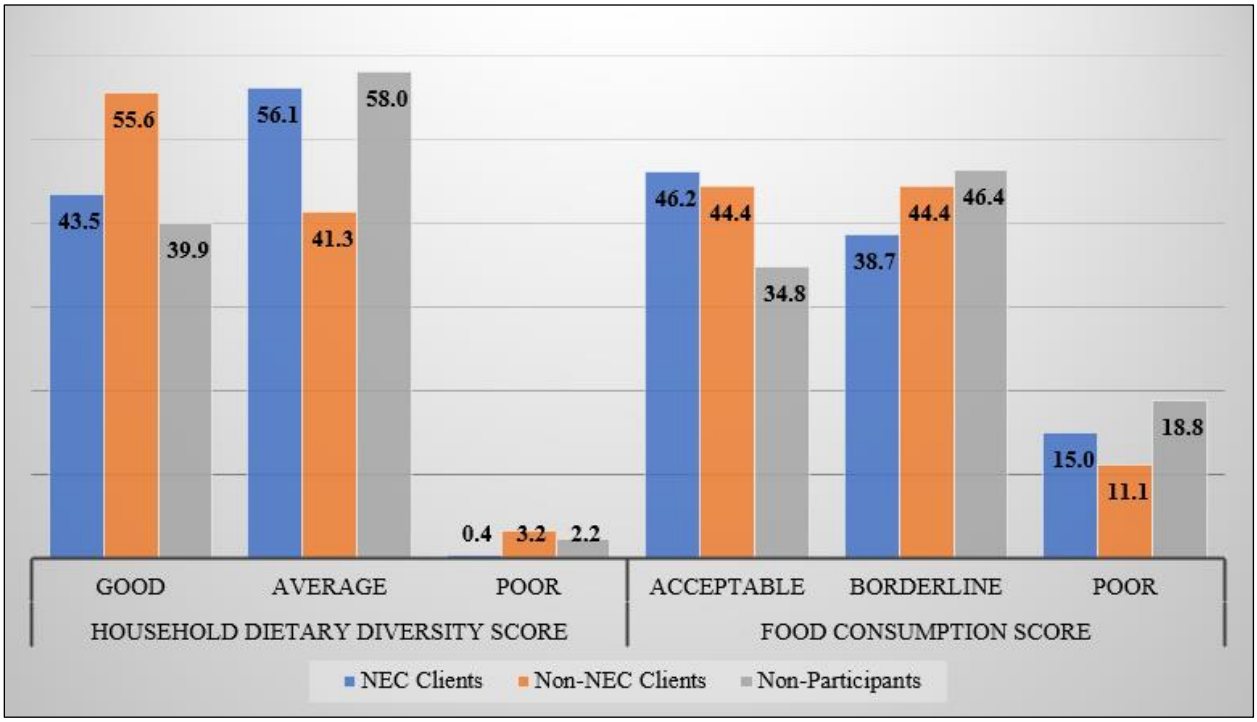
Household Dietary Diversity and Caloric Intake/Consumption Statuses

The study found statistically significant variations within and between households (Figure 5). In dietary diversity, overall, 44.1% had good dietary scores; however, by overall mean score, all households were within an average diet (8.33 ± 1.70). By affiliation with NECs, an ANOVA post hoc analysis showed that non-NEC households (8.84^{b} ± 2.06) had statistically ($p = 0.014$) higher mean scores compared to nonparticipants (8.09^{a} ± 1.65); however, these differences did not differ from NEC households ($8.33^{a,b}$ ± 1.60). Of the CSRL/ISU-UP households (NEC and non-NEC), 45.9% were associated with good diets compared to 39.9% of nonparticipants, which was not statistically significant. For caloric intake, 42.6% had acceptable scores; however, the overall score was 33.67 ± 12.53, indicating that households were within the borderline caloric intake. By affiliation with NECs, an ANOVA post hoc analysis showed that NEC (34.8^{b} ± 12.328) and non-NEC (36.0^{b} ± 13.534) households had statistically ($p = 0.002$) higher mean scores compared to nonparticipants (30.6^{a} ± 11.908). Of CSRL/ISU-UP households, 45.9% had acceptable caloric intake, compared to 34.8% of nonparticipants.

Food Groups Used in Determining HDDS and FCS Statuses

Of the 12 food groups classified for the dietary diversity score, four food groups revealed statistically significant associations with NEC participation. Consumption of fruits, meats, and eggs was, for instance, more associated with non-NEC compared to NEC and nonparticipants. Similarly, of the eight groups that reported their caloric intake, five revealed significant differences between households. NEC households, for instance, had higher caloric intake scores in main staples than nonparticipants, whereas non-NEC participants had higher scores in pulses and meats/fish than nonparticipants. For vegetables, NEC and non-NEC

Figure 5. Household Dietary Diversity and Caloric Intake



households had higher mean scores than nonparticipants. See Appendix E for detailed results.

Livelihoods Education Programs (LEPs) and Dietary Diversity and Caloric Intake

The study found that participants in livestock programs had a statistically more significant likelihood of having good diets than nonparticipants. Similarly, agronomy and postharvest, livestock, and nutrition programs had statistically significant associations with acceptable caloric intake among participants, compared to nonparticipants (Table 1).

Factors Influencing HDDS and FCS Statuses

Table 2 shows two binary logistic regression models: dietary diversity and caloric intake/consumption, regressed against 14 independent variables. Ten variables showed significant relationships with household diets and caloric intake. Among the spatial factors, the subcounty where the household was located was significant. Being in Namasagali had a 66.7% likelihood of poor/average diets, more than in Butansi subcounty. Similarly, there was a 32.9% likelihood of having good diets if the household heads lived in same villages where their homesteads are located rather than living outside them.

In demographic factors, 40.6% of households that had five or fewer members reported good diets, while only 2.0% of households were six or more members reported acceptable caloric intake. In socioeconomic factors, there was a 62.0% likelihood of having poor/average diets if the main occupation was "other jobs" other than farming and a 48.8% likelihood of having poor/borderline caloric intake. Other jobs included boda-boda riders, teachers, traders, builders, shopkeepers, and carpenters. Also, membership in community organizations was associated with a 75.4% likelihood of households having an acceptable caloric intake, more than for nonmembers. Most community organizations included burial and festival groups and village savings schemes.

In WASH, there was a 97.2% likelihood of having acceptable caloric intake among households with clean facilities such as latrines, bathrooms, tippy taps, kitchens, rubbish pits, and plate stands. Similarly, there was a 53.8% likelihood of having good diets among households who spent 30 or fewer minutes fetching water from primary

Table 1. Participation in LEPs and Household Dietary Diversity and Caloric Intake

LEPs, HDDS, and FCS Status	Household Dietary Diversity					Household Caloric Intake				
	Nonparticipants		LEPs Participants			Nonparticipants		LEPs Participants		
	f	%	*f*	%	χ^2	*f*	%	*f*	%	χ^2
Agronomy and Postharvest										
Good	95	40.4	105	47.9	0.102	79	33.6	114	52.1	<0.001
Average	135	57.4	113	51.6		111	47.2	79	36.1	
Poor	05	2.1	01	0.5		45	19.1	26	11.9	
Livestock Integration										
Good	105	37.5	95	54.6	<0.001	95	33.9	98	42.5	<0.001
Average	165	60.4	79	45.4		128	45.7	62	41.9	
Poor	06	2.1	—	—		57	20.4	14	15.6	
Nutrition and Infant Feeding										
Good	91	44.2	109	44.0	0.166	76	36.9	117	47.2	0.086
Average	110	53.4	138	55.6		94	45.6	96	38.7	
Poor	05	2.4	01	0.4		36	17.5	35	14.1	
Water and Public Health										
Good	91	44.6	109	43.6	0.150	76	37.3	117	46.8	0.117
Average	108	52.9	140	56.0		92	45.1	98	39.2	
Poor	05	2.5	01	0.4		36	17.6	35	14.0	
Complementary Services										
Good	77	45.0	123	43.5	0.760	67	39.2	126	44.5	0.535
Average	91	53.2	157	55.5		76	44.4	114	40.3	
Poor	03	1.8	03	1.1		28	16.4	43	15.2	
Community Income Generating Innovations										
Good	189	44.6	11	44.1	0.530	177	41.7	16	42.5	0.418
Average	229	54.0	19	54.6		179	42.2	11	41.9	
Poor	06	1.4	—	—		68	16.0	03	15.6	

water sources like boreholes used for cooking, drinking, irrigation, and animals. In production, keeping livestock was associated with a 24.9% likelihood of having acceptable caloric intake. Similarly, having at least four agricultural implements like hoes and pangas was associated with a 73.4% likelihood of having good diets. Likewise, households having 4 acres (1.6 hectares) of land or more had a 26.2% likelihood of having acceptable caloric intake.

Food Access/Dietary Diversity Pathway

Most foodstuffs were accessed through home or farmstead production, especially high-protein foods like beans and high-energy foods like maize. Market pathways through purchases were evident with animal products like milk and seafood like fish, as well as vegetables (Table 3).

Food Consumption Pattern Between Seasons of Plenty and Lean/Scarcity

Focus groups showed changes in food consumption patterns between seasons plenty and lean seasons (Table 4). In main staples, fresh sweet potatoes were most consumed; however, their consumption was switched for dried sweet potatoes in lean periods, and a similar pattern was observed in cassava consumption. Similarly, among pulses/ legumes, beans were most consumed in seasons of plenty and intermittently consumed in lean periods. In vegetables, leafy greens ranked high in seasons of plenty and also provided reliable food in lean periods. In seafood and meat, silver fish was consumed on average both in plenty and lean periods. Consumption of fish and meat was low in seasons of plenty and almost off the menu in lean seasons.

Table 2. Binary Logistic Regressions for Factors Influencing HDDS and FCS Statuses

	Model (1) for HDDS			Model (2) for FCS		
Model Variables/Factors	B	Sig.	Exp(B)	B	Sig.	Exp(B)
(Constant)	−2.504	0.005	0.082	−2.919	0.001	0.054
Spatial						
Subcounty	−0.405	0.047*	0.667	−0.250	0.245	0.779
Where the household head lives	1.203	0.052**	3.329	0.632	0.283	1.881
Demographics						
Household size	0.341	0.099**	1.406	0.507	0.020*	1.660
Gender	0.247	0.363	1.280	−0.151	0.590	0.860
Socioeconomic						
Education	−0.003	0.990	0.997	0.332	0.135	1.394
Main occupation	−0.478	0.058**	0.620	−0.717	0.007*	0.488
Membership to organizations	0.293	0.342	1.340	1.013	0.004*	2.754
WASH						
WASH cleanliness	0.336	0.107	1.399	0.679	0.002*	1.972
Time to collect water	0.431	0.041*	1.538	0.330	0.133	1.390
Production						
Keeps livestock	0.183	0.489	1.201	0.810	0.006*	2.249
Agricultural implements	0.550	0.009*	1.734	0.171	0.438	1.186
Food reserves	0.068	0.879	1.070	−0.584	0.204	0.558
Land access	0.153	0.620	1.166	0.816	0.021*	2.262
Micronutrient gardens	0.173	0.438	1.189	0.279	0.221	1.321

Model (1): Dietary diversity (0 = poor/average, 1 = good)
Model (2): Caloric intake (0 = poor/borderline, 1 = acceptable)
*Significance at p = 0.05; **Significance at p = 0.1

Food Insecurity Coping Strategies

In focus groups, mothers raised several coping strategies, mostly selling their labor to other community members for food or cash to buy food. All strategies are depicted in Figure 6, and lived experiences are also narrated.

The most used strategy was selling their labor either for cash or food, with narratives involving either the mothers and/or their husbands. One mother said, "I work in people's gardens during food scarcity periods to get some food to feed my family" (BUS1-4). Another mother also said, "My **husband** can go and work in people's sugarcane plantations so that he can get some money to buy food at home" (NAK2-2). While another mother said, "We work together with my husband so that we can get some money for buying food at home" (KAK1-6). Mothers also talked of working and rationing food: "For us, we work in the people's sugar cane plantations and when we get some money, we buy 4kgs of cassava flour to be eaten for four days to save the food" (KAB1-3), illustrating shifts from eating fresh cassava to processed cassava flour. With buying, one mother said, "My husband normally buys food at the shop, such as posho [maize meal]" (BUS1-1).

Using food reserves, specifically stores, a mother shared, "I store my dried food such as maize, cassava, and sweet potatoes. In food scarcity, we eat what I stored, and if the stored food gets finished, we start buying from the shops" (NAL1-3). On food reserves in the gardens**,** a mother narrated that "I normally reserve my cassava in the garden so that it can help me in the periods of food scarcity"; she added, "for us, we do not work in the people's gardens, we entirely eat our cassava during the periods of food scarcity since I have a big garden of cassava" (NAK2-6). Another mother added, "We also cope by eating cassava flour and dried potatoes since we reserve

Table 3. Percentage of Dietary Diversity Pathways by Food Groups

Foods groups	Foodstuffs	Farmstead pathways	Market pathways	Other pathways
Vegetables	Tomatoes	16.3	80.6	0.4
	Onions	9.9	86.6	—
	Eggplants	37.4	35.9	2.6
	Leafy amaranths	42.1	4.8	2.2
Proteins	Beans	79.7	9.5	2.8
	Milk	17.2	57.9	1.5
	Ground nuts	48.9	19.2	5.5
	Soybean	51.1	6.8	5
	Fish	—	49.3	—
	Eggs	22.2	18.7	0.7
	Beef	0.4	37.2	0.4
Energy-Starch	Maize	91.0	4.2	2.4
	Sweet potatoes	68.7	7.9	3.3
	Rice	13.2	59.0	2.4
	Cassava	47.6	11.2	4.6
	Matooke/plantain	33.7	15.2	0.9
	Pumpkins	41.6	2.2	3.7

See Appendix F for details.

them during plenty periods to wait for lean periods" (KIC2-3).

Regarding production strategies, one mother described "planting early maturing crops in the wetlands [swamps] because in most cases, the wetland is always wet, during drought periods, therefore in the food scarcity period we eat some potatoes we planted in the wetlands" (NAK2-8). Yet another mother added, "I go and work in the people's gardens so that they can give me some food, but in the case of vegetables, I grow my vegetables" (BUS2-2), demonstrating multiple strategies, especially with vegetables that can be grown on micronutrient gardens like keyhole and sack. On selling land, one mother said: "For us, if the situation worsens, we can sell a piece of land so that we get money to buy food instead of stealing people's food from their gardens" (NAK2-7). On friends, one mother said, "I cope by getting food from my friends, such as cassava, because my friends normally reserve some cassava in their gardens" (KYA2-1).

On fruit gathering, one mother said, "During lean periods, I tell my children to go and look for some fruit during the day, and then at supper, we can buy some food" (KYA1-2). Related to small businesses, one mother said, "During food scarcity seasons, since I have a small business, I use some profits to buy food for my family and sometimes I can borrow food [obtain on credit] at a different shop and pay later" (KAK1-1). This scenario illustrates social trust among small shop owners. On selling livestock, a mother said, "I am rearing pigs, goats, and chickens. If the situation worsens, I sell some livestock to buy food, but when the food is in plenty, I rarely sell livestock" (NAK2-9). Others reported relying on NEC porridge; a mother stated that "for me, I cope during food scarcity periods by getting the dense-nutrient porridge at the NEC" (KYA2-2).

Discussions and Conclusions

The discussions and conclusions are presented in four sections, including comparative dietary diversity and caloric intake statuses, dietary diversity pathways results from the 454 households surveyed, and changes in food consumption patterns and coping strategies during food scarcity periods from the 125 mothers involved in the 12 focus group discussions.

Household Dietary Diversity and Caloric Intake/Consumption

On average, all 454 households were within average dietary diversity and borderline caloric intake. These findings align with the results found in assessing food security status using the Household Food Insecurity Access Scale within this population, where, on average, households were found to be food insecure (Ikendi, Owusu et al., 2023a). These findings concur with researchers who validated that the three tools that measure food access using HDDS and FCS (Swindale & Bilinsky, 2006) and the Household Food Insecurity Access Scale (Coates et al., 2007) all yield similar results.

Nonetheless, there were improvements in food access from the baseline data of 2015, when HDDS reported 36.4% of households with good diets and FCS reported 38.2% with acceptable caloric intake. In 2019, in this study, HDDS reported 44.1% of households with good diets, and FCS reported 42.2% with acceptable caloric intake.

The CSRL/ISU-UP program households affiliated with the NECs and other program participants classified as non-NEC clients had better dietary and caloric intake scores than non-program participants. By participation in LEPs, households in the agronomy and postharvest programs were associated with good dietary scores. Similarly, acceptable caloric intake scores were associated with participation in agronomy and postharvest, livestock integration, and nutrition and infant feeding programs. Although not statistically significant, participants in water and public health services, complementary services such as nutrient-dense porridge, and income innovation better good dietary diversity and caloric intake than non-program participants.

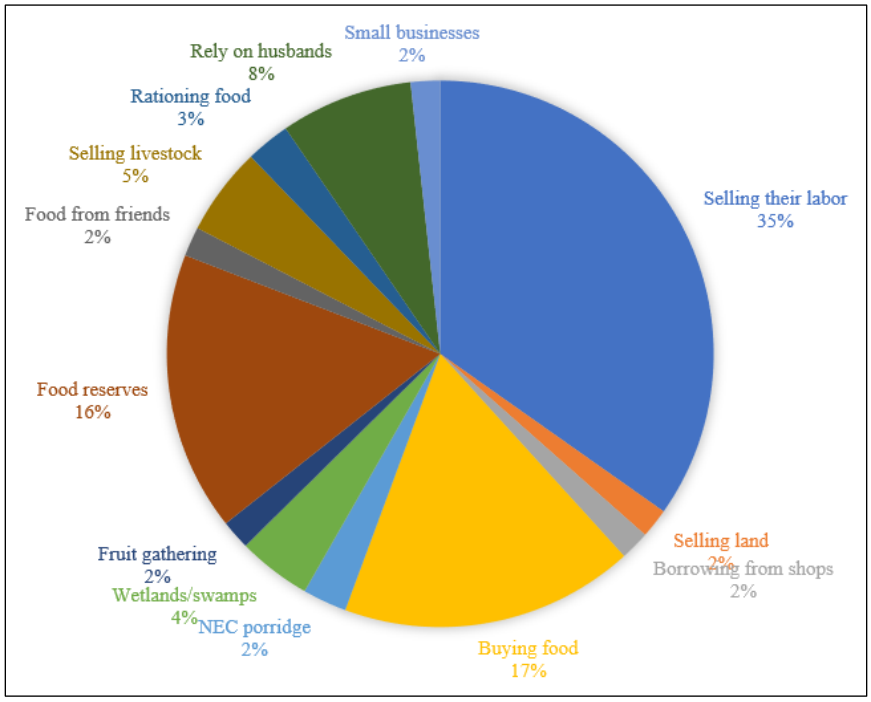
Participants in agronomy programs acquire knowledge on agronomical practices, based on scientific studies conducted within the programs on topics such as soil management (Akitwine, 2021; Anderson, 2023; Wokibula et al., 2024; Wokibula &

Table 4. Frequencies of Ranks in Changes in Food Consumption Patterns

	Ranking consumption in plenty					Ranking consumption in scarcity				
Foodstuffs by food groups	R5	R4	R3	R2	R1	R5	R4	R3	R2	R1
Main Staples										
Sweet potatoes	12	—	—	—	—	—	—	1	1	3
Dried potatoes	—	—	—	—	—	12	—	—	—	—
Posho	12	—	—	—	—	—	3	6	1	2
Rice	—	8	2	1	1	—	—	—	—	—
Fresh cassava	2	6	2	1	—	2	1	3	1	1
Cassava flour	—	—	—	—	—	11	—	—	—	—
Matooke	—	1	4	4	1	—	—	—	—	—
Pumpkin	—	1	1	—	—	—	—	—	—	1
Millet	—	—	—	—	6	—	2	1	5	—
Yams	—	—	—	1	1	—	—	—	—	2
Pulses/Legumes										
Beans	10	—	—	—	—	—	—	—	2	6
Ground nut	2	5	1	—	—	—	—	3	4	1
Soy bean	—	—	2	—	1	—	—	—	—	1
Sim-sim	—	—	1	1	2	—	—	—	1	1
Vegetables										
Leafy greens	11	—	—	—	—	2	5	4	—	—
Eggplants	2	2	—	—	—	1	2	2	—	1
Tomatoes	—	1	—	—	—	1	5	1	—	1
Cabbage	—	—	1	1	—	—	—	—	—	—
Irish potatoes	1	—	—	—	2	—	—	—	—	—
Seafood and Meat										
Silver fish	5	1	—	2	—	5	3	1	—	1
Fish	—	1	3	3	2	—	—	—	1	1
Meat	—	—	4	3	4	—	—	—	—	3
Chicken	—	—	—	—	3	—	—	—	—	—
Eggs	—	—	—	—	2	—	—	—	—	—

Note: R5 = most consumed and R1 = least consumed foodstuff.

Figure 6. Food Insecurity Coping Strategies



Westgate, 2016) and on high-yielding seeds and seed management, especially grain amaranth (Ainebyona et al., 2012; Muyonga et al., 2010), pumpkins (Kwikiiriza, 2022), and tomatoes (Tusiime et al., 2019; Tusiime et al., 2020). Participants also gain best practices, such as establishing micronutrient vegetable gardens like keyholes, sacks, and kitchen gardens to provide vegetables for household diets, including in schools supported by the program (Banige et al., 2024a, 2024b; Byaruhanga et al., 2017; Ikendi, 2022; Ikendi et al., 2024; Duerfeldt et al., 2016; Nonnecke et al., 2016). These micronutrient gardens have been a foundational food security strategy of the CSRL program from its inception in 2004 (Masinde & McMillan, 2015). Micronutrient vegetable gardens have been found to be associated with household food security (Ajal, 2025; Asante et al., 2024; Hansen et al., 2022; Ikendi, Owusu et al., 2023a). In postharvest programs, households get training and also receive storage facilities like silos and tarpaulins at subsidized prices to help with management of food reserves (Bbosa et al., 2017; 2020; Brumm et al., 2021; Ikendi et al., 2024; Mayanja et al., 2018; Tumutegyereize et al., 2022).

Similarly, households in livestock programs, in addition to knowledge, receive breeding animals such as piglets, local chickens, layer chickens, and water tanks to foster production, income, and consumption of animal-source proteins (Ikendi et al., 2025). Farmers engaged in egg production are required to pay back the loans in installments once their birds start laying. Goat farmers who receive breeders repay loans using the fees they charge in communities for breeding. Pig farmers are required to pass on two piglets to fellow farmers at first farrowing. Farmers who receive livestock water tanks cost-share with the program during construction. Livestock act as insurance to crop failure and are food security and poverty reduction pathways, especially among women farmers (Bain et al., 2020; Colverson et al., 2020; Kakungulu et al., 2025; Nagasha et al., 2024; Waiswa & Jolly, 2021).

Likewise, households who participated in nutrition and infant feeding programs are trained in best feeding practices from pregnancy, including exclusive breastfeeding and designing balanced diets for their households (Ikendi, Owusu, & Masinde, 2023; Masinde, McMillan et al., 2015; Winham et al., 2016). Clients receive theoretical and practical trained at the community-based NECs with cooking demonstrations. Such nutrition education programs support behavioral change towards food production and healthy feeding practices (Atim et al., 2024; Kansiime et al., 2021; Nakakawa et al., 2024).

Participants in water and public health receive training on WASH-related diseases and prevention through the construction and maintenance of these WASH facilities, such as latrines, which are key to household health (Auma et al., 2024; Ikendi, Masinde et al., 2025). Participants who receive complementary services such as therapeutic porridge are mainly at-risk-for-malnutrition mothers

and their children under rehabilitation (Ikendi, Owusu et al., 2023b). These clients also get family planning and immunization services with the help of government health center nurses, complementing its efforts in providing health services to needy communities (Namakula et al., 2021; Sharma et al., 2024). Likewise, participants in income innovations engage in craft-making activities like weaving baskets and making soap and bags, which are sold locally and internationally in the United States, helping to increase their income streams (Ikendi, Mwenyi et al., 2025; Martin, 2018). In sum, these findings partly speak to the significant role CSRL/ISU-UP LEPs have had on households by improving access to food.

Household Dietary Diversity/Food Access Pathways

Farmstead/home/own production and market/purchase were the two major dietary diversity pathways. Our findings concur with other studies, which also concluded that the home production pathway increases household dietary diversity (Morrissey et al., 2024; Sekabira et al., 2022; Waaswa et al., 2021; 2024). Wakaba et al. (2025) found similar results in Kenya, and added that market pathways, through sweet potato commercialization, improves dietary diversity. In the current neoliberal economy, where food is considered a commodity for sale (Bradley et al., 2023a; Canfield et al., 2021), farmstead pathways can counter the soaring food prices (Silva e Silva et al., 2024).

In earlier studies, we found low revenue from crops (Ikendi et al., 2024) and livestock (Ikendi et al., 2025) in this sample, and we can conclude that low sales have limitations on food access through market pathways, yet 79.3% of households relied on farming. Low purchasing power affects animal-source proteins, limiting their consumption, yet they have high dietary indices (Swindale & Bilinsky, 2006). Other aspects, like religion, also limit consumption of certain animal-source foods like pork among Muslims and Seventh-Day Adventists (den Hartog, 2024), who formed 21.4% of our study. Additionally, cultural beliefs among some groups in the study region prevent pregnant mothers from eating some species of fish, such as lungfish and mudfish (Tugume et al., 2024), reducing their dietary seafood options.

Dietary Patterns and Food Insecurity Coping Strategies

There were changes in consumption formats for similar foodstuffs, for instance, from consuming fresh sweet potatoes and cassava in the plentiful seasons to consuming dried potatoes and processed cassava flour in lean periods. Also, there were reductions in foodstuffs such as posho, beans, fish, and meat, and foods such as *matooke* (plantain) and rice eventually disappeared from the menu in lean periods. These aspects explain the low dietary diversity and caloric intake identified and the food insecurity within this population (Ikendi, Owusu et al., 2023a) and its neighbors (Kalinaki et al., 2025). Most foodstuffs in lean periods were accessed through purchases. Given the increasing prices with low incomes, it was difficult for households to cope with balanced diets. Moreover, the main coping strategy was selling labor and buying food, which all have implications for soaring food costs.

The other coping strategy was food storage, specifically food kept in store with limitations on recommended storage facilities in the area (Ikendi et al., 2024; Tibagonzeka et al., 2018). And having fresh food in gardens aligns with food crops like cassava and sweet potatoes, which also have a limited lifespan. Relying on husbands as a coping strategy demonstrates the importance of stable marriage in upholding their household and coalescing the families around food (Bradley et al., 2023b; Mohammed et al., 2023). Other strategies, like obtaining food on credit from shops and getting food from friends, demonstrate social capital, specifically cognitive bonding, which demonstrates trust and willingness to live together and help one another (Craig et al., 2025; Malual & Mazur, 2020; Neonbeni et al., 2025; Sseguya et al., 2018).

The production strategy was specifically mentioned by mothers who have access to land, especially wetland/swamps, to allow production in dry seasons. Whereas land access was key, we found that households had access to an average of 3.54 acres (1.43 hectares), with 13.4% accessing less than 4.0 acres (1.6 hectares). Also, the use of wet-

lands has had negative environmental implications, along with the destruction of forests in the study area (Thurow, 2024). Moreover, some mothers mentioned sending their children to gather fruits, though with reductions in forests, the hunter-gatherer strategy is less popular today than in the traditional heritage (Ikendi, 2023; Ingold et al., 2024). This scenario indicates the important role of promoting indigenous and wild edible trees as food security strategies (Okullo et al., 2022).

Similarly, sugarcane production has lured small landholders into modern-day land grabbing (Mwanika et al., 2021). This issue has escalated food insecurity, especially in Namasagali subcounty, which had low diversity scores and high food insecurity (Ikendi, Owusu et al., 2023a). Nevertheless, the promotion of micronutrient vegetable gardening has been key to supporting food production on limited land within program households and schools. Additionally, mothers mentioned using profits from their small businesses. Participants in income innovation programs earn income from making and selling crafts, soap, and sewing products like laptop bags (Ikendi, Mwenyi et al., 2025; Martin, 2018). Mothers use their income to set up small businesses like grocery shops, increasing their food access strategies, and households in income innovation were food secure (Ikendi, Owusu et al., 2023a).

Recommendations for Practice

The results of the study demonstrate the importance of LEPs in influencing food production and access. Since household training was associated with good diets and acceptable caloric intake, it is important that households engage in extension programs to access a blend of knowledge on food production through agronomy and livestock programs. Also, knowledge on nutrition and infant feeding can help support behavioral change toward design of recommended diets. Water and public health will support communities with an understanding of the role and importance of having WASH facilities. Improved cleanliness will reduce household predisposition to related diseases like diarrhea, which affects labor contribution to food production as members are bedridden.

Education opportunities through income innovations will enhance household income streams through women making various craft products using locally available materials and using the skills of their hand. Participating in complementary services, other than therapeutic porridge, reserved for at-risk-for-malnutrition mothers and children (Ikendi, Owusu et al., 2023b), such as immunizations, at NECs with the support of government nurses will help reduce the distances mothers have to travel to health facilities. This opportunity will in turn help them allocate more time to production activities. All education programs and innovations are designed based on scientific research conducted in the communities and blended with indigenous knowledge, making them effective in local communities to drive food security innovation (Davis et al., 2025).

Recommendations for Research

This study found changes in consumption patterns, especially from consuming fresh foods such as sweet potatoes and cassava in seasons of plenty to dried potatoes and cassava flour in seasons of scarcity. This finding implies a need to strengthen the development of postharvest management practices. The current practices have mainly focused on grain storage in the program, and there is a need to allocate research resources to postharvest management of starchy food. Moreover, the adoption of postharvest practices such as drying on tarpaulins and the use of silos was very low and significantly lower among non-trained households within this sample (Ikendi et al., 2024). Improper practices like drying on bare ground lead to food contamination, especially aflatoxins. The use of food reserves, especially food in household stores, was the third-ranked food insecurity coping strategy identified in the focus groups. Studies in Kamuli and other districts found that aflatoxin contamination in cassava was 60% and 35% in potatoes (Tibagonzeka et al., 2018), a factor associated with poor postharvest management. Moreover, potatoes and cassava are the foodstuffs fed to livestock within this sample (Ikendi et al., 2025). Research has shown that contaminated feeds, like poultry mash, has implications for the meat industry (Nakavuma et al., 2020).

The coping strategies that mothers provided demonstrate the unequal burden of finding food to

sustain their households. Strategies like selling labor more often involved women than men, and others, like use of profits from small businesses and obtaining food on credit and from friends, all focused on women. These revelations require additional investigation into men's roles in food insecurity coping strategies in Kamuli district. Studies conducted among both women and men, specifically with *matooke* (plantain), revealed divergencies in preferences such as tastes, connotation of food among women, and bunch and finger size, synonymous with sales for men (Mulugo et al., 2024). Additionally, the fact that *matooke* disappeared from the menu during lean periods, yet it is a staple food, requires further investigation into its production dynamics, as has been done in the central and western regions of Uganda to determine future production prospects (Tenywa et al., 2024). Scientific research (Acker et al., 2015; Ikendi, Mwenyi et al., 2025; Ikendi & Retallick, 2025) and indigenous knowledge (Masinde & McMillan, 2015) are the foundation for the CSRL/ISU-UP extension development to promote the adoption of innovations and create extension curricula to educate farmers on sustainable food production and nutrition technologies through the interrelated livelihoods education programs.

Recommendations for Policy

This study reiterates the important role that partners play in advancing the human capacity development of communities to improve food access through a public–private partnership. The CSRL/ISU-UP human development approach is synonymous with the call by the Office of the Prime Minister (2020) of Uganda to improve the structural functionality of the food and nutrition interventions through stakeholder collaboration. Government policies can support the continuity of public–private collaboration in supporting households through the development, implementation, and monitoring of food security interventions.

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Appendix A. Food Frequency Questionnaire for Determination of Household Dietary Diversity Scores and Food Consumption Scores

FOOD ITEM	Yesterday	Last Week	How Accessed*	FOOD ITEM	Yesterday	Last Week	How Accessed*
Cereals				**Other Vegetables**			
Maize (*any form*)				Tomato			
Millet				Onions			
Sorghum				Eggplants			
Amaranth grain				**Fruits**			
Rice				Mango			
Bread				Paw paws			
Chapatti				Orange			
Other cereals				Pineapple			
Legumes and Nuts				Passion fruit			
Beans				Jackfruit			
Soybean				Other fruits			
Other legumes				**Animal Products**			
Groundnuts				Beef			
Sim-sim				Chicken			
Vitamin A–rich Veg.				Pork			
Orange potatoes				Goat			
Pumpkins				Fish			
Carrots				Eggs			
White tubers				Milk			
Sweet potatoes				Ghee			
Cassava				**Other Products**			
Yams				Sugar			
Other tubers				Honey			
Matooke				Sweetened Soda			
Dark Green Veg				Sweets			
Cabbage				Tea			
Leaf amaranth				Cooking Oil			
Other dark greens				Iodized Salt			

Adopted and modified from Swindale and Bilinsky (2006, p. 4).

Appendix B. Independent Variables/Household Characteristics Used in the Binary Logistic Regression Models Believed to Influence the Household Dietary Diversity Score (HDDS) and Food Consumption Score (FCS) Statuses

Theme	Variables	Indicators	Frequency	Percentage
Spatial	Subcounty*	Butansi	261	57.5
		Namasagali	193	42.5
	Where the household head lives*	Outside of the home	17	3.7
		Within the home village	437	96.3
Demographic	Household size*	> 5 members	236	52.0
		≤ 5 members	218	48.0
	Gender of household head**	Female	81	17.8
		Male	373	82.2
	Marital status***	Married	392	86.3
		Not married	62	13.7
	Religion***	Anglican, Catholic, etc.	357	78.6
		Muslim, Seventh-day Adventist	97	21.4
	Age***	35 and below	197	43.4
		36–50	221	48.7
		Over 50	36	7.9
Socio-economic	Education of household head**	Primary level or less	308	67.8
		Post primary	146	32.2
	Main occupation of household head*	Farming	360	79.3
		All others	94	20.7
	Membership of community organizations*	No	65	14.3
		Yes	389	85.7
	Participation in LEPs***	Yes	316	69.6
		No	138	30.4
WASH	WASH Cleanness*	Poor	202	44.5
		Good	252	55.5
	Time to collect water*	> 30 minutes	170	37.4
		< 30 minutes	284	62.6
Production	Households keep livestock*	No	88	19.4
		Yes	366	80.6
	Home essential items***	Less than three	250	55.1
		At least three	204	44.9
	Agricultural implements*	Less than four	271	59.7
		At least four	183	40.3
	Household food reserve**	None	27	5.9
		Food in store/house	382	84.1
		Food in garden	45	9.9
	Land access*	Less than four	61	13.4
		At least four	393	86.6
	Micronutrient vegetable gardens**	No	305	67.2
		Yes	149	32.8

* Factor used and was statistically significant, ** Factor used but was not statistically significant, *** Factor dropped due to compliance with Tolerance Value and/or Variance Inflation Factor criteria.

Appendix C. Linear Regression Testing for Multicollinearity of the Household Dietary Diversity Score (HDDS) Study Variables

Model	*R*	*R* Square	Adjusted *R* Square	Std. Error of the Estimate
1	.368[a]	0.136	0.108	1.605

ANOVA[a]

Model		S Squares	df	Mean Square	F	Sig.
1	Regression	177.570	14	12.684	4.925	< .001[b]
	Residual	1130.529	439	2.575		
	Total	1308.099	453			

Coefficients[a]

	Unstd Coeff.		Std Coeff.			95% C.I for B		Collinearity Statistics	
Model variables	B	SE	Beta	t	Sig.	LB	UB	TV	VIF
(Constant)	6.298	0.619		10.172	< .001	5.081	7.515		
Spatial									
Subcounty	−0.324	0.156	−0.094	−2.072	0.039	−0.631	−0.017	0.951	1.051
Where HH head lives	0.746	0.411	0.083	1.815	0.070	−0.062	1.553	0.933	1.072
Demographics									
Household size	0.220	0.158	0.065	1.395	0.164	−0.090	0.530	0.915	1.093
Gender of HH head	0.174	0.205	0.039	0.848	0.397	−0.229	0.576	0.923	1.083
Socio-economic									
Education of HH head	0.128	0.164	0.035	0.779	0.437	−0.195	0.451	0.962	1.040
Main occupation	−0.391	0.193	−0.093	−2.028	0.043	−0.770	−0.012	0.930	1.075
Membership to org	0.443	0.231	0.091	1.916	0.056	−0.011	0.897	0.896	1.154
WASH									
WASH Cleanliness	0.481	0.159	0.141	3.031	0.003	0.169	0.793	0.911	1.097
Time to collect water	0.336	0.160	0.096	2.096	0.037	0.021	0.651	0.944	1.059
Production									
HH keep livestock	0.245	0.200	0.057	1.225	0.221	−0.148	0.638	0.908	1.102
Ag implements	0.521	0.162	0.150	3.213	0.001	0.202	0.839	0.898	1.113
Type of food reserve	−0.142	0.329	−0.020	−0.433	0.665	−0.788	0.504	0.939	1.065
Land access	0.350	0.231	0.070	1.518	0.130	−0.103	0.804	0.916	1.092
Micro veg. garden	0.263	0.172	0.073	1.528	0.127	−0.075	0.600	0.891	1.148

[a] Dependent Variable: Household Dietary Diversity Score.
[b] Predictors: Constant and all predictor variables.
Unstd Coeff.: Unstandardized Coefficients.
HH: Household.
Org: Organizations.
Ag: Agriculture.

Appendix D. Linear Regression Testing for Multicollinearity of the Food Consumption Scores (FCS) Study Variables

Model	*R*	*R* Square	Adjusted *R* Square	Std. Error of the Estimate
1	.417[a]	0.174	0.147	11.5646

ANOVA[a]

Model		S. Squares	df	Mean Square	F	Sig.
1	Regression	12354.100	14	882.436	6.598	<.001[b]
	Residual	58711.653	439	133.740		
	Total	71065.753	453			

Coefficients[a]

	Unstd Coeff.		Std Coeff.			95% C.I for B		Collinearity Statistics	
Model variables	B	SE	Beta	t	Sig.	LB	UB	TV	VIF
(Constant)	20.00	4.46		4.483	<.001	11.234	28.773		
Spatial									
Subcounty	−0.438	1.126	−0.017	−0.389	0.698	−2.65	1.774	0.951	1.051
Where HH head lives	1.872	2.96	0.028	0.632	0.528	−3.947	7.69	0.933	1.072
Demographics									
Household size	0.756	1.136	0.030	0.666	0.506	−1.476	2.989	0.915	1.093
Gender of HH head	−1.415	1.475	−0.043	−0.959	0.338	−4.315	1.484	0.923	1.083
Socio-economic									
Education of HH head	1.462	1.185	0.055	1.234	0.218	−0.867	3.791	0.962	1.040
Main occupation	−3.548	1.389	−0.115	−2.554	0.011	−6.277	−0.818	0.930	1.075
Membership to org	4.765	1.665	0.133	2.862	0.004	1.493	8.037	0.866	1.154
WASH									
WASH Cleanliness	4.067	1.144	0.162	3.555	<.001	1.819	6.315	0.911	1.097
Time to collect water	1.944	1.154	0.075	1.684	0.093	−0.324	4.213	0.944	1.059
Production									
HH keep livestock	3.049	1.441	0.096	2.116	0.035	0.217	5.882	0.908	1.102
Ag implements	2.946	1.167	0.115	2.523	0.012	0.651	5.240	0.898	1.113
Type of food reserve	−1.119	2.369	−0.021	−0.472	0.637	−5.774	3.536	0.939	1.065
Land access	4.925	1.663	0.134	2.962	0.003	1.657	8.192	0.916	1.092
Micro veg. garden	2.591	1.239	0.097	2.092	0.037	0.157	5.026	0.871	1.148

[a] Dependent Variable: Food Consumption Score/Caloric Intake Score
[b] Predictors: Constant and all predictor variables.
Unstd Coeff.: Unstandardized Coefficients.
HH: Household.
Org: Organizations.
Ag: Agriculture.

Appendix E. Comparison of Food Groups in the Household Dietary Diversity Scores (HDDS) and Food Consumption Scores (FCS) by Affiliation to the Nutrition Education Centers (NECs)

HHDS FCS		NEC Clients (*n* = 253)	Non-NEC (*n* = 63)	Nonparticipants (*n* = 138)	Overall (*n* = 454)	*P*-Value
Percentage of HDDS Foods						
HDDS	Cereals	97.2	98.4	95.7	96.9	0.523
	Legumes	91.7	95.2	87.7	91.0	0.185
	Vegetables	99.6	98.4	98.6	99.1	0.460
	Tubers	81.8	90.5	81.2	82.8	0.219
	Fruits	49.8	66.7	46.4	51.1	0.023*
	Meats	18.2	34.9	16.7	20.0	0.006*
	Fish/seafood	21.3	25.4	24.6	22.9	0.669
	Eggs	26.1	28.6	17.4	23.8	0.098*
	Milk/dairy	58.1	65.1	58.7	59.3	0.594
	Sugar/honey	92.9	92.1	87.0	91.0	0.140
	Oils/fats	96.4	90.5	94.9	95.2	0.141
	Miscellaneous	100	98.4	100	99.8	0.045*
Mean FCS						
FCS	Main staples	$12.6^{b} \pm 5.068$	$11.9^{a,b} \pm 5.581$	$10.8^{a} \pm 4.556$	11.9 ± 5.046	0.003*
	Pulses	$7.0^{a,b} \pm 3.148$	$7.3^{b} \pm 3.085$	$6.2^{a} \pm 3.061$	6.8 ± 3.136	0.014*
	Vegetables	$4.4^{b} \pm 1.279$	$4.4^{b} \pm 1.439$	$3.8^{a} \pm 1.198$	4.2 ± 1.298	0.000*
	Fruits	$1.4^{a} \pm 1.298$	$1.9^{b} \pm 1.374$	$1.2^{a} \pm 1.338$	1.4 ± 1.336	0.002*
	Meats/fish	$5.5^{a,b} \pm 4.832$	$6.5^{b} \pm 5.850$	$4.8^{a} \pm 4.732$	5.4 ± 4.975	0.061*
	Milk	$2.9^{a} \pm 1.785$	$3.1^{a} \pm 1.676$	$2.9^{a} \pm 1.793$	2.9 ± 1.771	0.693
	Sugar	$0.5^{a} \pm 0.082$	$0.5^{a} \pm 0.148$	$0.5^{a} \pm 0.136$	0.5 ± 0.112	0.024*
	Oil	$0.5^{a} \pm 0.070$	$0.5^{a} \pm 0.107$	$0.5^{a} \pm 0.060$	0.5 ± 0.074	0.312

Superscripts $^{a \& b}$ depict significant mean differences between groups for caloric intake status.

Appendix F. Pathways to Food Access in Survey

Food Groups	Examples of foods accessed per group	Percent (n = 454)	How food was accessed in percentages				
			Home	Bought	Exchanged	Loaned	Gift
Vegetables	Sim-sim	20.3	13.2	5.3	0.2	—	1.5
	Carrots	4.2	1.5	2.4	—	—	0.2
	Tomatoes	97.4	16.3	80.6	—	—	0.4
	Onions	96.5	9.9	86.6	—	—	—
	Egg plants	76.0	37.4	35.9	0.4	—	2.2
	Cabbage	67.8	6.4	60.8	—	0.2	0.4
	Leafy amaranths	49.1	42.1	4.8	0.2	—	2.0
	Other green veges	53.5	50.2	2.4	—	—	0.9
Proteins	Grain amaranths	39.4	31.1	4.2	0.2	—	4.0
	Beans	92.1	79.7	9.5	0.2	0.2	2.4
	Soybean	63.0	51.1	6.8	—	0.2	4.8
	Ground nuts	73.6	48.9	19.2	0.4	—	5.1
	Beef	38.1	0.4	37.2	—	—	0.4
	Chicken	14.5	8.6	5.5	—	—	0.4
	Pork	9.3	1.1	8.1	—	—	—
	Goat meat	7.3	0.2	7.0	—	—	—
	Fish/sea foods	49.3	—	49.3	—	—	—
	Eggs	41.6	22.2	18.7	—	—	0.7
	Milk	76.7	17.2	57.9	—	—	1.5
Miscellaneous	Sugar	95.8	—	95.4	—	—	0.4
	Honey	5.9	0.4	5.5	—	—	—
	Cooking oil	98.0	0.2	97.8	—	—	—
	Iodized salt	100.0	—	100.0	—	—	—
Fruits	Mangoes	13.2	10.1	2.2	—	—	0.9
	Pawpaw	28.0	25.3	1.1	0.2	—	1.3
	Oranges	31.3	27.1	3.1	0.2	—	0.9
	Pineapples	14.8	2.0	12.6	—	—	0.2
	Passion fruits	22.9	7.7	14.8	—	—	0.4
	Jackfruits	52.2	45.2	3.5	0.4	—	3.1
Carbohydrates/ Energy/ Starch	Maize	97.6	91.0	4.2	0.2	—	2.2
	Millet	44.5	34.8	7.0	0.2	—	2.4
	Sorghum	21.1	17.0	4.0	—	—	0.2
	Rice	74.7	13.2	59.0	—	—	2.4
	Bread	42.5	0.4	41.6	—	—	0.4
	Chapatti	63.9	0.4	63.4	—	—	—
	Orange.F.S.Potatoes	24.7	21.6	2.0	—	—	1.1
	Pumpkins	47.6	41.6	2.2	0.2	0.4	3.1
	Sweet potatoes	80.0	68.7	7.9	0.4	—	2.9
	Cassava	63.4	47.6	11.2	0.2	—	4.4
	Yams	12.1	8.4	2.9	—	—	0.9
	Matooke/plantain	49.8	33.7	15.2	—	—	0.9