Coping Mechanisms for Food Insecurity among Rural Households in Bitereko Sub- County, Mitooma District: Convergent Parallel Mixed-Methods Design

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ABSTRACT

Background: Food insecurity is a multifaceted global health concern, causing poor health in low- and middle-income countries, especially in rural sub-Saharan Africa. This study was done to assess causes of food insecurity, explore coping strategies and the effect of environmental factors and locally accessible resources on the food situation in Bitereko Sub- County, Mitooma district, Uganda

Method: This article's empirical analysis is predicated on data collected on thirty-two households from Bitereko Sub- County between September and October 2018 which were selected using stratified sampling technique. Focus group discussions, key informant interviews and a semi-structured questionnaire were used for data collection. Descriptive analysis was done using IBM SPSS version 20 while qualitative (thematic and content) analysis was conducted manually.

Result: The study findings show that population increase and land degradation is the main cause of food shortage in the area. Banana was reported (100%) by both genders to be the major food crop relied upon by the households. Reducing the number of meals (40.62%) was the main coping strategy to food insecurity. Diversification into non-farm activities and agricultural diversification are two main livelihood adjustment strategies that have emerged in the area in relation to environmental factors and locally available resources.

Conclusion: The study findings indicate that gender, age group and education level significantly influenced the food situation in a given household. Households whose heads were male were more likely to experience food insecurity as compared to the females χ^2 (1, N = 32) = .002, p = .041. Households with respondents aged between 20 – 29 years were less likely to experience food insecurity than those aged between 30 – 39 years χ^2 (5, N = 32) = 16.09, p = .007. Whereas respondents who had attained up to primary level of education were more likely to experience food insecurity in their households as compared to those who had never been to school χ^2 (4, N = 32) = 15.71, p = .003.
Keywords: Household food insecurity, Livelihood strategies, Diversification, Agricultural intensification.

INTRODUCTION

Human health, food security, and agriculture are closely intertwined (1; 2; 3); a healthy diet brought about by a thriving agricultural sector promotes human health and wellness, strengthens resilience to disease, and increases production (4; 5; 6). Food insecurity (FI), the state in which there is a lack of access to safe, nutrient-dense foods or a lack of certainty about how to obtain those foods in ways that are acceptable to society (7; 8) continues to be a major global public health concern (9; 10), and is a primary factor in low- and middle-income countries' malnutrition, ill health, low productivity, and survival difficulties (11; 12; 13). Approximately 2 billion individuals worldwide, or 26.4% of the world's population, suffer from

moderate to severe food insecurity; of these, 1.04 billion (or 52%) live in Asia and 676 million (or 34%) in Africa; in contrast to high-income nations, sub-Saharan Africa (SSA) is home to about 224 million people, or roughly one-third of the global total (14). As a result, SSA finds it challenging to feed its people because of climate change and rapid population growth (15). Uganda, an East African nation, is among the poorest in the world; a significant proportion of households, particularly those in rural areas, are projected to be severely food insecure (26%) (16).

The world's population is expected to increase to 8 billion people by 2025 and 9.4 billion people by 2050, with developing nations expected to account for 93% of this growth (17; 18). Already about 800 million people worldwide still go to bed hungry every night, and sub-Saharan Africa continues to require significant attention (19; 20; 21). For Uganda's poor subsistence farmers, a unit of land that used to support a family's livelihood can no longer do so because of land degradation and increasing population (22). More area is needed! However, due to overpopulation, the option of bringing additional land into production is not there. Food insecurity in Uganda worsens because soils in most parts of the country can no longer support growth of certain crops having severely degraded (23). This along with unpredictable rainfall patterns, recurrent droughts, pests and illnesses of crops and animals, results in a high degree of food insecurity and poverty, which has a detrimental impact on health (6).

Like any other region in the globe, Ugandan households that struggle with food insecurity don't give up; instead, they adopt a variety of coping strategies to lessen, manage, and adjust to the risks and shocks that they confront. Literature has revealed a variety of coping strategies that rural and peri-urban households typically use to offset losses in agricultural yields in response to food insecurity. The attempt to encroach on environmentally delicate places, such wetlands and forest reserves for charcoal burning, has been one of the main coping strategies used by the impoverished (24; 25). Additional coping strategies used by rural households include cutting back on food consumption, liquidating household belongings, skipping meals, borrowing food and cash from friends, family, and bankers, spending a significant portion of their time working for others, participating in non-farm pursuits, or pulling kids out of school (26). Therefore, in Bitereko Sub-county, coping techniques ranging from less to more extreme have been used, depending on the degree and duration of food insecurity. Although more research on food insecurity is being done in both rural and urban settings, the prevalence and contributing variables differ even within the same area (27; 28). Furthermore, there is a serious lack of evidence because no research has been done to characterize the coping strategies used by food insecure rural households in Mitooma district and Bitereko Sub-county in particular.

In this paper, we aim to examine the drivers of food insecurity, evaluate the various coping mechanisms that have emerged as a result of this food insecurity, and assess the influence of locally available resources and environmental conditions on the food situation in the area. This will complement current understanding of the various coping mechanisms used by rural households, particularly in Bitereko Sub-county. The study was hinged on the following three research questions viz; *(i). What factors influence the food situation in Bitereko Sub-county? (ii). How do households respond to food insecurity in both the short and long term? (iii). What are the available natural resources and their potential in sustaining the livelihoods of people in Bitereko Sub-county?* The results of this study will be a useful tool for informing potential policy initiatives to improve the state of food security on a national, regional, or even global level.

CONCEPTUAL FRAMEWORK

Before we can begin to comprehend the possible causes of food insecurity in Bitereko Sub-county, it is essential to first clarify our definition of "food security". Food security is a complex, multifaceted issue. FAO (2006) defined food security as having many dimensions beyond a situation where all people always have physical and economic access to sufficient, safe, nutritious food for a healthy and active life. It also includes ethical and human considerations. This definition builds on the promises made at the World Food Summit in 1996 (29). Part of the social, economic, and human development goals that must be established

by everybody is achieving global food security and ending hunger and malnutrition (30; 31).

There are three parts to food security: availability, accessibility, and utilization (29; 32; 33)**.** Food access is a result of the social, political, and physical environments, which influence how well households use their resources to achieve their goals for food security (34). Severe variations in these circumstances, such as those that occur during times of civil unrest or drought, have the potential to substantially impair production capacity or the ability to generate revenue from it, endangering the affected households' access to food (35). These shocks have serious ramifications for families' future productive capacity and, consequently, their long-term food security. They also impair households' temporary access to food and frequently result in the loss of productive assets like cattle (34; 35). This idea implies that if these circumstances worsen, households may experience food insecurity and may consume fewer than three meals a day, or the adult equivalent.

Food insecurity is a dynamic phenomenon, with different effects based on its intensity, length, and local socioeconomic and environmental factors. It can either be chronic or transient (32; 35; 36; 37; 38). Chronic food insecurity indicates that there is a constant danger that a home won't be able to provide for the food needs of its members. On the other hand, transitory food insecurity happens when a household experiences a brief decrease in the security of their entitlement and the possibility of not being able to cover their short-term food demands (32). When facing both scenarios, households react differently in an effort to change the circumstances. A frequent term for the range of actions used by households is "coping mechanisms." (39; 40). Consequently, the households' level of food security may be enhanced. However, if the difficulties occur more frequently over time, there may be a detrimental effect on food security that results in the loss of productive assets (such as the sale of land, cattle, etc.), which may eventually jeopardize future livelihoods and the long-term status of food security (25; 37). Although coping mechanisms primarily involve the aftermath of a crisis, they can also trigger the need for new livelihood patterns. For this reason, the term "coping mechanisms" as used in this study has taken into account a variety of factors that may be expected to determine how livelihood strategies are configured over time (37; 38; 39; 40; 6)**.**

The following conceptual framework served as the study's foundation.

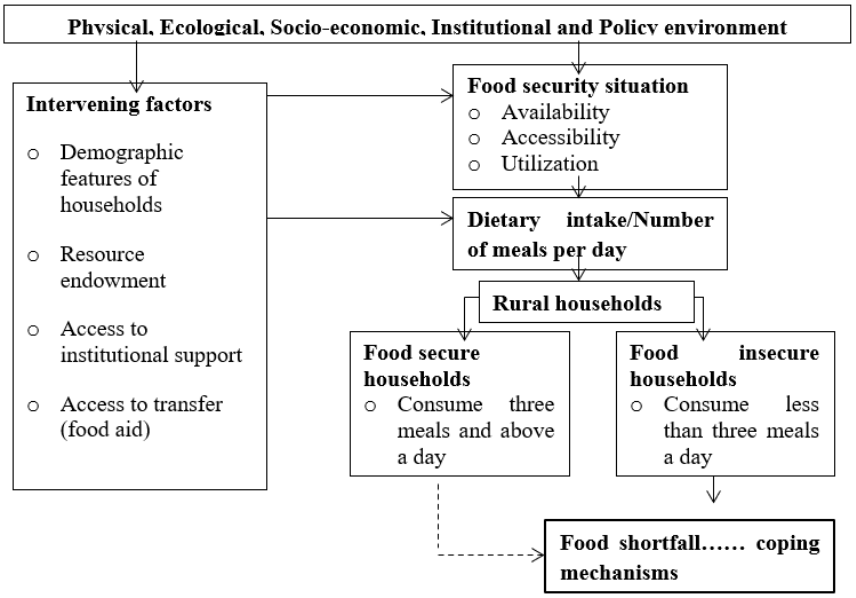

Figure 1: Conceptual framework of food security developed for the study.

The broken line shows that, although food-secure households typically eat three or more meals a day and meet their nutritional requirements, they occasionally experience food shortages during the year and are compelled to apply coping mechanisms.

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MATERIALS AND METHODS

Description of the Study Area

The study took place in Bitereko Sub-county in Mitooma district, which is part of the Ankole sub-region in western Uganda. Mitooma district (00 36S, 30 00E) is situated about 25 kilometers by road southwest of the closest large town, Bushenyi, and about 85 kilometers by road west of Mbarara, the main city in the Ankole sub-region. The district was established by a parliamentary act and went into operation on July 1st, 2010. The district was formerly Ruhinda County within the larger Bushenyi district. Mitooma district shares boundaries with Bushenyi district to the north, Sheema district to the east, Ntungamo district to the south, and Rukungiri district to the west. The district is made up of three counties (Ruhinda South County, Ruhinda County, and Ruhinda North County), thirteen sub-counties, five town councils, and eight health center IIIs, two health center IIs, and one health center IV, which is presently being converted to a district hospital. The district consists of 565 villages and 77 parishes/wards. There are 39,800 households in the Mitooma district, an estimated population of 183,444 (16) with an average land holding of 0.25-0.45 ha per household. Just 6.2% of the population lives in urban areas, with the majority of the population (93.8%) being rural (16). In Ruhinda North County, the Bakiga are the dominant group, whereas Banyankole are dominant in Ruhinda South and Ruhinda Counties. Acute lower respiratory infections, malaria, HIV/AIDS, urinary tract infections, and diarrhea are the top five infections reported in the district (41).

Study Design and Period

A convergent parallel mixed-methods household survey was carried out between September and October 2018 as a part of the COBERMS project, which is a prerequisite for Kampala International University's Master of Public Health degree. The capacity of a mixed-methods design to address intricate problems related to food poverty led to its selection (42; 43) combining quantitative and qualitative data in a way that allows research questions to be adequately addressed. A logical foundation, methodological flexibility, and a thorough comprehension of minor examples were also provided (43; 44). The utilization of mixed-methods study design allowed for a thorough and comprehensive response to the research questions (45) and assisted in extrapolating the research's conclusions and ramifications to the entire population. In mixed methods research, a convergent design using pragmatism as a theoretical premise is a common and effective method (42). Because the various types of data were analyzed separately using quantitative and qualitative analytical procedures, respectively, the study was able to achieve triangulated conclusions through the combination of qualitative and quantitative methodologies (42; 43; 44; 45). The integration of both data in a convergent design facilitated the validation of one set of findings with the other and provided a comprehensive picture of the problem that was being investigated (42; 43; 44; 45).

Study Population

The unit of study was a household. 32 households in all, chosen from an updated household folder of Kamabare II village (n=77) using the stratified sample technique, took part in the research. Four focus group discussions (FGDs) and thirteen key informant interviews (KIIs) were carried out for the study's qualitative phase. Using quota and snowball sampling approaches, key informants (KIs) were chosen from Bitereko Sub-county's various regions, and FGDs were conducted in the four parishes that were purposefully chosen (Kigarama, Bugongo, Buheregyenyi, and Karimbiro).

Sample Size Determination

Stratified sampling approach was used to select the households from the respondents. All of the households in Kamabare II village were first ranked according to wealth/income with the assistance of the LCI Chairperson to form three different strata (the well-off, the intermediate, and the poor). Equal representation

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was then ensured for each stratum based on the total number of households in each stratum. After conducting a methodical sampling, 5 households were selected from the well-off stratum, 17 households from the intermediate stratum and 10 households from the poor stratum making a total of 32 households in the whole village. Four of the five parishes that make up Bitereko Sub-county were designated as the purposeful targets for Focus Group Discussions. Non-probability sampling procedures were employed for timeline interviewees and KIs, as it was necessary to include those with extensive historical experience and understanding of the area under investigation, particularly the elderly. Here, the researcher used the snowball and quota sampling approaches. First, the researcher started with a small group of key informants who were well-known to be competent in the subject field. These individuals were then asked to recommend other people who had similar knowledge and were able and willing to participate in the study.

A total of 13 KIs were interviewed, including 8 participants in off-farm activities, 4 seniors, and the in-charge of Bitereko Health Center III. The respondents were from various sections of Bitereko Sub-county and were all timeline interviewees. The Bitereko Health Centre III in-charge was brought in to assist in providing access to medical records and data regarding the health status of the community, to establish and identify current and anticipated health problems, and to determine priority areas in need of government and/or community interventions that can address such problems. By conducting time line discussions (group discussions) with participants in various study activities and interviewing elders, it was possible to provide summaries of important historical events in the area under investigation, so addressing research questions one and three.

Data Collection and Procedure

Face-to-face interviews were conducted with every participant at their residence for a duration of two months, from September to October 2018. Building rapport and confidence with participants was one of the proper interview strategies followed during the interviews. The duration of each participant's interview was between twenty and thirty minutes. The researcher translated the English version of a semi-structured questionnaire into the local language (Runyakitara) and used it to gather data from households. The questionnaire was divided into two sections. The first section focused on the respondent's and the household's demographic and socioeconomic characteristics, while the second section examined the coping strategies the households used to deal with food insecurity.

Tools and Techniques

An array of strategies and procedures were utilized in collecting both primary and secondary data, including questionnaires and interviews, participant observation during field trips, and document searches. The field work was divided into two major phases (the qualitative and quantitative). The qualitative phase was intended to address question one while the quantitative phase was intended to address question two and three as expounded in chapter one. That is; (i) factors influencing the food situation; (ii) responses to food insecurity; and (iii) the potential for sustained livelihoods in the Sub-county. The different techniques and tools that were used in addressing these research questions are described in the table below:

Table 1. Tools and Techniques used during data collection

Research Question	Objective	Technique
(i). What factors influence the food situation in BiterekoSub-county?	To give a historical overview of the variables that have shaped Bitereko Sub-county's development and to investigate the ways in which these variables have impacted the availability and accessibilityof food.	Documentary search, in-depth interviews with key informants and group interviews (Timeline)using in-depth interviews (IDI) guide.

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(ii). How do households respond to food insecurity in both the short and long term?	To examine the significance of local knowledge in agricultural production, food systems, and nutrition in order to give insight into how households deal withfood insecurity.	Semi-structured interviews
(iii). What are the available natural resources and their potential in sustaining the livelihoods of people in Bitereko Sub-county?	To examine the possibilities of locally accessible natural resources in Bitereko Sub-county for maintaining livelihoods	Documentary search, in-depth interviews with key informants and group interviews (Timeline) using in-depth interviews (IDI) guide.
Topic of Discussion for the Key Informant Interview		
1. In your opinion, what does food security mean for this Sub-county?		
2. In what ways would you contrast and compare this Sub-county's previous and present levels of food security?		
3. Which major factors contribute to food insecurity in this Sub-county?		
4. When do families typically run out of money and food? What actions do they typically take? Which coping strategies do they use to handle the circumstance?		
5. What kind of meals is typically prepared in households? When choosing foods, what factors do they take into account? How do they ensure that the food they serve is sufficiently nutritious?		
6. How do the environment and resources available locally influence food security in this Sub-county?		
7. How has the health and well-being of the inhabitants in this Sub-county been impacted by food insecurity?		

Data Analysis

Following the interviews and questionnaire responses from the participants, raw data was sorted, cleaned, coded, and imported into Microsoft Excel for Windows 10. It was then exported to IBM SPSS version 20 for descriptive analysis.

RESULTS

The descriptive results are presented as percentages and frequencies in tables, graphs, and charts, but the qualitative results are shown as themes.

Socio-demographic Characteristics of the Study Participants

The study involved thirty-two households from Kamabare II village, Bitereko Sub-county, Mitooma district. Participants' socioeconomic traits were noted in order to gain a thorough understanding of how humans interact with their surroundings in particular socioecological contexts.

Gender of Respondents

Data on gender of various respondents during the household survey was compiled as shown below.

Table 2. Gender of Respondents

Gender	Number	Percentage
Male	13	41
Female	19	59

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Total	**32**	**100**

Source: Primary data

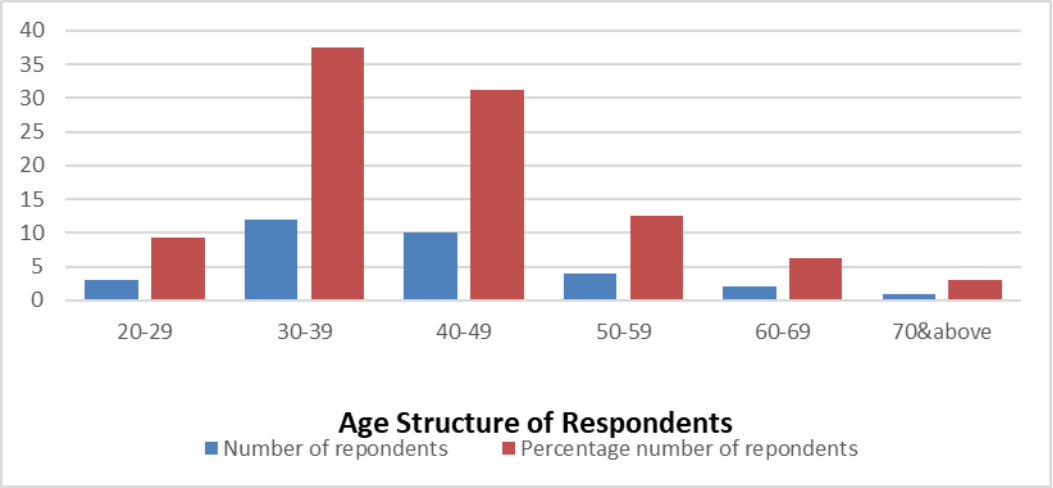
The males were 19(59%) and the rest 13(41%) were females.

However, there were many females than males living in the households surveyed.

Age Structure of Respondents

Respondents were grouped in age groups of 20-29**,** 30-39, 40-49, 50-59, 60-69, and 70+

Figure 2. Age Structure of Respondents

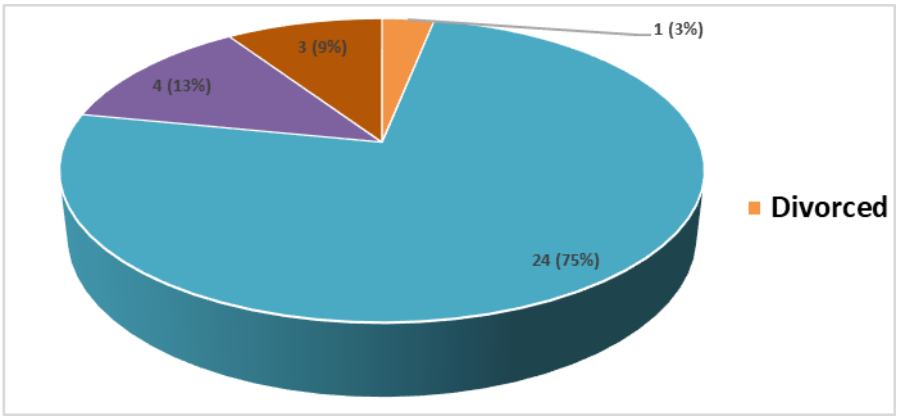


The figure shows that the majority, 12 (37.5%) of respondents were in the age group of 30-39 years, and the least 1(3.1%) in the age group 70+ years.

Marital status of Respondents

Data on marital statuses of the respondents was collected as shown in the figure below;

Figure 3. Marital statuses of Respondents



Source: Primary data

Of the total people interviewed; the majority 24(75%) were married and the least 1(3%) divorced.

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Educational levels of Participants

Despite the fact that a cross-examination revealed that the respondents' occupation and educational attainment did not, for the most part, significantly affect the level of food security in the community, this information is nonetheless shown in the table below. On the other hand, it was discovered that gender had a significant impact on food security.

Table 3. Respondents' major sources of Income by Educational Level

	Educational Level					
Sources of Income	Never been to school	Primary	Secondary	Certificate	Diploma+	Total
Craft		3	1			**4**
Casual Labour		3	2			**5**
Bodaboda/Driver			1	1		**2**
Formal employment			1	2		**3**
Professional				1	1	**2**
Farming	3	7				**10**
Trade		1	5			**6**
Total	**3**	**14**	**10**	**4**	**1**	**32**

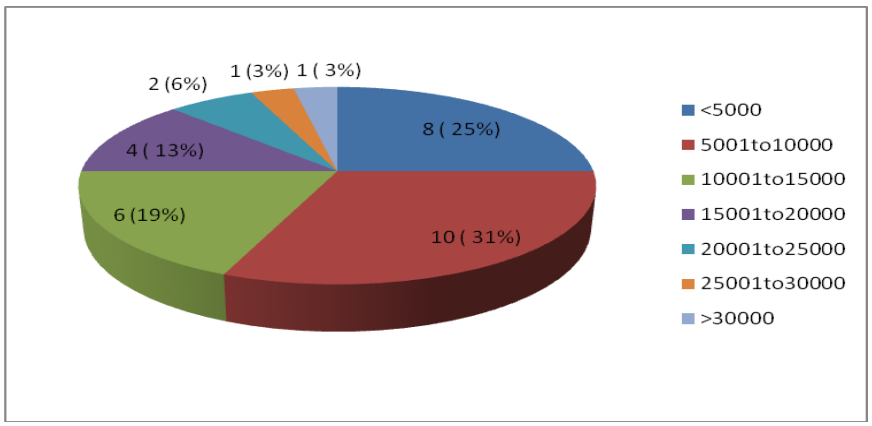
Source: Primary data

The majority 10(31.2%) comprised of those who had never been to school and those who attained primary education had farming as their major source of income.

Weekly Expenditure of Households

Data on household expenditure is presented in the figure below

Figure 4. Weekly Expenditure of Households



Source: Primary data

Of the 32 households interviewed, the majority 10(31%) reported to be spending from 5000 to 10000 shillings in a week, while the least 1(3%) reported to be spending between 25,000 and 30000 shillings in a week. The relative size of household income was estimated from the information on reported weekly expenditure on a range of domestic consumables including food items, travel, health care and education.

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Sizes of land owned by individual households

In order to understand properly the households' production-income-consumption links it was necessary to establish the land estimates for each household interviewed.

Table 4. Land Sizes of Respondents (acres)

Acreage	Number of Households	Household Percentage
<1	2	6.3
1-1.9	5	15.6
2-2.9	15	46.9
3-3.9	7	21.9
4-4.9	2	6.3
>5	1	3
Total	**32**	**100**

Source: Primary data

Of the interviewed households, the majority 15(46.9%) had relatively 2-2.9 acres while the least 1(3.1%) had 5+ acres.

Major crops produced in Households by Gender

To better understand how households attempt to ensure food security in the study region, an investigation was conducted by gender on the main food crops (bananas, grains, and pulses) planted by households in the study area.

Table 5. Major Crops grown in Households by Gender

Major Crops grown	**N and Percentage by Gender**	
	Male N(%)	**Female N(%)**
Banana	19(100%)	13(100%)
Pulses:		
Beans	4(21%)	11(85%)
Peas	1(5%)	4(31%)
Grains:		
Maize	9(47%)	7(54%)
Millet	2(10%)	8(62%)
Sorghum	6(31%)	5(38%)
Coffee	15(80%)	6(46%)
Tea	3(16%)	0(00%)

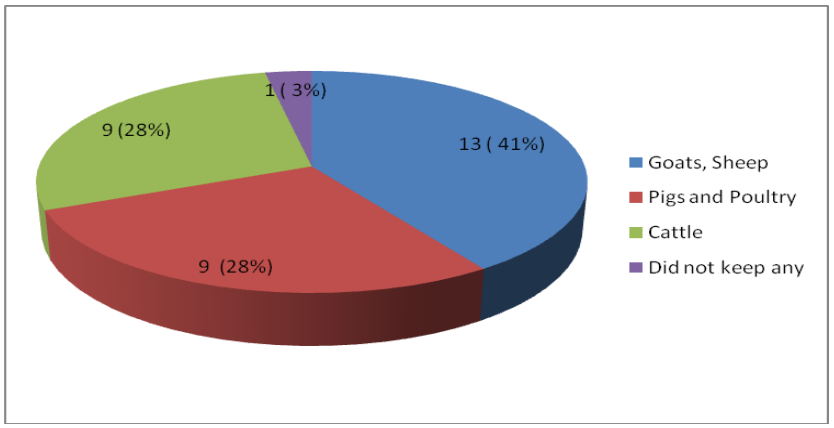
Source Primary data

Banana was the major crop produced in the area mentioned by all genders (100%).

Major types of livestock kept in households

Data on major types of livestock kept in households is presented here below

Figure 5. Major types of livestock kept in households



Source Primary data

Household surveys revealed that the majority 13(41%) of respondents kept goats and sheep and the least 1(3%) did not keep any of the livestock.

Factors influencing the food situation

The table below shows the analysis of factors influencing food situation

Table 6: Factors influencing the food situation

Characteristic		**Experienced food insecurity**		**Chi square test (χ^2)**
		F (n = 15)	**P (%)**	
Gender	Male	10	66.7	χ^2 (1) = .002 *p* = .041* n = 32
	Female	5	33.3	
Age group of the respondents	20 – 29	3	20	χ^2 (5) = 16.097 *p* = .007* n = 32
	30 – 39	5	33.3	
	40 – 49	3	20	
	50 – 59	1	6.7	
	60 – 69	2	13.3	
	70 and above	1	6.7	
Marital status	Divorced	0	0	χ^2 (3) = 3.297 *p* = .348 n = 32
	Widowed	4	26.7	
	Single	2	13.3	
	Married	9	60	

Education level of the respondents	Never been to school	3	20	χ^2 (4) = 15.709
	Primary	9	60	*p* = .003*
	Secondary	3	20	n = 32
	Certificate	0	0	
	Diploma +	0	0	
Weekly expenditure of the respondents (UGX)	< 5000	5	33.3	χ^2 (6) = 11.520
	5001 – 10000	7	46.7	*p* = .074
	10001 – 15000	2	13.3	n = 32
	15001 – 20000	1	6.7	
	20001 – 25000	0	0	
	25001 – 30000	0	0	
	> 30000	0	0	
Size of land owned by respondents (acreage)	< 1	2	13.3	χ^2 (5) = 10.899
	1 – 1.9	5	33.3	*p* = .053
	2 – 2.9	7	46.7	n = 32
	3 – 3.9	1	6.7	
	4 – 4.9	0	0	
	5 and above	0	0	
Sources of income of the respondents	Crafts	2	13.3	χ^2 (6) = 11.753
	Casual labour	3	20	*p* = .068
	Boda-boda rider/ driver	1	6.7	n = 32
	Formal employment	0	0	
	Professional	0	0	
	Farming	7	46.7	
	Trade	2	13.3	

Study findings in the table above indicate that of the factors studied to determine their influence on the food situation, only the gender, age group and education level of the study respondents were found to be significantly associated with households experiencing food insecurity.

The gender of the respondents was found to significantly influence the food situation in a household, χ^2 (1, N = 32) = .002, p = .041. Households whose heads were male were more likely to experience food insecurity as compared to the females. The age group of the respondents was found to significantly influence the food situation in a given household, χ^2 (5, N = 32) = 16.09, p = .007. Households with respondents who were aged between 20 – 29 years were less likely to experience food insecurity than those aged between 30 – 39 years. The study findings also indicate that the education level of the study respondents significantly influenced food situations in the studied households χ^2 (4, N = 32) = 15.71, p = .003. Respondents who had attained up to primary level of education were more likely to experience food insecurity in their households as compared to those who had never been to school.

Coping Mechanisms employed for Food Insecurity by Households

Based on wealth ranking, coping strategies used by households during peak food insecurity periods were analyzed. The table below shows the results.

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Table 7. Respondents' major Coping Mechanisms for Food Insecurity

	Household Status/Wealth Ranking			
Coping Mechanism	The Well-off	The Intermediate	The Poor	Total
Reducing number of meals	3	8	2	13
Reducing size of meal	1	3		4
Borrowing grain and cash		1		1
Receiving food aid		2	2	4
Sale of livestock	1			1
Food for work		3	5	8
Dropping out of school			1	1
Total	5	17	10	32

Source: Primary data

The majority of Bitereko Sub-county households have experienced temporary food insecurity for the majority of years. Each household has a varying level of the food scarcity issue, and those that are food insecure employ various coping strategies. Early on in a food shortage, households employ roughly seven main techniques. Therefore, at the beginning of food insecurity, 60% of the well-off, 47% of the middle-class, and 20% of the poor cut back on the number of meals they eat. During severe periods of food insecurity, the impoverished class employs 50% of the workforce to procure food.

Analysis of Food Situation among Households

The study applied wealth ranking as a stratification technique, based on reported principal sources of income, weekly household expenditures, and land estimates. This allowed for the definition of socio-economic groups within the study area, which included the Well-off, the Intermediate, and the Poor.

The Well-off were those who possessed all or most of the following: sizable herds of animals, sizable farms, cars, other significant investments, steady, well-paying occupations, sizable amounts of food saved, and the capacity to use hired labor. The results showed that these made up 15.6% of all the households surveyed. These were able to create and store surplus (above and beyond household needs) since the possession of such assets indicated the ability to obtain sufficient food through animal sales, cash crop sales, or personal agricultural production.

The Intermediate made up the majority of the households in the villages under investigation. Results indicate that this group comprised 53.1% of all polled homes. In terms of food security they could endeavour to be self-sufficient most of the times when conditions are favourable like good rains received such that food produced could sustain them throughout the year; and when the conditions are good enough they could strive to produce surplus for sale.

The Poor households in this group relied on agricultural production and the provision of their own labor for the purpose of earning money and food. According to the study's findings, this group made up 31.3% of all the households examined. Their own crops do not yield enough food to feed them for the entire year, and the food they store barely lasts four months. They frequently experience food shortages, sometimes their food stocks are exhausted before the harvesting season ends. They are unable to produce enough food from their own crops since they must work for others the majority of the time.

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Qualitative Findings

Qualitative interviews with households, timeline interviewees, and key informants revealed that rural lifestyles are diverse and varied and in the home, men and women do not contribute equally to food production. Land degradation, consequent from population upsurge in the area was mentioned by majority as the major cause of food insecurity in the area. This finding is in agreement with (22). Men were reported to be primarily involved in the production of bananas, coffee, tea, and other off-farm economic activities like brick making, charcoal burning, and bodaboda) that required longer hours away from their homes. The majority of females who would engage in off-farm activities to supplement agricultural production (like craft, local brew, "Muramba"/Porridge) would use hours after domestic work or during leisure hours; therefore, such activities would not compromise food production.

The Physical environment of the study area

Information about the physical environment was got from documentary search, field observation and interviews with key informants.

Rain fall and Temperature

It was reported that the months of March through May and mid-August through November saw bimodal rains in Bitereko Sub-county. According to published reports, the region's yearly rainfall previously varied between 1200 and 1500 mm, with one and a half to two months of dry spells in between. February was thought to be the hottest month, with temperatures between 28 and 30 ˚C. Two yearly harvests could be grown successfully each year under this predicted weather pattern. Nevertheless, throughout the previous ten years, the region has seen increasingly severe droughts and floods, which has had an impact on local agriculture and livelihoods. This finding is in agreement with what was reported by (46; 47)**.** Global temperature variations may be caused by emissions and deforestation, which are common in tropical regions.

Relief and water source/reliability

The landscape of the region is undulating, with gently sloping hills covered in rough terrain and mostly flat areas. Two large rivers, the Ncwera and Kamabare/Rwihwa, as well as a few smaller tributaries, are present in Bitereko. It also features year-round water supplies from open wells and springs.

Soils and land suitability

Although the area's soil types are diverse and their nutrient statuses vary greatly depending on location, they are primarily clayey-loam soils that can sustain the growth of specific crops even if they are worn tropical soils susceptible to leaching. This finding is consistent with the findings of (23).

The Socio-economic environment of the area

In order to give some basic information on the residents (Banyankole/Bakiga) in terms of their means of subsistence, including gender system, this information regarding the situation in the research area and spanning back over a period of 40 years was included. As a source of money and insurance for many households in the event of crop failure, livestock have played a significant role in both social and economic life. These people's livestock economy has been centered on non-ruminant animals (pigs, rabbits, and poultry), small ruminants (sheep and goats), and long-horned Ankole cattle. Previously, farmers used to collectively graze their animals in communal land locally termed "Amashamba" but as the population grew, communal grazing was no longer possible and these lands were split among themselves to allow for

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individual grazing.

The potentials of local resources in Bitereko Sub-county and livelihood adjustment

The efforts covered in this chapter were evaluated in light of the recent developments in the research domain. Through cooperative efforts and the pooling of the resources of impoverished farmers, these have changed the patterns of subsistence for the local population, lowering transaction costs and achieving economies of scale. Agricultural intensification and diversification into non-farm activities were the two main livelihood categories that were found.

Diversification into non-farm activities

In the study region, non-farm income generating activities are undertaken by the majority of the population in their quest for food security and overall livelihood security. This has historically been done on an as-needed basis in reaction to food shortages. Nevertheless, extensive interviews with participants in various off-farm activities revealed that these pursuits are now seen as part of their overall livelihood plans rather than just coping techniques. In light of the recent developments in the area, these livelihood strategies were analyzed from a gender perspective. As a result, women's activities included making traditional baskets, pottery, brews from the area (such as muramba or porridge), and crafts like mats. On the other hand, men's occupations included bodaboda, beekeeping, charcoal making, brick making, and traditional papyrus carpet manufacture.

Agricultural Intensification

The production of high-value commercial food crops including tomatoes, cabbages, sugarcane, and various fruit trees is indicative of agricultural intensification in the research area. Production of tomatoes and sugarcane was the most common activity among all the crops that respondents listed. Thirty percent of the households surveyed were involved in the marketing process to make money, and more than fifty percent had previously produced tomatoes and/or sugarcane.

CONCLUSION AND RECOMMENDATIONS

Conclusion

In Bitereko Sub-county, food insecurity remains a serious problem that needs to be tackled on several fronts. Despite the fact that farmers in these areas intentionally grow food for their houses, most of the time there was not enough food in the households of the farmers who were interviewed. Most of the time, some households experience a food deficit before the harvesting period ends, and the average amount of staple food produced is insufficient for four months.

But with the knowledge and technology of today, we ought to be able to feed everyone at all times. Ensuring that the impoverished and malnourished have access to both the global potential and the methods and knowledge required to fully utilize it is a critical first step (48).

Recommendations

It is clear from the results that most of the factors that contribute to food insecurity are reversible. According to several experts, in order to meet the world's food demands by 2025, we will need to grow 50% more food grains. This necessitates the use of agricultural methods that use less land, labor, water, and chemicals while still maintaining biodiversity. In order to overcome this obstacle, we must apply plant biotechnology

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technologies to make it easier to produce crop types that are more resilient to stressors like salinity, drought, and unfavorable temperatures. Therefore, it is advised that when creating a food security policy for agro-land communities, the government take into account the following potential strategic choices in coordination with other stakeholders:

- In order for food security to become a reality, we must actively strive toward the goals of the World Food Summit, where inspiring statements were transformed into a framework of seven promises that need to be fulfilled right away (29; 30; 31). To develop policies that will aid in achieving these objectives, governments must be resolute in their collaboration with the business community and civil society (6). The democratic procedures that oversee such measures should be centered on empowering the current food insecure populations, which are primarily the impoverished in rural areas (49).
- Local efforts are necessary because many of the barriers that prevent individuals from achieving their full potential—including access to education, information, health care, employment, technological advancements, credit, and land and water resources—are country- and region-specific by nature (48; 49). Analysis of rural resources and local livelihoods in most developing nations is further complicated by the tremendous variety of the environment, whether it be biophysical, social, economic, or political. It is challenging to distinguish the components that are purely coincidental from the driving forces when patterns are controlled by such intricate and multifaceted changes (48; 49).
- Government should take action to correct the biased distribution of assets and services which generally favours the urban areas. These should be able to reach the rural agro-communities since agriculture is the engine of growth in many developing countries' economies where by in some of the poorest countries it generates as much as 30 to 50% of GDP, employs 70 to 80% of labour force and contributes 40 to 70% of export earnings.
- Since agricultural and technological innovations are essential to improve the situation of emerging nations, the government should make investments in these fields. Tensions will decrease with more equal access to land, water, and capital. The most impoverished will be integrated into the mainstream economy through poverty alleviation initiatives aimed at rural areas.
- If better nutrition, more food production, and higher family incomes are to become a reality, the government should empower rural women. This makes it crucial for women to have access to credit, land, and technology.
- In order to maximize agricultural productivity, the government should create and support Extension staff training programs that revitalize technical support services for rural farmers. Examples of these services include business skills, farm management, project analysis, and assessment.
- The government ought to improve farmer-researcher ties, particularly with regard to the management of harmful pests and diseases.
- The government should create more effective markets that can provide farmers with higher returns, enabling them to use the money they make to support their households and maintain their way of life.
- In order to generate new economic opportunities and encourage the use of locally available resources, the government should implement complete rural electrification. Additionally, incentives should be offered to the private sector to encourage investment in agro-processing and agriculture.
- Lastly, to lessen the burden that the poor place on their meager household resources, the government should subsidize the cost of social services, particularly health and education.

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