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Assessing the Impact of Climate Change on Food Security in Northern Ghana: Causes and Coping Strategies in the Upper East Region

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Abstract: Food insecurity remains a significant developmental challenge, particularly in rural areas, despite ongoing efforts to mitigate it. To better understand the persistence of this issue, this study investigates the causes of household food insecurity and the coping strategies employed by households in Zorkor Goo, Zorkor Kanga, and Zorkor Kadaare communities within the Bongo District of Ghana's Upper East Region. A descriptive cross-sectional survey was conducted, sampling 196 households systematically from these communities. Data were collected through a structured questionnaire covering socio-demographic factors, causes of food insecurity, household coping strategies, and dietary intake. The analysis was performed using SPSS (Version 21.0), with food security status and dietary intake assessed via the FANTA Household Food Insecurity Access Scale (HFIAS) and Food Consumption Score, respectively. The study identified key factors contributing to food insecurity, including soil infertility, poor rainfall patterns, food spoilage, extravagant funerals, large family size, high unemployment, and lack of education. Major coping strategies among households included meal skipping, reducing meal size and frequency, migration, asset sales, and basket weaving. The findings revealed that 96.4% of households were severely food insecure, and over two-thirds (67.3%) exhibited poor dietary consumption. Notably, household employment levels, education, and food consumption scores were significantly associated with food insecurity ($P<0.001$). These findings underscore the need for targeted interventions addressing the root causes of food insecurity and enhancing household resilience in these communities.

Keywords: climate change; food security; Ghana; consumption

1. Introduction

Food security is a critical component of overall well-being (Takal et al., 2023). Over the past decade, increasing attention has been devoted to addressing global food insecurity and hunger. Notably, the 1992 International Conference on Nutrition and the 1996 World Food Summit highlighted the urgent need to reduce food insecurity and hunger on a global scale (Iversen et al., 2023; Guo et al., 2021). During the 1996 World Food Summit, 182 nations reached a consensus on defining food security as "access by all people at all times to enough nutritionally adequate and safe food for an active and healthy life." In conjunction with this focus on combating food insecurity, there was also a call for the development of appropriate methods to monitor food security (FAO, 2019).

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Recent FAO estimates reveal a continued global trend toward hunger reductio (FAO, 2019). Between 2012 and 2014, approximately 805 million people were chronically food insecure, a decline of more than 100 million over the past decade and 209 million since 1990-92 (FAO, 2019). However, despite these improvements, nearly one in nine people worldwide still lack sufficient food for an active and healthy life (Herforth et al., 2020; Tahiru et al., 2024). The majority of these undernourished individuals reside in developing countries, where an estimated 791 million people experienced chronic hunger between 2012 and 2014 (Millward-Hopkins et al., 2020).

The need to prevent food insecurity is paramount due to its severe consequences, including malnutrition, deterioration in public health, the prevalence of conditions such as high blood pressure, nutritional deficiencies, and the rise of social issues such as begging, ritual practices, prostitution, armed robbery, child labor, juvenile delinquency, hunger, unemployment, and the production of citizens with low self-esteem and integrity (Breda et al., 2020 ; Kobik & Aryee, 2024). Additionally, food insecurity is linked to high infant mortality rates, shorter life spans, and an increase in divorce rates (Testa & Jackson, 2020 ; Gall et al., 2022). Hege (2022) further emphasizes that food scarcity profoundly affects both individual destinies and national development. Patel & Dev (2023) also notes that food insecurity hampers national progress and disrupts essential agricultural inputs, infrastructure provision, and the adoption of new techniques.

Despite ongoing campaigns for food security, food insecurity remains persistent, even with efforts from governments and individuals. Many development workers view food security as the availability of food in global markets and the effectiveness of food production systems in developing countries (Pawlak & Kołodziejczak, 2020; Schleifer & Sun, 2020 ; Smith & Glauber, 2020). The causes of food insecurity are multifaceted and include climate change, unstable social and political environments that hinder sustainable economic growth, war and civil strife, macroeconomic imbalances in trade, natural resource limitations, a poor human resource base, gender inequality, inadequate education, poor health, natural disasters such as floods and locust infestations, and a lack of good governance (Islam & Kieu, 2020 ; Scherer et al., 2020 ; Xie et al., 2021). These factors contribute to either insufficient national food availability or inadequate access to food by households and individuals (Atanga & Tankpa, 2021).

Coping strategies during food-insecure periods include relying on less preferred or inexpensive foods, borrowing food, seeking help from friends or relatives, gathering wild foods, hunting, harvesting immature crops, consuming seed stock reserved for the next planting season, sending household members to eat elsewhere, limiting portion sizes at meals, restricting adult consumption in favor of children, reducing the number of daily meals, skipping entire days without eating, and begging from neighbors or friends (Melese et al., 2021; Puddephatt et al., 2020 ; Gallegos and Dryland, 2023). During these periods, households employ various mechanisms and community support networks, such as wild food collection, market purchases, in-kind (food) payments, support from relatives and friends, sales of livestock and household valuables, migration, and wage labor. Other strategies include reducing the number of daily meals, decreasing portion sizes, and consuming less preferred foods (Junaidi et al., 2022 ; Mabuza & Mamba, 2022 ; Deschak et al., 2022).

Areas prone to severe malnutrition often overlap with conflict zones, but nutritional emergencies can also arise seasonally in stable regions (Kobik & Aryee, 2024). While the most severe food insecurity is typically linked to disasters like droughts, floods, wars, or earthquakes, most food insecurity is not tied to such catastrophes (Jackson at el., 2020). In fact, only 8% of hunger-related deaths in 2004 were due to humanitarian emergencies, with the remaining 92% attributed to chronic or recurrent hunger and malnutrition (Edwards et al., 2021). For instance, agricultural households frequently face seasonal hunger, a period when food stocks are depleted before the next harvest. Climatic shocks, shifting weather patterns, political instability, and global market fluctuations can exacerbate food insecurity (Bedasa & Deksisa, 2024).

One of the most influential definitions of food security comes from the World Bank in 1986, which described it as "access by all people at all times to enough food for an active and healthy life." This definition addresses multiple aspects, including food production in terms of availability, distribution to ensure accessibility for all, and consumption to meet individual nutritional needs for

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an active and healthy life. Additionally, the sustainability of food availability and accessibility is crucial (Pawlak, K., & Kołodziejczak, M. (2020). A recent FAO (2021) programme report on Paper on Indigenous Peoples' Food Systems also highlighted the importance of increasing food production in developing countries as a foundation for building their food security. In Ghana, the Ministry of Food and Agriculture defines food security operationally as "good quality nutritious food hygienically packaged, attractively presented, available in sufficient quantities all year round and located at the right place at affordable prices" (Kolog et al., 2023 ; Nkegbe et al., 2017; Awoyemi et al., 2023).

The three dimensions of food security are accessibility, availability, and utilization (UN, 2021). At the household level, food security entails having sufficient access to food over time, without disruptions from shocks or disasters that affect food production (Kolog et al., 2023). A nation is considered food secure "when all people at all times have access to sufficient, safe, nutritious food to maintain a healthy and active life" (FAO, 2021).

Despite Ghana's economic growth, primarily driven by revenues from oil and other natural resources, the country remains one of the world's poorest, with significant portions of its population facing food insecurity (Kipkoech et al., 2023; Alorki et al., 2024). Recent statistics reveal that 1.2 million Ghanaians struggle to access sufficient and nutritious food year-round, while an additional 2 million are at risk of becoming food insecure during the lean season or in the event of a natural or man-made disaster (Boachie-Mensah et al., 2021; Osman et al., 2023). Although these figures represent only 5 to 10% of the total population, the majority of those at risk are concentrated in the Northern, Upper East, and Upper West regions. The Upper East Region, in particular, is profoundly affected, with 15% of its population—approximately 102,000 people—classified as food insecure, making it the second most affected region after Upper West (Osman et al., 2023). Furthermore, about 40% of the population in these northern regions is vulnerable to food insecurity, a stark contrast to the rest of the country, where food insecurity is less pervasive but still significant (Osman et al., 2023). Understanding the specific causes of persistent food insecurity in the Upper East Region is crucial for developing effective interventions. Addressing these causes will not only help to alleviate food insecurity in this region but will also contribute to broader national efforts to enhance food security. Given the limited research on food insecurity in both developed and developing contexts, particularly in Northern Ghana, this study aims to fill this critical knowledge gap, providing insights that can inform policy and practical approaches to improving food security in one of the country's most vulnerable regions.

2. Research Methodology

2.1. Study Area

Zorkor Goo, Zorkor Kanga and Zorkor Kadaare are communities in Bongo District of the Upper East Region. The economy of these communities is based on agriculture, primarily cattle-rearing and growing cereals like sorghum, rice, maize and millet (Mensah et al., 2021). The communities are also known for their handicraft and locally brewed beer known as "pito". They share one market which has a long history; visitors come to buy baskets, metal products, leather products, straw hurts and traditional clothing. The communities which are under Upper East Region are also within the Sudan savannah zone, characterized by a uni-modal rainfall regime lasting five to six months and a long dry period of six to seven months (Salifu & Salifu, 2024). It is a well-known fact that the unfavorable climatic conditions coupled with the low inherent fertility with nitrogen and phosphorus as the most deficient in the soils account for poor yields of crops in the Upper East Region especially these communities. (Abanyie et al., 2023. Predominantly, household food and nutrition security become a major problem even though they are tediously and ambiguously till the land for cropping each year prior to farming.

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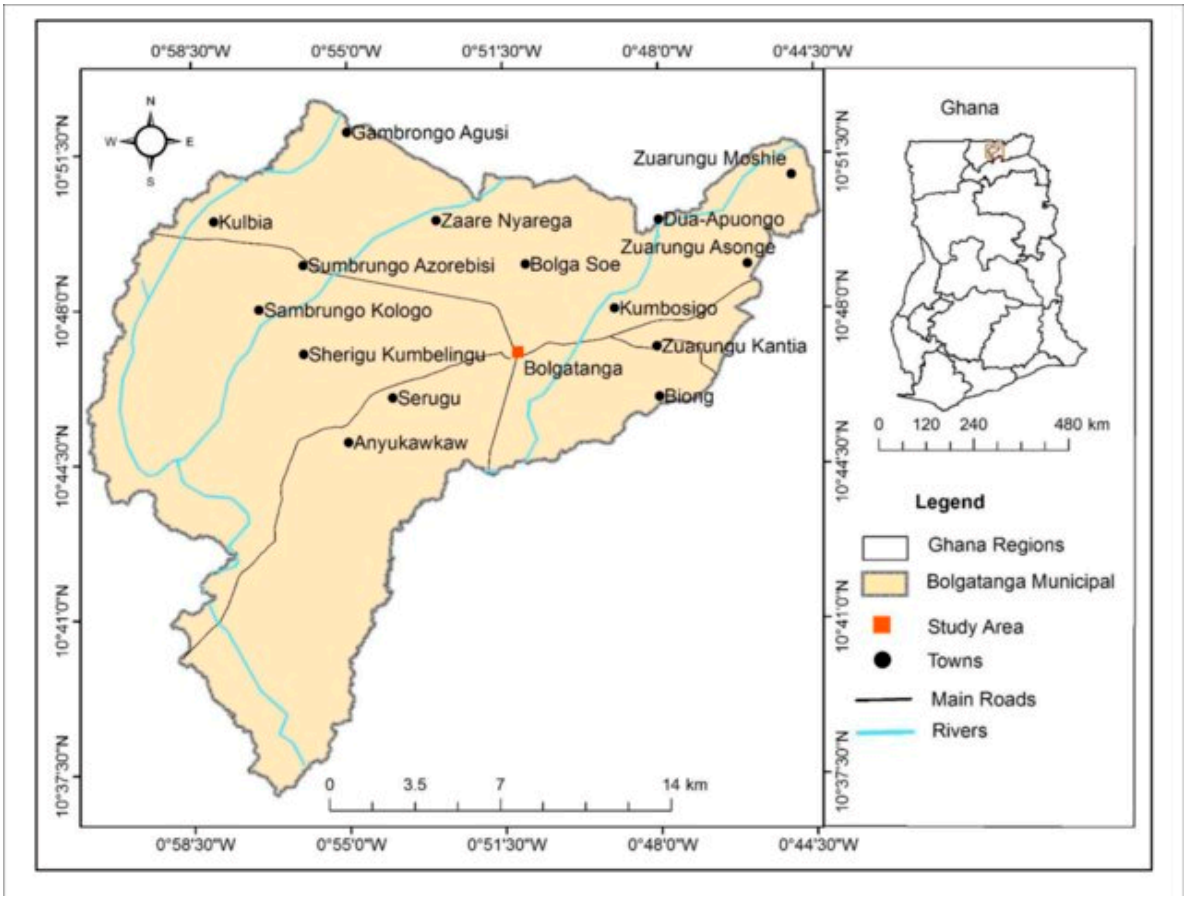

Figure 1. Map of Bolgatanga (source: Kuusaana et al., 2022).

2.2. Sample Size Determination

Using Snedocor's formula with 95% confidence level, the sample size was determined as follows. Prevalence rate of food insecurity in the Upper East Region is 15% (0.15) (de Baptista et al., 2020).

$$\_n = \frac{z^2 p(1-p)}{ME^2}$$

n= 196/3 =65

Margin of Error (ME=5%) =0.005
n= (1.96) * 0.15(1-0.15)
n= 3.8416 * 0.15(0.85)
n=3.8416*0.1275=0.489804
n=0.489804/0.0025
n=195.9216=196
n= Sample size
e= Level of precision
z= Abscissa of the curve that cut off an area at the tail
p= Estimated proportion

2.3. Sampling Technique

The total sample size for the current study was determined to be 196 people. This was then equitably divided among the three communities of Zorkor for the study, hence, 65 people were selected from Zorkor Goo, 65 from Zorkor Kanga and 66 from Zorkor Kadaare. A systematic random sampling technique was employed to select the households for the research interviews. Borgstede &

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Scholz, (2021) explained that "systematic sampling is an improvement over the simple random sampling" which is a less complex way of selecting a sample at reduced cost which allows conclusions and generalizations to be made from a sample. However, subjectivity could be associated with systematic sampling which also comes along with risks associated with conclusions and generalizations from a sample (Baltes & Ralph, 2022).

2.4. Data Collection Methods and Pretesting

The study utilized both primary and secondary sources of information. Primary data were collected through structured and semi-structured questionnaires, which focused on socio-demographic factors, wealth index, causes of food insecurity, food consumption scores, and coping strategies. Secondary data were obtained from journals, reports, and articles. To ensure the reliability and accuracy of the data collection process, a two-day training session for enumerators was conducted from July 7th to 8th, 2022. During this training, four enumerators were trained in the administration of the questionnaires. The questionnaires were pre-tested prior to the training and further tested by each enumerator as part of their preparation. The pre-testing was conducted in Nyariga, a nearby community in the Bongo District, to refine the questionnaires. Following the training, three trainees were selected to carry out the data collection exercise. Interviews were then conducted with the selected 196 sample households, through which the necessary information was obtained.

2.5. Data Analysis

With the aid of SPSS (version 21.0) and setting significance at P-value < 0.05, all categorical data were coded and compared using proportion and all continuous data were computed using Chi-square. Dependency ratio was used to determine whether dependency can affect household food insecurity (World Food Programme, 2007). The severity of food insecurity was assessed using FANTA HFIAS, Food Consumption Score (FCS) was used to assess the pattern of food consumed (WFP-FAO, 2007).

2.5.1. Household Food Insecurity Access-Related Conditions

This is employed in determination of the number of households experiencing X condition at any time during the recall period.

$$no.of\ HH\ with\ response = \frac{1(yes) to\ Q7}{total\ no.of\ HH responding\ to\ Q7}\ X100\%$$

Where HH = household

2.5.2. Household Experiencing Conditions at a Given Frequency

This is employed in the determination of % of households that responded often, sometimes and rarely to a specific frequency-of-occurrence question. For example,

$$no.of\ HH\ with\ response = \frac{3(thus\ often)}{total\ no.of\ HH\ responding\ to\ each\ Q}\ X100\%$$

Where HH = household, Q = Questions

2.5.3. Household Food Insecurity Access Related Domains

$$no.of\ HH\ with\ response = 1\ to\ Q28\ OR\ 1\ to\ Q30\ or\ 1\ to \frac{Q32}{Total\ no.HH\ responding\ to\ Q28, Q30\ or\ 32}\ X100\%$$

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Where HH = household, Q = Questions

2.5.4. Household Food Insecurity Access Scale (HFIAS) Score

The analysis, the HFIAS Score was computed for each of the 196 households using Excel software. Table 1 shows the interpretation of HFIAS score.

Interpretation of HFIAS Scores

Table 1. Interpretation of HFIAS Scores.

	SCORE	INTERPRETATION
	0	Food secured
	1 -3	Mild food insecurity
	3-10	Moderate food insecurity
	10-27	Severe food insecurity

Source: WFP, 2007.

2.5.5. Wealth Index

The wealth index allows for the identification of problems particular to the poor, such as unequal access to health care (USAID, 2000). A total of fourteen assets were used. Assets >7 is classified as low wealth index and ≥7 is classified as high wealth index.

2.6. Ethical Consideration

Prior to the data collection, permission was granted by GIMA to undertake this study. Informed consent of the chiefs and people of the Zorkor communities was sought and obtained before data collection commenced. The respondents were assured of confidentiality.

3. Results

3.1. Demographic Characteristics of Households

Most of the respondents (33.2%) were in the age range 18-35 years. The youngest respondents were 18 years and the oldest were 72 years. Majority of the respondents (50.5%) were males; 52% were married and 62.8% had no formal education. Most of the respondents were employed (73.5%) with majority being farmers whilst 26.5% of them were unemployed. With respect to the household size, most of the households (43.9%) had 6-10 members as shown in Table 2.

Table 2. Socio-demographic Characteristics of Respondents.

Variable	Frequency	Percentage (%)
Age		
18-35	65	33.2
36-54	63	32.1
55-72	58	29.6
73-88	10	5.1
Total	**196**	**100**
Sex		
Male	99	50.5
Female	97	49.5
Total	**196**	**100**

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Marital status		
Single	46	23.5
Married	102	52.0
Divorced	6	3.1
Widow	42	21.4
Total	**196**	**100**
Educational status		
Nil	123	62.8
Primary	36	18.4
Middle school	14	7.1
Senior high	20	10.2
Tertiary	3	1.5
Total	**196**	**100**
Employment status		
Trader/vender	33	16.8
Farmers	99	50.5
Worker (civil servant)	10	5.1
Unemployed	52	26.5
Mechanic	2	1.0
Total	**196**	**100**
Household size		
≤ 5 members	36	18.4
6 - 10 members	86	43.9
11 - 20 members	54	27.5
> 20 members	20	10.2
Total	**196**	**100**

3.2. Assets Owned by Respondents

Based on the assets owned by respondents, majority of them (88.3%) belonged to the low wealth index as shown in Table 3 below.

Table 3. Socio-economic Status.

Assets	Frequency	Percentage
Low wealth index	173	88.3%
High wealth index	23	11.7%

3.3. Households Employment Status

The results on the number of employed people in a household are presented in Figure 1 below. Just a little over a fifth of households (23%) had members being employed. Of the households with people employed, more than half of them had only one member of the household being employed (60%) with the others having either 2 or maximum of three members in the household being employed.

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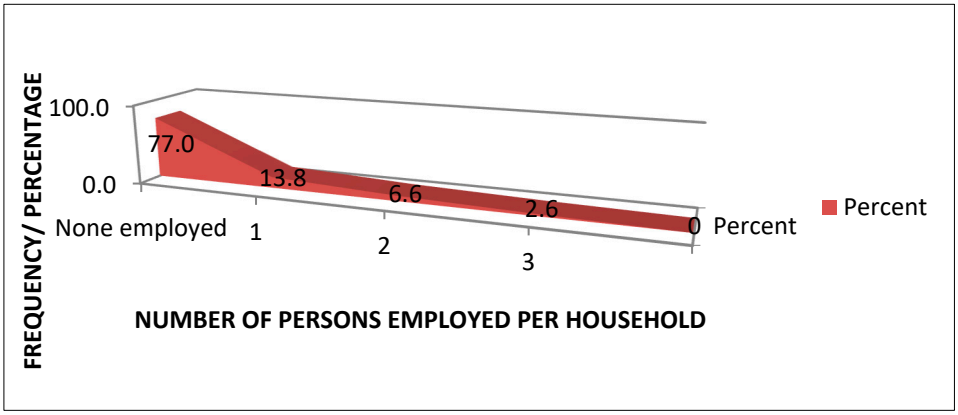

Figure 1. Number of Employees in the Households.

3.4. Sources of Food and Food Spoilage

Most of the respondents (91.3%) reported producing their own food whiles the others (8.7%) said they purchased their food. Answers to a further question asked on food spoilage are presented in Figure 2 below. Only 11.2% of respondents said they did not experience food spoilage but most of the respondents (58.7%) said as much as more than half of the food they had got spoilt.

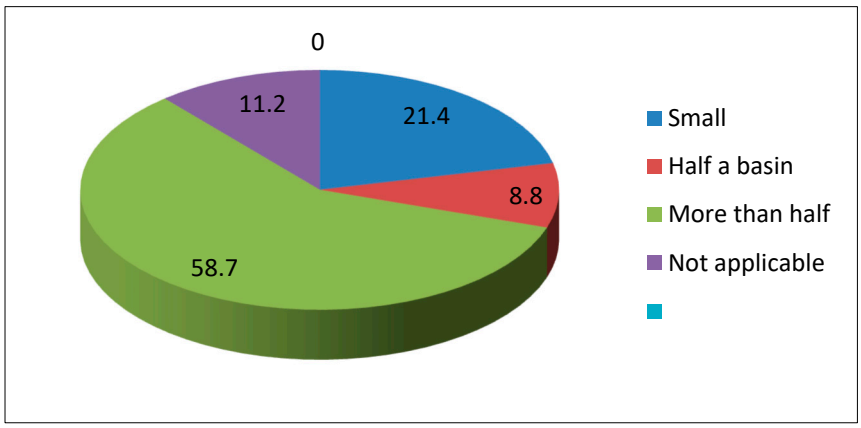

Figure 2. Proportion of Food Spoilage.

3.5. Household Food Insecurity

3.5.1. Household Food Insecurity Access-Related Conditions

From the Table 4, it was noticed that virtually all the respondents were victims of access related food insecurity for each of the nine conditions during the past 4 weeks. The problem of food insecurity was serious such that about 98.9% worried several times in a month for fear that they would not have food to eat. A similar percentage had to eat smaller meals than they felt or eat fewer meals in a day because there was lack of resources. All households (100%) had to eat a limited variety of foods due to inadequate resources. Majority of respondents (91.3 %) had to go a whole day and night without eating anything because there was not enough food.

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Table 4. Household Food Insecurity Access-Related Conditions.

Household food insecurity access related conditions at any time during the recall period	Frequency (response=yes)	Percentage
Did you fear that your home wouldn't have enough food throughout the last four weeks?	193	98.5%
Did you or any family member find it difficult to consume the foods you wanted to over the last four weeks due to a lack of resources?	195	99.5%
Did you or any family member have to restrict your diet during the last four weeks because of financial constraints?	196	100%
Have you or any other household member been forced to consume any items you truly didn't want to eat over the last four weeks due to a lack of money to buy other sorts of food?	194	99%
Did you or any other family member have to eat fewer meals than you considered necessary in the last four weeks due to a shortage of food?	193	98.5%
Did you or any other family member have to skip meals during the last four weeks due to a shortage of food?	193	98.5%
Did your home ever go without any food for the last four weeks due to a lack of resources to buy food?	192	98%
Did you or any other family member go to bed hungry during the last four weeks due to a lack of food?	188	95.9%
Did you or a family member go without food for the entire day and night in the last four weeks due to scarcity?	179	91.3%

3.5.2. Household Experiencing Conditions at a Given Frequency

From Table 5, it can be said that for all nine conditions with regards to the frequency of occurrence, thus “often, sometimes or rarely” of food insecurity situation, it was realized that an average of 31.4%, 57.8% and 8.3% of the households were food-insecure respectively.

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Table 5. Households Experiencing Conditions at a Given Frequency.

Household experiencing conditions at a given frequency any time during the recall period	Frequency (%) (response=yes; often)	Frequency (%) (response=yes; sometimes)	Frequency (%) (response=yes; rarely)
Did you fear that your home wouldn't have enough food throughout the last four weeks?	75(38.3%)	109(55.6%)	9(4.6%)
Over the last four weeks, did you or any other household member find it difficult to eat the foods you wanted to eat due to a lack of resources?	84(42.9%)	102(52.0%)	9(4.6%)
Did you or any other family member have to eat a restricted range of foods in the last four weeks because of financial constraints?	75(38.3%)	112(57.1%)	9(4.6%)
Have you or any other household member been forced to consume any items you truly didn't want to eat over the last four weeks due to a lack of money to buy other sorts of food?	68(34.7%)	118(60.2%)	8(4.1%)
Did you or any other family member have to eat fewer meals than you considered necessary in the last four weeks due to a shortage of food?	71(36.2%)	113(57.7%)	9(4.6%)
Did you or any other family member have to skip meals during the last four weeks due to a shortage of food?	65(33.2%)	123(62.8%)	5(2.6%)
Did your home ever go without any food for the last four weeks due to a lack of resources to buy food?	63(31.1%)	110(56.1%)	19(9.7%)
Did you or any other family member go to bed hungry during the last four weeks due to a lack of food?	48(24.5%)	115(58.7%)	25(12.8%)
Did you or any member of the household go without meals for the entire day and night during the previous four weeks?	7(3.6%)	118(60.2%)	54(27.6%)
Average	31.4%	57.8%	8.3%

3.5.3. Household Food Insecurity Access Related Domains

With regards to uncertainty and anxiety 99.3% households were victims. Almost all households (98.6%) had insufficient quality of food and 95.1% were victims of insufficient food intake and its physical consequences (Table 6).

Table 6. Household Food Insecurity Access-Related Domains.

Type of domain	Household food insecurity access related domains at any time during the recall period	Frequency (response=yes)	Percent
Anxiety & uncertainty	Did you fear that your household wouldn't have enough food in the last month	193	193+196+195 =584
	Did you or any family member find it difficult to consume the foods you wanted to over the last four weeks due to a lack of resources?	195	196 *3=588
	Did you or any family member have to restrict your diet during the last four weeks because of financial constraints?	196	584/588*100 = **99.3%**

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Insufficient quality	Did you or any other household member have to consume any items you really didn't want to eat over the last four weeks because you didn't have the means to get alternative kinds of food?	194	580/588*100 = **98.6%**
	Did you or any other family member have to eat fewer meals than you considered necessary in the last four weeks due to a shortage of food?	193	
Insufficient food intake and its physical consequences	Did you or any other family member have to eat fewer meals than you considered necessary in the last four weeks due to a shortage of food?	193	559/588*100 = **95.1%**
	Did your home ever go without any food for the last four weeks due to a lack of resources to buy food?	192	
	Did you or any other family member go to bed hungry during the last four weeks due to a lack of food?	188	
	Did you or any member of the household go without meals for the entire day and night during the previous four weeks?	179	

3.6. Status of Household Food Insecurity

From the Table 7, it can be noticed that all the households sampled were food insecure.

Table 7. Status of Household Food Insecurity.

	FREQUENCY	PERCENT
Food secured	0	0
Mildly food-insecure	1	0.5
Moderately food- insecure	6	3.1
Severely food-insecure	189	96.4

3.7. Coping Strategies

Table 8 shows the daily strategies adopted by households. Sixty four percent (64.8%) skipped meals as a coping mechanism, 28.6% eat less food and 6.6% purchased food on credit out of the 196 households. The seasonal strategies adopted include migrating to other places for greener pastures (46.9%), selling their assets in order to cope up (33.9%), doing butter trading (13.3%) and doing nothing (0.5%).

Table 8. Coping Strategies.

	FREQUENCY	PERCENTAGE
	DAILY STRATEGIES	
Skipping meals	127	64.8
Eating less food	56	28.6
Purchase of food on credit	13	6.6
Total	**196**	**100.0**
	SEASONAL STRATEGIES	
Migration	92	**46.9**
Butter trade	26	**13.3**
Sale of assets	78	**39.8**
Total	**196**	**100.00**

3.8. Coping Mechanism

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Different coping mechanisms used or employed by the households are shown below. Most of the respondents migrate (25.5%), weave baskets and hats (23%) and reduce quantity of food (23%). The other coping mechanisms are shown in Figure 3.

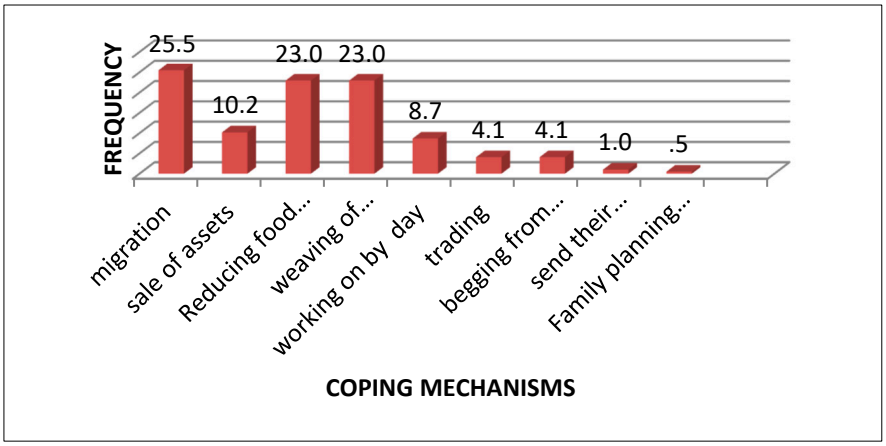

Figure 3. Household Coping Strategies.

3.9. Food Consumption Score (FCS)

Figure 4 shows the assessment of the foods consumed by households. Majority of the households (67.3%) had poor food consumption scores whiles the food consumption of only 1.5% of household was acceptable.

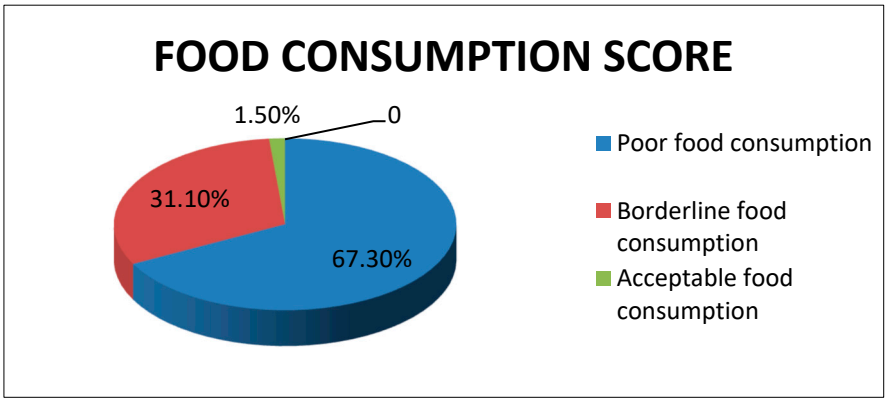

Figure 4. Household Food Consumption Score.

3.9.1. Relationship between Employment, Household Size, Educational Level, Food Consumption Score, and Food Insecurity

This study showed that number of employed people in the household, level of education and food consumption scores were significantly associated with food insecurity (P<0.001) but household size had no relationship with food insecurity (Table 9).

Table 9. Relationship between employment, household size, educational level, food consumption score, and food insecurity.

Variable	Food insecurity		p-value
Unemployment in each household	Moderate food insecure	Severely food insecure	<0.001
None	2	149	
One	3	24	
Two	0	13	

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Three	2	3	
Household size			
1-10 people	5	117	0.833
11-20 people	1	53	
21-30 people	1	12	
31-40 people	0	4	
41-50 people	0	3	
Educational level			
Nill	0	123	<0.001
Primary	1	35	
Junior high	1	13	
Senior high	4	16	
Tertiary	1	2	
Food Consumption Score			
Poor food consumption	5	127	<0.001
Borderline Food Consumption	0	61	
Acceptable food Consumption	2	1	

3.10. Dependency Ratio

Table 10 shows that there was an imbalance in households. The total dependency ratio was 140%. Households with higher number of dependents were more food-insecure (5% and 135% moderately and severely food-insecure respectively) than non-dependent households (2% and 54% moderately and severely food-insecure respectively). There was no significant relationship established between food security status and dependency ratio (P> 0.05).

Table 10. Dependency Ratio.

	Moderately food-insecure	**Severely food-insecure**
Dependency ratio below 100%	2%	54%
Dependency ratio above 100%	5%	135%

4. Discussions

4.1. Causes of Food Insecurity

***Low Income and Poverty*:** The study reveals that low income and poverty are primary drivers of food insecurity within the surveyed communities. These financial limitations severely restrict access to nutritious, high-quality food, often forcing individuals to rely on cheaper, carbohydrate-rich options.

One respondent noted, *"With the little money I have, I can only afford to buy rice and maize. I wish I could buy more fruits and vegetables, but they are too expensive*." This overreliance on carbohydrates not only limits dietary diversity but also poses significant health risks, including an increased likelihood of obesity.

As another respondent explained, "*We don't earn enough to feed our families properly, so we end up eating the same starchy foods every day*."

This sentiment echoes the findings of Nabuuma et al. (2021), who also identified poverty as a critical barrier to accessing balanced diets, leading to food insecurity and associated health challenges. The

 doi:10.20944/preprints202409.0827.v1

connection between low income, food choices, and health outcomes underscores the urgent need for targeted interventions to improve both economic conditions and food access in these communities.

***High Dependency on Agriculture*:** Another significant cause of food insecurity identified in the study is the community's heavy dependence on agriculture as the primary source of income.

The results in Table 10 highlights the imbalance in the dependency ratio within households in the study area, with a higher proportion of dependent households compared to non-dependent ones. Households with a higher number of dependents are more likely to experience food insecurity, with 5% and 135% of such households being moderately and severely food insecure, respectively, compared to 2% and 54% among non-dependent households. The overall dependency ratio of the population is 140%, which is alarmingly high.

Many households rely solely on food crop production to sustain their families, but this dependence is fraught with challenges such as infertile land, inadequate farming techniques, and poor crop yields. One respondent shared, "*Our land is no longer fertile, and we don't have the means to improve it. Every year, our harvests get smaller, and it becomes harder to feed our children."*

These agricultural difficulties contribute to heightened food insecurity, particularly in households where no member is employed outside of farming. "*We all depend on the farm, but when the harvest is poor, there's nothing else to fall back on,"* another respondent explained, highlighting the vulnerability of these communities.

This finding is consistent with Phamova et al. (2020), who reported that 77.0% of households had no member employed outside agriculture. In these cases, the responsibility of providing for large families falls on the few employed individuals, whose earnings are often insufficient to meet the needs of their dependents. This situation exacerbates food insecurity, leaving many households struggling to make ends meet.

***Unemployment*:** The high unemployment rate is another critical factor that exacerbates food insecurity within the community. The findings reveal a significant relationship between unemployment and household food insecurity, with a p-value less than 0.001. This result indicates that unemployment is strongly associated with food insecurity, confirming that the lack of employment significantly contributes to food insecurity in households. Despite rural populations having access to land and opportunities for food production, the data shows that the majority (76%) of unemployed individuals experience severe food insecurity. Further, with limited employment opportunities, many individuals are unable to earn a stable income, making it difficult to purchase enough food to meet their dietary needs. As one respondent expressed, "*Without a job, it's hard to buy even the basic food items. We just get by with whatever little we can afford."* This struggle is particularly acute in households without any employed members, as these families are more prone to experiencing food insecurity.

On the other hand, households with employed members are generally better off, as employment helps diversify and increase household income, directly improving food security. Another respondent noted, "*When my husband found work, things got easier. We could buy more food, and it wasn't just about surviving anymore*." This observation aligns with the literature, where studies by Endris & Kassegn (2022), Singh et al. (2021), Hwalla et al. (2021), and Erokhin & Gao (2020) all emphasize the crucial role of employment in enhancing food security by providing the financial means to secure sufficient and nutritious food.

 doi:10.20944/preprints202409.0827.v1

***Poor Storage Facilities*:** The lack of adequate storage facilities, coupled with poor storage and processing methods, is a significant contributor to food insecurity in the study area. Without proper storage, post-harvest losses are substantial, leading to wasted food and lost income for farmers. One farmer highlighted the issue: "*We lose so much of our harvest because there's nowhere to store it. After a few months, the crops start to spoil, and we have no choice but to sell them off cheaply."*

This problem is compounded by a lack of awareness regarding food preservation techniques, further threatening food security. "*If we had better storage, we could keep food for when times are hard, like during a drought,"* another respondent pointed out, emphasizing the critical need for storage facilities. These facilities are essential for preserving food and agricultural produce, particularly during emergencies such as famines, poor harvest seasons, and droughts.

The absence of proper storage leads to significant crop and financial losses, forcing many small-scale farmers to sell their produce quickly and at lower prices, knowing it will spoil within a few months. This situation exacerbates food insecurity within their communities. The importance of adequate storage facilities in ensuring food security is well-documented, as evidenced by the findings of Neme et al. (2021), Sugri et al. (2021), and Bechoff et al. (2022). These studies highlight the critical role that proper storage plays in maintaining food supplies and supporting farmers' livelihoods.

***Lack of Education*:** The lack of education is another significant factor contributing to food insecurity in the community. Education, particularly nutrition education, is crucial for enabling individuals, especially farmers, to make informed decisions about food production and consumption. The results presented in Table 10 show a significant relationship between education and household food insecurity ($p < 0.001$).

One respondent highlighted the issue: "*We don't know much about nutrition, so we just grow and eat what we're used to, even if it's not the best for our health*."

This lack of knowledge is closely linked to food insecurity, with many food-insecure households being led by individuals with little or no formal education. "*If we had more education, we could learn better ways to farm and feed our families*," another respondent reflected, emphasizing the importance of education in enhancing food security.

The correlation between education and food security is supported by research from Savari et al. (2020), Ingutia & Sumelius (2022), and Samim et al. (2021), all of whom found that households headed by individuals with no formal education are far more likely to experience food insecurity. This underscores the critical need for targeted educational programs that can empower communities to improve their food security through better farming practices and nutritional awareness.

***Family Size*:** Family size is a critical demographic factor that significantly impacts household food security. The results table 9 indicate no significant relationship between household size and food insecurity, as evidenced by a p-value greater than 0.05 notwithstanding the qualitative responses in the study show that, larger families are often more vulnerable to food insecurity compared to smaller ones. One respondent expressed the challenge, stating, "*With so many mouths to feed, it's hard to make the food last. We often run out before the month is over."*

This study found a strong correlation between large family sizes and increased food insecurity, confirming the expectation that more extensive households struggle more to secure adequate food. "*It's difficult to provide enough for everyone when the family is big, especially when income is limited*," another respondent shared, highlighting the strain that larger families face.

 doi:10.20944/preprints202409.0827.v1

These findings are consistent with previous research by Owoo (2021) and Mekonnen et al. (2021), which also indicate that households with larger families are more likely to experience food insecurity. This underscores the need for targeted interventions that consider family size when addressing food security challenges.

***The performance of extravagant funerals*:** Extravagant funeral practices were identified as a significant cultural factor exacerbating food insecurity in rural communities. Many indigenous farmers, despite having only a modest harvest, prioritize lavish funeral ceremonies, often at the expense of their family's well-being. As one respondent explained, "*After the harvest, we use most of the food to honor the dead. By the time the funerals are over, there's hardly anything left for the children.*" This practice leaves families, especially women and children, in a precarious situation, with little to no food reserves until the next harvest season.

Children are particularly affected, as they often suffer from severe hunger for months, which can negatively impact their focus and performance in school. "*After the funerals, there's nothing left. The children go to school hungry, and they can't concentrate,"* another respondent shared. Funerals typically involve the use of various foodstuffs such as groundnuts, beans, millet, and even farm animals like cows, goats, and fowls depleting valuable resources that could otherwise sustain the family.

This finding is consistent with the literature, where Vave et al. (2023) and Shagari & Utsua (2022) also highlight the adverse impact of extravagant cultural practices on food security. To address this issue, there is an urgent need for a paradigm shift that balances cultural traditions with the pressing need to ensure food security for vulnerable populations.

Low Working Age and High Dependency Ratio: The study also found that food insecurity is compounded by a low working-age population relative to a high dependency ratio. "*There are too few of us who are young and strong enough to work and provide food,"* one respondent noted. The elderly, who form a significant portion of the population, are often unable to contribute to food production or income generation, placing additional strain on the few who are actively working. This demographic imbalance further exacerbates food insecurity, as the burden of providing for large dependent families falls on a small number of active workers.

***Drought and other extreme effects of climate change*:** The research identified drought and extreme weather events as significant contributors to food insecurity in the community. These environmental challenges often lead to poor or failed harvests, which in turn result in food scarcity and inflated prices for the limited available food. One farmer explained, "*When the rains don't come, our crops wither, and we have nothing to harvest. The little food that's left in the market becomes too expensive for us to afford."*

These findings are consistent with previous studies by Ahmad et al. (2022), Van & Biradar (2021), and Mbuli et al. (2021), all of which highlight the devastating impact of extreme weather on agricultural productivity and food security. Another respondent shared, "*When the drought hits, it's not just the crops that suffer. The prices go up, and we can't buy enough food for our families*." This underscores the critical need for strategies to mitigate the effects of climate change and improve the resilience of agricultural systems in order to ensure food security in the face of increasingly unpredictable weather patterns.

Pests, livestock diseases and other agricultural problems: In addition to extreme weather events, the study found that many failed harvests in these communities were also caused by pests, particularly desert locusts. These pests devastated crops, further exacerbating food scarcity. *"The*

 doi:10.20944/preprints202409.0827.v1

locusts came and ate everything. We were left with nothing to harvest," one farmer lamented. Beyond pests, cattle diseases and other agricultural challenges, such as erosion and soil infertility, also contributed to food insecurity.

These issues are consistent with findings from previous studies by Muoghalu & Akanwa (2021) and Adewuyi & Ezeamaka (2023), who reported similar challenges in other regions. Another respondent emphasized, *"When our cattle get sick, we lose not just the animals but also the food and income they provide."* The combination of these agricultural problems makes it increasingly difficult for farmers to sustain their livelihoods, leading to greater food insecurity in their communities.

Asset possession: The research revealed that ownership of consumer durables and productive assets significantly affects food insecurity. The study assessed whether asset ownership correlates with better living conditions and food security. The findings showed that only a few individuals owned items such as refrigerators, computers, electric fans, animal-drawn carts, and vehicles, indicating a higher level of food insecurity among these individuals. One respondent noted, *"We don't have many of these gadgets because they are too expensive. Without them, it's harder to manage our food supply and daily needs."*

The lack of such assets is largely attributed to poverty, as many community members cannot afford to purchase them. Additionally, a lack of education further limits access to certain assets. For example, computers were predominantly owned by those with higher education levels, such as those who completed tertiary education. As another respondent explained, *"Only those who went to school can afford and use computers. Most of us have no education, so we don't see the need for such gadgets."*

These findings align with the literature, where studies by Sisha (2020), Kehinde et al. (2021), and Chegini et al. (2021) also highlight the relationship between asset ownership and food security. Ownership of essential assets reflects an individual's income level and poverty status, impacting their ability to secure adequate food and improve their overall quality of life.

4.2. The Relationship Between Food Insecurity and Food Consumption Score

The research findings underscore a significant relationship between food insecurity and food consumption scores, with statistical analysis revealing a p-value of less than 0.001. This indicates a strong correlation between poor food consumption and heightened food insecurity. Figure 4 in the study further illustrates the gravity of the situation, showing that a staggering 67.3% of the study population falls within the poor consumption score category, while only 1.5% of the population has an acceptable food consumption score. This high percentage of individuals with poor consumption scores highlights the severe risk of food insecurity in the community. One respondent noted, "We often have to skip meals or eat very little because there just isn't enough food to go around." Those with borderline food consumption scores are also at significant risk, as another respondent shared, "Even when we have food, it's not always nutritious or sufficient. We're just getting by." These findings are consistent with previous studies by Opaluwa et al. (2021) and Chikako et al. (2021), which also reported a strong link between poor food consumption scores and increased food insecurity. The data suggests that households with poor and borderline consumption scores are particularly vulnerable, underscoring the urgent need for interventions that can improve food availability and nutritional intake in these communities.

4.3. Coping Strategies

The research revealed a range of coping strategies employed by communities to deal with food insecurity, with skipping meals being the most common, reported by 64.8% of respondents. Other strategies included eating less food, purchasing food on credit, migrating to other places in search of better opportunities, selling assets, bartering, and reducing the quantity of food consumed. Some

 doi:10.20944/preprints202409.0827.v1

community members also resorted to weaving baskets and hats, working as day laborers, trading, begging, or sending their female children away to reduce the household burden. Alarmingly, some respondents reported doing nothing at all to cope with their food insecurity, indicating a sense of hopelessness.

These coping mechanisms reflect the dire circumstances faced by the study population and align with strategies identified in previous research by Abebe (2021), Benti et al. (2022), and Nienkerke et al. (2023). The findings underscore the extreme vulnerability of the communities, where more than 96% of respondents were classified as severely food insecure. One respondent explained, "We skip meals almost every day. It's the only way to make the little food we have last longer." Another shared, "We've sold everything we can, but it's still not enough. We don't know where our next meal will come from."

The reliance on such extreme coping strategies is compounded by various factors identified earlier in the study. These include the devastating impact of droughts and extreme weather events leading to poor harvests, the destruction caused by pests and cattle diseases, and the challenges posed by low income and poverty. Additionally, high unemployment rates and lack of adequate storage facilities further exacerbate the food insecurity crisis, forcing many to adopt desperate measures.

The data also suggest that households with low ownership of consumer durables and productive assets are particularly vulnerable, as they lack the resources to secure food during difficult times. Moreover, the impact of cultural practices, such as extravagant funerals, drains essential resources, leaving families with little to sustain themselves. Large family sizes further strain limited resources, intensifying the need for coping strategies like skipping meals or selling off assets.

The severity of food insecurity in these communities is alarming, especially considering the long-term health implications. Good health depends on the consistent intake of vital nutrients, yet far too many respondents are uncertain about where or when their next meal will come. The profound impact on health, development, and behavior calls for urgent attention. Policymakers, community leaders, and NGOs must work together to increase access to food, provide education on nutrition, and develop resources to mitigate the adverse effects of food insecurity. Addressing these challenges is crucial for improving the resilience of these communities and ensuring a more secure future for all.

5. Conclusions

This study identified several critical factors contributing to food insecurity in the communities, including soil infertility, poor rainfall patterns, the performance of extravagant funerals, large family sizes, high unemployment rates, and a high dependency ratio with low working-age population. Food insecurity was found to be alarmingly severe, with none of the households classified as food secure. The vast majority (96.4%) of households were severely food insecure, 3.1% were moderately food insecure, and only 0.5% were mildly food insecure. Households employed various coping strategies to manage food shortages, such as reducing the size and number of meals per day, purchasing food on credit, migrating to other areas, selling assets, weaving baskets, skipping meals, and, in some cases, sending female family members away. In terms of dietary intake, more than two-thirds of households (67.3%) had poor food consumption scores, while almost a third (31.2%) were at the borderline level. Alarmingly, only 1.5% of households achieved acceptable food consumption levels. The study also revealed significant relationships between unemployment and food insecurity, household food consumption scores and food insecurity, as well as education levels and food insecurity, with all relationships showing strong statistical significance ($P < 0.001$). Given that food security is now virtually synonymous with overall development, it is imperative that urgent attention is directed toward addressing the pressing issue of food insecurity in these communities. Implementing effective policies and interventions will be crucial to improving the resilience and well-being of the affected populations.

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