Effect of Seasonal Floods on Farmers' Household Food Security in the Kassena Nankana Municipal of Ghana.

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ABSTRACT

The Kassena Nankana Municipality has experienced an increase in the frequency and severity of seasonal floods, threatening the livelihoods of local farmers. These floods disrupt agricultural activities and exacerbate regional food insecurity. This study examined the extent to which floods affected local farmers' food security. Interviews were conducted with 150 farm households from five different communities. To understand the nature, scope of the flooding and damages caused by the floods, descriptive statistics were employed. The floods' effect on farmers' food security were examined using Ordinary Least Squares (OLS) econometric modelling. The Food and Nutrition Technical Assistance (FANTA) Household Dietary Diversity Score (HDDS) and Food and Agriculture Organization (FAO) Food Consumption Score (FCS) models were used to assess food security levels. The majority of the floods in the area were caused by heavy rains. These floods resulted in total asset losses of GHS 653,640.6 (USD 116,722.00), with maize crops bearing the brunt of the damage at GHS 106,712.00. (USD 19,056.00). Properties worth GHS 276,275.00 (USD 49,335.00) were destroyed, including houses, animal pens, storage rooms, bicycles, and motorbikes, and with estimated loss of 3,383 birds. Due to the floods, two people died and 201 people became ill. Food security was found to be positively associated with factors such as male-headed households, age, income, and access to credit. The size of a household had a negative impact on food security. The study recommended targeted policies to improve agricultural productivity and support smallholder farmers, such as loan and social security schemes, women's empowerment, and the establishment of irrigation facilities to improve regional food security.

Keywords: Agriculture, Climate Change, Disasters, Floods, Food Security, Household

INTRODUCTION

Agriculture plays a pivotal role in Africa, where approximately 70% of the population resides and earns a living in rural communities. It accounts for 40% of all export earnings and generates roughly one-third of the national income (Musah et al., 2013). Nevertheless, the agricultural sector remains vulnerable to climate change, resulting in agricultural production losses and unpredictable environmental repercussions that impact food security. Rain-fed agriculture, upon which many Africans depend for sustenance and livelihoods, is particularly susceptible to climate change (Armah et al., 2010). In Ghana, agriculture contributed approximately 19.7% to the GDP in 2018 (Ghana Statistical Service, 2015). Smallholder farming is the predominant mode of agricultural production in the country (Statistics Research and Information Directorate – SRID, 2011). In the Upper East Region, which includes Kassena Nankana Municipal, a significant proportion of households engage in agriculture. According to the GSS (2013), of the total households in the region, approximately 93.7% of rural households are engaged in agriculture, producing key crops such as groundnut, maize, millet, sorghum, rice, and shea.

Over the years, floods have had its way on humanity. It destroyed lives, properties and displaced people. The after effect of floods on the various sectors of humanity such as health, agriculture, economic

development, livelihoods, social and human life are devastating (Armah et al., 2010; Echendu, 2020; Atanga & Tankpa, 2021; Ghambi et al., 2023). These floods are considered as biological or environmental uncertainties whose occurrence are sudden and therefore give people little time to prepare for it. One can argue that, not all disasters are naturally induced but human activities (anthropogenic) have had a significant influence on some of them.

Ghana has had its share of disasters in the form of floods affecting some of its major cities and towns. An unforgettable event occurred on June 3, 2015, in Accra, where continuous rainfall led to the loss of at least 152 lives due to an explosion at a nearby petroleum station caused by flooding (Asumadu-Sarkodie et al., 2015). Similarly, between October 6th and 12th, 2019, devastating flooding struck the Upper East Region of Ghana, affecting municipalities and districts, including Bolgatanga, Kassena-Nankana, Bawku, Builsa North, Builsa South, Binduri, Talensi, Garu Tempane, and Bongo. Reports from International Federation of Red Cross and Red Crescent Societies (IFRC), (2020) indicated potential fatalities, with as many as 29 people losing their lives in flood-related incidents that year. The floods also resulted in the destruction and severe damage of thousands of buildings, including nearly 2,000 in the Kassena-Nankana Municipality alone. These calamities have not only claimed lives but have also caused widespread damage to farms, homes, and properties, leaving countless individuals displaced. This is especially significant in Ghana, where farming is primarily rain-fed (Müller-Kuckelberg, 2012). As Musah et al. (2013) noted, disasters have far-reaching economic and food security implications for vulnerable households. They directly impact agriculture by reducing crop yields, leading to financial losses for farmers, and consequently affecting both agricultural growth and rural livelihoods.

The Kassena Nankana Municipal area is no exception; it has experienced its share of floods, most notably from October 6th to 12th, 2019. Heavy rainfall led to the overflow of the Tono irrigation dams, inundating 844 hectares of farmland in the municipality (floodlist, 2019). For many residents, especially those in rural areas, these farmlands represent their sole source of livelihood. Consequently, this raises concerns about food security, as farm output is likely to decline. A report from myjoyonline.com on October 18, 2019, highlighted that victims of the flooding in Kassena Nankana Municipality were facing food shortages, a harbinger of potential hardships in the months to come.

Food security is a pressing concern in West Africa, with approximately 14.7% of the population experiencing undernourishment (FAO, 2020). In West Africa, 56.1 million people are undernourished, with an additional 182.8 million severely food insecure. Darfour and Rosentrater (2016) reported that 5%, or approximately 1.2 million, of Ghana's population faces food insecurity, with an additional 2 million people at risk. Furthermore, about 28% of those facing food insecurity are from the Upper East Region (Elliot & WFP, 2012). This region has a history of food insecurity, with farming households experiencing periods of high food insecurity, lasting from 3 to 7 months (Quaye, 2008). This poses more questions that intrigues into their food security level, since the district is seen as one of the places vulnerable to food insecurity. According to Frederick (2014) a significant majority of about 89% his respondents believed that the changing climatic conditions had an effect on the households' food security in the Kassena Nankana Municipal. UNDP (2011) also recounted that, 26% of the rural households in the Kassena Nankana Municipal were food insecure. It will therefore be fair to say, the community will be worse off than they were after the recent floods. This will not only affect the municipal but also the nation's goal to achieve the Sustainable Development Goal of zero hunger and no poverty by 2030.

While previous research has increasingly focused on floods and climate change coping and adaptation strategies Apuri et al., (2018); Kabobobah et al., (2018) & Baffour-Ata et al., (2021), there is a notable gap in understanding the effect of seasonal floods on food security, particularly in the context of Kassena Nankana Municipal. Existing studies have largely concentrated on the threats to food security, leaving limited exploration of the direct impact of seasonal floods on food security among local farmers. It is within this context that this study endeavors to examine the effect and extent of floods on food security among

farmer households in the Kassena Nankana Municipal of the Upper East Region. Specifically, the study examined;

1. The nature of floods in the Kassena Nankana Municipality
2. The damages caused by floods to farm produce and food stock in the municipality
3. The effect of these floods on the farmers' household food security status.

METHODOLOGY

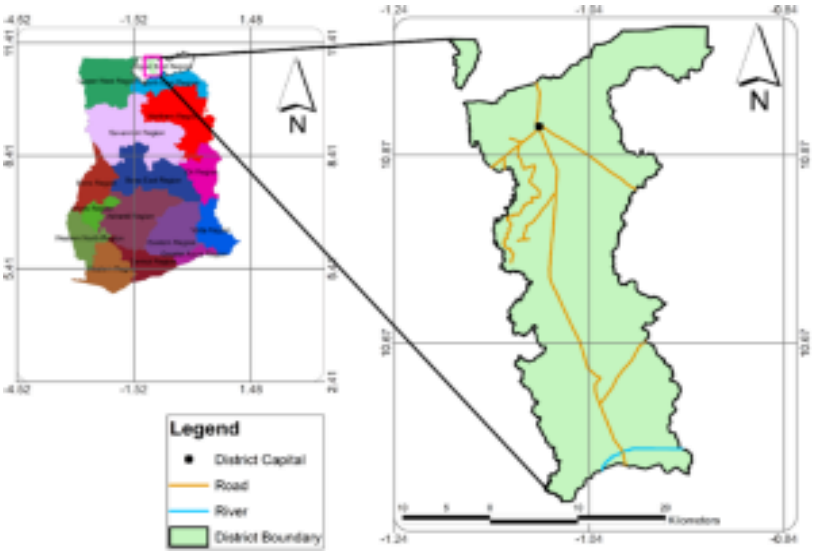
Study Area: Kassena Nankana Municipality

The research was conducted within the Kassena Nankana Municipality, a region of significance elevated to municipal status by Legislative Instrument (LI) 2106. This administrative change occurred subsequent to the establishment of the Kassena Nankana District in 1988, as authorized by LI 1855. The municipality is one of the thirteen districts/municipalities situated in the Upper East Region of Ghana, with its capital in Navrongo.

Geographically, the Kassena Nankana Municipality is positioned approximately between latitude 11°10' and 10°3' North and longitude 10°1' West. It shares its boundaries with the Kassena-Nankana-West District and Burkina Faso to the north, while to the east, it borders the Kassena-Nankana West District and Bolgatanga Municipal. To the west, it shares boundaries with the Builsa District, and to the south, it shares borders with the West Mamprusi District in the Northern Region (Feed the Future, 2017).

The municipality falls within the tropical continental climatic zone, characterized by a mean annual rainfall of 950mm and average maximum temperatures reaching 42°C, with minimum temperatures at 18°C. The region predominantly features gentle sloping terrain, ranging from 1% to 5%, although approximately 70% of the area faces moderate to severe sheet and gully erosion challenges. Erosion is a persistent issue in the region. Valley areas within the municipality exhibit a range of soils, from sandy candy loams to salty clays, which possess higher natural fertility but are more challenging to till and are susceptible to seasonal water logging and floods.

Agricultural production in the Kassena Nankana Municipality encompasses a variety of commodities. Rice holds the largest share, constituting 54.8% of agricultural output, followed by sorghum, groundnut, and maize. In 2015, the municipality contributed approximately 4.5% to the regional agricultural production (Feed the Future, 2017).



Source: Anokye et al., (2023)
Figure 1: Map of Ghana and Kassena Nankana Municipal.

Sampling, Data Collection Technique and Data Analysis

Sampling Technique: The study employed a purposive sampling technique to select specific areas within the research area.

Sample Size: A sample size of 150 farming households were used in the study.

Data Collection: Primary data was collected through a structured questionnaire administered via face-to-face interviews with farm households.

Research Design: The study adopted a cross-sectional (or survey) design, enabling data collection at a single point in time to assess the effect of seasonal floods on food security.

Data Analysis: Data analysis encompassed descriptive, statistical, and econometric methods, facilitating a comprehensive examination of the data, including summarizing findings, identifying patterns, and quantifying relationships between variables of interest using Stata.

Analytical framework

The Kassena Nankana Municipal is mostly affected by two types of floods, thus, Heavy torrential rains or the spillage of the dam. This study therefore outlines the nature of the floods in the municipal using descriptive statistics. The study also employs the use of descriptive statistics to describe the damages caused by floods to their farms, properties and lives. Finally, the effect of floods on famers' household food security are measured using the Ordinary Least Squared (OLS) regression model. The food security of the household is also measured using the FAOs model for measuring food security thus, the Food Consumption Score (FCS) and FANTA's model of measuring food security thus, the Household Dietary Diversification Score (HDDS).

The FCS model is calculated by multiplying the foods against their weights and summing them, thus, FCS = (starches*2) + (pulses*3) + vegetables + fruit + (meat*4) + (dairy*4) + (fats*0.5) + (sugar*0.5). The household's food consumption status/food security status is determined with the following thresholds: 0-28; Poor consumption
28.5-42; Borderline

>42; Acceptable

The HDDS is also measured by summing all the food groups together.

HDDS = Cereals+ Fish and seafood + Root and tubers + Pulses/legumes/nuts +Vegetables+ Milk and milk products+ Fruits + Oil/fats + Meat, poultry, offal + Sugar/honey + Eggs+ Miscellaneous/ Condiments

The research uses OLS to measure the effect of floods on famers' household food security level and the model is represented as,

$$Y=\beta i\ Xi+\varepsilon$$

Where,

Y= Food security status

Xi = Explanatory factors/determinants of food security

ε= Error term which is normally distributed

RESULTS AND DISCUSION

Descriptive Statistics of Socioeconomic Variables

In line with GSS (2013) data, which indicates that most households in northern Ghana are headed by males, 84.67% of the sampled households in the study area had male household heads, while the remaining 15.33% were headed by females. This reflects the traditional cultural norm where males are typically considered the heads of families. However, in cases where there is no eligible male head, females assume this role. Marital status among the sampled population revealed that approximately 78.67% were married, while the remaining 21.33% were single. On average, each household had a size of 6 individuals. The average age of household heads was 51 years. The most dominant age group among household heads was the 36-65 age group, representing 61.33% of the sample. The youngest household head was 24 years old, while the oldest was 98 years old. In terms of education or literacy levels, 46% of household heads had no formal education, making it the largest group. Additionally, 36% had received basic education, 14.67% had completed secondary education, and 3.33% had tertiary education. The study found that the average household income was GHS 9,037.5. Household incomes varied widely, with the lowest reported income being GHS 0, suggesting dependence on remittances, while the highest income reported in the sampled communities was GHS 42,000. Among the 150 sampled respondents, 19.33% of farming households were members of farmer-based organizations. Moreover, approximately 56.67% of households reported having access to credit, while 38% indicated having access to extension services.

Table 1 Socio demographic characteristics of the sampled population.

Variable	Frequency	Percentages
Sex		
Males	**127**	**84.67%**
Females	**23**	**15.33%**
Marital status		
Married	**118**	**78.67%**
Single	**32**	**21.33%**

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Literacy level		
None	**69**	**46%**
Basic	**54**	**36%**
Secondary	**22**	**14.67%**
Tertiary	**5**	**3.33%**
Age		
Below 18	**0**	**0%**
18-35	**30**	**20%**
36-60	**92**	**61.33%**
Above 60	**28**	**18.67%**
FBO membership		
Yes	**29**	**19.33%**
No	**121**	**80.67%**
Access to credit		
Yes	**85**	**56.67%**
No	**65**	**43.33%**
Received remittances		
Yes	**29**	**19.33%**
No	**121**	**80.67%**
Received extension services		
Yes	**57**	**38%**
No	**93**	**62%**

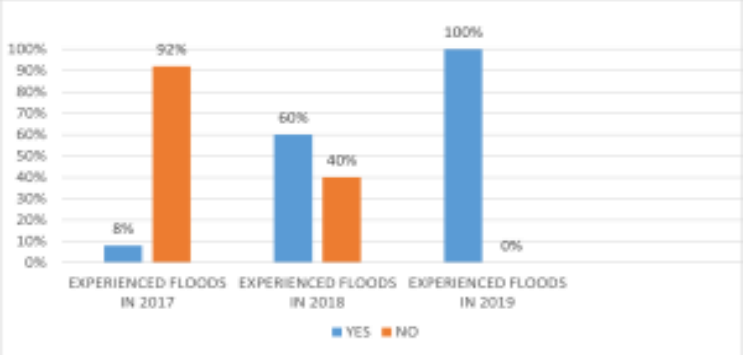
Source: field survey 2020

The Nature of Floods in the Kassena Nankana Municipality

From the data analysis conducted across the five communities, it was evident that 100% of the respondents had experienced floods over the past three years. Specifically, in 2017, 8% of the respondents reported experiencing floods. In 2018, the incidence of floods affected a substantial portion, with 60% of the respondents encountering flood-related issues. In 2019, the situation escalated further, with 100% of the

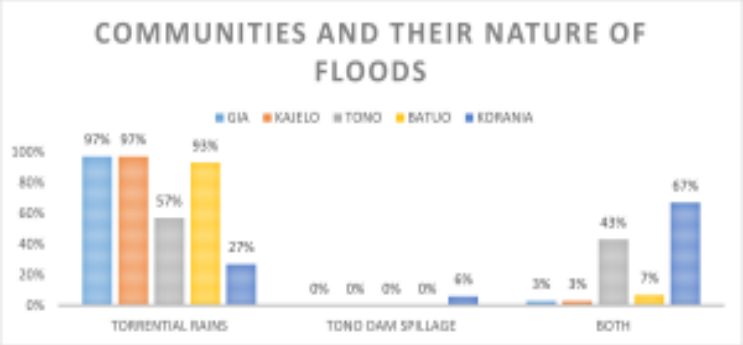
respondents' experiencing floods. Regarding the types of floods that affected the study area, the breakdown is as follows: 97% of both Kajelo and Gia respondents were primarily affected by floods caused by torrential rain. Korania was the only community that was affected by floods caused by the spillage of the Tono dam with 6% of farm households in the area being affected. 67% of floods in the same community were attributed to a combination of torrential rain and the spillage of the Tono dam.

Furthermore, an examination of the communities revealed specific patterns in the types of floods experienced: Gia, Batuo, and Kajelo communities were predominantly affected by floods resulting from torrential rains. In contrast, Korania and Tono communities were predominantly affected by floods stemming from the spillage of the Tono dam. This could be attributed to the proximity of Korania and Tono communities to the Tono dam, as well as the presence of canals linking the dam to these communities. In contrast, Gia, Batuo, and Kajelo communities are situated farther away from the Tono irrigation dam.



Source: ***field survey 2020***

Figure 2: Farming households' experience of floods in 2017, 2018 and 2019



Source: ***field survey 2020***

Figure 3: Communities and the nature of floods experienced in 2019

Damages Caused by Floods to Farming Households.

The damages inflicted by the floods were both extensive and devastating, encompassing the destruction of livestock, agricultural produce, stored food, properties, and even human lives. The cumulative financial loss due to flood-related destructions amounted to GHS 653,640.6 (USD 116,722.00), profoundly impacting the livelihoods of the respondents. This encompassed losses in crops, buildings, animals, stored grains, and human lives. A total of 3,996 animals worth GH 113,593.00 (USD 20,284.00) were lost due to the floods. These animals included poultry, cattle, sheep, goats, pigs, and donkeys, with poultry being the most affected category, accounting for 3,383 of the total losses. Similarly, a total of 1,739.5 bags of various crops such as maize, rice, millet, sorghum, and groundnuts were destroyed. These bags were either damaged on the farms or while stored in homes. The estimated value of the destroyed bags of produce was GHS 244,045.6 (USD 43,580.00). Maize, both on farms and in storage, suffered the most significant losses, with 762.66 bags destroyed, while sorghum was the least affected with 55.13 bags destroyed. Groundnut was moderately

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affected, with 321.75 bags destroyed. A total of 686 properties, including houses, animal pens, store rooms, bicycles, and motorbikes, were destroyed by the floods, with a combined value of GHS 276,275.00 (USD 49,335.00). Houses were the most affected category, accounting for GHS 223,650 (USD 39,938.00) of the total property losses. The floods also inflicted harm on lives, resulting in illness among 201 individuals. These illnesses incurred a total cost of GHS 19,727.00 (USD 3,523.00) for medical treatment. Tragically, two lives were lost due to the floods.

Table *2* Damages caused by floods to the farmers' livelihood

Livelihood and Properties Destroyed	Quantities	Value of Damages (GHS)
Livestock		
Poultry	**3383**	**21135**
Cattle	**29**	**30100**
Sheep and Goats	**367**	**43000**
Donkeys	**29**	**15900**
Pigs	**188**	**3460**
Total	**3996**	**113,595**
Food Crops Destroyed on Farms		
Maize	**714.33**	**99946**
Rice	**483.83**	**58188**
Millet	**84.5**	**11829.3**
Sorghum	**49.34**	**7800.8**
Groundnut	**305.75**	**51977.5**
Total	**1637.75**	**229741.6**
Stored Food Crops Destroyed		
Maize	**48.33**	**6766**
Millet	**18.99**	**2492**
Rice	**12.66**	**1520**
Sorghum	**5.76**	**806**
Groundnut	**16**	**2720**
Total	**101.74**	**14304**

Properties Destroyed		
Houses Animal	**212**	**223650**
pen Store	**293**	**21990**
rooms Bicycles	**54**	**7350**
Motorbikes	**98**	**12875**
Total	**29**	**10410**
	686	**276275**
Damages to life		
Illness	**201**	**19727**
Deaths	**2**	***PRICELESS***
Totals		
Grand Total		**653642.6**

Source: field survey 2020

The Effect of Seasonal Floods on Farmers' Household Food Security.

The study utilized the Food Consumption Score (FCS) model and the Household Dietary Diversification Score (HDDS) to assess the food security levels of various farm households. Using the FCS Model (Table 3), both income and access to credit exhibited positive and significant effects at the 1% level. This finding aligns with research by Frimpong (2013), which suggests that individuals with higher incomes and access to credit are more food secure. Higher income levels enable households to purchase food when their agricultural produce is compromised by floods, allowing them to withstand adversities. Moreover, access to credit positively influences food security, as households can utilize credit for diversification into non-farm or non-agricultural activities, potentially enhancing their food security by generating income from various sources.

The gender variable (male=1; female=0) had a positive influence on the level of food security, indicating that households headed by males were more food secure than those headed by females. The positive impact of male-headed households on food security can be attributed to traditional gender roles in many societies. Males are often seen as primary breadwinners and decision-makers in households. This result is consistent with findings from Pankomera et al. (2015) which suggest that males may have greater access to resources and opportunities, which can enhance their ability to secure food during times of crisis.

Age exhibited a positive influence on food security, indicating that households headed by older individuals tended to be more food secure. This relationship can be attributed to the fact that age often comes with experience, enabling older individuals to work more efficiently, earn more income, and adapt to challenges effectively. This finding is supported by research from Asenso-Okyere et al. (2013).

Household size on the other hand, showed a negative but significant influence at the 5% level. This suggests that households with a larger number of members are less food secure compared to smaller households. This

finding is consistent with the work of Beyene & Muche (2010) who argued that the negative relationship can be attributed to the fact that larger households have more mouths to feed, potentially leading to reduced meal quality or skipped meals in order to provide food for everyone. This observation is further supported by Thecla I et al. (2018), who noted that people often skip meals during times of crisis, which affects their ability to access sufficient food.

Table 4 depicts OLS Regression Results on the Effect of Floods on Farmers' Food Security Levels using the HDDS Food Security Model. The results of the regression analysis using this model reveal crucial insights into the impact of various factors on farmers' food security levels in the Kassena Nankana Municipal of the Upper East region in Ghana. Gender is a significant factor at the 1% level, affirming that households headed by males tend to be more food-secure than those headed by females. This finding is supported by Ashagidigbi et al., (2022) who indicated that de jure female-headed households are more food insecure than male-headed households and de facto female-headed households. This study supports the idea that there is a gender-based difference in food security, with male-headed households generally being more food-secure than female-headed households.

Age is also significant at the 5% level, indicating that older household heads are associated with higher food security levels. Older household heads often have more experience and resources to ensure food security. They may have better access to stable income sources, social support networks, and knowledge of food production and preservation. These factors can contribute to higher food security levels among older individuals or households. This finding is affirmed by Muche (2015) who suggests that, as the household head's age increases, food security levels tend to improve, keeping other factors constant.

Income has a significant positive impact on food security, with households with higher incomes being more food-secure. This can be largely attributed to the fact that, higher income households have more money to spend on food, which allows them to purchase a wider variety of nutritious foods. This increased purchasing power can lead to better access to essential nutrients. Also, higher income households are better equipped to handle unexpected financial challenges that may arise due to natural disasters or job loss. This financial resilience reduces the risk of food insecurity during times of economic hardship. This result aligns with prior research findings. According to Zalilah and Tham (2002) research, household food security improved as household income and income per capita rose.

Similarly, households with access to credit exhibit higher food security levels, significant at the 10% level, suggesting the importance of financial resources in achieving food security. Access to credit allows households to invest in agricultural inputs such as seeds, fertilizers, and equipment. This investment can lead to increased agricultural productivity and, consequently, greater food availability within the household. Similarly, credit can serve as a financial safety net during periods of disasters like floods, crop failures or economic hardship. When households face unexpected challenges, having credit can help them purchase food and meet their basic needs, preventing food insecurity. This finding is affirmed by Salima et al., (2023) who suggest that access to formal credit improves household food security however, access to informal credit worsens food security in Malawi.

Surprisingly, experiencing floods in the previous farming season is positively significant at the 10% level. This suggests that those who have experienced floods may be better prepared to cope with future occurrences, a finding supported by Jega et al. (2018). Also, in regions prone to flooding, farmers may choose flood-resistant crop varieties that can withstand or even benefit from inundation. Moreover, in regions prone to flooding, farmers may choose flood-resistant crop varieties that can withstand or even benefit from inundation.

Households that made recoveries from damaged food products are more food-secure, significant at the 10% level. This result is consistent with the findings of Jega et al. (2018), which reported that those who made

recoveries were more food secure. Also, the type of flood (Torrential rains, Tono dam, or both) has a positive and significant effect at the 5% level. Farmers whose farms were affected by torrential rains alone tend to have higher food security levels compared to those affected by dam spillage or both. This finding is in line with the understanding that the spillage of the dam has a more devastating effect on crop production, especially for farms near the dam and its canals.

As expected, household size has a negative impact on food security, significant at the 1% level. Increasing the number of people in a household is associated with a decrease in food security levels, consistent with existing research Worku, (2023). In larger households, resources such as income, food, and assets must be distributed among more individuals. This can lead to a dilution of resources per capita, making it challenging to ensure an adequate supply of food for each member. Also, in many parts of Africa, larger families are valued, leading to a preference for more children. This cultural aspect can contribute to larger household sizes but may also result in food security challenges.

Damages to food crops on farms have a negative coefficient, significant at the 10% level. This aligns with the findings of Jega et al. (2018), indicating that households that experienced greater damage to their crops are more likely to face food insecurity. The study also found that longer flood durations are negatively associated with food security, significant at the 10% level. Households experiencing prolonged floods are more likely to have their produce and properties destroyed, contributing to food insecurity, a trend also noted by Jega et al. (2018). Interestingly, damages to livestock have a positive and significant impact at the 1% level. This finding, while unexpected, suggests that households with more significant livestock losses may be more food-secure.

In conclusion, the regression analysis provides valuable insights into the complex relationship between floods and farmers' food security in the study area, with findings supported by prior research. These results can inform policy and interventions aimed at enhancing food security among vulnerable farming communities facing the challenges of seasonal floods.

Table 3 OLS regression model of the effects of floods on farmers' food security level using the FCS food security model.

Variables	*Coefficients*	*Std. Err.*	*t. statistics*	*p. value*
Gender	16.759***	5.203222	3.22	0.002
Age	0.2198***	0.0816765	2.68	0.008
Household size	-1.3034**	0.54939	-2.38	0.019
Marital status	-5.232165	4.602863	-1.12	0.266
Level of literacy	2.390815	1.532078	1.54	0.125
Income level	0.000426***	0.0001536	2.76	0.007
Experienced floods in '18	-0.54119	2.292755	-0.26	0.793
Flood duration	0.1606241	0.1458685	1.10	0.273
Flood type	3.61478	2.523301	1.44	0.153
Member of FBO	-0.635628	3.114159	-0.17	0.866
Receives remittances	-0.67582	2.917028	-0.23	0.818
Access to credit	5.33026***	2.171715	2.48	0.014
Access to extension service	2.903521	2.718193	1.04	0.299
Recoveries	-0.2416281	1.066231	-0.05	0.958
Quantity of farm foods destroyed	-0.0371313	0.1433064	-0.15	0.880
Quantity of stored farm foods destroyed	-0.2398347	0.8472217	-0.28	0.778

Quantity of animals destroyed	0.0629169	0.0411015	1.53	0.128
Properties destroyed	-0.0001948	0.0006381	-0.31	0.761
Illness due to flood	0.3494067	0.7152805	-0.49	0.626
Constant	39.90072***	8.100876	4.93	0.000
Number of observations 150	Prob. > F 0.0000	R-squared 0.3155	Adj. R-squared 0.2273	

****, **, and * at 1%, 5% and 10% significance level respectively.*

Table 4 OLS regression model of the effects of floods on farmers' food security level using the HDDS food security model.

Variables	*Coefficients*	*Std. Err.*	*t. statistics*	*p. value*
Gender	1.232617**	.5468744	2.25	0.026
Age	0.0207839**	0.0085271	2.44	0.016
Household size	-0.1589123***	0.0583764	-2.72	0.007
Marital status	-0.146546	0.483163	-0.30	0.762
Level of literacy	0.1439451	0.1605576	0.90	0.372
Income level	0.0000518***	0.0000167	3.10	0.002
Experienced floods in '18	0.4048904*	0.2402186	1.69	0.094
Flood duration	-0.0285046*	0.0152585	-1.87	0.064
Flood type	0.5451449**	0.2784535	1.96	0.052
Member of FBO	-0.0700277	0.3269842	-0.21	0.831
Receives remittances	-0.0269701	0.308299	-0.09	0.930
Access to credit	0.3988819*	0.2290984	1.74	0.084
Access to extension service	0.1498774	0.2844474	0.53	0.599
Recoveries	0.1927971*	0.115431	1.67	0.097
Quantity of farm foods destroyed	-.0255443*	0.0156117	-1.64	0.104
Quantity of stored farm foods destroyed	-0.0462699	0.090988	-0.51	0.612
Quantity of animals destroyed	0.0119213***	0.0044628	2.67	0.009
Properties destroyed	1.85e-07	0.0000662	0.00	0.998
Illness due to flood	-0.0621881	0.0742042	-0.84	0.404
Constant	3.479636***	0.8403963	4.14	0.000
Number of observations 150	Prob. > F 0.0000	R-squared 0.3408	Adj. R-squared 0.2444	

****, **, and * at 1%, 5% and 10% significance level respectively*

CONCLUSIONS AND RECOMMENDATIONS

This research has shed light on the profound effect of seasonal floods on farmers' food security in the Kassena Nankana Municipality. It has underscored the diverse nature of floods in the area, stemming from torrential rains, Tono dam spillage, or a combination of both. Notably, torrential rains have inflicted more significant damage on the populace than dam spillage. The study has revealed the devastating consequences of the 2019 floods, resulting in extensive damages valued at GHS 653,642.6 (USD 116,720.00), along with the loss of two invaluable lives. Properties incurred the most substantial monetary losses, while maize crops suffered the most severe damage. Livestock, particularly poultry, also bore the brunt of the disaster. Moreover, the research has identified several factors influencing the food security of farming households, including flood duration, flood type, crop damages, access to credit, household size, recoveries from crop damages, exience of previous floods, age, gender, and income. Income, recoveries, and access to credit were positively associated with food security levels among farming households.

Recommendations

Based on the findings of this research, the following recommendations are proposed:

- The Ministry of Finance, in collaboration with microfinance institutions in Ghana, should allocate more credit and social protection funds to the most vulnerable farmers. Microfinance institutions can offer flexible loans to farmers, enabling them to cope with flood-related challenges. These loans can be utilized for non-farm businesses or farming activities during lean seasons, ultimately improving food security and reducing rural poverty.
- The government, through the Navrongo Municipal Assembly, should implement stringent measures to discourage farming near the banks of the Tono dam and its canals during the rainy seasons. This proactive approach will minimize damages caused by dam spillage, safeguard lives, and protect properties.
- The establishment of women empowerment programs in these communities by the Government of Ghana through the Ministry of Gender and Social Protection and gender-focused NGOs like Plan International Ghana is essential. These programs can engage women in income-generating activities, offering support to households led by females. By elevating women's economic status, these initiatives will contribute to improved food security levels among farming households.
- The provision of irrigation facilities, including water harvesting systems by MoFA, is crucial for enabling farmers to remain productive during dry seasons. Given the municipality's reputation for pepper and tomato production, these measures will not only increase farm income but also enhance food security for farming households.

Addressing the multifaceted challenges posed by seasonal floods on food security requires a holistic and proactive approach. By implementing these recommendations, we can help safeguard the livelihoods of vulnerable farming communities in the Kassena Nankana Municipality and make meaningful strides toward food security and poverty reduction. Furthermore, future research endeavors could delve into the development of flood prediction models and early warning systems tailored to the region, aiding in proactive disaster mitigation. Additionally, exploring the socio-economic implications of food security challenges resulting from floods and the potential role of community-based adaptation strategies offers promising avenues for further study. Lastly, investigating the effectiveness of gender-inclusive agricultural support programs in building resilience against flooding events would contribute to comprehensive solutions for the Kassena Nankana Municipality.

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