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RESEARCH ARTICLE

Farm households' choice of strategies in response to floods in the Builsa-North district, Ghana

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ABSTRACT

The incidence of flooding has increased tremendously in the Northern parts of Ghana, with little knowledge known as to how affected people respond. The research focused on the factors that influence household choice of strategies in response to floods in the Builsa-North district. A multivariate probit model was employed to examine the drivers of household choice of strategies in response to flood. The descriptive analysis indicates that a total of eight (8) response strategies are used, with early planting being the most dominant, while migration was the least used. The results revealed that age, extension services, NADMO services etc are significant determinants of response strategies to floods. NADMO is a government agency responsible for the management of disasters and other emergencies in Ghana. It further on recorded complementary and substitutable response strategies. Using response strategies, farmers face challenges such as low access to extension services etc. It is recommended that avenues must be created to deepen access to extension services available to farmers in other to provide adequate and quality information that will help resolve conflicts in farmers' use of strategies. NADMO services must be targeted at the elderly persons since they view flood phenomenon as acts of their deity.

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1. Introduction

Globally, disasters are reported to have one of the most distressing and disturbing impacts on livelihoods, agriculture, health, social and human life and overall economic development (Musah et al., 2013). Humans are open to various natural disasters and among all the natural hazards to which humans are exposed to floods are seen to account for most damages and loss of lives as well as the most widespread (Noji & Lee, 2005). Flood, a temporal run-off of water onto land that is normally dry or the extreme discharge of water exceeding a channel capacity poses substantial threats to both social and economic growth of places they occur (Shehu, 2014). For human populations, floods have endlessly been a major challenge and concern. Severe floods damage agricultural output, human settlements, arable lands, road networks, infrastructures among others (Mohan et al., 2014).

Agriculture is said to be the key source of livelihood and main activity for most rural households in Sub-Sahara Africa (World Bank & World Bank, 2014). In Ghana, agriculture is mostly dominated by small scale farmers cultivating on farm sizes of less than 2 hectares. The anticipation of this sector is to satisfy the food security needs of the country as well as provide raw materials for industrialization. However, this sector is usually prone to various forms of climatic shocks like floods which cause damages to agricultural output, loss of lives and properties etc (Pincha, 2008; Selase et al., 2017). Particularly, the Northern sector of Ghana, floods are among the most frequent and persistent environmental issues affecting people's livelihood and food safety status (Musah & Akai, 2014). Flooding in the country mostly occur in the months of August and September as a result of heavy rainstorms and the spilling of the Bagre dam by the neighbouring country that is Burkina Faso (Musah et al., 2013). Anytime these floods occur, the repercussion is that the welfare, food security status and livelihoods of smallholder farmers in the country are at risks (Shehu, 2014). The ripple impacts of these repeated floods have generally been food shortages, greater agricultural commodity prices, and the ruin of the country's natural resource amount and quality (Lolig et al., 2014).

Today, there appears to be great public concern and awareness about these annual floods that desolate the region and the district. Thus flood-related disaster effects are most commonly addressed by providing relief products to flood victims, providing them with the capacity to contain future disasters (Lolig et al., 2014). Despite all the bearings of these floods, there seems to be little documented literature available that examined the drivers of farm households' choice of response to flood.

Available literature (see Elum et al., 2017; Emran, 2014; Mandal, 2014; Mulwa et al., 2017; Musah & Akai, 2014; Shehu, 2014; Watanabe et al., 2018) does not draw distinction between strategies used in response to floods and other disaster caused by climatic factors. For instance, Berman et al., (2015) explored how rural livelihoods in groups dependent on natural resources react to shocks in their livelihoods. It must be emphasized that the shock was in general under this study. They

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further on indicated that, the shared strategies adopted were practices in agriculture, financial activity and social aid. In addition, a study by Lolig et al. (2014) on Households' coping strategies in drought and flood prone communities, sort to combine response strategies for both flood and drought. Nevertheless, if such response strategies were projected individually we were optimistic that there might have been differences in the response strategies used which could have been of much relevance. Further, previous studies have failed to investigate the complementarities and substitutability of the various strategies used by farm households in response to flood. For example, using the treatment effect model Lolig et al. (2014) made a distinction between the various coping / adapting strategies used by families to respond to droughts and floods by categorizing them into strategies on the farm and off-farm without accounting for any possible correlations. Hence to be able to address these gaps and manage the issue of these floods effectively and efficiently, this study is targeted at unravelling the various strategies used by smallholder farmers and the factors that affect the use of these strategies as well as the limitations faced by these households in the usage of the strategies.

The next section describes the research methods, which highlights the study area and sample, as well as the analytical framework. After the methods section, the results and discussions follow, before the last section concludes and provides policy implications for the study.

2. Research methods

2.1 *Study area and data*

This study was conducted in Builsa-North in Upper East Region of Ghana (see Figure 1 below). The district covers an area of 2,200 km^2 accounting for over a quarter of the total land area of the Upper East region. A report by (Hill & Kirwan, 2015) indicates that people in the district are mainly small-scale farmers who depend on rain and are also involved in livestock and poultry production. Thus, main food crops grown in the district are maize, rice, millet, sorghum, cowpea and groundnuts. Peculiarly the district is divided by a number of Red and White Volta tributaries and records annual rainfall extending from 85 to about 1150 mm. The district has mean monthly temperatures varying from 21.90°C to 34.10°C, the highest temperatures are registered in March whereas in January the smallest temperatures are recorded.

The data for the study was obtained through a cross-sectional survey of farmers engaged in food crop production in the district. The research employed a two-stage sampling technique. Thus, at the initial stage five communities which are, Kori, Abil-yeri, Nyaansa, Chuchuliga and Wiaga were purposively selected because they are more susceptible to floods. Whiles at the final stage, with the aid of a structured questionnaire 200 farmers were randomly sampled from the five listed communities. A simple random technique was used because it is usually unbiased and gives equal opportunities to the whole population for the result to be a true representation of the entire population (Selase et al., 2017).

2.2 Estimation techniques

2.2.1 Multivariate probit model analysis framework

Confronted with negative climatic changes such as extreme rainfall that can trigger flooding, farmers may opt to often make use of the combination of approaches as a means of adaptation rather than depending on a single approach to exploit options (Mulwa et al., 2017). It is therefore essential to use a model that estimates the impact of exogenous variables on

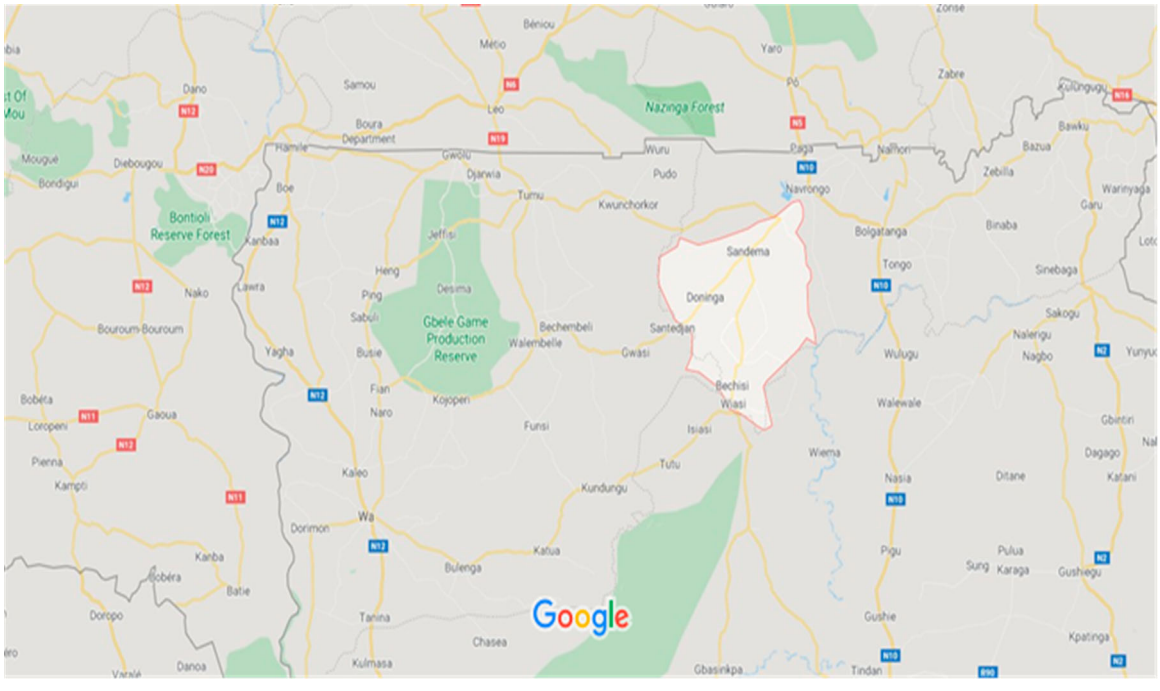

Figure 1. A Map of the Builsa North District.

the selection of reaction strategies concurrently, while enabling for free correlation between the error terms of each of these approaches (Mulwa et al., 2017). This motivated this study to use the Multivariate probit model.

The multivariate probit model is normally used when the decision-making unit is confronted with two or more outcomes, each requiring a choice between two alternatives (Ashford & Sowden, 1970). Under the model, the decision-maker (the farmer), can make a choice among two or more binary choices. Thus, under this scenario, the farmer is presented with different strategies such as early planting, use of early crops, planting in uplands, use of flood defences, petty trading, migration, crop rotation etc. The farmer can decide to adopt early planting or not ($Y_1 = 1, 0$), or can adopt planting in uplands ($Y_1 = 1, 0$), thus a farmer choice of adopting one particular response strategy does not prevent or preclude him from making use of others or another. The model allows for the modelling of joint decisions simultaneously and this gives the opportunity to judge whether there are significant correlations among the options available or not.

The general formula is given by:

$$Y_{im} = X_{im} b_m + e_{im} \tag{1}$$

where $m = 1,\ 2,\ \ldots\ldots\ldots 10$

In this study, the choice of strategies is represented by (y) which is a dummy variable (adopter/non-adopter) thus:

$$y^* = \beta_{0+} \sum_{j=i}^{k} b_j x_{ij} + \varepsilon_i \tag{2}$$

where y^* is a latent variable that measures the choice of strategies in response to flood. What is actually observed is a dummy variable y, defined as

$$y = \left\{ \frac{1 \text{ if } y^* > 0 \text{ response to flood}}{0 \text{ if } y^* \leq 0 \text{ non response to flood}} \right\} \tag{3}$$

Since y^* is unobserved, it is assumed to relate to the observed characteristics of the individual farmer by the relation;

$$\begin{aligned} y^*_{im} = {} & \beta_0 + \beta_1 \text{age} + \beta_2 \text{sex} + \beta_3 \text{household size} \\ & + \beta_4 \text{education} + \beta_5 \text{total farm size} \\ & + \beta_6 \text{extention services} + \beta_7 \text{severity} \ldots . \beta_{13} + \varepsilon_i \end{aligned} \tag{4}$$

b_{im} Are unidentified factors to be determined

whiles ε_i is the error term.

In the MVP framework, where many strategies are used simultaneously, the error terms jointly multivariate standard distribution (MVN) with zero conditional mean and unit-standardized variance covariance where

$$\begin{pmatrix} e_1 \\ e_2 \\ e_3 \\ e_4 \\ e_5 \end{pmatrix} \Big| X_1, X_2 \ldots\ldots\ldots\ldots X_{10} \approx N \begin{bmatrix} 0 \\ 0 \\ 0 \\ 0 \\ 0 \end{bmatrix} \times \begin{bmatrix} 1 & \rho_{12} & \rho_{13} & \rho_{14} & \rho_{15} \\ \rho_{21} & 1 & \rho_{23} & \rho_{24} & \rho_{25} \\ \rho_{31} & \rho_{32} & 1 & \rho_{34} & \rho_3 \\ \rho_{41} & \rho_{42} & \rho_{43} & 1 & \rho_{45} \\ \rho_{51} & \rho_{52} & \rho_{53} & \rho_{54} & 1 \end{bmatrix}$$

The dependent variables of the study are the various response strategies that are adopted by farm households to adapt to the adverse impacts of floods. The choice of independent variables was influenced by the literature reviewed on the determinants of strategies adopted by households in response to various climate shocks. The variables are described in the Table 1 below.

3. Results and discussion

3.1 Descriptive statistics of socio-demographic features of respondents

Table 2 presents the descriptive statistics of the socio-demographic, institutional and farm-specific features of the farm households. Based on the results, majority of the households (85.6%) are headed by males, while few (14.4%) are headed by females. This supports the general claim that, in Northern Ghana, households are largely headed by males, except in some few cases where households are headed by females (Musah & Akai, 2014). The average age of farm households

Table 1. Variable with their definitions and a priori expectation with respect to response strategies.

Variable	Measurement	A-priori expectation
Age	Age of farmer in years	±
Sex	1 if farmer is a male, 0 if female	±
Education	Farmers' years of education	+
Household size	Number of people who eat from the same pot	±
Farm size	Size of farmlands in acres	+
Farm experience	Number of years in farming	+
Extension services	1 if farmer has access to extension service,0 if not	+
Location	Location of farms near water body = 1, 0= otherwise	–
Crop	Types of crops grown	–
Group	1 if farmer belongs to a group,0 if not	–
Income	Households' income in Ghana cedis	+
NADMO	1 if farmer has access to NADMO service,0 if not	+
Credit	1 if farmer has access to credit, 0 if not	+
Severity	1 if farmer perceived flood to be severe,0 if not	+
Challenge	1 if farmer faces challenges in adapting to flood, 0 if not	–
Crops	Number of crops grown on a farm	+

Table 2. Socio-demographic characteristics of respondents.

Variable	Mean	SE
Age	46.195	1.15
Gender[a]	0.856	0.34
Household size	6.41	0.19
Income	497.15	39.41
Years of education	6.135	5.34
Institutional factors		
Extension services[a]	0.41	0.03
Access to credit[a]	0.47	0.04
NADMO service[a]	0.24	0.03
Information on CS[a]	0.58	0.50
Farm- specific factors		
Farm size	3.70	0.17
Farming experience	21.13	1.117
Distance	32.12	2.498
Location[a]	0.62	0.034

Note: [a]Frequencies of categorical data.

is 46.195years which implies that the farmers fall within the youthful or active working age, thus have more energy and can contribute to production. On average household contains about 6.41 members which is greater than the standard national average, of 4 members per household in the 2010 population census. The average years of formal education of the household head 6.13 years, suggesting that, there is high illiteracy among the farmers, which may affect their response to flood.

About 41% of the respondents had access to services of extension whiles 24% had access to NADMO (responsible for the management of disasters as well as other emergencies in Ghana) services and received relief items. Respondents who had access to extension services made it known that they often derived such services from various Farmer Base Organizations, MOFA and other experience peers. Ministry of Food and Agriculture (MOFA) for instance, are in charge of sending agricultural extension officers to farmers. The extension officers seek to aid farmers in interpreting seasonal climate forecasts correctly and make appropriate decisions, such as the time of planting, choice of crops and crop varieties, application of fertilizers, herbicides (Shankar et al., 2011) etc. Farmer Base Organizations also comprises of aggregation of smallholder farmers and other resource poor agricultural producers. They usually form such groups to aid in assessing timely farming inputs, credits, information relating to farming activities etc which could have been tedious to acquire on individual bases (Salifu et al., 2010). In our local communities, there are individuals who are renowned for their experience in farming since they are known to be engaged in agriculture for longer periods. Such individuals seems to have in-depth knowledge and understanding on flood related issues, variety of seeds to cultivate, good agronomic practice etc and often stands to share with the inexperience farmers. Through the focus group discussion farmers revealed that often such services delay to the extent that they are made available when the flood have already occurred. Also, about 58% of the respondents had access to information on climate shock. They indicated that they often had access to information such as onset of rain, time period of flood, quality early maturing crops to plant, highlights on some strategies to use etc. It was further on revealed by the farmers that they often access such information via Agricultural extension officers, Ghana Meteorological service (GMS), Farmer Based Organizations, local experienced farmers and Radio stations etc. However, farmers complained of late dissemination of such vital information hence, giving ample time to prepare to strictly adhere to such directives. Furthermore, 47% indicated that they have access to credit whiles the remaining 53% have no access to credit. The results of the analysis indicated that, averagely a farmer has 3.7 acres (1.48 hectares) of farmland for production and a 21 years farming experience. The fact that the average acres of farmland is 3.7 supports the claim made by MoFA (2011), that, majority of farmers in Ghana are small-holder farmers cultivating less than 2 hectares. The results also indicate that averagely, it takes a farmer about 32 minutes to walk to his or her farm from the house. About 62% of the respondents had their farms located near water bodies. The fact that 62% of the farmers had their farmlands located near water bodies increases their vulnerabilities to floods in case of heavy downpours or spillage of excess water by the Bagre dam. This may have implications on the choice or the decision to response to flood.

3.2 Nature of floods

In analyzing the nature of floods in the district, five considerations including the knowledge of respondents on floods, causes of floods, perception of floods, severity of floods and month of occurrence were examined. Based on the results on Table 3, the main causes of flood as articulated by the farmers are heavy downpours (41.5%), spillage of the Bagre dam (16.5%), and environmental degradation (6%). The study revealed that floods in the district normally occurs in the months of August and September. The findings are shown in Table 3.

3.3 Households' ratings of perception and effects of floods on livelihood and environment over the past ten years

In this section, households were asked about their perception of floods and the severity of floods over the past ten years in their various communities. They were asked to indicate whether they perceived that flood occurrences over the past years have increased, decreased, and remained unchanged or indifferent. This is important to the study because household's perceptions and experiences with flood events have implications on their choice of response strategies. From the results as presented on Table 4, most respondents (60%) perceived flood occurrences to have increased over the past years. About 15.5% perceived a decrease in occurrences of floods over the past years, 15% of the respondents also perceived that flood occurrences over the past years have not changed and 9.5% indicated that they did not know. Also, some of the respondents indicated

Table 3. Causes of flooding in the study area.

Responses	Frequency	Percentage(%)
Heavy downpours	83	41.5
Spillage of Bagre Dam	33	16.5
Environmental degradation	12	6.0
All the above	68	34.0
None of the above	4	2.0

Source: Field survey, 2019.

Table 4: Perception and Effects of flood on livelihood and environment the past years.

Flood related issues	Frequency	Percentage
Perception Responses		
Increased	120	60
Decreased	31	15.5
Unchanged	30	15
Don't know	19	9.5
Effects of flood		
Farm destruction	162	81.0
House destroyed	123	61.5
Loss of animal	84	42.0
Water borne disease	44	22.0
Pest infestation	70	35.0

Source: field survey, 2019.

that the worst experience of floods was in 2007, 2012, and 2017, while others too indicated their worst experience of floods to be in 2018.

Floods are said to have devastating and destructive impacts on the environment and livelihoods. The effects and damages caused by floods on the livelihood and the overall environment in the Builsa-North district were enormous. According to the report from the NADMO office on the updates after flood disasters in the district, in 2018 alone, 10,856 households were affected in five zones that is Sandema, Chuchuliga, Wiaga, Siniensi, and Kadema, including the study communities. As showed from Table 4, the respondents indicated destruction of houses (61.5%), crops and farmlands (81%), loss of animals (42%), water-borne diseases (22%), and pest infestations (35%) to be some of the effects of floods on their livelihoods. Other impacts enumerated by the respondents during focus group discussions were damages to bridges and water system, as well as food storage facilities.

3.4 Household strategies in response to floods

One of the particular aims of this research was to define the different strategies used by households in response to floods. Farmers were questioned about their insights of changes in flood occurrences over the past 10 years and how many times they had encountered particular flood hazards. Grounded on these experiences, farmers were asked to list their recent approaches for reducing the hazards associated with flood events. In addition to this, households were also presented with some response strategies to choose from as a result of the literature review undertaken. Table 5 presents the results of household strategies used in response to floods.

From the results about 29.5% of the farmers planted early as a response to evade floods. The farmers believed that planting early allows them to be able to harvest early to evade the destructions that may be caused by the rains or the spillage of the Bagre dam which are believed to occur within specific months. In addition to planting early, some farmers also used early maturing plants (13.5%) as well as crop rotation (15.5%) as a strategy to safeguard against impacts of floods. However, the farmers argued that early planting and the use of early maturing plants are often practice due to its convenience, though some cost are often incurred. Also, some of the households make use of planting in uplands (27%) as a means of responding to floods. It can be said that most lands in the communities are low lying, thus anytime there are heavy rains or spillage from the Bagre dam, they are susceptible to floods, hence to avoid the destruction of their farmlands by these floods they normally look for hilly areas or uplands to plant, so that adverse effects of flood can be reduced or if possible avoided.

Table 5. Strategies used by Smallholder Farmers in Response to floods.

Responses	Percentages (%)	SE
Early planting (EP)	29.5	0.032
Use of early maturing plants (EMP)	13.5	0.024
Planting in uplands (UP)	27	0.031
Flood defences (FD)	15	0.025
Crop rotation (CR)	15.5	0.017
Migration (MIG)	6	0.026
Petty trading (PT)	21	0.029
Appeal to deity	6.5	0.017

One other strategy that households in the various communities use to cope with floods is petty trading (21%) which was reported to be often used by females. Some commodities that were commonly traded were charcoal, groundnuts, cooking ingredients etc. They trade these kinds of items in other to gain some income to support the household. As presented on Table 5 the least used strategy to cope with flood is migration (6%). Those that had their houses entirely destroyed had no option but to migrate to nearby towns which were not affected to stay. Surprisingly, in some of the communities such as Nyansa, and Abilyeri, households thought that floods were related more to God or deity than caused by any external force or damage. They believed that, floods are acts of God, and that only God or their deity had the supremacy to cause rains or deny rains. As a response measure, they prayed, consulted and made sacrifices (6.5%) in request for decrease in the volume of rains that cause destruction to their lands.

3.5 Determinants of household adoption of strategies in response to floods

The multivariate probit model allows the identification of likely correlations that exist or could exist between the various response strategies used by farmers. There are discrepancies in the combinations of response strategies indicating that farmers' use of one strategy could correlate with another. Thus, the coefficient of correlation across multivariate probit model residuals is shown in Table 6. The coefficients show the correlation of the various approaches. A positive correlation coefficient designates complementarities of strategies, that is, two strategies could be used together. A negative correlation coefficient, on the other hand, indicates the substitutability of the various strategies, thus one strategy could be used instead of the other.

From the results, there is a positive correlation between early maturing plants and early planting, upland planting and early planting, flood defence and early planting, flood defence and upland planting, crop rotation and early maturing plants, crop rotation and upland planting, and petty trading and migration. Thus, all such strategies are complementary to each other. The correlation coefficient between early planting and use of early maturing plants is significantly positive at 1%, suggesting that households that plant early as a response

Table 6. Coefficients of correlation of the different strategies from the evaluation of Multivariate Probit regression.

Strategies	EP	EMP	UP	FD	CR	MIG	PT
EP	1						
EMP	**0.263***	1					
	(0.123)						
UP	**0.263****	0.086	1				
	(**0.127**)	(0.146)					
FD	**0.285****	0.101	**0.309****	1			
	(**0.134**)	(0.166)	(**0.155**)				
CR	−0.019	**0.429*****	**0.252***	0.207	1		
	(0.142)	(**0.140**)	(**0.156**)	(0.163)			
MIG	−0.059	0.094	0.182	**−0.353*****	0.002	1	
	(0.136)	(0.158)	(0.142)	(**0.133**)	(0.147)		
PT	0.128	0.158	0.123	**−0.337*****	−0.043	**0.907*****	1
	(0.115)	(0.171)	(0.150)	(**0.111**)	(0.153)	(**0.041**)	

Note: EP: early planting; EMP: early maturing plants; UP: upland planting; FD: flood defences; CR: crop rotation; MIG: migration; PT: petty trading. Standard errors are in the brackets.
***, **, *represents significance level 1at 1%,5% and 10% respectively. Likelihood ratio test chi2 (21) = 127.076 Prob > chi2 = 0.0000.

strategy are also likely to use early maturing plants. This implies that farmers can harvest early to evade the destructions that may be caused by the rains or the spillage of the Bagre dam which are believed to occur within specific months (Kawar et al., 2018). Also, that of early planting and planting on uplands indicates that households that use early planting as a response strategy are likely to combine it with planting on uplands. This is because the lands of the various communities are low lying lands, thus to prevent destructions that could arise from floods, they normally plant on uplands as intentions are made also to plant early. Also, it can be said that farmers who make use of crop rotation as a response strategy are also more likely to make us use upland planting. This helps to ensure that no room is given for destruction on their farmlands.

From the results, a negative correlation coefficient was observed between migration and flood defence and also petty trading and flood defence. Hence, can be said that a farmer's use of the other strategy makes it unlikely to use the other. Considering that of migration and flood defence for example, it is often said that the time spent on seasonal migration lowers the amount of time left to dedicate to participate on farm activities like use of flood defences. Since farmers that make use of migration as a response strategy intends to avoid participation in agricultural activities.

3.6 Determinants of household strategies in response to floods.

From the results (as shown in Table 7), age was discovered to have negative relationship with early planting and crop rotation at 1% and 10% significant level respectively. There was also a negative significant relationship between age and petty trading at 10% significant level. Thus, age had a significantly negative relationship with all the strategies, indicating that older farmers were less likely to adopt coping/adaptive strategies in response to floods, hence, supports the findings of Enete et al. (2015) and Berman et al., (2015) reporting that the aged mostly do not adopt strategies in response to floods, thus more likely to rely on social support. This peculiar finding can be ascribed to the perception of most aged of floods being affiliated to acts of God, thus there is nothing that they could do, which accounts for the non-adoption of strategies in response to flood. This, however, met the a priori expectation of the study.

Gender had a positive significant relationship with farmers' decision to adopt early planting and the use of flood defences. Thus, males are more likely to adopt early planting technique as a coping/adaptive strategy. On the other hand, gender had a significant negative relationship with flood adaptation strategies such as petty trading and migration. This implies that women are more probable than men to participate in non-farm operations. This finding is consistent with the findings of Lolig et al. (2014) but contradicts with studies such as Asfaw et al. (2017), Fofana, (2011) and Rahman et al., (2014), which all argued that, males participate in off-farm activities as response strategies than females, because women are often engaged in household chores, thus do not have the necessary time left for off-farm activities.

Years of education had a positive significant relationship with farmer's decision to use migration as flood adaptation strategies. Thus, as years of education of farmer increases by a year the farmer is more likely to migrate than those with less years of education. This is because farmer's education enables him/her to have an indebt knowledge and information about all available strategies (Onyango et al., 2014). Hence, will prefer to make use of off-farm strategy to be better positioned than to experience such bad effects of the flood every season.

Household size was found to have a negative significant association with farmers' decision to use petty trading and migration as flood adaptation strategies. This implies that larger household sizes were less likely to engage in petty trading as a response strategy or seasonally migrate than small household size. This contradicts the findings of Rana et al. (2012), who reported that increase in household size increases the possibility of engaging in off-farm activities rather than farm activities.

The results further revealed a positive significant relationship between farm size and farmers' decision to adopt upland planting as flood adaptation strategy. Thus, as farm size increases a farmer will be more likely to adopt upland planting as compared to their other counterparts. Generally, farmers with large farm sizes are more vulnerable to loss of large proportions of their farms produce in any event of flood as compared to those with small sizes, hence will be eager to adopt

Table 7. Estimate of the determinants of choice of strategies in response to floods from the Multivariate probit model.

Variable	EP	EMP1	UP	FD	CR	MIG	PT
Age	**−0.036*** **	−0.008	−0.015	0.009	**−0.019***	−0.001	**−0.017***
	(0.127)	(0.143)	(0.011)	(0.013)	**(0.012)**	(0.009)	**(0.011)**
Gender	**0.494*** **	0.003	0.194	**1.017*** **	0.148	**−0.586*** **	**−0.693*** **
	(0.255)	(0.329)	(0.247)	**(0.322)**	(0.283)	**(0.214)**	**(0.254)**
Years of Education	−0.016	0.016	−0.007	−0.001	0.022	**0.037***	−0.005
	(0.024)	(0.028)	(0.022)	(0.026)	(0.0256)	**(0.020)**	(0.268)
Household size	0.046	0.069	−0.029	−0.067	0.065	**−0.079****	**−0.079***
	(0.044)	(0.054)	(0.048)	(0.054)	(0.051)	**(0.020)**	**(0.053)**
Income	−6.86e-06	0.000	**0.000***	−0.001	0.000	−0.000	−0.000
	(0.00)	(0.000)	**(0.000)**	(0.000)	(0.000)	(0.000)	(0.000)
Farm size	0.078	0.064	**0.120*** **	0.049	0.007	0.037	−0.029
	(0.047)	(0.053)	**(0.051)**	(0.055)	(0.047)	(0.039)	(0.057)
Experience	0.029**	0.016	0.012	−0.014	0.004	0.007	0.002
	(0.129)	(0.015)	(0.012)	(0.013)	(0.013)	(0.008)	(0.011)
Mj.crop	**0.0129**	0.057	0.036	0.017	**0.309*** **	−0.037	−0.068
	(0.103)	(0.132)	(0.099)	(0.128)	**(0.125)**	(0.090)	(0.105)
Location	0.002	0.307	−0.242	**0.937*** **	**0.505***	0.188	0.269
	(0.236)	(0.307)	(0.229)	**(0.323)**	**(0.273)**	(0.204)	(0.236)
Severity	**−0.351*** **	−0.062	−0.085	**−0.396****	0.085	**0.212***	**0.251***
	(0.145)	(0.176)	(0.141)	**(0.184)**	(0.163)	**(0.135)**	**(0.150)**
Information	**0.452***	0.134	0.133	0.476	−0.116	0.031	0.193
	(0.252)	(0.312)	(0.239)	(0.286)	(0.256)	(0.211)	(0.259)
Credit	0.045	−0.093	0.051	0.369	**−0.508***	0.246	0.159
	(0.227)	(0.308)	(0.223)	(0.271)	**(0.279)**	(0.198)	(0.225)
Extension	**0.766*** **	**0.589***	**0.502****	−0.014	**0.527***	0.208	**0.376***
	(0.246)	**(0.329)**	**(0.235)**	(0.292)	**(0.279)**	(0.209)	**(0.249)**
NADMO	−0.039	**0.689*** **	−0.338	0.234	**−0.601***	−0.051	−0.289
	(0.259)	**(0.276)**	(0.257)	(0.286)	**(0.314)**	(0.220)	(0.272)
Challenge	**0.596*** **	**0.615****	−0.047	0.255	**0.695*** **	**0.346***	0.368
	(0.249)	**(0.308)**	(0.262)	(0.274)	**(0.279)**	**(0.237)**	(0.272)

Note: EP: early planting; EMP: early maturing plants; UP: upland planting; FD: flood defences; CR: crop rotation; MIG: migration; PT: petty trading. Standard errors are in the brackets.

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

upland planting to offsets such adverse effects. This findings, however, contradicts that of Rahman et al., (2014) and Iqbal et al. (2015), but is in consonance with Tesso et al. (2012) who also postulates that the size of the farm is connected with increased riches that can boost choice of strategies for adaptations.

It was also relevant to identify whether farmers experience had any influence on their choice of strategies in response to floods. There is a positive significant relationship between farmers experience and adoption of early planting. Thus, farmers with higher years of experience are more likely to plant early as a response strategy. This is because farmers with higher years of experience may know the trends of the flood events and thus adopt strategies accordingly. It tends to be in consonance with findings of Onyango et al. (2014) that experienced farmer is more or better informed about precipitation changes and thus employ strategies accordingly to respond.

The results indicated that severity had a significant positive relationship with migration and petty trading. This suggests that households perceiving flood to be severe are more likely to seasonally migrate or engage in petty trading since they may priory estimate higher losses as compared to others that perceive it to be not severe. On the other hand, it was revealed that severity of flood has a significantly negative relationship with adoption of early planting and flood defences as flood adaptation strategies. This implies that farmers who perceived floods to be severe were less likely to use early planting and flood defence than their other counterparts. This can be ascribed to the acts of some respondents ascribing flood issues to deity. In attempts, consultation and sacrifices are offered to smaller gods in request for decrease in the volume of rains that cause destruction to their lands. This makes such farmers unwilling to practice such strategies such as early planting and flood defence since they feel secured.

Access to information is essential because even if farmers can access the resources they need to adapt, they can still fail to do so if they dismiss it as unprofitable or lack the data and abilities to implement or use it (Mulwa et al., 2017). The results indicated a significant positive relationship between access to information and early planting. This implies that farmers that had information about flood shocks prior to their occurrence adopt early planting as flood response strategy. This is because they have better advantage of knowing about the floods before they happen, thus planting early to avoid the destruction of crops and farms by the floods.

Credit access was another decisive factor in the choice to embrace a reaction strategy. With resource constraints, farmers may fail to satisfy coping/adaptation expenses and may not be able to take advantage of the data accessible (Sebopetji & Belete, 2009). The results depicted the likelihood of credit-constrained households, that is, households' that do not have access to credits using crop rotation (1% significant) as a response strategy to floods. This contradicts our a priori expectation as the use of crop rotation can be expensive, thus may require credit.

Access to extension services had a positive significant effect on the adoption of early planting, use of early maturing plants, upland planting, crop rotation and petty trading . This indicates that access to extension services increases the likelihood of adopting these strategies. This emphasizes the important role of extension services and information available to farmers

because extension services help influence correct information and knowledge that helps resolve conflicts in farmers' strategies and technology adoption behaviour (Mulwa et al., 2017).

Access to NADMO services had positive significant effect on adoption of early maturing plants. In contrast, access to NADMO services decreases the likelihood of adopting crop rotation as a response strategy. This implies that farmers that had visits and information from NADMO were more likely to use early maturing plants, but less likely to use crop rotation as a response strategy. This is because they have better advantage of having practical knowledge and demonstrations on flood management.

Challenge was also found to exhibit a significant positive relationship with early planting use of early maturing plants, crop rotation and migration. This indicates that, farmers who were really challenged by the impacts of the floods are more likely to use these strategies in response to the floods as compared to others who were not really challenged largely because they are more vulnerable to the impacts of the floods.

3.7 Challenges faced by small holder farmers in the use of strategies

Based on the experiences and the use of the various strategies in response to flood by the respondents, they were asked to list challenges they encountered with the use of the strategies. The results indicated that about 34% of the respondents did not face any challenge in the choice and use of strategies in response to floods. While as 23.5% of the respondents reported low access to extension services and advices, also 17.5% argued of being faced with inadequate funds to purchase certain inputs, 15.5% indicated inadequate information and knowledge on the various strategies, their uses and the proper management of these strategies. Finally, 9.5% of the respondents also indicated that limited access to credit, especially those using the early maturing plants are the challenges they faced in responding to flood. The results are presented in the Table 8 below;

4. Conclusion and recommendations

This paper examined farmer's perception about flood events in the area, response strategies to floods and the factors determining the choice of strategies adopted. Multivariate probit model was used to examined the drivers of farmer's choice of coping strategies to flood. Majority of the farm households perceive floods in the district to be attributed to heavy downpours, the annual spillage of the Bagre Dam by neighbouring Burkina Faso and environmental degradation. Most farmers (60%) perceived flood occurrences have increased over the past ten (10) years which have destroyed their farmlands. The various response strategies used by majority of the farmers are early planting, use of early maturing plants, upland planting, flood defences, crop rotation and petty trading. Seasonal migration and appeal to deity are the least used response strategies to floods. Early planting and early maturing plants were used together whiles migration and the use of flood defences were not. The predictors of farmer's choice of response strategies to floods are age, gender, household size, income, years of education, farm size, farm experience, location of farm, access to credit, information access, access to extension services, severity of floods, NADMO, and challenges.

Policy wise, Government and policy makers should ensure accurate and timely establishment of early warning and tracking systems to aid prompt and appropriate readiness and reaction. Also, extension services should be made readily available to farmers in other to provide adequate and quality information that will help resolve conflicts in farmers' use of strategies. NADMO services in as much should make it a point to target more of the elderly people since they were found of not using response strategies since they see flood phenomenon as acts of their deity.

Table 8. Challenges faced in the use of strategies.

Challenge	Frequency	Percentage
Low access to extension service	47	23.5
Lack of knowledge & information	31	15.5
Limited access to credit	19	9.5
Inadequate funds	35	17.5
None	68	34.0

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