

Paper:

Households' Coping Strategies in Drought- and Flood-Prone Communities in Northern Ghana

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This study seeks to explore stakeholders' perceptions, causes, and effects of extreme climatic events, such as droughts and floods, in the Wa West District of Ghana's Upper West Region. A multi-stage sampling procedure is used to select 184 respondents. Data collection methods include individual questionnaire administration, focus group discussions, and a stakeholders' forum in the Wa West District Assembly. While frequencies are used to show respondents' perceptions of the severity of climate change effects, a treatment-effect model is used to determine the factors influencing farmers' choices of on-farm coping strategies over off-farm activities in both periods of drought and flood. Findings are the following: farmers perceive that climate change is real and has severe consequences. Consequently, they resort to both on-farm and off-farm strategies to cope with the effects of climate change. While men mostly adopt the former, women adopt the latter. Both strategies are, however, not viable for taking them out of poverty, though off-farm activities are more effective. Education and extension services are other important factors influencing the choice of coping strategies as well as farmers' welfare. Farmers must be supported with more viable income-earning activities, ones that can take them out of poverty. Women should be given priority. Access to education and extension services must also be stepped up to facilitate the adoption of the coping strategies and to increase welfare.

Keywords: climate change, drought, flood, coping strategies

1. Introduction

It is currently predicted, based on scientific studies, that increasing climate extremes will continue to negatively impact millions of small farmers globally, farmers that are dependent on agriculture for their livelihoods [1, 2]. In Africa, widespread poverty and low adaptive capacity

renders the continent more vulnerable than other parts of the world [3-5]. Empirical evidence shows that in sub-Saharan Africa (SSA), the incidence of extreme climatic conditions, such as droughts, floods, and high temperatures due to climate change and variability, will worsen the problem of crop failures in fragile farmlands, increasing hunger, malnutrition, and disease [6-8].

In Ghana, rain-fed agriculture contributes about 35% of Ghana's Gross Domestic Product (GDP), generates about 30-40% of the foreign exchange earnings, and employs about 55% of the population [9]. However, the country is vulnerable to climate change and variability due to its location in the tropics. Ghana, as the Atlantic Ocean lies to its south, is exposed to contrasting oceanic influences and atmospheric changes, so it can be prone to extreme weather events [10, 11]. Projections based on climate change scenarios indicate that the country is likely to experience greater rainfall variability and higher temperatures in the future [12]. In all agro-ecological zones, temperature is expected to increase on the average by 0.25°C from 2010 to 2020. With regard to rainfall, the situation is more complex, with a projected decrease in most agro-ecological zones (including the Guinea and Sudan Savannah zones) and an increase in the rain forest zone. The Sudan Savannah in parts of the Upper West and Upper East Regions is the zone predicted to be most affected by warmer, drier conditions [13, 14].

In the recent past, the Upper West Region, like its counterparts in the northern part of the country, has suffered recurrent droughts and floods that have had disastrous consequences on crop and animal production in particular and rural livelihoods in general. Drought, conceptualized in this paper as a situation when the amount of water in the soil no longer meets the need of a particular crop [15], is reportedly becoming more unpredictable and longer in duration in the northern part of Ghana. Literature suggests that when this kind of drought, referred to as agricultural drought, arises, expected crop yields are affected [16] and households that depend on rain-fed agriculture are common victims. Unlike drought, the onset of which is slow [17, 18], floods are classified as rapid-onset

events [19]. In 1999, extreme flooding in northern Ghana damaged or destroyed homes, crops, irrigation networks, dams, and livestock, and it killed at least five people [20]. The resulting lack of access to clean water and the rise in water-borne diseases affected as many as 290,000 people and created considerable threats from cholera, diarrhea, and typhoid [21].

In November 2010, 55 communities in the Central Gonja District located in the Savannah region of Ghana were affected by floods. About 700,000 people were displaced, 3,234 houses collapsed, and 23,588 acres of farmlands were destroyed at a cost of 116,340.22 US dollars [22]. Buipe, an urban center within the district, was the most affected. Here, 12,418 people were displaced, 1,196 houses collapsed, and 81 acres of farms were destroyed at an estimated cost of 48,410.76 US dollars. Also highly affected was the Yapei community, where 784 people were displaced and 298 acres of farms were destroyed at an estimated cost of 31,912.26 US dollars [22]. Similarly, in 2005, floods in Ghana killed 20 people and rendered over 350,000 people homeless. Many livestock and several thousands of hectares of crops were also destroyed.

In 2007, floods following major rains in northern Ghana resulted in 61 deaths with 317,127 people displaced. In addition, 25,923 houses together with 634 drinking water and 39 irrigation facilities were destroyed while 955,050 tons of cereals were rendered unusable by the floods [23, 24]. The government of Ghana had to spend 25.1 million dollars as direct emergency funding in the three northern regions [23]. Furthermore, in 2010, at least 25,112 people in the northern region were displaced as a result of floods. Considerable farmland and livestock were lost. It was estimated that the loss of cereals and food items amounted to 257,076 metric tons [25]. Few [26] identified heavy rains as the most common cause of floods. However, in some communities along the Black and White Volta in northern Ghana, excess water spillage from the Bagre Dam in the Republic of Burkina Faso, exacerbated by intensive rainfall [27], has been the major cause of flooding. Flooding in Ghana is ranked as some of the worst in West Africa [28].

Overall, the ripple effects of these recurrent droughts and floods have been food shortages, higher prices for agricultural commodities, and the destruction of the quantity and quality of natural resources in the country [29, 30]. Natural disasters such as droughts and floods everywhere in the world are difficult to prevent. However, with the right capacity, their effects can be minimized through appropriate coping and adaptation strategies to enhance welfare.

Currently in Ghana, the effects of drought and flood-related disasters are most commonly handled by distributing relief items in an ad hoc manner, which offers little capacity for affected households to contain future disasters. Thus, households continue to remain vulnerable to drought and flood with yearly persistent calls for aid from government and donors. Household vulnerabilities and persistent demand for aid by communities prone to

drought and flood can and will be reduced if their coping and adaptive strategies are enhanced, and that is the motivation for this study. One way to do so is by obtaining a better understanding of households' prevailing coping and adaptation strategies in drought and flood conditions, the determinants of such strategies, and how their welfare is enhanced by the use of such strategies. Coping strategies are considered to be short-term measures, while medium- and long-term measures are considered to be adaptation strategies because the coping mechanisms have been perfected and are more planned [31].

This study sought to explore coping and adaptive strategies used by households in response to extreme climatic events, such as droughts and floods, in the Wa West District of Ghana's Upper West Region.

Specifically, the study addresses the following objectives.

- Identify the coping and adaptive strategies used by households in response to drought and flood conditions.
- Analyze the extent to which household socio demographic factors and farm specific factors influence coping strategies.
- Measure the extent to which the strategies affect households' well-being.

The main factors that influenced the choice of the district and communities were the following. a. The district falls within the Sudan Savanna zone and is therefore prone to drier conditions. b. Most communities in the district are either settled along the Black Volta River or have their farms close to it, making them prone to flooding in seasons of heavy rains or to overflows from the Bagre Dam in Burkina Faso.

1.1. Review of Literature on Socioeconomics Studies on Climate Change

Many socioeconomic studies on climate change [32-36] have been carried out at the household level using primary data. Essentially, the objectives of the studies have centered on farmers' perceptions of reality or of the causes of climate change. Other studies have focused on the coping and adaptation strategies adopted by farmers to mitigate the effects of climate variability. The commonest methods of analysis include descriptive and inferential statistics as well as estimation of a limited dependent variable model and a production function. For instance, [32] assessed the perceptions of farmers in terms of their awareness of climate change on their farming activities, including its causes and impacts. The studies further identified and described the various coping strategies adopted by farmers and ways of improving upon them to effectively tackle changes in climatic conditions. Descriptive statistics and chi-square were used. The study results showed that farmers were well informed about the reality of climate change and its impacts on their farming activities. The main causes of climate change were

God's plan, signifying the end of time, deforestation, indiscriminate bush burning, farming alongside rivers, illegal mining, and the usage of heavy machinery on land, air, and water. Among the coping strategies identified were soil fertilization, lining and pegging, farm size and shade management, as well as land preparation. In [33], the most common coping strategies adopted by the farmers included mixed cropping, early planting, mixed farming, and off-farm activities. The socioeconomic determinants of the adoption of the coping strategies included age, education, household size, and farm size. While [33] estimated a Tobit model, [35] estimated a multinomial model. They found that informal credit from relatives and friends, the noticing of decreased rainfall and increased temperature, the location of the farmer, and farmer-to-farmer extension were the factors that influenced the choice of indigenous climate-related strategies in northern Ghana. Using the same methodology, [34] found that the factors that positively influenced the coping strategies of farming households in the Nile Basin of Ethiopia included the educational level of the head of household, the gender of the head of household being male, farm income, livestock ownership, access to extension services for crop and livestock production, the ownership of a radio, better quality houses, and temperature. Lastly, [36] studied the adaptive capacities of rice farmers in the northern region of Ghana. However, they estimated quantitatively and categorized the adaptive capacities into high, moderate, and low. On the average, the respondents were moderately adaptive to climate change. Also, the more ability a farmer had to adjust to climate change, the greater the level of his/her output. It is worthy of note that coping strategies as well as their adoption are time, situation, and location-specific. Therefore, it is important for researchers to study the area continuously to update their research findings. The aforementioned notwithstanding, there are three important things that the studies reviewed above failed to directly address. Firstly, they failed to draw a distinction between the adoption behaviour of farmers in drought- and flood-prone areas. Similarly, a distinction was not made between on-farm and off-farm coping strategies. Thirdly, many of them did not measure the effects of adoption on farmers' welfare. In other words, they failed to show the extent to which household socioeconomic indicators explain the differences between the adoption of on-farm and off-farm coping strategies or which of them made farmers better off. The present study seeks to fill this knowledge gap.

2. Methodology

2.1. Study Area

2.1.1. Location

The study focused on four communities located in the Wa West District of the Upper West Region of Ghana. The District lies approximately between 9°49'35"N and 2°40'51"W. It is bordered by the Nadowli District to the north, the Wa Municipality to the east, the Sawla-Tuna-Kalba District to the south, and Burkina Faso to the west.

Table 1. Summary of the sampling frame and sample size.

Name of Community	Number of households per community	Number of households sampled based on PPS
Chietanga	37	15
Baleufili	86	35
Banpkama	79	32
Zowayili	25	10
Total	258	92

Source: Authors

The District is located in the Savanna high plains, which are generally rolling with an average height of between 180 m and 300 m above sea level. It has a distinct uni-modal rainfall pattern lasting 4-6 months (from May to October) and a long dry period of 6-8 months (from November to April). The mean annual rainfall figures vary from 840 mm to 1400 mm. A very important feature of the rainfall in the district is that it is erratic in nature, torrential and poorly distributed. Temperatures are high most of the year, ranging from 22.5°C to 45°C. The rolling nature of the landscape is good for agriculture and other physical developments. The main drainage system is the Black Volta River and its tributaries.

The vegetation of the Wa West District is of the Guinea Savanna grassland. The predominant trees in the district are shea (*Vitellaria paradoxa*), dawadawa (*Parkia biglobosa*), kapok (*Ceiba pentandra*), baobab (*Adansonia digitata*), mahogany (*Khaya senegalensis*), cashew (*Anacardium occidentale*), mango (*Mangifera indica*), akee apple (*Blighia sapida*), guava (*Psidium guajava*), teak (*Tectona grandis*), and neem (*Azadirachta indica*). Cashew and mango trees are exotic species, but they also thrive well in the District. Large tracts of the natural vegetation are disappearing, largely due to human activities in the form of cultivation of new farms, overgrazing by animals and setting of bushfires by hunters and charcoal production. There are also gallery forests along the Black Volta River and its tributaries. Climbers and shrubs are common plant types found in the Guinea Savanna.

2.1.2. Sampling, Survey Instrument, and Data Collection Methods

A cross sectional household survey was carried out using a standard structured questionnaire. A multistage sampling frame was used. The first stage involved getting a list of all the CECAR Africa study communities, namely Chietanga, Baleufili, Bankpama and Zowayili. The common feature across the communities is that they are all prone to flooding due to their proximity to the Black Volta River. However, when rain fails to fall, drought sets in. The second stage involved obtaining a list of all households in the respective communities from the project data set and finally using a proportional sampling procedure to randomly sample 40% of households in all the communities. A male, preferably the head of household, and a female from each household responded, giving a total sample size of 184 respondents. **Table 1** provides a sum-

mary of the sampling framework.

Complementing the household survey were Focus Group Discussions (FGDs) held with traditional leaders, groups of men, and groups of women in all the study communities. In each community, three (3) FGDs were held simultaneously with the respective groups, so a total of twelve (12) FGDs were held across the communities. A checklist was drawn up with specific variables of interest related to households' coping and adaptation strategies and discussed with participants of respective groupings. Finally, the team facilitated the Wa West District stakeholders' plenary meeting by discussing various issues related to climate and ecological changes and disaster governance. The team interacted with about 40 key stakeholders at the Wa West District Assembly, National Disaster Management Organization (NADMO), Ministry of Food and Agriculture (MoFA), Environmental Protection Agency (EPA), and other Ministries, Departments, and Agencies (MDAs) and non-governmental organizations (NGOs), all of whom were working in the District. The data were then entered into Excel spreadsheets and exported to Stata for analysis.

2.2. Analytical Framework

2.2.1. Theoretical Model

Given

$$A_i^* = z_i'\gamma + e_{1i} \quad (\text{selection equation}) \quad \dots \quad (1)$$

where $A_i = 1$ if $A_i^* > 0$ the i -th farmer has adopted an on-farm coping strategy and zero if he has adopted an off-farm coping strategy. z is a vector of farm and farmer characteristics, and A_i is the observed value of the latent variable Adoption. e_{1i} is a two-sided error term with $N(0, \sigma_v^2)$. Also,

$$W_i = z_i\beta + A_i\delta + e_{2i} \quad (\text{Substantive equation}) \quad (2)$$

where W_i is welfare; e_{2i} is also a two-sided error term with $N(0, \sigma_v^2)$. β and δ are parameters to be estimated.

The rest are as defined. Note that we cannot simply estimate the substantive equation (without first estimating the selection equation) because the decision to adopt may be influenced by unobservable variables, such as management ability, that may also influence welfare. This implies that the two error terms (in the selection and substantive equations) are correlated, leading to biased estimates of β and δ .

If we assume that that e_{1i} and e_{2i} have a joint normal distribution with the form

$$\begin{bmatrix} e_{1i} \\ e_{2i} \end{bmatrix} \sim N \left(\begin{bmatrix} 0 \\ 0 \end{bmatrix}, \begin{bmatrix} 1 & \rho \\ \rho & \sigma^2 \end{bmatrix} \right), \dots \dots \dots (3)$$

then it follows that the expected welfare of those who adopt on-farm technologies is given as

$$\begin{aligned} E[W_i|A_i = 1] &= z_i\beta + \delta + E[e_{2i}|A_i = 1] \\ &= z_i\beta + \delta + \rho\sigma\lambda_i \quad \dots \dots \dots (4) \end{aligned}$$

where

$$\lambda_i = \frac{\phi(-z_i'\gamma)}{1 - \Phi(-z_i'\gamma)} \quad \dots \dots \dots (5)$$

is the Inverse Mills Ratio (IMR).

Equation (5) implies that when we estimate Eq. (2) without the Inverse Mills Ratio (IMR), the coefficients β and δ will be biased, hence the use of Heckman's two-stage procedure. Heckman's two-stage procedure simply states, "Estimate the selection equation, and use the predicted values of adoption to form an IMR, which appears as an additional explanatory variable in the substantive equation." The treatment effect model is a special case in which the adoption variable also appears as an additional explanatory variable. According to [38], if we use all observations on welfare for both categories of adopters, Eq. (2) takes the form

$$W_i = \beta'(\Phi_i z_i) + \delta'(\Phi_i A_i) + \sigma\phi_i + e_{2i} \dots \dots (6)$$

where $\Phi_i \equiv \Phi(z_i'\gamma)$.

2.2.2. Empirical Model

The empirical model estimated to determine the factors that influence the adoption of on-farm coping strategies as well as the effects of their adoption on welfare is given below. The treatment effect model offers us the opportunity to do a simultaneous estimation of the adoption and welfare equations. While the estimation of the adoption model enables us to know what factors influence the choice of a coping strategy, the welfare model helps us to measure the effects of the choice of a coping strategy on household welfare as well as other determinants of welfare. In this study, the coping strategies were categorized as on-farm and off-farm. "On-farm strategies" meant coping strategies that were related to agriculture while "off-farm strategies" meant coping strategies that were not. Agriculture-related coping strategies included planting early/late, planting in valleys/uplands, and depending on dry season farming. Off-farm activities included petty trading, selling ruminants and poultry, and selling charcoal. The codes given were one (1) for on-farm and zero (0) for off-farm.

The model was estimated using Stata software by the maximum likelihood approach. **Table 2** gives the definition and the *a priori* expectations of the variables used in the model. We acknowledge that the welfare variable, which was constructed in line with the Ghana Living Standards Survey (GLSS), does not include a sufficient number of elements, but, given the nature of our data, that is what we could use.

$$\begin{aligned} \text{Adoption} &= \gamma_0 + \gamma_1 \text{Age} + \gamma_2 \text{Sex} + \gamma_3 \text{Group} + \\ &\quad \gamma_4 \text{Educ} + \gamma_5 \text{Fsize} + \gamma_6 \text{Extension} + \gamma_7 \text{Hsize} + \\ &\quad \gamma_8 \text{Severity} + e_i \end{aligned}$$

(Adoption Model)

$$\begin{aligned} \text{Welfare} &= \beta_0 + \beta_1 \text{Age} + \beta_2 \text{Sex} + \beta_3 \text{Educ} + \beta_4 \text{Hsize} + \\ &\quad \beta_5 \text{Fsize} + \beta_6 \text{Extension} + \beta_7 \text{Group} + \\ &\quad \beta_8 \text{Credit} + \beta_9 \text{Childsch} + \beta_{10} \text{Severity} + \\ &\quad \delta_1 \text{Adoption} + e_2 \end{aligned}$$

(Welfare model)

Table 2. Definition and *A priori* expectations of variables.

Variable	Definition	<i>A priori</i> Expectation
Adoption	1 if farmer adopted on-farm coping strategy; 0 if off-farm	+/- for welfare
Age	Age of farmer in years	+/- for both adoption and welfare
Gender	1 if farmer is male; 0 if female	+ for both adoption and welfare
Group	1 if farmer belongs to a socioeconomic group; 0 if not	+ for both adoption and welfare
Education	Farmer's years of formal education	- for adoption, + for welfare
Farm size	Size of farmer's farm(s) in acres	+ for both adoption and welfare
Extension	1 if farmer accessed extension service in the farming year under review; 0 if not	+ for both adoption and welfare
Household size	Number of members in farmer's house eating from same plot	+ for adoption; - for welfare
Credit	1 if farmer accessed credit during the farming year under review; 0 if not	+ for both adoption and welfare
Severity	1 if farmer perceived drought/floods to be "most severe"; 0 if otherwise	+ for adoption, - for welfare
Welfare	Household per capita income (household income divided by household size)	N/A

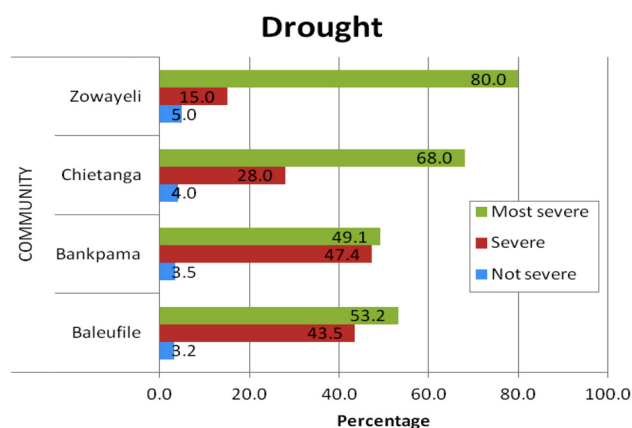
3. Results and Discussion

3.1. Households' Ratings of Level of Severity of Droughts and Floods in Respective Communities

In this section, households were asked to rate the severity of droughts and floods on a 3-point Likert scale according to their view of the occurrence of each event. First on the scale was "most severe," followed by "severe" and "not severe." This was relevant in this study because households' views and experiences with either event had implications on their choice of coping and adaptation strategies. Beginning with drought, the findings show that all households within each study community rated droughts as most severe and severe, with few households viewing the occurrence of the event as not severe, as indicated in Fig. 1. The highest rating, 80%, was obtained from Zowayeli, followed by Chietanga (68%), Bankpama (49.1%), and Baleufili (53.2%).

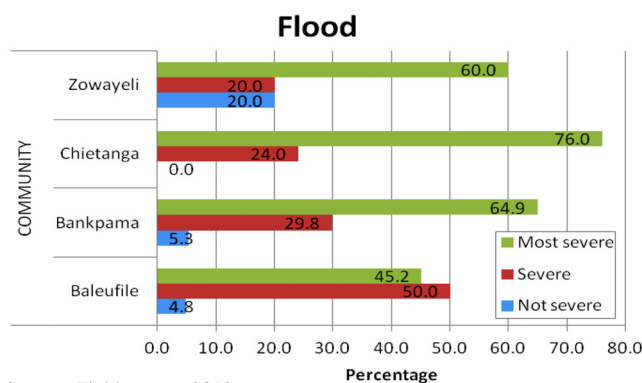
In all the FGDs and the district-level plenary session, there was a high level of agreement that human activities, mainly setting bushfires and felling trees for fuel or charcoal, were identified as some of the major causes of the level of severity of droughts and floods that they experienced, and these activities lead to desertification. Immoral behaviors and other social vices on the part of the youth in particular, as well as the disapproval by the gods of the "modern lifestyle," were some beliefs held by some respondents across all study communities. An elder in an FGD in Baleufili remarked, "Years ago, it was not common to see people having sex in the open (bush), and stealing was also not common. But this current generation engages in all these without fear, and the gods definitely have to punish us for our crimes. Floods and droughts and the levels at which they occur now are forms of protest from the gods." This implies that although respondents believe that human activities contribute to climate change, they equally associate the gods with changes in climatic events.

Household views on the severity of flooding were not any different. Generally, floods were rated "most severe" and "severe," with very few households again saying the



Source: Field survey

Fig. 1. Household rating of level of severity of droughts.



Source: Field survey, 2013

Fig. 2. Households' ratings of the severity level of floods.

floods were not severe. Based on the analysis, 60%, 76%, and 64% of households in Zowayeli, Chietanga, and Bankpama, respectively, rated floods as most severe. In Baleufili, 50% of households rated the floods as severe; less than 5% said the floods were not severe, as indicated in Fig. 2. These findings confirm those of several studies [14, 20, 21] that have either predicted or found that the northern sector of the country was vulnerable to droughts and floods.



Fig. 3. Shea nuts ready for processing into butter for consumption.

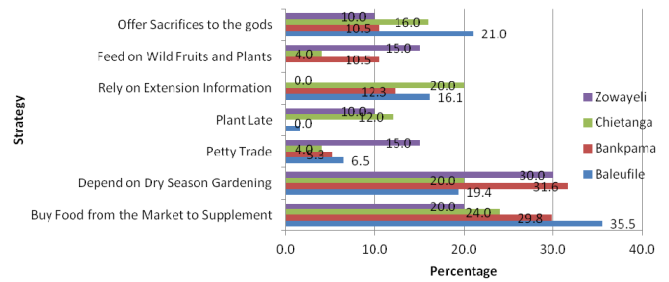
3.2. Coping Strategies Used by Households in Communities During Droughts and Floods

One of the specific objectives of this paper was to identify the various means that households in the respective communities used in response to droughts and floods. To explore this specific topic, respondents were asked in the questionnaire and FGDs to mention the strategies they used to cope with droughts and floods when such events did occur. **Figs. 3** and **4** present the findings for droughts and floods, respectively, in all the study communities. Household coping strategies varied depending on the hazard.

3.2.1. Appeal to the Deity

In all the communities, households thought drought was related to the deity and their belief that the deity had the power to cause and to deny rains. As a coping strategy, therefore, they consulted and offered sacrifices to the “rain gods” in request for rains in times of drought. Such sacrifices were made from community contributions. They appeased the gods as a community and not on an individual household basis. At various FGDs, respondents expressed the opinion that their ancestors had obeyed and done what was right before the gods; hence, they had good rainfall patterns with fewer droughts. However, the sins of present generations were at variance with the demands and requirements of the gods, so droughts set in as punishments from the gods. Although this finding may not have any scientific grounds and there is no literature on it, it falls in line with respondents’ traditional belief systems. The finding, however, was conspicuously missing as a strategy used to cope with floods in all the communities. This is perhaps due to the slow onset nature [19] of droughts, which keeps households away from their livelihoods for a length of time. This provides them the chance to reflect on what options they could adopt to cope, unlike the rapid onset nature of floods, which cause more devastation within a short period of time. Our expectation was that both types of disaster would attract

Drought coping strategies



Source: Field survey, 2013

Fig. 4. Coping strategies households use during droughts.

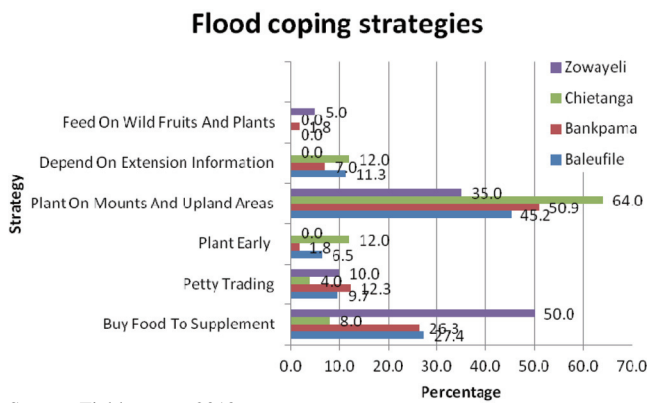
some level of consultation with the gods. However, farmers choose this option only when there are droughts and not floods. Perhaps prolonged floods, which are not common, would lead to offerings and sacrifices to the gods.

3.2.2. Feed on Wild Fruits and Plants

The findings also show that respondents coped with both droughts and floods by depending on the fruits and leaves of wild plants for their energy needs. The shea (fruits and nuts) and the dawadawa trees were the two main trees commonly mentioned by households. Those trees provided the people with both fruits and income from the processing of shea butter and dawadawa (a local spice), respectively. However, in severe droughts, there were other lesser-known fruits and leafy plants that households consumed. During the FGDs, it was observed that women were mainly responsible for searching and processing these plants for family consumption. **Fig. 3** shows a basket of shea nuts, used by households for food as a coping strategy during times of drought in Bankpama. It must be noted, however, that this coping strategy in itself depends on favorable weather conditions. During floods, few households, 5% and 1.8% of households in Zowayeli and Bankpama, respectively, used this strategy to cope, as shown in **Fig. 5**. This is because floods occur late in the farming season (August-September) and at a time when the fruiting of most trees and wild plants is over. Also, this period coincides with the maturity of crops, such as groundnut, maize, and other cultivated crops, that households can at least depend on to consume.

3.2.3. Reliance on Extension Information

Reliance on extension information is another coping strategy that households relied on during both droughts and floods. The relevant institutions that gave extension advice were the Ministry of Food and Agriculture (MOFA), NADMO, GMET, EPA, and the Wechau Sanctuary (a local NGO). The results further indicate that during both droughts and floods, respondents from Zowayeli did not mention reliance on extension information as a coping strategy. However, 20%, 13.3%, and 16.1% of households in Chietanga, Bankpama, and Baleufili, respectively, relied on extension information



Source: Field survey, 2013.

Fig. 5. Coping strategies households undertake during floods.

during droughts, but 12%, 7%, and 11.3% did so during floods. The high percentage of households using this strategy reflects their access to extension services. The type of information that households relied on during droughts included weather forecast, which predicted likely periods of rainfall, when to plant and engage in other farming activities, and likely periods of floods and the required safety measures. A study conducted in Zimbabwe by [40] found that there had been a tremendous increase in farmers' willingness to use seasonal scientific climate forecasts when such predictions were presented in conjunction with and compared to the indigenous forecasts of the people.

3.2.4. Cropping Practices

Climate change is indeed a huge challenge that farming households are battling, especially when they have to make decisions in terms of their cropping practices in the light of droughts and floods. Fig. 4 shows that 10% of households in Zowayeli planted late in the farming season as a strategy to avoid drought, while Fig. 5 shows that 12% of households in Chietanga did so. On the other hand, 12% and 6.5% of households in Chietanga and Baleufili, respectively, planted early as a strategy to avoid floods. This finding confirms [30], which found that farmers in the Bawku West District of Ghana planted early to avoid both droughts and floods. In addition to early planting, 35%, 64%, 50.9%, and 45.2% of households in Zowayeli, Chietanga, Bankpama, and Baleufili, respectively, planted on mounds or in upland areas as a way of coping with floods. During FGDs, respondents indicated that the usual short dry spell experienced in the early part of the rainy season had given way to a prolonged drought that set in around May-June. As such, some households simply wait for that season to give way and start planting in July when, according to their experience, droughts are over. On the other hand, late planting poses two main dilemmas. The first is the likelihood that floods will set in at a time of the maturity of crops and thus cause havoc. The second is that if a farmer does not plant early maturing varieties, the rains may stop when crops are still not mature. Households therefore have to make decisions

based on their knowledge, experience, and education from extension sources to strategically cope with both types of disaster.

3.2.5. Diversification

One other strategy that households use to cope with both droughts and floods in all the study communities is engagement in small businesses. This is done mainly by women, but also by men in some isolated cases. Commodities commonly traded include fuel wood, charcoal, household cooking ingredients, and edible plant. These they engage in to get some income to buy foodstuffs for household consumption. The study also revealed that during droughts, households do also engage in some dry season gardening using water from the Black Volta. Households in Baleufili, however, are resourced with a small-scale irrigable dam they rely on. Crops cultivated are mainly vegetables. However, during FGDs, it was revealed that the main constraint to dry season gardening along the Black Volta is the destruction of crops during the night by hippopotamus in the river. Thus, except for the dam at Baleufili, very minimal dry season activity takes place in the remaining communities.

3.2.6. Dependence on the Market for Food

Linked to diversification is the strategy of buying food from the market to supplement the little a household is able to harvest during droughts and floods. Respondents indicated that when hit by drought or flooding, the market becomes their main source of access to food. In that case, households sell assets (e.g., ruminants and poultry), burn charcoal, and fell trees to be able to buy food. Another source of income that households depend on to buy food is remittances from migrant relatives. Tree felling for the purpose of making charcoal to some extent leads to the degradation of the natural environment, which can cause surface run-off. Surface run-off results in erosion, which has damning consequences such as the reduction of infiltration, loss of soil fertility (loss of soil nutrients), water pollution, and flooding [40].

3.3. Determinants of Household Coping Strategies During Times of Drought

The determinants of household coping strategies were assessed with the treatment effects model outlined in Section 2.2. As indicated earlier, the treatment effect model offers us the opportunity to do a simultaneous estimation of the adoption and welfare equations. While the estimation of the adoption models enables us to know the factors influencing the choice of a coping strategy, the welfare models helps us to measure the effects of the choice of a coping strategy on household welfare as well as other determinants of welfare. It must be recalled that the coping strategies were categorized as on-farm or off-farm. That is to say that the former means coping strategies that are agriculture-related while the latter means coping strategies that are not. The codes given were one (1) and zero

(0), respectively. This section discusses the determinants and effects of a coping strategy choice during droughts and floods in the study area.

We observe from **Table 3** that gender, group membership, access to extension services, and household size are statistically significant determinants of coping strategies. Out of these, only group membership had a negative sign; the rest maintained a positive sign. The positive sign of the gender variable means that males had a greater probability of adopting on-farm strategies than their female counterparts. This meets our *a priori* expectations because males are more involved in farming while females are more involved in off-farm activities, such as trading and processing. The negative sign of group membership also means that farmers who belonged to a socioeconomic group had a greater probability of adopting off-farm coping strategies. The positive sign of the extension variables did not come as a surprise to us, either, considering the fact that agricultural extension services are needed more in on-farm than in off-farm activities. Similarly, agricultural activities require a large family size as a labor force in most developing countries, including Ghana. The positive sign of the household size variable confirms the fact that the probability of adopting on-farm coping strategies increases with household size. Most of these findings are consistent with that of [33-35].

3.4. Determinants of Household Coping Strategies During Floods

As seen in **Table 4**, the variables that were significant in influencing the choice of coping strategies during floods were age, gender, group membership, and education. Once again, only group membership had a negative sign, meaning that the probability of adopting on-farm coping strategies was greater for non-group members than group members. The positive sign of the age variable, however, implies that older farmers had greater probability of adopting on-farm strategies than younger ones. This is understandable, considering the fact that younger farmers are more enterprising and are more likely to engage in off-farm activities than older farmers. As the case of drought, the positive sign of the gender variable means that the probability of adopting on-farm coping strategies during floods was higher for males than females. On the other hand, the positive sign of the education variable means that the probability of adopting on-farm strategies was greater for farmers who had more years of formal education. This is inconsistent with our *a priori* expectation because we thought that higher education would enable farmers to go into off-farm activities to supplement their farming work.

3.5. The Effects of Coping Strategies on Welfare

Tables 5 and **6** contain the estimated results of the welfare model. The significant determinants of welfare were coping strategy, gender, group, extension service, and household size. While gender, extension, and household size had a positive sign, coping strategy and group

Table 3. Factors determining the choice of on-farm coping strategies during droughts.

Variable	Coefficient	Standard error	Minimum	Maximum
Age	0.002	0.008	17	83
Gender	1.510***	0.376	0	1
Group	-1.092***	0.274	0	1
Education	-0.213	0.145	1	7
Farm size	-0.012	0.036	0	28
Extension	0.549**	0.257	0	1
Household size	0.048**	0.020	3	35
Severity	0.218	0.275	0	1
Constant	-1.598	0.705		

** means significant at 5% while *** means significant at 1

Source: Field survey, 2013

Table 4. Factors determining the choice of on-farm coping strategies during floods.

Variable	Coefficient	Standard error	Minimum	Maximum
Age	0.011**	0.005	17	83
Gender	0.297**	0.176	0	1
Group	-0.674***	0.179	0	1
Education	0.161**	0.094	1	7
Farm size	-0.019	0.021	0	28
Extension	-0.032	0.16	0	1
Household size	0.006	0.013	3	35
Severity	0.143	0.145	0	1
Constant	-0.346	0.409		

** means significant at 5% while *** means significant at 1

Source: Field survey, 2013

membership maintained a negative sign. The negative sign of the coping strategy variable means that farmers who adopted on-farm coping strategies during droughts were poorer than their counterparts who adopted off-farm strategies. This finding lends support to the findings that off-farm activities increase farmers' incomes. Similarly, the positive sign of the gender variable means that males were generally richer than females. Thus, the feminization of poverty may be said to characterize the farming population of the study area. Furthermore, household welfare increased with increasing household size as well as extension services. The positive household size is not consistent with the findings by [41]. Donkoh's argument was that high household size meant more mouths to feed and therefore lower welfare. On the other hand, in a farming population where large family size is needed as labor on the farms, it is not surprising that the variable is positively related to welfare. The negative sign of group membership is not consistent with our *a priori* expectations, however.

4. Conclusions

Based on the evidence, the following conclusions can be drawn:

1. Consistent with our *a priori* expectations, farmers per-

Table 5. Factors influencing household welfare with on-farm coping strategies during droughts.

<i>Variable</i>	<i>Coefficient</i>	<i>Standard error</i>	<i>Minimum</i>	<i>Maximum</i>
Coping strategy	-819.13***	193.26	0	1
Child in school	17.20	46.11	0	3
Credit	177.32	141.73	0	1
Age	0.002	0.008	17	83
Gender	1.510***	0.376	0	1
Group	-1.092***	0.274	0	1
Education	-0.213	0.145	1	7
Farm size	-0.012	0.036	0	28
Extension	0.549**	0.257	0	1
Household size	0.048**	0.020	3	35
Severity	0.218	0.275	0	1
Constant	-1.598	0.705		

** means significant at 5% while *** means significant at 1

Source: Field survey, 2013

Table 6. Factors influencing households' welfare with on-farm coping strategies during floods.

<i>Variable</i>	<i>Coefficient</i>	<i>Standard error</i>	<i>Minimum</i>	<i>Maximum</i>
Coping strategy	-1140.84***	160.96	0	1
Child in school	3.87	44.43	0	3
Credit	71.51	132.16	0	1
Age	0.002	0.008	17	83
Gender	1.510***	0.376	0	1
Group	-1.092***	0.274	0	1
Education	-0.213	0.145	1	7
Farm size	-0.012	0.036	0	28
Extension	0.549**	0.257	0	1
Household size	0.048**	0.020	3	35
Severity	0.218	0.275	0	1
Constant	-1370.47	131.49		

** means significant at 5% while *** means significant at 1

Source: Field survey, 2013

ceived that climate change was real and had severe consequences.

2. Farmers resorted to both on-farm and off-farm strategies to cope with the effects of climate change. While men adopted the former, women mostly adopted the latter. The strategies may be said to be ineffective considering the severity of the effects of climate change, however.
3. Education, extension services, and group formation were other important factors influencing the adoption of the coping strategies.
4. Farmers' perceptions of the severity of climate change effects did not significantly influence the adoption of on-farm versus off-farm coping strategies.
5. Point 4 notwithstanding, off-farm strategies increased welfare more than did on-farm activities.
6. There was evidence of the feminization of poverty.

4.1. Recommendations

In light of the above conclusions, the following recommendations are made:

1. Farmers must be supported with more viable income-earning activities that can take them out of poverty. Women in particular should be given priority. As the findings show, farmers who adopted off-farm strategies were better off than those who adopted on-farm ones. Women had a greater probability of adopting off-farm activities than men, so it was expected that the former would be better off than the latter. However, the opposite was the case. Affirmative action should be taken to help raise women's welfare. One way would be to increase their access to economic resources and opportunities, such as land, credit, and income generating activities.
2. Access to education and extension services must also be stepped up in the study area to facilitate the adoption of coping strategies and to raise the standard of living.
3. Although respondents currently are not using the Black Volta for dry season gardening or year-round farming, the river is a natural resource that could greatly contribute to poverty reduction and drastically reduce the impact of flooding and drought on households. The study therefore recommends stakeholder meetings with local institutions and communities to discuss and plan how the river can be utilized for dry season farming.

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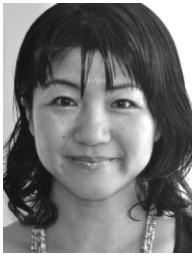
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Lecturer/Researcher, University for Development Studies

Selected Publications:
• K. B. Gordana and B. Z. Gandaa, "Business opportunities in safe and
productive use of waste in Tamale," Sustaining Financing for WASH and
Urban Agriculture (UA), Vol.26, pp. 47-51, 2013.