IJFAEC
International Journal of
Food and Agricultural Economics

FACTORS AFFECTING RISK MANAGEMENT STRATEGIES TO CLIMATE CHANGE EFFECTS IN GHANA

Emmanuella Ellis

Department of Agricultural Economics, Faculty of Agricultural and Environmental Sciences, McGill University, Quebec, Canada, Email: ellisemmanuella@yahoo.com

Abstract

The continued dependence on rain fed production by farmers increases their vulnerability to risk. In view of this, the study assessed the major risk faced by farmers, the main coping strategies adopted and the determinants of the strategies employed by farmers. Cross sectional data was obtained from 208 farmers randomly selected from the Eastern region of Ghana using a structured questionnaire in the year 2014. The Multinomial Logit regression model was employed to examine the factors influencing the coping strategies adopted by farmers. To cope with risks, farmers mainly preferred to practice crop diversification, borrow money or use up their savings. Results showed that the choice of coping strategies used by the respondents were influenced by their individual and farm characteristics, and the available institutions and capital resources. The study recommends the formulation of policies aimed at increasing farm and off farm income, and promote savings to strengthen farmers' capacity to cope with risks.
Keywords: *Coping strategy, determinants, Multinomial logit, risks, smallholder farmers*
JEL Codes: D81, Q12, Q15

1. Introduction

Agricultural risks are common in both developed and developing countries. Although, the predominant sources and consequences may differ between countries they are generally experienced by most farmers in most countries. Agriculture in sub-Saharan Africa (SSA) is an important sector of the economy serving as a stimulus for growth, assisting in poverty reduction and the provision of food security. Yet, food insecurity and poverty are critical issues for most developing countries in SSA. Among the numerous reasons, one cause of this problem could be attributed to agriculture's susceptibility to production risks which impact farmers' income and welfare (Cervantes-Godoy, Kimura & Antón, 2013).

In Ghana, agriculture produces approximately 22 percent of GDP (GSS, 2014) and provides 51% of the employment in the country (Stutley, 2010). It also provides 75% of foreign exchange earnings (Armah et al., 2011) with crop production making up approximately two-thirds of the sector. Ghana's agriculture is risky as it is mainly rain fed and prone to a number of climatic, natural and biological hazards. Hazards such as floods, drought, fire, pests and diseases, affect different crops and can result in a decrease in the national value of production. Most maize and rice farmers in Ghana for instance, are exposed to either drought or excess rainfall hazards. These have led to a decrease of 6.3% and 9.3% in the national value of maize and rice production respectively over the last two decades (Stutley, 2010). Though there has been the introduction of other agricultural interventions such as improved crop varieties and production technologies to increase yield, the impact of climate related and other forms of risk is still very costly for farmers.

Farmers have dealt with production risk, economic fluctuations and individual specific shocks through self-insurance and a large array of informal coping strategies. These tend not to be very effective, efficient or profitable. As a result, risk management strategies of smallholder farmers in developing countries might in fact push them into poverty.

Improving the risk coping strategies adopted by farmers is however heavily dependent on the knowledge of the different strategies used by farmers. The aim of the study is to assess the determinants of coping strategies employed by cereal farmers in Ghana. The study seeks to answer the following research questions in addressing the main objective; What are the major risks faced by farmers in the study area and 2) What are the main coping strategies adopted by farmers in the study area and 3) What are the factors influencing the coping strategies adopted by farmers?

This study provides an understanding of farm households' need for alternative and efficient risk management strategies which can be vital for policy action and the design of efficient risk management strategies.

2. Literature Review

2.1 Hazards and Risks

Risk can be defined as an incomplete knowledge where the probability of loss or possible outcome or consequence to a specific action is known (Abebe & Bogale, 2014). Agricultural production is characterized with uncertainty and risk due to uncontrollable factors, such as weather, which plays an essential role. Farmers are faced largely with yield, price and resource risks which makes production and incomes unsteady year after year. Risks can be categorized into individual or household risk (micro), group or community risk (meso) and regions or national risk (macro). It can also be categorized into its degree of correlation across households, how often they occur and severity of loss (Abebe & Bogale, 2014). Ghana faces two major hazards namely drought and floods with unfavorable effects on production and lives (Agyemang, 2010).

In the Brong Ahafo region of Ghana, Kwadzo, Kuwornu, and Amadu (2013) solicited food crop farmers' responses on the perils that affected production. Bush fires were ranked highest by most farmers followed by droughts and windstorms. The severity and the rate of impact on production and welfare of these perils were ranked in the same order as previously reported. The occurrence of these perils on the other hand varies from 3 to 5 years following the year in which the study was undertaken. The northern regions of Ghana, particularly the Upper East region, for the past 30 years have experienced high climate variability resulting in floods, droughts, high winds and temperatures, bushfires and erratic rainfall (Obeng & Assan, 2009). These risks cause variability in yield, farm household income and result in welfare losses.

2.2 Self –Insurance (Risk Management Strategy)

Modern risk management strategies such as irrigation, forward pricing, and agricultural insurance until recently have not been available to most farmers in developing countries and therefore they have resorted to self-insurance so that their lives have not been left to chance. Weather related and other production shocks determine the coping mechanisms farmers adopt which are quite heterogeneous across households. Coping strategy can be defined as a technique adopted by households to enable them to get through unforeseen livelihood struggles (Ellis, 2000).

As economic and climatic environments change, farmers adopt and create new innovations to assist in coping with these changes. Coping strategies are adopted either before, in

anticipation of a risk or after the occurrence of the hazard. Some ex-ante coping strategies generally adopted by farmers are low risk, low return cropping pattern and production technology, limited use of new and risky technology, plot, crop and income diversification (Cervantes- Godoy et al., 2013; Trang 2013). In Ghana, some farmers reduce fertilizer and pesticide applications in anticipation of risk from crop loss (Kwadzo et al., 2013).

Ex-post strategies utilized by farmers are diversification through income earning activities, reduced food consumption and expenditure, borrowing, off-farm investments such as petty trading, migration, selling of assets and reliance on external help from farmer cooperatives. Selling of assets were found to be the most adopted action among farmers followed by reduced consumption in most countries not excluding Ghana (Kwadzo et al., 2013; Obeng & Assan, 2009). Land and livestock sales act as buffer in times of hardship, proceeds from these are used for consumption or to settle other commitments. Some animals sold are likely to have significant contribution to farm production such as draft animals like oxen which are essential for land preparation or breeding stock which constitute household's wealth (Toulmin, 1987).

Farmer's choice of coping strategies are dependent on several socioeconomic characteristics and therefore varies among and within countries. In the Nile Basin of Ethiopia, the choice of coping strategies in response to extreme climate events was found to be influenced positively by access to extension services and income (Deressa, Ringler & Hassan, 2010). A study in Bangladesh revealed that farmers who were older, less educated, with larger farm size were less likely to adopt an adaptive strategy such as crop rotation, irrigation and crop insurance to climate change (Uddin, Bokelmann, & Entsminger, 2014). Farm size, farm experience, income and education significantly influenced the adoption of coping strategies by Yam and Cassava farmers in Nigeria (Ike & Ezeafulukwe, 2015).

2.3 Effects of Self-insurance

Self-insurance does not imply that farmers are able to successfully cope with risk especially large shocks such as drought. They often have negative impacts on the wellbeing of farmers (Mjonono, Ngidi & Hendriks, 2009) enhancing survival chances in a limited way. Cole, Bastian, Vyas, Wendel, and Stein (2012) noted that in the quest to self-insure, farmers adopt strategies that are costly with low efficiency rates. These risk management strategies affect their livelihood in various ways, ranging from the loss of assets, children dropping out of school to loan defaults. They usually lose income as a result of their portfolio choices especially underinvestment which affects household income and consumption (Hess & Syroka, 2005).

Risk can thus have two separate effects in a system; ex-ante efforts to reduce risk exposure can dampen asset accumulation creating a low-level equilibrium while ex-post consequences of a shock can put people back into poverty (Barnett & Mahul, 2007). The frequency and aggregation of these strategies is an obstacle to poverty alleviation and ultimately traps households into poverty. Shocks can result in lasting consequences through the practices farmers engage in to minimize its effect. Forgoing consumption or reducing food and non-food expenses such as health and education reduces the value of human capital (Hoddinott, 2006; Radermacher & Roth, 2014). There could even be severe cases of morbidity and mortality (Janzen & Carter, 2013). Inferring from the effects of self-insurance being addressed in this section, the cost of uninsured risk on the welfare of farm households is relatively high.

2.   Methodology

3.1 Data Description

The study was conducted in the Eastern region of Ghana. The region is located in the southern part of the country and in the transitional agro-ecological zone with an annual mean rainfall of 1300 mm (Stutley, 2010). The Eastern region constitutes one of the largest maize producing regions in the country with about 380,505 MT in 2010. Crop production in this region is susceptible to drought and is mainly practiced by smallholder farmers under rain fed conditions.

The study area was selected through a multistage sampling technique with steps were taken to purposively sample districts and communities for the survey. Data were obtained by using a structured questionnaire designed specifically to gather information through personal face-to-face interviews with cereal farmers. The questionnaire includes modules on household demographics, income, assets and details on farm characteristics. The survey contained questions regarding farmers' access to credit, extension services and membership in farmer-based groups. It also includes modules on the sources of production risks and risk management mechanisms. The total sample size for this study is 208 cereal farmers in the Eastern region.

Data obtained were analyzed using descriptive statistics and the multinomial logit regression model. The descriptive statistics employed involved the use of distribution tables, frequency, percentages, arithmetic mean scores and standard deviations. The descriptive statistics were used to present the socio-economic characteristics of the respondents. The data entry and preliminary analysis were conducted using the Statistical Package for Social Scientist (SPSS) and STATA package was used for model analyses.

3.2 Model of Specification

The percentage of farmers who employ different risk management strategies were presented in the study and the factors influencing the strategies used was determined. Most studies do not determine the correlation between individual and farm characteristics and the coping strategies used by farmers. This study addressed this objective with the use of Multinomial Logit regression. The choice of coping strategy was modelled as the dependent variable and regressed on a set of explanatory variables described above. Since a single decision was made among a number of alternatives without an obvious ordering, the Multinomial Logit regression is employed.

The model compares multiple groups through a combination of binary logistic regression models. This model is widely used in studies to explain the choice of an alternative among a set of options (Adepoju & Obayelu, 2013; Demurger, Fournier & Yang, 2010). The model is based on a random utility theory where the utility of a farmer who chooses a risk management strategy is described as a linear function of the individual, farm and institutional characteristics and the stochastic component. The choice of a strategy is dependent on the probability of that choice providing a greater utility than the utility from other risk management alternatives (Wanyama et al., 2010). This is due to the fact that a farmer's objective is to select an option that best maximizes his utility by minimizing risk. The dependent variable is a discrete variable with values lying between 1 and 8, each value representing a risk management strategy. When there are j categories of variables, the Multinomial Logit model consist of j-1 Logit equations which fit simultaneously. The model is described in detail below.

The concept underlying this objective is that the negative effect of risks can be inferred from the knowledge of farmers' risk management strategies. This provides a justification for the potential benefits from crop insurance and has a significant implication for farmers'

decision to purchase insurance as a risk management strategy. The Multinomial Logit regression is specified as follows;

The model assumes that the log odds for each response follows a linear model and compares a number of dichotomies instead of one. It works by comparing one risk management strategy to a reference risk management group determined by the group with the highest numerical score (Rodriguez, 2007). This is estimated for every explanatory variable and therefore each variable has two comparisons and a set of coefficients.

$$\eta_{ij} = \log \frac{\pi_{ij}}{\pi_{iJ}} = \alpha_j + X_i' \beta_j \tag{1}$$

The probability response for the distribution is multinomial instead of binomial and therefore there are J-1 equations instead of one thus j= 1, 2 ….J-1. α_j is a constant and β_j is a vector of regression coefficients. The multinomial J-1 Logit equations contract each category 1,2,3……J-1 with category J. For the j-1 possible outcomes, each individual i has a representation of 1 if an alternative j is chosen and 0 if not. The parameters in the model are estimated by maximum likelihood. In terms of probabilities where j=1 …J, the multinomial Logit regression can be written as shown below. The equations provides a set of probabilities for J+1 choices of a farmer with characteristics x_i (Greene, 2002).

$$\pi_{ij} = \frac{exp\{\eta_{ij}\}}{\sum_{k=1}^{J} exp\{\eta_{ik}\}} = \text{Prob}(Y_i = j) = \frac{e^{\beta'_{jx_i}}}{\sum_{k=0}^{j} e^{\beta'_{jx_i}}} \quad j=0,1,…,J \tag{2}$$

4. Results and Discussion

4.1 Demographic Characteristics

Table 1 shows the household and farm characteristics of respondents. Of the total respondents, 74.0% were males while 26.0% were females. The large number of males compared to females was expected since most household heads are males and they own most of the land. The women do not own land due to the culture, thus women work on land owned by their husbands. The ratio of men to women is not different from other studies in Ghana (Aidoo, Mensah, Wie & Awunyo-vitor, 2014). The majority of the survey respondents, 161 were married with of them having only basic education. Individuals above the age of 50 represented 39.9% of the sample. Individuals who were less than 30 made up 4.8% of the sample. The mean age was 46.7 years with a minimum of 25 and a maximum of 78 years. The majority of the younger farmers had household sizes between 2 and 4 while older farmers (>50yrs) had household sizes between 3 and 15. Most of the farmers, 148 of the 208 respondents, have been producing cereals for at least 10 years with the majority of them having 10 to 20 years of farming experience. Thus the farmers in the study area were quite experienced in grain production.

Most of the respondents, 169 out of 208 respondents, had small size farms. Small size farms are less than 2 hectares, medium size farms are 2-8 hectares and large size farms are greater than 8 hectares. The majority of Ghanaian farmers have small size farms (Kwadzo et al., 2013). Of the 54 female farmers, only 1 had a medium size farm compared to 25 males. The majority of the farmers in the study were maize famers; 166 respondents out of 208. Out of the 42 rice farms, 83.3% were small size farms and 2.4% were large size farms. Farm size for maize farms were 80.7% small size farms, 12.0% medium size and 7.2% large size farms.

Table 1. Household and Farm Characteristics

Variable			Variable		
		Number of Respondents			Number of Respondents
Gender	Male	154	**Age**	≤ 30	9
	Female	54		< 31- 50	118
Marital Status	Single	14		>51	81
	Married	161	**Household Size**	0 - 3	37
	Divorced	9		4 - 6	115
	Widower	17		7 - 10	50
	Other	7		11 - 15	6
Education	No formal education	60	**Farming Experience**	< 5	5
				5 – 10	55
	Basic education	91		11 – 15	60
				16 – 20	40
	Secondary education	40		21 -30	40
				>30	8
	Tertiary education	17	**Crop Type**	Maize	166
				Rice	42
Farm Size	Small Size	169			
	Medium Size	26			
	Large Size	13			

Source. Field Survey data, 2015

4.1.1 Economic Welfare

Respondents' total household incomes comprised of their farm and off-farm incomes. The survey results indicate that a majority of the farmers had monthly income below 500GH cedis[1]; approximately 52.6% of the survey sample. Approximately, 25.5% of the farmers earned between 500 and 1,000 GH cedis, 14.4 % while 6.2% of the farmers earned above 3,000 GH cedis on a monthly basis. The survey results indicate that 67.2% of the non-educated farmers had incomes below 500 GH cedis. Approximately, 53.7% of the educated farmers had income above 500 GH cedis (Table 2). A higher percentage of the large size farm owners (46.2%) had incomes above 2,000 GH cedis as compared to small and medium size farm owners.

Table 2. Income Levels with Respect to Educational Levels and Farm Size

Variable		<500 GH cedis (%)	500-2000 GH cedis (%)	>2000 GH Cedis (%)
Education	At least basic education	46.3	36.9	16.8
	No education	67.2	29.3	3.4
Farm size	Small size	63.0	27.4	9.6
	Medium size	26.9	65.4	7.6
	Large size	7.7	46.2	46.2

Source: Field survey data, 2015

---

[1]1 USD = 3.21 GH cedis

Credit is an important extra source of income for households usually serving as an additional income to finance farm investments (and/or household consumption expenses). Out of the total respondents, 81 had access to credit while 127 did not. The majority of the farmers with higher incomes had access to credit as compared to those with lower incomes. 4 out of 5 farmers with income above 5000Gh cedis, and 6 out of 11 farmers with incomes between 2000 to 3000Gh cedis had access to credit while only 32 out of 103 farmers with incomes below 500Gh cedis had access to credit (Figure 1). It is evident that farmers' total household income is an important factor in determining access to credit. Farmer access to credit facilitates the generation of additional income. The credit obtained could be used to finance farm investments to increase yields and incomes or invested in other non-farm activities. Household incomes of individuals with access to credit were higher compared to those without access to credit and is similar to the findings by Langat (2009).
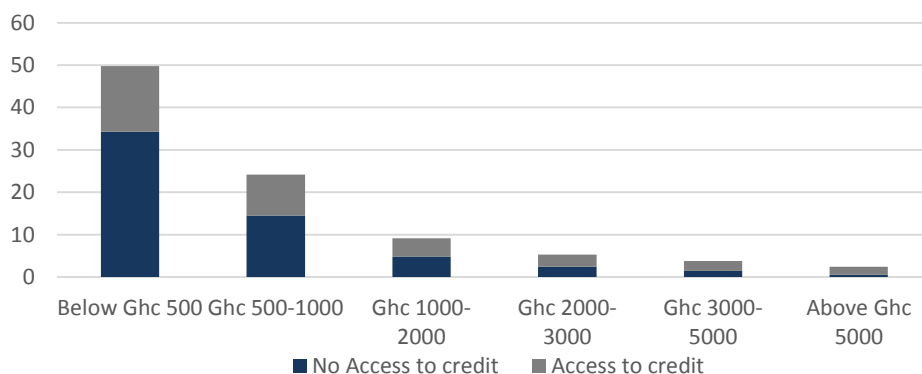

Figure 1. Farmers' Access to Credit in Relation to Their Monthly Income Levels

Most of the respondents had other occupations apart from cereal production (Table 3). Only, 10.6% of the respondents indicated that they did not have another occupation in addition to farming. Results from the survey indicated that all of the single and younger farmers (< 30 years) had other occupations. The majority of small size farms owners, more experienced and the highly educated farmers did not have other occupations. One hundred and fifteen of the respondents stated that agriculture was their major occupation, while 23 respondents said sales.

Table 3. Major Occupation of Farmers

Variable	Number of Respondents
Agriculture	115
Sales	23
Craftsmanship	15
Salaried worker	18
Retired	6
Services	28
Other	3

Source: Field survey data, 2015.

Sixty three percent of the males stated that cereal production was their major occupation. The largest number of the female respondents were engaged in sales (40.7%) as their major occupation while agriculture was the major occupation of 31.5%. With regards to farmers who engaged solely in agriculture, 71.4% of them earned below 500 GH cedis while 28.6% earned

between 500 and 2,000 GH cedis on a monthly basis and none earned above this amount. This suggests that off farm employment contributes significantly to farmers' total household income. Respondents who earned above 3,000 GH cedis were dominated by service and salaried workers while those with lower income levels were dominated by sales, craftsmanship and agriculture. It can be inferred that households with lower incomes were those with agriculture as their major occupation. Farmers who depended solely on agriculture had lower incomes than those who engaged in other income generating activities.

4.2 Risk Faced by Farmers in the Study Area

A large proportion, 151 out of 208 respondents were aware of changes in climate. It was therefore not surprising to observe that 200 respondents had experienced crop failure. The major sources of risks faced by maize and rice farmers were largely production risks. The most identified risk was variability in rainfall followed by cyclones, floods, drought, bush fires, crop pests and disease, in that order (Table 4). This is consistent with the findings of Aidoo et al., (2014) and Falola, Ayinde, and Agboola (2013) and who classified droughts, pests and diseases and bad weather among the most important risks faced by farmers in Nigeria and Ghana respectively. However, Kuoame (2010) did not observe drought as an important risk among farmers in Cote d'Ivoire since only 27% of farmers ranked it as such. The two least important risks faced by maize farmers were identified as non-availability of production inputs and poor soil fertility. Among the production risks, pests and diseases was less important for rice farmers as compared to maize farmers. Compared to maize farmers, the non-availability of inputs was one of the major concerns of rice farmers who ranked it as the 3rd most important risk factor.

Table 4. Major Risks Faced by Farmers

Risk	Maize		Rice	
	Mean	Rank	Mean	Rank
Rainfall Variability	1.47	1	1.98	2
Cyclone, flood, drought and bushfires	2.76	2	1.74	1
Crop pests and diseases	3.27	3	3.40	4
Poor soil fertility	4.26	5	4.67	5
Non-availability of production inputs	3.84	4	3.19	3

Source: Field survey data, 2015

4.3 Risk Management Strategies

To cope with risks households adopt many different risk management strategies. The strategy that was adopted by the most households, 96 out of 208 respondents was crop diversification (Table 5). Farmers in the study area also practiced other coping strategies such as borrowing from friends and relatives, using savings as well as marketing and production contracts. It can be inferred from the results that almost all of the respondents were faced with risks which they managed by adopting at least one of the risk management strategies. This was made even more evident because only two of the respondents did not use any risk management strategy. This could be due to the fact that they either did not consider the shocks severe or the shocks did not have severe implications on their livelihoods, or they did not have enough resources to deal with risks (Long, Minh, Manh & Thanh, 2013). These farmers could also be receiving assistance or remittances from family, friends or other support groups. Apata (2011) and Deressa et al., (2010) also observed that 51.3% and 35.4% of the sampled farmers in

Nigeria and Ethiopia respectively did not adopt any strategy to deal with risks. These percentages are higher than what was observed in this study. The findings of this study agree with Aidoo et al., (2014) and Kuoame (2010) who observed that crop diversification was the most used risk management strategies in Ghana and Cote d'Ivoire, respectively. Reviews of the literature on the coping strategies suggests that other strategies adopted by include social support or networking, seeking off farm opportunities, engaging in mixed farming, planting trees, irrigation, mulching, making ridges and labor exchange (Apata, 2011; Berman, Quinn & Paavola 2013; Deressa et al., 2010; Kuoame, 2010).

Table 5. How Sampled Households Deal with Risk

Management Strategy	Number of Respondents
Crop diversification	96
Bank Loan	3
Savings	32
Marketing/ Production contracts	10
Borrowing from friends/family	47
Sales of fixed assets	3
Others	15
None	2

Source: Field survey data; note ***, **, * represents 1%, 5% and 10% respectively.
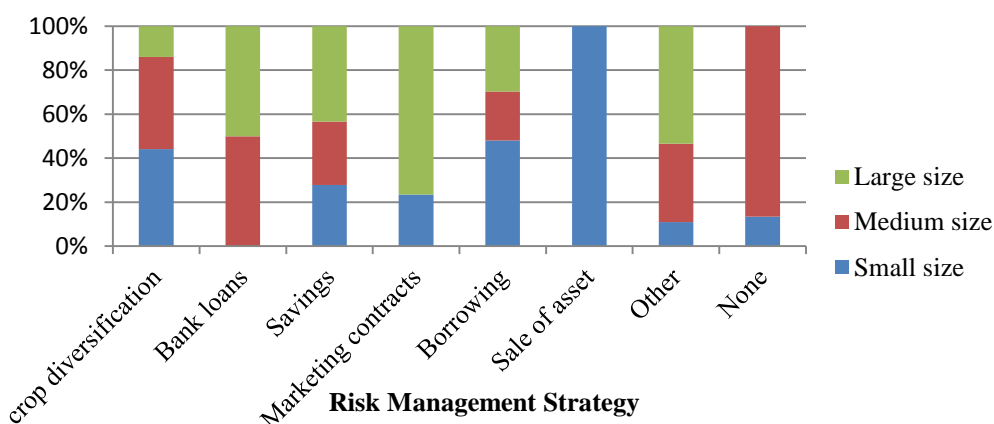
Figure 2. Distribution of Risk Management Strategies According to Farm Size
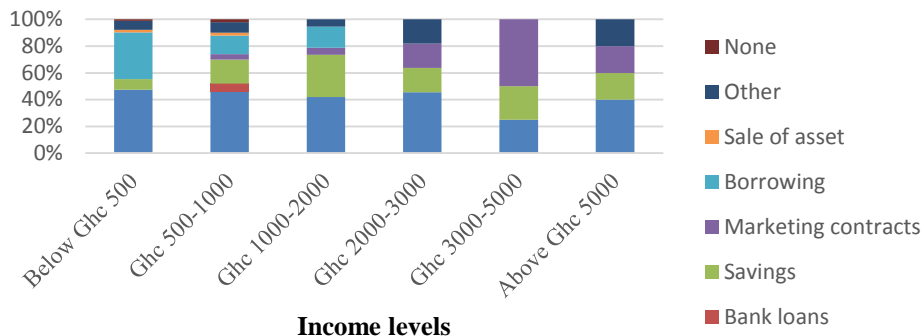
Figure 3. Distribution of Risk Management Strategies According to Household Income
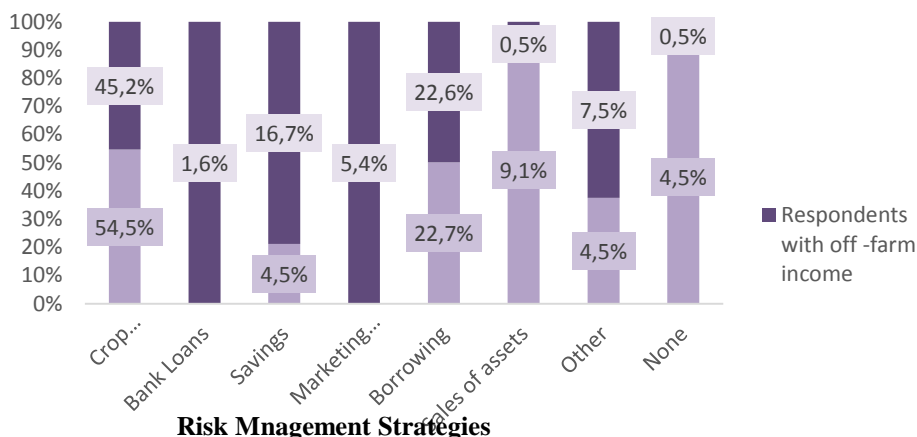

Figure 4. Distribution of Risk Management Strategies According to Occupation

It was found that few of the sampled farmers obtained services from formal financial institutions since only 3 of the farmers had access to bank loans. All the farmers who had access to bank loans and marketing contracts were medium or large size farm owners, farmers with no more than 20 years of experience, educated and higher income farmers. Approximately 90.0% of the farmers who had marketing contracts and approximately 65.0% of those who used savings had access to extension services while 74.5% of farmers who borrowed did not have access to extension services. Farmers with no basic education mainly borrowed from friends (36.2%) or adopted crop diversification (46.6%). Only farmers with no formal education and small size farm owners indulged in the selling of assets as a management strategy (Figure 2). The use of saving was second to crop diversification among the majority of medium and large size farm owners while borrowing was second to crop diversification among small size farm owners. It was noted that farmers with incomes above 2,000GH cedis did not borrow from friends or sell fixed assets (Figure 3).

Farmers whose sole occupation was agriculture did not access bank loans or marketing contracts but they engaged in crop diversification, selling of assets and borrowed from friends (Figure 4). Off-farm employment can be viewed as a risk management strategy because it provides farmers with additional income to finance farm and household expenses. It was

observed that farmers with other occupations besides cereal production still adopted other management strategies to cope with risk. They had access to more productive strategies such as loans which were not available to farmers who depended solely on farming. Engaging in another occupation can be considered not only beneficial as a risk management strategy but also as a good complement to other risk management strategies. Thus individuals with no formal education, low income, large household sizes and those who mostly depended solely on farming constituted a vulnerable section of the farmers. They mostly diversified their crops, borrowed and sold their assets which has negative implications such as reduced investments, reduced income, loss of assets and loan defaults.

4.4 Factors influencing the Risk Management Strategy Adopted by Farmers

The multinomial logit regression model was used to analyze the determinants of the coping strategies used by farmers. In each column, the coefficient shows the effect of the independent variable on the adoption of the risk management strategy under consideration relative to crop diversification which was the base outcome. Crop diversification was chosen as the base outcome because it is the strategy used mostly by farmers in the study area. The Chi square value was significant at 1% which indicates that the model is a good fit for the data. The results of the multinomial logit regression analysis are reported in Table 6. The factors influencing the choice of coping strategies are given below.

Bank Loans

None of the variables had a statistically significant effect on the use of bank loans, however, the results indicate that farm size positively influenced the probability of using bank loans with respect to crop diversification. This could be due to the fact that farmers with larger farm sizes have the capacity to use land as collateral to obtain loans. The likelihood of diversifying crops was observed to be higher relative to taking loans among higher income farmers since they have the capacity to undertake investments in the production of different crops in a risky environment.

Savings

Relative to crop diversification, education had a positive and significant influence on the probability to use savings as a management strategy. Educated farmers were more likely to be aware of the need to save to secure future welfare from uncertainties and thus draw on savings when the need arose. The relationship between the likelihood of using savings compared to engaging in crop diversification was found to be positively significant with respect to the age of farmers. Older farmers were therefore less likely to diversify their crops compared to using savings. The choice of one strategy over another could be due to the fact that they had more knowledge of the benefits and risks of a variety of coping strategies. Also these farmers tended to have larger households and more responsibilities and thus a higher probability of saving for future demands. This is in line with results obtained by Kuoame (2010) who found a positive relationship between these variables and savings. Maize farmers were found to have a higher likelihood of engaging in crop diversification relative to using savings as a management strategy. This could be due to the fact that it may be easier to intercrop with maize compared to rice especially because it is produced mainly in waterlogged areas.

Marketing and Production contracts

The results indicate that gender and age had a negative and significant effect on the likelihood of having marketing and production contracts relative to crop diversification. This suggests that females and older farmers were more likely to engage in crop diversification relative to having contracts. This could be explained by the fact that marketing contracts may not be available and accessible to most farmers, leaving crop diversification, which is known to be used by a majority of farmers as the next best alternative. Younger farmers are less risk averse and more willing to try new avenues while older farmers are more willing to engage in practices that they are familiar with (Aidoo *et al.,* 2014).

The relationship between the likelihood of having a marketing contract compared to engaging in crop diversification was found to be positive and significant with respect to income and farming experience. More experienced farmers were more likely to opt for marketing contracts since with more experience they are better able to anticipate production yields and prices and are also more aware of marketing channels and agents in the community. Farmers with higher incomes have the capacity to undertake investments in crop production in a risky environment and probably meet the terms of the contract and thus have a higher likelihood of having contracts.

Borrowing from friends and family

Gender of the farmer had a negative and significant influence on the likelihood of borrowing relative to crop diversification. Males were less likely to borrow relative to engaging in diversification as a risk management strategy. The results show that in comparison with crop diversification, borrowing from relatives and friends as a risk management option was more likely with married farmers. This variable was observed to have a positive and significant influence on borrowing. This could be due to the fact that married individuals had children, and therefore opted to borrow to finance production investments and household needs. Nevertheless, engaging in farming as a major occupation negatively and significantly influenced the choice of borrowing compared to diversification. These farmers are likely to be knowledgeable about the techniques employed in diversification and will undertake the necessary measures to obtain the maximum possible yield from the activity that serves as their major source of livelihood.

The type of crop the farmer produced negatively and significantly influenced the probability of borrowing from friends and family relative to adopting crop diversification. It was found that maize farmers compared to rice farmers were less likely to borrow. This could be due to the fact that diversification is not very feasible for rice farmers and therefore these farmers are more likely to borrow to finance household expenses during and after harsh climatic events. It was also observed that farmers with more experience in farming were more likely to borrow relative to diversifying their crops. This can be explained by the fact that experienced farmers were usually older farmers who may have larger households and more responsibilities and may need to borrow to supplement income.

Table 6: Determinants of Risk Management Strategy
The dependent variables in this model are 1= Bank Loans 2 = Savings 3 = Marketing and production contacts 4 = Borrowing from friends/relatives
5 = Sale of assets 6 = Other 7 = None 8 = Crop diversification (reference group).

Variable	1	2	3	4	5	6	7
	Co eff.	Co eff.	Co eff.	Co eff.	Co eff.	Co eff.	Co eff.
Sex	-13.862	-0.6318	**-3.4696***	**-1.6939*****	**-8.7309***	15.571	-4.1709
	(1881.6)	(0.6310)	(1.98004)	(0.5847)	(4.9104)	(2396.9)	(3.7094)
Age	-0.1157	**0.0534***	**-0.1942***	0.0458	0.3450	0.0115	-0.0104
	(0.5212)	(0.0301)	(0.10943)	(0.0298)	(0.2398)	(0.0586)	(0.1453)
Married	1.2412	0.3462	0.5049	**1.7775****	-0.8976	17.792	17.494
	(2242.2)	(0.6342)	(2.1002)	(0.6621)	(2.0855)	(3295.8)	(6690.32)
Single	0.9607	0.8356	3.1824	**2.4670***	-4.3499	16.024	0.9429
	(5865.1)	(1.0568)	(3.0077)	(1.4610)	(3924.9)	(3295.8)	(12705.6)
Education	4.8840	**0.1250****	0.1797	-0.0716	-0.0740	**0.7208*****	-0.1374
	(4.7235)	(0.0554)	(0.22409)	(0.0465)	(0.1768)	(0.2341)	(0.2093)
Crop type	-7.2862	**-1.0127***	17.847	**-1.1756***	-5.5251	**-2.6029 ****	-5.5383
	(6.5090)	(0.5742)	(3418.10)	(0.6237)	(3.6858)	(1.2046)	(3.2474)
Household size	2.0639	-0.1121	0.1331	0.0143	0.3358	-0.4048	0.3975
	(2.8878)	(0.1249)	(0.35719)	(0.1068)	(0.5256)	(0.2837)	(0.4937)
Income	-2.6005	-0.0524	**2.6777*****	-0.0784	0.4713	-0.1436	-0.3663
	(3.0599)	(0.1345)	(0.75459)	(0.1508)	(1.3135)	(0.2088)	(1.1319)
Farm size	14.920	0.5897	0.4635	0.2710	-12.775	0.3601	2.9140
	(13.901)	(0.4352)	(0.68724)	(0.4828)	(4241.0)	(0.5892)	(2.5228)
Farm Experience	0.1860	0.0043	**0.2393***	**0.1228*****	0.1882	**0.1879***	-0.0601
	(0.3679)	(0.0419)	(0.14204)	(0.0400)	(0.1267)	(0.1112)	(0.1863)
Major occupation	48.156	-0.1004	-1.8114	**-1.0075****	-0.5529	-1.2923	-20.042
	(512.06)	(0.4994)	(1.23586)	(0.4877)	(2.6275)	(0.9161)	(3175.48)

Source: Field survey data, 2015

Note: Number of observations = 207 LR Chi^2 (77) = 210.24   Prob > Chi^2 = 0.000 Log likelihood = -202.64822 Pseudo R^2 = 0.3416

***, **, * Significant at 1%, 5% and 10%
Values in parenthesis are standard errors

Sale of Assets

Gender of the farmers negatively and significantly influenced the probability of selling assets relative to crop diversification. Male headed households were less likely to sell assets relative to engaging in diversification as a risk management strategy. This may be due to the fact that crop diversification spreads risk across commodities and has the prospects of returns in yield and income even if insufficient and much less risky compared to selling assets.

Other risk management strategy

Education had a positive and significant influence on the use of other strategies compared to adopting crop diversification. The more educated the farmer the higher the likelihood of having knowledge about other risk management strategies and thus a higher probability of opting for other strategies depending on the potential benefits. However relative to crop diversification, farming experience had a positive and significant influence on the use of other strategies. The more experienced the farmer, the higher the likelihood of using other strategies with respect to diversification. This suggests that with more experience, this group of farmers do not view crop diversification as adequate in managing the risk they face and would rather opt for other alternatives. This could be due to the fact that they are likely to be older farmers and therefore with lifelong experience they have more knowledge on a variety of coping strategies and their benefits.

Crop diversification

In summary, the results showed that males, older farmers and those who identified farming as their major occupation were more likely to engage in diversification relative to having marketing contracts, selling assets or borrowing. Kuoame (2010) observed a positively significant relationship between education and crop diversification explaining that these individuals may be better educated on the techniques utilized in diversification to obtain the maximum possible yield. This was also similar to the results by Ajewole (2013) who ascertained that age had a positive and significant impact on the adoption of crop diversification. Farmers with larger farm sizes and more experience were less likely to diversify their crops relative to having marketing contracts, using savings or borrowing. There was a higher probability for higher income farmers to engage in crop diversification rather than borrow from friends or the bank. Farmers with larger household sizes were also more likely to sell assets or borrow and less likely to use savings relative to diversification. Ajewole (2013) established that Nigerian farmers with larger household sizes were more likely to diversify their crops. This observation is in line with the adoption of crop diversification among Ghanaian farmers only in relation to using savings.

5. Conclusion and Recommendations

Descriptive statistics indicated that the majority of farmers were male, married, middle aged, had at least basic education, were low income earners, had small farm sizes and had many years of experience in cereal farming. The major risks faced by farmers were rainfall variability and drought. To cope with these risk, the study found that the farmers mainly preferred to practice crop diversification, borrow money or use up their savings. Employing the Multinomial Logit model, it showed that gender, age and major occupation negatively influenced the use of at least one of the coping strategies identified by the farmers relative to

crop diversification. Also, farm size, income and education positively influenced the adoption of at least one risk management strategy relative to crop diversification.

Farmers that adopt less efficient risk management strategies, such as sales of assets and borrowing, are usually characterized by lower incomes, small scale farms, lower education and larger household size. Farmers' access to information is necessary to increase farmers' awareness and knowledge on the specific coping strategies which are efficient for their condition. The government should formulate policies aimed at increasing farm income, encouraging off farm income generation and promote savings to strengthen farmers' capacity to cope with risks. This can be done through forming small business groups and facilitating savings and credit cooperatives.

Improving farmers' asset accumulation and income generation is necessary to increase their capacity to better cope with risks. Farmers in the study area are susceptible to rainfall variation and its resulting impact on crop yield. One recommended alternative strategy that could be introduced and made accessible to farmers to improve farmers' resilience to climate change is crop insurance. To reduce the vulnerability of farmers to risk and to improve yields, many countries have introduced and implemented agricultural insurance to assist farmers to manage and cope with risk (Abebe & Bogale, 2014).

Farmer access to credit facilitates the generation of additional income. The credit obtained could be used to finance farm investments to increase yields and incomes or invested in other non-farm activities However, majority of the farmers did not have access to bank loans which was found to be evident among farmers whose sole occupation was agriculture. Despite the fact that majority of financial institutions do not have establishments in the rural areas, the few available are unwilling to loan to farmers. This is because agriculture is viewed as a very uncertain venture which makes farmers a very risky group of people to offer loans to since they may not be able to pay back. Also, most farm lands are owned by families and therefore cannot be used as collateral to solicit a loan when the opportunity is presented to farmers. Crop insurance is one mechanism that allows farmers to access credit since its serves as a form of collateral for loan acquisition. This provides one more reason for farmers to have access to crop insurance schemes.

About 48% of the farmers did not have access to extension services which is likely to have a negative influence on the choice of risk management strategies adopted by farmers. Extension services provide farmers with information on the different risk management strategies available to farmers, the most appropriate kinds for specific risks, their advantages, limitations and how to obtain the different forms that are not within their reach. It is therefore essential that farmers have access to extension services on a regular basis and also educated on the need to involve themselves in training services undertaken by extension agents when available. Extension agents should be adequately trained by personnel from the Ministry of Food and Agriculture to be able to deliver the right information to farmers.

References

Abebe, T. H., & Bogale, A. (2014). Willingness to pay for Rainfall based Insurance by Smallholder Farmers in Central Rift Valley of Ethiopia: The Case of Dugda and Mieso Woredas. *Asia Pacific Journal of Energy and Environment* 1(2), 121-155.

Aidoo, R., Mensah, J.O., Wie, P., & Awunyo-vitor, D. (2014). Prospect of Crop Insurance as a Risk Management Tool among Arable Crop Farmers in Ghana. *Asian Economic and Financial Review* 4(3), 341-354.

Adepoju, A. O., & Obayelu, A.O. (2013). Livelihood diversification and welfare of rural households in Ondo State, Nigeria. *Journal of Development and Agricultural Economics* 5 (12), 482-489.

Agyemang, M. (2010). The Determinants of Cocoa Output: A Case Study of the Aowin Suaman District. *American Journal of Environmental Sciences* 1(3), 194-201.

Ajewole, O. C. (2013). Adoption of Crop Management Options as Coping Strategies to Climate Variability among Arable Farmers in Ekiti State, Nigeria. *IJAFS 4* (1&2), 392-400.

Apata, G. T. (2011). Factors Influencing the Perception and Choice of Adaptation Measures to Climate Change among Farmers in Nigeria. Evidence from Farm Households in Southwest Nigeria. *Environmental Economics* 2(4), 74-83.

Armah, A.F., Odoi, J.O., Yengoh, G.T., Obiri, S., Yawson, D.O., & Afrifa, E.K.A. (2011). Food Security and climate change in drought-sensitive savanna zones of Ghana. *Mitigation and Adaptation Strategies for Global Change* 16, 291–306.

Barnett, J.B., & Mahul, O. (2007). Weather Index Insurance for Agriculture and Rural Areas in Lower- Income Countries. *American Journal of Agricultural Economics* 89 (5), 1241-1247.

Berman, R., Quinn, H.C., & Paavola, J. (2013). Identifying Drivers of Household Coping Strategies to Multiple Climatic Hazards in Western Uganda: Implications for Adapting to Future Climate Change. Centre for Climate Change Economics and Policy Working, Paper No. 149. Sustainability Research Institute, Paper No. 51. University of Leeds.

Cervantes-Godoy, D., Kimura, S., & Antón, J. (2013). Smallholder Risk Management in Developing Countries. OECD Food, Agriculture and Fisheries Papers, No. 61: OECD Publishing.

Cole, S., Bastian, G.G., Vyas, S., Wendel, C., & Stein, D. (2012). The effectiveness of index-based micro-insurance in helping smallholders manage weather-related risks. London: EPPI-Centre, Social Science Research Unit, Institute of Education, University of London.

Deressa, T. T., Ringler, C., & Hassan, R.M. (2010). Factors Affecting the Choices of Coping Strategies for Climate Extremes: The Case of Farmers in Nile Basin of Ethiopia. IFPRI Discussion Paper 01032, Washington, DC, USA.

Demurger, S., Fournier, M. & Yang, W. (2009). Rural Households' Decision towards Income Diversification: Evidence from a Township in Northern China. Documents De Travail – Working Papers, 09-23. France. ftp://ftp.gate.cnrs.fr/RePEc/2009/0923.pdf

Ellis, F. (2000). Rural Livelihoods & Diversity in Developing Countries. Oxford University Press, Oxford. *Journal of Development Economics* 70 (1), 248-252.

Falola, A., Ayinde, A.E. & Agboola, B.O. (2013). Willingness to Take Agricultural Insurance by Cocoa Farmers in Nigeria. *International Journal of Food and Agricultural Economics* 1(1), 97-107.

Ghana Statistical Service. (2014). Poverty Profile in Ghana (2005-2013). Ghana Living Standards Survey, Sixth Round Report (GLSS 6). Accra, Ghana.

Greene, H. W. (2002). Econometric Analysis, 5th ed. Upper Saddle River, NJ: Prentice Hall, New York University.

Hess, U., & Syroka, J. (2005). Weather-based Insurance in Southern Africa: The Case of Malawi. Agriculture and Rural Development Discussion Paper 13. Washington, D.C: World Bank.

Hoddinott, J. (2006). Shocks and their consequences across and within households in Rural Zimbabwe. *Journal of Development Studies* 42(2), 301- 321.

Ike, C. P., & Ezeafulukwe, C. L. (2015). Analysis of Coping Strategies Adopted against Climate Change by Small Scale Farmers in Delta State, Nigeria. *Journal of Natural Sciences Research* 15(4), 15-22.

Janzen, A. S. & Carter, M.R. (2013). The Impact of Microinsurance on Assets Accumulation and Human Capital Investments: Evidence from a Drought in Kenya. Research Paper, No.31. International Labor Office: Geneva.

Kuoame, B. E. (2010). Risk, Risk Aversion and Choice of Risk Management Strategies by Cocoa Farmers in Cote D'Ivoire. PhD thesis, University of Cocody. Retrieved from http://www.csae.ox.ac.uk/conferences/2010-edia/papers/267 (accessed December 9, 2015).

Kwadzo, T-M. G., Kuwornu, J.K.M., & Amadu, I.S.B. (2013). Food Crop Farmers' Willingness to Participate in Market-Based Crop Insurance Scheme: Evidence from Ghana. *Research in Applied Economics* 5(1),1-21. ISSN 1948-5433.

Langat, K. J. (2009). Effect of Credit on household Welfare: The Case of "Village Banks" Model in Bomet District, Kenya. Master Thesis. Egerton University.

Long, Q. T., Minh, T.B., Manh, C.N., & Thanh, T.V. (2013). Farm Households' Willingness to Pay for Crop (micro) insurance in Rural Vietnam: An Investigation Using Contingent Valuation Method. East Asian Development Network (EADN) Working Paper No.64.

Mjonono, M., Ngidi, M., & Hendriks, S.L. (2009). Investigating Household Food Insecurity Coping Strategies and Impact of Crop Production on Food Security using Coping Strategy Index (CSI). 17th International Farm Management Congress, Bloomington/Normal, Illinois, USA.

Obeng, K. F., & Assan, J. (2009). Environmental Variability and Vulnerable Livelihoods: Minimising Risks and Optimising Opportunities for Poverty Alleviation. *Journal of International Development* 21(3), 403-418. doi: 10.1002/jid.1563

Radermacher, R., & Roth, K. (2014). A Practical Guide to Impact Assessments in Micro insurance. Micro insurance Network and Micro Insurance Academy, New Delhi.

Rodriguez, G. (2007). Generalized Linear Models. Lecture notes. Princeton University. Retrieved from http://data.priinceton.edu/ww5509/notes (accessed September 15, 2015).

Stutley, C. (2010). Crop Insurance Feasibility Study. Innovative Insurance Products for the Adaptation to Climate Change Project Ghana (IIPACC). Ghana. Retrieved from http://seguros.riesgoycambioclimatico.org/DocInteres/eng/Ghana-Crop-Insurance.pdf. (accessed April 6, 2015).

Toulmin, C. (1987). Drought and the Farming Sector: Loss of Farm Animals and Post-Drought Rehabilitation. *Development Policy Review* 5, 125-148. doi: 10.1111/j.14677679.1987.tb00370.x

Trang, M. N. (2013). Willingness to Pay for Area Yield Index Insurance of Rice Farmers in the Mekong Delta, Vietnam.

Uddin, N. M., Bokelmann, W., & Entsminger, S. J. (2014). Factors Affecting Farmers' Adaptation Strategies to Environmental Degradation and Climate Change Effects: A Farm Level Study in Bangladesh. *Climate* 2, 223-241. doi:10.3390/cli2040223

Wanyama, M., Mose, O.L., Odendo, M., Okuro, J.O., Owuor, G., & Mohammed, L. (2010). Determinants of income diversification strategies amongst rural households in maize based farming systems of Kenya. *African Journal of Food Science* 4 (12), 754-763.