Farmers Willingness to Pay for Crop Insurance: Evidence from Eastern Ghana

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Abstract

Crop insurance is designed for managing crop production risks through the compensation of farmers in the event of a hazard or crop failure. The continued dependence on rain fed production by farmers increases their vulnerability to risk leading to variability of production and income. Since crop insurance is a risk management tool with the potential of dealing with risk more efficiently, the study uses a dichotomous contingent valuation method to elicit the willingness to pay for crop insurance among cereal farmers in the Eastern region of Ghana. A sequential decision was considered. An initial decision regarding the willingness to purchase and a subsequent decision on the willingness to pay amount conditional on a positive initial decision was determined. The study employed descriptive statistical techniques to analyse primary data obtained from 208 sampled farmers in the region. Out of the sampled farmers, 52.9% expressed interest in crop insurance. The Probit model was used to estimate the mean willingness to pay (WTP) for crop insurance. The results revealed that farmers were willing to pay approximately GHc 69.6 per cropping season. The demand for insurance was found to be negatively correlated with the premium amounts suggesting that it is a normal good. A Heckman two stage approach was employed to estimate the factors influencing the WTP for crop insurance. The empirical results of the Probit model revealed that marital status, education, crop type, access to extension service, borrowing, savings and awareness of crop insurance influenced farmers willingness to purchase insurance. Farmers WTP amount estimated with the interval regression model was shown to be influenced by key variables such as age, marital status, education, crop type, farm size, farm experience, income, weather variation, borrowing, savings and access to extension agents. The study recommends that with adequate and detailed information and affordable premiums, farmers will be willing to purchase insurance. Innovative insurance products and the appropriate distribution channels are also recommended to incite demand for crop insurance.

Résumé

L'assurance-récolte est conçu pour la gestion des risques de production des cultures grâce à la compensation des agriculteurs en cas d'un danger ou d'une mauvaise récolte. La dépendance continuelle sur la production pluviale par les agriculteurs augmente leur vulnérabilité au risque conduisant à la variabilité de la production et des revenus. Depuis l'assurance-récolte est un outil de gestion des risques avec le potentiel de traiter plus efficacement les risques, l'étude a utilisé un méthode d'évaluation contingente dichotomique pour susciter la volonté de payer pour l'assurance-récolte parmi les agriculteurs céréales dans la région Orientale du Ghana. Une décision séquentielle a été considérée. Une décision initiale concernant la volonté d'acheter et une décision ultérieure sur la volonté de payer le montant conditionnel sur une décision initiale positive a été déterminée. L'étude a utilisé des techniques statistiques descriptives pour analyser les données primaires obtenues à partir de 208 agriculteurs échantillonnées dans la région. À partir des agriculteurs échantillonnés, 52,9% ont exprimé leur intérêt dans l'assurance-récolte. Le modèle Probit a été utilisé pour estimer la volonté moyenne de payer (VDP) pour l'assurance-récolte. Les résultats ont révélé qu'en moyenne les agriculteurs sont prêts à payer 69,6 GHc par campagne agricoles. La demande pour l'assurance a été constaté d'être une corrélation négative avec les montants des primes suggérant qu'il est un bien normal. Une Heckman two-step approach a été utilisé pour estimer les facteurs qui influence la VDP pour l'assurance-récolte. Les résultats empiriques du modèle Probit ont relevé que l'état matrimonial, l'éducation, le type de culture, l'accès aux services de vulgarisation, l'emprunt, l'épargne et la connaissance de l'assurance-récolte influençaient la volonté des agriculteurs d'acheter une assurance. Le montant estimé par les agriculteurs VDP avec le modèle de régression par intervalles a été montré pour être influencé par des variables clés comme l'âge, l'état matrimonial, l'éducation, le type de culture, la taille de la récolte, l'expérience agricole, le revenu, la variation de la météo, l'emprunt, l'épargne, et l'accès aux agents de vulgarisation. L'étude recommande qu'avec des informations adéquates et détaillées, et avec les primes faits abordables, les agriculteurs seront prêts à acheter une assurance. Les produits d'assurance novateurs et les canaux de distribution appropriés sont recommandés d'inciter à la demande pour l'assurance-récolte.

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Abbreviation	
ADVANCE	Agricultural Involvement and Value Chain Enhancement
CV	Contingent Valuation
FAO	Food and Agricultural Organization
GAIP	Ghana Agricultural Insurance Programme
GTZ	Deutsche Gesellschaft fur Technische Zusammenarbeit (German Technical Cooperation)
GSS	Ghana Statistical Service
IFAD	International Fund for Agricultural Development
IFC	International Finance Corporation
ILO	International Labor Organization
IPA	Innovation for Poverty Action
IPCC	Intergovernmental Panel on Climate Change
IPPAC	Innovative Insurance Products for the Adaptation of Climate Change
MoFA	Ministry of Food and Agriculture
NGO	Non-Governmental Organization
SRID	Statistical Research and Information Directorate
USAID	The United States Agency for International Development
WII	Weather-Based Index Insurance
WTP	Willingness to Pay

Chapter 1 INTRODUCTION

1.1 Background

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, price and policy risks which impact farmers' income and welfare (Cervantes-Godoy *et al.,* 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 and most of these risks can't be controlled by the farmers themselves (Baquet *et al.,* 1997). 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).

Inadequate or erratic rainfall and extreme temperatures due to climate change increases the risks faced by farmers, negatively affecting yields of most crops in developing countries (Nelson *et al.,* 2009). Although there has been the introduction of other agricultural interventions such as improved crop varieties and production technologies to increase yield and thus reduce poverty, the impact of climate related risk is still very costly for farmers. The effects of climate risks in developing countries are still prevalent among farming households and most often experienced by poor vulnerable subsistence farmers in rural communities (Aidoo *et al.,* 2014). These farmers live from the income earned from harvest to harvest and therefore do not have the ability to absorb large production losses in any one year.

Production risks have always presented a challenge to farmers whose livelihoods are closely linked to the environment. They put a constraint on their income generation and loan acquisition due to the resulting high risk profile. 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. Some of these strategies can be ex-ante or ex-post strategies such as selling of assets, borrowing or engaging in the production of lower risk but lower return crop varieties (Cervantes-Godoy *et al.,* 2013). These coping strategies may not be adequate to manage large levels of risk (Kurukulasuriya *et al.,* 2006). As a result risk and risk management strategies of smallholder farmers in developing countries might in fact push them into poverty.

It is worth noting that Ghana has put in place some programs to assist smallholder farmers and reduce their vulnerability to risk. Interventions such as rural and agricultural finance program and smallholder input supply and marketing project have been implemented to provide farmers with access to financial services, improved technologies and also link them to marketing channels (IFAD, 2015).

Nevertheless, there are projections suggesting that changes in climate will result in increasing global temperatures in addition to frequent and extreme weather events (IPCC, 2007), with Ghana in particular predicted to experience rainfall reductions and higher temperatures (Stutley, 2010). This is predicted to have an impact on agricultural production and poverty reduction in SSA by the end of the 21st century (Obeng and Assan, 2009). The development of a risk management tool which will enable poor vulnerable farmers adapt to these changes is therefore essential. One adaptation mechanism that has the potential to enable smallholder farmers to manage climate related risks in developing countries is agricultural (crop) insurance (Kwadzo *et al,* 2013; Sundar and Ramakrishnan, 2013).

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 and Bogale, 2014). Ghana has recently introduced its first crop insurance scheme to assist farmers. Crop insurance aids in protecting farmers by transferring the risk to another entity by indemnification with several types of schemes being implemented in different countries. It protects farmers against uncertainties and cushions them from shocks when there is a bad year, improving

their risk bearing capacity. It reduces the impact of crop damage and losses as well as providing them with income and production smoothing (ILO, 2011).

Limiting risks by improving the financial market will encourage farmers to invest. This has high returns especially since the average farmer in Ghana does not invest in crop production (Karlan *et al.*, 2013). Crop insurance is a means of potentially elevating poverty traps and poverty reduction (Morduch, 2010) while improving the food security of farmers which ultimately impacts positively on the welfare of farm households (Nicola, 2010). These benefits suggest that crop insurance is a tool that can reduce the impact of production risk.

Crop insurance although new to Ghana, has the potential of lifting smallholder farmers out of poverty and making commercial farmers more competitive (Modern Ghana, 2011). Theoretically and empirically, agricultural insurance has evolved as a robust way to help farmers manage risks and also improve their production and welfare. Three studies supporting these findings were authored by Karlan *et al.,* (2010), Nicola (2012) and Radermacher and Roth (2014) although most of these were not undertaken in Ghana. The urgent need to provide farmers with an efficient way to manage production risk can be addressed with the implementation of an agricultural insurance scheme. It is therefore necessary that the majority of farmers are provided with the opportunity to purchase this product. However, it is important to know if there is a demand for crop insurance among farmers.

1.2 Problem Statement

Agriculture is the mainstay in Ghana and smallholder farmers are the central component of food production. Unfortunately, the agricultural sector in Ghana is plagued with a number of constraints that make it difficult for the country to realize its full benefits. Agriculture's susceptibility to a variety of risks is not restricted to Ghanaian farmers since farming in most countries is generally exposed to environmental conditions. Thus the associated risks require proper management (Abebe and Bogale, 2014). In the case of production risks, farmers do not only suffer from crop failure but this can lead to a reduction or even elimination of their entire livelihood. In response to climatic and production shocks, poor farming households have managed risk through informal mechanisms for years now but without much success.

Better decisions can be made by farmers if more productive innovations such as forward contract, futures and options contracts, early warning systems to drought and flood, microfinance institutions, credit and savings cooperatives are made available to them. They could gain by adopting these technologies, which will improve their productivity and increase their income, if some of the production risk can be reduced. This calls for the implementation of an appropriate risk management strategy of which crop insurance appears to be an attractive tool. Ex-ante micro insurance has gained attention over the years with various developing countries exploiting the market due to unpredictable climate conditions and frequency of production risks that impose significant challenges for sustainable production (Gulseven, 2014; Lui *et al.,* 2015; Long *et al.,* 2014).

Realizing this situation, the government of Ghana and other stakeholders in the agricultural and insurance sectors developed, piloted and implemented a crop insurance scheme in 2011. This was an attempt to enable poor, and thus vulnerable, farmers to have access to a market-based risk management strategy in order to deal with risks that are beyond their control (Stutley, 2010; GAIP, 2013). Nevertheless, improving the risk coping strategies adopted by farmers is heavily dependent on farmers' willingness to adopt these strategies. The country's new focus appears to be on yield risk with the intention of relying on insurance based products as one of the solutions to risk. But it's not clear if this new focus and product will lead to increased adoption of the scheme. This is due to the fact that developing a new risk management scheme does not imply that farmers are interested in participating and purchasing the product. The risk portfolio of farmers and their demand options need to be studied and understood with emphasis on the characteristics that influence producers' decision to join or otherwise.

The commercially based insurance product is offered particularly to farmers in the three Northern regions of Ghana with plans for expansion to be made in the near future. Insurance is therefore available to a relatively small proportion of farmers in the country. But before structures are put in place for expansion of the scheme, farmers' interest in crop insurance as a risk management tool and their readiness to pay for the contract is an open question which this study is designed to address. One major constraint with the implementation and expansion of an intervention such as crop insurance in Ghana is the absence of knowledge on farmers' willingness to participate in the scheme and pay for insurance contracts. To achieve the goal of the government and other

stakeholders in a reasonable time frame, understanding smallholders' participation and willingness to pay for such a management tool is vital.

The crop insurance scheme that is available in Ghana at the present time, and thus is the insurance under consideration for this research project, is the weather index insurance primarily designed for maize and three other crops. Owing to the different risks faced by crop and livestock farmers in the country, a large group do not have agricultural insurance coverage at this time. Insurance is thus new to farmers in Ghana and attempts are being made to increase its adoption therefore, necessitating research to investigate its demand. The process of marketing crop insurance could be accelerated if there was information on the willingness of farmers to pay for insurance which would provide an indication as to their perception of its worth.

1.3 Research Questions

The study seeks to assess the demand for crop insurance by cereal farmers in Ghana. The following questions are therefore addressed by the study;

1) What are the main coping strategies adopted by farmers in the study area?
2) Are farmers interested in the crop insurance scheme and which of them will be early entrants into the insurance market?
3) How much are farmers willing to pay for the insurance scheme and what are the factors influencing the various premium amounts?

1.4 Objectives of the Study

The main objective of the study is to analyze the willingness to pay for crop insurance by cereal farmers in the Eastern region of Ghana.

The specific objectives of the study are as follows:

1) Delineate the profile characteristics and production risks of cereal farmers.
2) Identify the informal coping strategies adopted by farmers in the study area and the factors influencing the various strategies used.
3) Determine the factors influencing farmers' willingness to purchase crop insurance and the amount they are willing to pay as a premium.

1.5 Relevance of Study

The sustainability of the insurance program depends on purchase and repurchase year after year. This study addresses one essential part of it. Most studies determine the factors influencing farmers' willingness to pay for agricultural insurance with few going further to estimate the average premiums farmers are willing to pay. Although this study also analyzes this objective it goes further to determine the factors influencing the amount farmers are willing to pay for insurance. This study provides an understanding of farm households' need for insurance, aiding the enhancement of the product and the search for the best ways to protect farmers' livelihood from risk and the effect of ineffective risk management. It also contributes to a large literature on risk management, technology adoption and has implications for agricultural insurance nationally. It can be vital for policy action and the design of insurance contracts by providing information on the demand for insurance, the prospective farmers and locations to target as well as the various risks farmers desire to protect themselves against.

Analyzing the demand of the insurance program is necessary for sustainable market development (Radermacher and Roth, 2014) aiding in the allocation of resources to best improve the expansion of the program. The study provides decision makers with evidence-based tools to serve as a guide to effectively promote and develop demand oriented crop insurance products that meets farmers' needs. Also incisive conclusions can be made on agricultural insurance as a policy tool to manage risk and achieve improved welfare. The results of this research will hopefully provide information that will complement the literature on the negative effects of risk on the livelihoods of poor households by inferring from farmers the demand for an alternative risk coping mechanism.

1.6 Organization of the Study

The study is structured into five chapters. The background of the study, problem statement, research objectives and the relevance of the study are presented in the first Chapter. Chapter 2 provides a review of literature on production risk and risk management, studies on agricultural insurance and empirical studies on willingness to pay for agricultural insurance. Details of the conceptual framework as well as the theoretical and empirical models for analyzing each objective are provided in Chapter 3 after a description of the study area and the sampling and data collection technique are outlined. Chapter 4 presents the empirical findings of the research and discussions of the results. Chapter 5 concludes by summarizing the findings and providing policy implications.

Chapter 2 LITERATURE REVIEW

Introduction

Chapter 2 is divided into different sections after the basic definitions and concepts are outlined. Section 1 reviews risks, informal coping strategies and their effects. Section 2 addresses the rationale behind agricultural insurance as well as a general overview comprising the types, benefits, constraints and demand for insurance. Section 3 presents empirical literature on the willingness to adopt and pay for agricultural insurance with emphasis on the methodology and outcome of the studies. The final section covers agricultural insurance in other countries and crop insurance in Ghana.

2.1 Basic definitions and concepts

Household: A group of people who live together under one roof, who are involved in the same housekeeping arrangements and eat from the same pot (GSS, 2013).

Willingness to participate and Willingness to pay: Willingness to participate is the act of making a choice to join an agricultural insurance program and this may be because the products appear useful or attractive but this does not imply that there is a willingness to pay for it. These are independent decisions. This could be due to the lack of trust in the insurance company or the inability to pay for the product. Willingness to pay is the amount of money an individual is willing to use in purchasing the product given a number of characteristics such as income, risk perception and level of risk aversion (Ali, 2013).

Risk and Uncertainty: Uncertainty is a state where the probability of possible event is not known. 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 and Bogale, 2014). Agricultural production is characterized with uncertainty and risk due to uncontrollable factors, such as weather, which plays an essential role.

Premium: It is the monetary sum paid by the insured to the insurers for a period of insurance provided by the policy. The policy is a formal document expressing the terms and conditions of the insurance contract between the insurer and the insured (Chen, 2011).

Indemnity: An amount payable by the insurer to the insured usually in the form of cash or replacement or repairs in the event of a loss. The amount is calculated based on the extent of the insured economic loss which is usually set before the loss and does not exceed the actual value of the matter insured (Chen, 2011).

Moral Hazard: It is a situation where there is a change in the decisions taken by the insured person leading to a less optimal decision after purchasing insurance, increasing the loss accompanying the insured event. Usually this behavior increases the probability of the insured event occurring (Chen, 2011). It is a position farmers tend to take by changing their production behavior after being insured by increasing risk.

Adverse selection: This is a situation where there is a high probability of people who are more likely to be affected by the insured loss participating in the insurance program. Risk-averse farmers purchase insurance and less risk averse farmers do not. This occurs due to information asymmetry between insurers and the insured and disadvantageous to the insurers because there will always be losses and claims/indemnity payments that needs to be paid (Chen, 2011).

2.2 Risks and Risk Management Strategy

2.2.1 Hazards and Risks

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 and Bogale, 2014). Idiosyncratic risks faced by farmers and groups of farmers range from individual illness, personal hazards such as death, disability and loss of non-farm income sources to rainfall variability and limited access to credit and insurance markets. There are also region-wide hazards such as floods, drought, pests and price fluctuations. (Cervaret-Godoy, 2013). These region wide hazards can be grouped into output risks and price risks (Mishra, 1996). In relation to agricultural risk, a single event or risks usually leads to several events accompanied with severe impacts. Natural hazards often lead to a reduction in or total loss of food produced for consumption and

income earned from the harvest. Ghana faces two major hazards namely drought and floods with unfavorable effects on production and lives (Agyemang, 2010).

In the BrongAhafo region of Ghana, Kwadzo *et al.,* (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 and Assan, 2009). This is evident among farmers in this area who often face the risk of crop failure and death of livestock thereby losing income (Machetta, 2011). These risks cause variability in yield, farm household income and result in welfare losses.

2.2.2 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). Some of these livelihood struggles are not always unanticipated especially because farmers can sometimes predict the occurrence of an event and make decisions and choices with respect to those predictions. Risk management can be differentiated from risk coping strategies in the sense that the former focuses on ex-ante strategies to reduce risk through income smoothing while the latter focuses on ex-post strategies through consumption smoothing (Davies, 1993).

As economic and climatic environments change, farmers adopt and create new innovations to assist in coping with these changes. They develop new informal ways and also alter adopted innovations to suit their environments and enable them to cope with the food security and poverty issues resulting from weather and related production changes (Rej and Waters-Bayer, 2001). 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 (Trang 2013; Cervaret- Godoy, 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, food processing, livestock husbandry and hunting, migration, selling of assets and reliance on external help from family and 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 (Machetta, 2011; Kwadzo *et al.,* 2013; Obeng and Assan, 2009; Akinola, 2014). Selling of assets fetch low prices in the event where the shock affects the whole community and therefore do not gain much. 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, donkey which are essential for land preparation or breeding stock which constitute household's wealth (Toulmin, 1987).

2.2.3 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 *et al.,* 2009) enhancing survival chances in a limited way and therefore are not a sustainable tool for managing risk. Cole *et al.,* (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. It hinders farmers from being able to move from subsistence to commercial farming due to the lack of interest in investing in a new technology (Jones *et al.,* 2009). They usually lose income as a result of their portfolio choices especially underinvestment which affects household income and consumption (Hess and 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 and Mahul, 2007). These measures can lead to a

decrease in growth and investment and further translate into reduced household welfare (Jones *et al*., 2009). 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 their effect. Forgoing consumption or reducing food and non-food expenses such as health and education reduces the value of human capital (Hoddinott, 2006; Radermacher and Roth, 2014). There could even be severe cases of morbidity and mortality (Janzen and 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. This demonstrates that with an appropriate risk management tool such as crop insurance, farmers are likely to be better off (gain welfare benefits) than they are currently.

2.3 Overview of Agricultural Insurance

2.3.1 Agricultural (Crop) Insurance

The concept underlying agricultural insurance is no different from that of other forms of insurance except it is specific to agriculture just as insurance may be solely for health or property. Adams (1995) defined insurance as a signed contract between two parties involving an exchange in the form of a premium from one party to another party who is responsible for paying a fixed amount to the other party when an unpredicted event occurs. It works by exchanging a small amount of money regularly paid for a large irregular yet unforeseen loss likely to occur (Kwadzo *et al.,* 2013). In this case money is paid by farmers and other agricultural stakeholders to an insurance agency. Insurance does not reduce the probability of an event occurring or the uncertainty associated with it but decreases the effect of an event on the financial standing of the individual (Danso-Abbeam *et al.,* 2014). Agricultural insurance provides farmers with a means of financing losses when hit by a shock, helping farmers and other stakeholders to manage the impact of shocks more efficiently (Nnadi *et al.,* 2013).

Agricultural insurance generally lowers risk faced by farmers by compensating them for damages, thus allowing them to increase the level of investment and income (Nahvi *et al.,* 2014). A household which has a large potential to lose income and assets due to risk with very limited chances of recovery has the highest probability of taking insurance (Brown and Churchill, 1999). Crop insurance can be categorized into two major groups namely the indemnity based insurance

and the index based insurance. The indemnity based insurance is made up of the multi-peril crop insurance, named peril and yield insurance. Other types of crop insurance are the price, income and revenue insurance which covers fluctuation in prices, yield, cost of production and farm revenue respectively. The index based insurance is made up of the area yield index, area revenue and indirect index insurance.

2.3.2 Indemnity based insurance

Indemnity based insurance (traditional) focuses on the actual loss of the farmer and claim payments are made in respect to the loss. The loss is assessed from visitation to the farm by the agent and the corresponding indemnity is calculated. Insurance coverage depends on a specific classification which could be a named peril where insurance covers only one peril or the Multi-peril crop insurance (MPCI) where a number of perils are covered. The different perils could span floods, droughts, pests and therefore could be bundled together to form one policy. MPCI is a traditional insurance scheme which covers all perils affecting production with the exception of specific perils not indicated in the insurance contract. Indemnity based insurance can also be available for livestock and aquaculture. The sum insured is based on either the production cost or the expected crop revenue (Tsikirayi, *et al.,* 2013).

Crop insurance is constrained mainly with covering covariate losses. These losses cover a large region as a result of droughts or flood and are usually severe. Traditional insurance is notably plagued with a number of challenges which the index based insurance tackles (Aidoo *et al.,* 2014). Indemnity based insurance has associated with it problems of moral hazard, adverse selection, high transaction and administration costs which are the result of an endeavor to address the problem of moral hazard, adverse selection, gathering information and sorting out valid losses. (Binswanger-Mkhize, 2012; Jones *et al.,* 2009; Barnett and Mahul, 2007). These challenges are evident from available qualitative and quantitative studies, and they have led to its failure in most countries, developing and developed even with earlier schemes being practiced in the US and Canada (Kwadzo *et al*., 2013).

2.3.3 Index based insurance

Index insurance is basically dependent on using triggers as referees for actual crop loss and loss assessments. A trigger is an index threshold below or above, which payments start (Cole *et al.,* 2012). Triggers can be made in various ways either by using data on rainfall amounts as in Malawi

or by using crop yield data in a locality or district as in Peru or the level of vegetation and or livestock mortality rate as in Mongolia (ILO, 2011). Payment of claims is not based on actual individual farm losses as in the case for the traditional multi-peril schemes but on deviations from the index such as rain, humidity or soil moisture. Area yield insurance is a type of insurance that measures as an index the crop yield in a particular geographical area.

Indirect index insurance on the other hand uses external indices such as weather derivatives, satellite or vegetation. Farm visitations are therefore not required under this scheme. Payouts are made when crop yield falls below a predetermined trigger (Cole *et al.,* 2012). It is determined by assessing yield on a few farms (a block) as a representation of the geographical area. It is constrained with unreliable insufficient historical yield data and possible manipulation of current area yield (Aidoo *et al.,* 2014). Weather index based contracts are designed for specific perils such as drought, flood or windstorms which are usually recorded at local weather stations. Loss assessments are dependent mainly on data gathered from weather stations. Payouts are made when the index, such as rainfall amounts, falls below or rises above a defined threshold expected to result in crop loss.

The crop insurance scheme in Ghana is a weather (drought) index insurance and covers only crop loss resulting from the lack of or excessive rainfall. The contract usually covers one complete crop cycle. The amount insured by the contract is estimated using the potential crop revenue, production cost as in Ghana or the difference between the two. In computing the index, rainfall data from a weather station is gathered and used as a representation of the climatic forecast in the area where the crop being insured is produced. Weather indices often used are daily average or cumulative annual temperature, precipitation, wind, and cooling and heating degree days (Goovaerto, 1998).

2.3.4 How the index based insurance scheme operates

Muamba and Ulimwengu (2010) provide a general overview of how the insurance contract works following an example of USAID (2006). This example demonstrates how an index insurance, covering rainfall risk that begins payments when the seasonal rainfall is 100mm or less, works. There is usually a threshold and limited rainfall volume level which is required for indemnification. The threshold is the accumulated rainfall volume that would trigger an indemnity payment while the limit is the minimum level at which the maximum payment will be received. Premiums are sold at the actuarially fair price where the agency sells a voucher that enables the farmer to receive

a predetermined indemnity payment depending on the rainfall volume. Indemnity payments start and increase until the index reaches the limit when the threshold is reached. This example assumes the policy holder pays for $50,000 in liability.

• Index variable: total accumulated rainfall measured at a local weather station for the cropping season

• Threshold: 100 millimeters of rainfall

• Limit: 50 millimeters of rainfall

• Liability purchased by the policyholder: $50,000

• Payment rate: = (threshold − actual value)/ (threshold − limit)

= (100 − actual value)/ (100 − 50)

• Indemnity payment: The payment rate multiplied by the total liability:

= (100 − actual)/ (100 − 50) × $50,000

Table 1: Rainfall insurance payout scenarios

Total rainfall (mm)	Indemnity payments
110	0. The threshold has not been reached
80	(100 − 80)/(100 − 50) × 50,000 = $20,000
50	(100 − 50)/(100 − 50) × 50,000 = $50,000 (maximum payment)
40	$50,000. 50-millimeter limit has been exceeded.

Source: Muamba and Ulimwengu (2010), pp.3

Crop insurance schemes can be provided at three different levels which are the micro, intermediate and macro levels. At the farm level, the index insurance provides protection financially against unfavorable weather variability that affects farmers' production. At the intermediate level, banks package loans with an index insurance together with an interest rate that includes the premium paid for by the bank to the insurer. In the event of a drought, the farmer pays a portion of the loan due which reduces default. Lastly at the macro level, a nationwide production index for the country could serve as the base for an index insurance policy (Hess and Syroka, 2005).

2.3.5 Advantages of index based products

Index based contracts are uniformly structured (IFC, 2011) and easy to administer with less administration and operating cost. This is advantageous to both insurers and farmers because the cost of having to verify damages on farmers plots is much lower leading to less administrative and

operational cost and affordable premiums (Ali, 2013). It can easily be bundled with other financial services such as credit or production inputs. Index based insurance cannot be influenced by an external factor (Tsikirayi, *et al.,* 2013) since historical data is used and farmers or other individuals cannot alter information to suit themselves. This feature also makes payouts quicker to administer. Insured farmers therefore receive the same indemnity per unit of insured crop since the same per unit premium rates are charged (IFC, 2011). These characteristics distinguish it from the indemnity based insurance by addressing its major problems.

2.3.6 Challenges with index based products

One major challenge with index based insurance is that the farmer may face a loss on his farm but may not receive payments depending on the point at which the index falls. There may be losses but no payouts or payouts are made when there are no losses. This problem is referred to as the basis risk and it depends on how the farmer's yield co-varies with the index. This is attributable to little or no correlation between the individual loss and the insurance trigger causing the indemnity payout to vary (ILO, 2011). It can be due to the design of the contract, data used in structuring the product, or a difference between the farm and the weather station (spatial basis risk). It can also be temporal (due to timing of the event) or loss specific where loss is poorly related to index (Jones *et al*., 2011). In the presence of basis risk, individuals are not fully insured and may need other informal strategies to cover other losses. Limited and quality data for calculating the appropriate indemnity payments corresponding to a loss is a drawback with index based insurance (Boucher and Mullally, 2010). The challenge of high startup costs for the scheme is a hurdle for most countries.

2.3.7 Benefits of agricultural insurance

Agricultural insurance induces farmers to put more value on farm production thereby increasing the willingness to invest in more high yielding yet risky technologies (Radermacher and Roth, 2014) due to the guaranteed compensation when there is a loss (Mani *et al.,* 2012). Agricultural insurance, by serving as a source of collateral for farmers, enhances a farmer's access to credit (Ajieh, 2010) as observed in countries like India and the Philippines (Stutley, 2010) which is useful not only for financing production costs but to satisfy other monetary constraints. In Ghana, rainfall insurance led to increased fertilizer purchase, the allocation of acres of land for insured crops and an increased production of the insured crops (Karlan *et al.,* 2013). Insured crop farmers examined

by Varadan and Kumar (2012) practiced less crop diversification thereby absorbing production risk efficiently.

Ke *et al*., (2014) showed that farmers' utility and welfare was higher with crop insurance than without crop insurance. Nicola and Hill (2012) revealed that weather insurance contributed to welfare improvements by increasing household consumption particularly among poor households which do not purchase much. Janzen and Carter (2013) provide evidence not only to the presence of poverty traps but also the potential of insurance as a tool to help households escape from it. Studies show indications of insurance increasing the use of high return agricultural inputs, securing farm income, limited use of costly coping strategies, use of market oriented outlets, decrease in indebtedness and take up of loans (Olubiyo *et al.,* 2009; De Bock and Ontiveros, 2013; Carriquiry and Osgood, 2006; Hill and Viceisa, 2010). There is therefore evidence of the potential impact of insurance on risk taking, investment, agricultural productivity and an increase in income.

2.4 Willingness to pay (WTP) for Agricultural insurance

Stutley (2010) reported the findings of a crop insurance feasibility study conducted in Ghana which revealed that farmers' demand for crop insurance coverage for drought and flood was mainly for pineapple, maize and rice crops. Factors that are likely to influence these farmers WTP for insurance can be determined from a number of studies outlined in this section. The section contains findings by authors whose results corroborate one another and although based on different countries, they do not contrast with behaviors observed among Ghanaian farmers. Nonetheless, very few studies on WTP for insurance have been undertaken so far in Ghana.

Hill *et al*., (2013) studied the willingness to pay for weather insurance by households in Ethiopia with the availability of panel data. The study revealed that the rich, educated, proactive and younger farmers were more likely to purchase insurance. Basis risk and high priced contracts were likely to reduce the likelihood of purchase. Probit results showed that households with some degree of self-insurance and those people who were less risk averse were less likely to purchase insurance. Among many reasons for the lack of willingness to purchase insurance, the most stated response was the inability to purchase even although there is a desire to buy the product.

A survey of demand factors of rainfall index based insurance in four different regions in Morocco showed that farmers in lower rainfall variability regions preferred insurance contracts that were

less expensive with lower trigger values than farmers in high rainfall variability regions (McCarthy, 2003). Apart from the influence of climatic factors, past experience with a natural disaster increases the awareness of Chinese farmers in a flood prone province about the necessity of insurance and thereby significantly affected farmers' interest in insurance. Empirical results from Logit, Tobit and Interval censored regression models showed that, farmers' interest in and willingness to pay for rainfall index insurance is significantly and positively influenced by household assets, their expectation of flood in the future and the amount of loan involved (Liu *et al*., 2015).

Employing the Probit model, Ali (2013) identified household income, land and asset holdings, type of crop produced, access to credit and extension services as the factors influencing the WTP for index insurance in Pakistan. These variables were found to have a positive and significant effect on farmers' willingness to pay. The index based insurance was also found to have an impact on food and cash crop acreage since farmers' willingness to increase these crop acreages were significantly positive. Farmers involved in non-farm activities who therefore earned extra income were found to be less willing to pay for insurance. Abebe and Bogale, (2014) revealed in a study among farmers in the Central Rift Valley of Ethiopia that the income of the household and ownership of a radio have positive and significant effects on the willingness to pay for insurance. Off-farm income and age on the other hand were found to have negative and significant influences on WTP. The ownership of a radio probably represents a farmer's physical asset holding and also indicates farmers' value and need for information. Responses to the contingent valuation single bounded dichotomous choice model revealed that the majority of farmers who were interested in purchasing insurance were willing to pay less than 100 birr as premium.

Long *et al*., (2013) pointed out that households' total value of assets, size of field and ability to borrow had positive correlations with farmers' willingness to buy insurance. The study found a negative correlation between households' expenditure per capita as well as coping strategies and their willingness to participate and pay for insurance. Results from the Ordinary Least Square (OLS) estimation in the Heckman procedure showed that the amounts farmers are willing to pay are less among poor households, farmers with large expenditures and surprisingly those highly exposed to severe natural disasters because they see it as a usual incident. The authors mentioned the motive for the use of the specified model as being applied to avoid selection bias.

Gulseven (2014) surveyed 200 farmers in Anatolian basin, Turkey, to determine their willingness to pay for index insurance. The study performed a twofold empirical analysis, first using the logit model to determine farmers' demand for insurance and a contingent valuation open ended and take it or leave it type questions to derive farmers' WTP amounts. Education and farm income were shown to have positive and significant effects on farmers WTP but household size and union membership were not found to be statistically significant. The authors found strong evidence that, demand is downward sloping with farmers' willingness to pay declining sharply with lower coverage levels. Results show that most farmers were willing to pay a reasonable amount for full coverage and also found greater willingness to pay for fruit insurance than crop insurance.

Falola *et al*., (2013) examined the willingness of cocoa farmers to take agricultural insurance in Nigeria. Out of the sampled farmers, 39% of the sample with knowledge of the product were willing to participate. The main variables used in the study included age, farm income, education, access to extension services, farm income and household size. These variables were revealed to influence the willingness to take agricultural insurance according to the explanatory model developed using the probit model. Farm income was surprisingly found to have a negative effect by the reason that, farmers with more income are likely to adopt other risk management strategies. This suggests that with inadequate knowledge about crop insurance and lack of trust in insurance companies, high income farmers are rather willing to adopt other strategies even if at a high cost than purchasing insurance. The average amount respondent were willing to pay per hectare was estimated to be N11087.5/ha ($69.85) with majority willing to pay between N5000 – N10000.

Sarris *et al*., (2006) identified a number of factors influencing Tanzanian households' willingness to pay for rainfall insurance. These were noted as higher incomes, safety mechanisms adopted, exposure to rainfall decline and exposure to markets mostly for farmers sensitive to income instability. Abdullah *et al*., (2014) maintained in a study that crop insurance is one of the important instruments which can aid in mitigating production risk caused by climate change. The authors therefore examined the willingness of paddy farmers in Malaysia to pay for crop insurance. With a surveyed sample of 286 farmers, the bidding game elicitation technique was employed to estimate farmers' mean willingness to pay. Farmers were willing to pay about 8% of the total coverage per crop season. Results from the logit regression model revealed that farmers' WTP is

affected positively by attendance to paddy production courses, farming experience and farm size but negatively by age.

Kwadzo *et al*., (2013) reported the WTP for crop insurance among farmers in the Kintampo north municipality of Ghana who were predominantly male, married with more than 50% having no formal education. Educated farmers were assumed to have exposure to more sophisticated risk management practices since they were not observed to have interest in the scheme. Moreover, farmers with large families above the mean average of 4.6 persons were likely to purchase insurance since with a large number of people depending on the farm, the responsibility to reduce potential losses is high. Farmers who were likely to purchase were willing to pay a maximum premium of GHC 80 for insurance coverage.

Aidoo *et al*., (2014) indicated the need for a risk management strategy in the Sunyani Municipality of Ghana because 79% of the surveyed farmers indicated crop production as their source of income. Respondents were characterized as being income poor by the authors who found that their per capita per day wage was less than a dollar. The study found out that 76% of farmers were willing to adopt crop insurance which shows a demand for the product. While tenants and sharecroppers were willing to adopt, farmers with security of their own land were not. Farmers were willing to pay between GHC 19 and GHC 24 annually and this was explained to be influenced positively by their farm income and negatively by farm size possibly due to higher total cost of premiums.

Danso-Abbeam *et al*., (2014), studied cocoa farmers' willingness to pay for farm insurance in the Western region of Ghana using the dichotomous contingent valuation approach. The independent double hurdle model was employed in addressing the objective with the assumption that a farmer's interest and the amount they are willing to pay for an insurance policy are independent. Results from the probit regression revealed that married farmers with a lot of responsibility and educated farmers who are more likely to understand the scheme were willing to participate. Other factors such as farm size and income, land ownership and farming experience, most of which conform to other studies were the determining factors of the willingness to insure. Particular to this crop, the age of the cocoa farm was observed to have a significantly positive correlation with the willingness to participate in the scheme. The truncated regression results revealed similar findings on determinants of farmers' WTP amounts.

Nimoh *et al*., (2011) examined the interest of cocoa farmers and insurance companies in farm insurance in Sekyere West Municipal of Ghana. Results showed 32% of respondents obtained knowledge about farm insurance mostly from radio broadcasts and extension agents. The study revealed that most farmers (67%) were willing to pay less than 11% of their annual incomes as premiums while 12% were willing to pay between 11-20% of their income. Reasons indicated by farmers as influencing their desire to insure were protection against uncertainties and to serve as a buffer. The lack of awareness and income were found to deter farmers from insuring their crops. Although insurance companies indicated their interest in farm insurance, only 30% were willing to carry it out due to the high risk involved. This outcome is likely to be a barrier to agricultural insurance establishment and expansion in Ghana.

Ramasubramanian (2012) made a clear distinction between the willingness to join (WTJ) and the willingness to pay for rainfall index insurance among farmers in India with the justification that some farmers will be willing to participate but may not be willing to pay for a number of reasons. The study employed a Heckman selection model for analyses with a first stage ordered probit and a second stage interval regression. A higher percentage of farmers were observed to be willing to join the micro insurance scheme and this was highly dependent on wealth. Insurance literacy and basis risk were positively correlated with WTJ, with the latter being contradictory to most studies. Consistent with other literature, risk averse and younger individuals were less likely to join. Using an open ended interactive bidding process, the amount farmers' were willing to pay was found to be driven by the availability of other coping mechanisms, acres planted and risk attitudes.

Sundar and Ramakrishnan (2013) based on a survey of farm households in the Pondicherry district, India found that 56% of the farmers who were predominantly older, educated and owned lands, were aware of crop insurance. The majority obtained information about the scheme mostly from banks and financial institutions. Most farmers did not feel crop insurance suited them because of the high premium and therefore concluded that they were for farmers with large farm sizes and higher incomes. A number of farmers were willing to purchase only if certain conditions such as reduction in premium and smaller insurance sizes for small farms are met.

Kouame and Komenan (2012) analyzed the WTP for minimum price insurance among cocoa farmers in Cote D'Ivoire. More than 50% of the sampled farmers showed positive interest in the insurance scheme. Authors used the contingent valuation method and the Heckman two-stage

model in soliciting farmers' willingness to pay and determining the factors influencing the demand for insurance respectively. The independent variables used in the regression analysis were farm size, farm experience, education and livestock ownership. The effect of these variables were tested both for farmers' interest and WTP amounts all of which had a positive correlation with farmers' interest and WTP. Risk aversion greatly inhibits demand for insurance. Farmers' were willing to pay between 8% and 13% of the underlying contract value as premium.

In summary, the literature review shows that most researchers have determined farmers' willingness to pay for different types of agricultural insurance schemes. However, only a few studies have distinguished between the determinants of farmers' willingness to purchase insurance and the amount farmers are willing to pay as premiums. Most WTP studies undertaken in Ghana are centered on cocoa farmers although other farmers face similar climate related production risks. In Ghana, crop insurance studies have been centered on farmers in the Northern regions due to its susceptibility to drought with less attention given to farmers in other drought prone areas. This study therefore provides an insight into WTP by cereal farmers in one of the largest maize producing regions which is also susceptible to drought.

2.5 Agricultural insurance schemes in different countries

The Philippines has been offering the multi-peril crop insurance for three decades and it is subsidized by the government covering rice and corn. The insurance covers losses for natural calamity, pests and diseases. The delivery channel is through the agricultural credit offered by the Land Bank of the Philippines and is compulsory for borrowers (Bangsal, 2012). Nigeria has an agricultural insurance scheme (NAIS) which is accessible to all groups of farmers and covers perils such as fire, drought, windstorm, pests and diseases. The sum insured under the NAIS is computed using the expected revenue from anticipated harvest (Nnadi *et al*., 2013). NAIS is linked to credit and loan scheme providers and is therefore mandatory for farmers who take loans from these providers (Aina and Omunona, 2012). The national agricultural insurance scheme in India provides coverage for a wide scope and range of crops as well as farmers. The scheme is compulsory for farmers who have loans and is voluntary for others. Weather based insurance has been adopted in this country since 2003 in a number of states and is subsidized by the government (Kiran and Umesh, 2012).

Malawi has a three-phase drought index insurance which was designed in 2005. The product is bundled with credit, improved seeds and fertilizer. The insurance agency pays out the rest of the loan while the farmer pays a fraction in case of a drought (World Bank, 2011). Mexico has been running quite a successful index insurance program through a Ministry of Agriculture program. In comparison with other scheme delivery in different countries, the insurance contracts in Mexico are offered to state governments as directly to individuals (Cole *et al*., 2012).

The largest of the weather index insurance schemes in Kenya is the Kilimo Salama maize rainfall index product. This product was developed by the Syngenta foundation for sustainable agriculture in conjunction with a mobile network (Safaricom) in Kenya. A mobile application is made which tracks weather forecasts and sends short messages to farmers. The mobile service also provides the opportunity for farmers to call in and receive information from call agents on insurance, agronomic advice and direction to sales outlet. The product is also bundled with the sale of inputs through a network of registered agricultural input dealers who receive premiums and pay them to the insurance company. More importantly, the input dealers are close to farming communities and also offer advice on farm management, credit and spraying practices. The scheme is supported financially through investment in weather stations and 50% premium subsidies by Syngenta (World Bank, 2011).

It can be observed that most of the countries have their agricultural insurance schemes bundled with other products. Linking insurance with other products has been observed as a feature of successful crop insurance schemes in different countries because it enhances the demand for the insurance product (IFC, 2011). The link between agricultural insurance and other financial services especially credit is very essential because it motivates and provides farmers with the capital to purchase insurance premiums, reducing the lack of incentive in using scarce resources to finance risk coverage. This approach has the advantage of potentially reaching a large number of clients because it provides a package with more than one product and reduces the cost incurred by the insurance company to market the product since there is already a clientele base (Stutley, 2010).

2.6 Crop Insurance in Ghana

Crop insurance schemes are relatively undocumented in Ghana. Most of the information in this section about crop insurance in Ghana was gathered from an interview with a director at the Ghana Agricultural Insurance Program (GAIP) which is the institution responsible for

underwriting and providing Weather index insurance (WII) to farmers. Other information, although scarce was gathered from articles in newspapers, GAIP and other agriculture related websites. Insurance companies in Ghana are mainly devoted to offering life, burglary, health, auto and fire insurance but have not offered crop insurance commercially on a large scale until recently.

The non-existence of crop insurance in the country could be due to the lack of insurance companies willing to underwrite the product. These companies are also less motivated to enter into such insurance due to the high risk and administrative cost related to insuring small scale farmers and the lack of networks in rural areas to serve farmers (Stutley, 2010). Commercial farms noted for taking insurance generally have their machinery and buildings insured (Anaman, 1988). There have been a couple of insurance pilot projects in Ghana, Danso-Abbeam *et al.,* (2014) established that Ghana Cocoa Board has started a crop price insurance pilot project to protect cocoa farmers against production uncertainties.

Innovation for Poverty Action (IPA) studied the demand for a rainfall insurance product in 2009 by maize farmers in some selected areas in the Northern region of Ghana. The "Takayua" rainfall insurance was developed covering losses caused by excess or deficit rainfall. This experimental project offered insurance for free in the first year and at varied prices (GHc 1 to GHc 14) in the second year. A strong demand for insurance was observed among farmers in the second year (2010) with majority of farmers willing to pay GHc 1 for an acre. The authors indicated that a follow up survey was to be conducted in 2011 (Karlan et *al.,* 2010).

2.6.1 Ghana's Weather Index Insurance

To deal with the threatening influence of climate change on agriculture in Ghana a project was implemented in December 2009 by German International Co- Operation (GTZ) dubbed Innovative Insurance for Adaptation to Climate Change (IPPAC). The goal of the project was to assist Ghana tackle climate risk by developing an insurance product which is economically sustainable and demanded by farmers. Different institutions partnered to make this possible. GTZ played its role by promoting the network between Ghanaian insurance companies with international reinsurers. GAIP was developed under the initiative of IPPAC to design and implement the insurance scheme and supported in its early stages by SwissRe as the re-insurer. The Ministry of Food and Agriculture (MOFA) also provided training opportunities for stakeholders on designing crop insurance schemes as a measure to boost food security in the country (Feed the Future, 2012).

GAIP provided the first agricultural insurance during the pilot stages and is currently the only agency providing crop insurance to farmers in Ghana since it was launched in June 2011. The crop insurance scheme covered selected regions namely the Northern region, Upper East and Upper West regions of Ghana and the type of scheme that was provided and currently being provided is the weather index insurance specifically the drought index insurance (GAIP, 2013). The three Northern regions were selected at the very onset because they constitute the food basket of the country and are drought prone. In May 2011, the weather index insurance product with coverage of more than 3,000 smallholder maize farmers in the Northern region was developed and sold. A number of towns where farmers are being offered weather insurance in the three Northern regions are Tamale, Savalegu Nangton and Yendi in the Northern region, Bolgatanga, Bohu and Navrongo and in the Upper West region and Wa, Tung and Fumsi in the Upper East region.

2.6.2 Structure of the Scheme

The insurance contracts provided to farmers is handled by two NGO's namely IPA and ADVANCE (Ghana News Agency, 2012). GAIP offered drought index insurance which covered only maize crops but has currently expanded its coverage to include soybean, millet, sorghum, and rice. The agricultural insurance system is a public and private system with Ghana Re and SIC insurance Co. Ltd as Re-insurance agencies (GAIP, 2013). The government is not involved in the implementation and management of the scheme as in other countries, such as Canada and USA, where insurance is mainly subsidized (Mahul and Stutley, 2010). The Government contributes only through policy formulation and therefore this program is not subsidized by the government. The GTZ funded the program until June 2014 when funding was terminated. USAID on the other hand also supports the program but it does this through ADVANCE which is a Feed the Future initiative.

2.6.3 Delivery of the scheme

GAIP has two clientele bases, one at the micro-level and the other at the meso-level. At the micro-level, insurance is offered to farmers who are able to purchase directly from GAIP to protect them against weather variability. At the meso-level, input suppliers and financial institutions are offered insurance to help protect their portfolios. There are a number of banks namely the Stanbic Bank and the Agricultural Development Bank as well as farmer organizations involved. Insurance policies are sold directly to farmers and currently not through banks, input suppliers with plans of

involving the insurance companies in the near future. Insurance is therefore not bundled with any other product such as credit or farm inputs such as seeds or fertilizer. It is also not offered through any intermediary channel such as mobile operators as in Malawi and Kenya (World Bank, 2011) or as suggested by Karlan *et al.,* (2013) as an innovative approach for Ghana.

2.6.4 Insurance Scheme Operation

Currently measures are being put in place to implement drought index insurance in three other regions apart from Northern Ghana namely Eastern, Ashanti and Brong-Ahafo region for maize and soya crops. The scheme is dependent on automated weather stations that record climatic data on rainfall, temperature, wind and relative humidity. Data on rainfall amount are used to determine what occurs on the farm and to determine claim payments. If recorded rainfall falls below a specified level, it signifies an expected crop loss on the field and payouts are made.

In determining premiums, the cost of farm production is calculated by an external agent and an agro-meteorologist with GAIP and not the farmers themselves. The scheme works by farmers paying one tenth of the cost of their farm production to GAIP (local agents) at the beginning of the farming season and receive a payout when there is no rain (less than 2.5mm of rain) for 12 consecutive dry days. On average farmers pay 10% of whatever amount is spent on an acre of land which is calculated for each crop. For instance, if the cost of production is GHC100 for an acre, farmers pay 10 GH cedi as the insurance premium and receive 100 GH cedi (sum insured) as a payment when everything is lost. Payouts are made within 30 days after the cropping season to insured farmers within 20km radius of a selected weather station. Farmers have access to insurance through local agents who come to the villages at the beginning of the cropping season to create awareness and register farmers willing to insure their crops.

2.6.5 Other types of insurance products

In 2013, procedures were being put in place to create a pilot project for an area yield index insurance. Commercial farms with 20 hectares and above presently have the opportunity to purchase multi-peril insurance for crops such as maize, soya, rice and citrus. Perils that are covered under the scheme are drought, excessive rainfall, fire, windstorm and uncontrollable pests and diseases. GAIP intends to offer new products to cover various commercial crops and livestock, a windstorm cover for banana and long term plans to cover cocoa, forestry and fisheries.

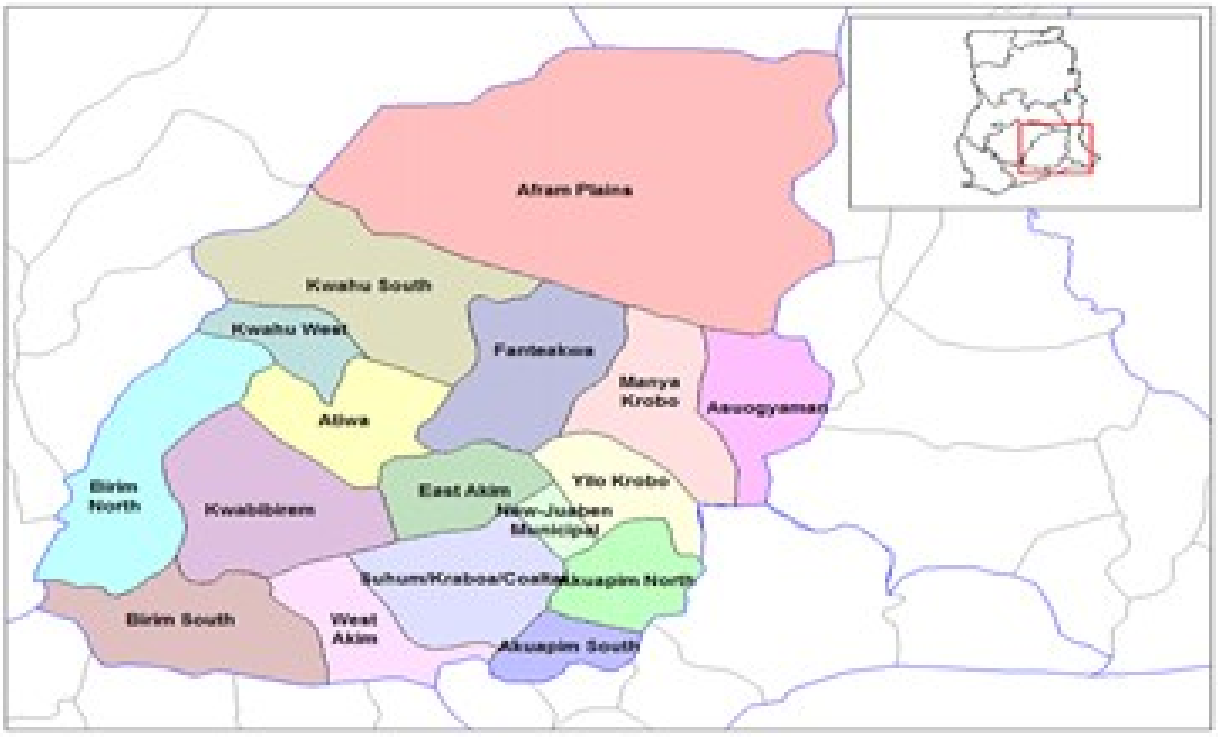
Chapter 3 METHODOLOGY

This chapter provides a brief description of the study area, sampling and data collection methods. The conceptual framework and the willingness to pay elicitation methods are also presented. The theoretical and empirical approaches employed for data analysis are specified in the concluding section of the chapter.

3.1 The study area

The Eastern region is located in the southern part of the country with a total population of 2,596,013 as of 2010 (MOFA, 2011). The region lies between latitudes 6º and 7º North and between longitudes 1º30' West and 0º30' East. The region shares boundaries with the Greater Accra region to the south and has a land mass of 19,320km^2. Agriculture is an important sector in this region of which crop production accounts for 70-85% of agricultural output. It has an agricultural labor force of 531,635 comprising of 51.4% males and 48.6% females (MOFA, 2011).

Figure 1: Map showing the study area (Eastern region)



This region is in the transitional agro-ecological zone with an annual mean rainfall of 1300 mm (Stutley, 2010). Rainfall is distributed within the months of March to July (major season) and September to November (minor season). Agricultural lands in the Eastern region are mainly used for food crops such as maize, rice, yam, plantain and cassava, cash crops and livestock production. 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. Total area under informal and formal irrigation is 596.16 hectares and 116 hectares in the Eastern region (MOFA, 2011).

3.2 Data description

A rural survey data gathered by Munkaila (2015) was used to estimate the willingness of farmers to pay for crop insurance in Ghana. The data being used for the study has already been used for a similar study, nevertheless, the objectives for this current study are different as well as the methodology employed for analysis of the objectives. In analyzing the factors influencing farmers' WTP, the logit model was used for analyzes by the researcher but this study employs the Heckman two-stage model. The effect of a number of objectives are tested in this study to determine their influence on farmers' WTP that were not included in the previous study. This study will produce findings that are different from the results obtained by the previously named researcher and therefore they will complement the other study. The study area was selected through a multistage sampling technique with priority given to the Eastern region due to it susceptibility to drought and also because it is a major cereal producing region. Steps were taken to purposively sample five (5) districts and twenty-one (21) communities for the survey. The criteria used for the selection of the districts was the production levels of cereals in each district, with those districts having high production levels being chosen for the survey (Munkaila, 2015).

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, risk management mechanisms as well as farmers' perception and awareness of insurance. Farmers' willingness to

purchase insurance and the premium they were willing to pay were also investigated. The total sample size for this study is 208 cereal farmers in the Eastern region.

3.3 Conceptual framework

Crop insurance is very new to farmers and therefore this would be an entirely new product to farmers especially since very few, if any, have dealt with a formal financial institution before. A decision to purchase crop insurance will be similar to making a decision on purchasing a new technology. The utility maximization assumption is the basis for the adoption of a technology. The expected utility of adopting a technology should be larger than non-adoption for a farmer to adopt a technology. The utility or satisfaction obtained from adoption is not observed but rather the decision to adopt can be (Aidoo *et al.,* 2014). In this study the farmer makes the decision to purchase crop insurance as a risk management tool. This decision is taken when there are risks and uncertainties associated with the probability of an event. On the other hand, adoption is dependent on certain elements which are social, natural and economic factors influencing demand for a product. As suggested by Akter *et al.,* (2008), a theoretical model representing farmers' decision to participate in crop insurance can be expressed as

$$P_i = f\ (R_i, Y_i, C_i, D_i)$$

Where P_i represents the decision to participate in insurance by an individual farmer *i* which is expected to be influenced by risk (R_i), income (Y_i), credit (C_i) and demographic and socio-economic characteristics (D_i).

Risk is expected to affect the demand for insurance because farmers who are exposed to risk would want to avoid it by adopting risk protective measures either before or after its occurrence. According to the framework by Akter *et al.,* (2008), risk can be categorized as an exogenous or endogenous risk exposure. In this study, the exogenous risk is represented by the occurrence of a production risk and measured as the different causes of crop failure identified. The endogenous risk is represented as the ex-ante and ex-post strategies adoption which is measured as the risk management strategies used by farmers. It is therefore hypothesized that exposure to risk will have a positive influence on insurance participation while the use of a risk management strategy will have a negative influence on farmers' participation and WTP (amount) for insurance.

Income and access to credit is an indication of farmers' ability to pay the insurance premium and thus directly influences insurance demand. It is expected that insurance purchase will be positively influenced by income and access to credit. A wide range of demographic characteristics have varied effects on the demand for insurance such as education which is expected to have a positive effect on demand. The description of other explanatory variables are discussed in detail in a later section.

3.3.1 Utility Framework[1]

With the farmers' knowledge of the various production risks, alternative coping strategies, cost and expected benefits of insurance as a risk management strategy and the availability of resources, an informed purchasing decision will be made. The farmers' utility function for purchasing or not purchasing insurance will be different.

Assuming a farmer's initial level of welfare yielded the indirect utility function expressed as $V = (y, p^0, q^0; Z)$.Where y is income, p^0 is the price vector for the goods vector q^0 without insurance and Z is vector of socio-economic and demographic characteristics. Goods in this model represent the different risk management strategies already utilized by the farmer. A farmer is willing to pay to obtain q^1 with insurance if

$$V\ (y - WTP, p^0, q^1; Z)\ \geq V\ (y, p^0, q^0; Z) \text{ ---------- (1)}$$

q^1 has one more good than q^0 which is insurance, the price p^0 remains the same since insurance is paid by WTP. Therefore a farmer will prefer to subscribe and pay for crop insurance when the utility derived from insurance is greater than without insurance and vice versa, i.e. $V_i \geq V$.

The utility of not purchasing insurance is represented by V_i^0 where X_{iq} is a vector for an individual farmer's characteristics and Y_i denotes income. This can be written as

$$V_i^0 = a_{i0} + a_q X_{iq} + a_Y Y_i + e_i$$

[1]. The theoretical framework was suggested by Long *et al.,* (2013) and Wan (2014)

a_0 is a constant term, a_Y and a_q are unknown coefficients and e_i is the stochastic term. If WTP_i is a random term representing farmer i's WTP for premium then the utility for purchasing crop insurance V_i^1 is shown as

$$V_i^1 = a'_{i0} + a'_q X_{iq} + a_Y (Y_i - WTP_i) + e_i$$

WTP_i for the farmer can be expressed as

$$WTP_1 = \beta X_i + e_i$$

Where βX is the difference between the deterministic part of utilities representing a farmer's decision to purchase crop insurance or not. With the assumption that WTP^* represents the true WTP for farmer i,

$$WTP_i^* = \beta X_i' + u_i \; and \; WTP^*/x \sim Normal\,(\beta X', \sigma^2)$$

$\sigma^2 = Var(WTP^*/x)$ and assumed not to depend on x while u_i is a mean zero constant variance error term.

3.4 Theoretical and Analytical Techniques

Literature on WTP indicates various ways of estimating an individual's willingness to pay. These techniques are not different from those applied in empirical studies on WTP for insurance. The first approach is the revealed preference technique where the production patterns and other behaviors of the farmer are analyzed to determine the value of the good. The second approach is by estimating the indirect market premium by combining household and market variables. It is an indirect approach where the level of utility of farmers with and without insurance is compared and the amount they would be willing to pay from moving from a state without insurance to one with insurance is estimated (Chantarat *et al*., 2009).

The third approach is the contingent valuation (CV) method which is widely utilized and this takes the form of describing the situation or product to the individual and asking them directly what he/she is willing to pay for it. This valuation method is a stated preference approach and it is mostly used in analyzing environmental goods which are not sold or bought in the marketplace. The technique is generally employed to determine the value of a hypothetical or non-existing market good. This method is applied in this study since agricultural insurance has a similar feature and is

also observed to be widely used in WTP studies involving agricultural insurance as described by Wan (2014) and Kouame and Komenan (2012). This method is most preferred because of its flexibility in valuing a diverse range of non-market goods and is very helpful in situations where no market data are available (Abebe and Bogale, 2014).

3.4.1 Elicitation Methods

There are different elicitation methods applied when using this technique, one of which is asking open-ended questions on WTP. This is less often used due to the possibility of having missing values as a result of the difficulty in answering the payment question or having understated or overstated values. There is also the take it or leave it approach, where the individual decides to accept a product presented at a predetermined price or not accept it. It is considered to be a practical approach to gathering information on the preference of consumers. Another technique is the payment card method where prices are presented to the respondent to help them make a choice. It has the likelihood of restricting the responses of the individual to the bids on the card. Also there is the iterative bidding approach, where individuals are questioned on their willingness to pay an initial amount after which the amount is increased or decreased depending on the initial response. The maximum amount with a positive response is taken as the WTP for the product (Ramasubramanian, 2012; Abdullah *et al*., 2014).

There is the dichotomous choice approach where the individual is asked if he would pay a certain amount for the product. This technique can be a single or double bounded dichotomous choice where a simple one time yes or no response is required for the bid mentioned in the single bounded choice but a follow up bid is presented to the respondent after the initial response in the double dichotomous case (Abdullah *et al.,* 2014). Double bounded models are quite complex because the second question depends on the first question and therefore respondents are likely to treat the responses for both questions differently (Haab and McConnell, 2002). On the other hand, it is simple for respondents to make a choice and it has the advantage of limiting the possibility of receiving calculated responses (Abebe and Bogale, 2014). Researchers have used a combination of the various elicitation techniques in soliciting WTP information to reduce biases and improve efficiency.

3.5 Willingness to pay (WTP) technique employed in the study

A farm household survey was used to elicit farmers' willingness to pay for crop insurance after a detailed description of how a weather index insurance contract works was presented to them. The index based crop insurance scheme was described to farmers in as much details as possible focusing more intently on how it works. The basic principle was communicated to farmers as an insurance guaranteeing a minimum payout for a specific peril over a predetermined period of time in exchange for a charge known as the premium. Production risk and its effect as well as information on the difference between purchasing or not purchasing the product in terms of the costs and benefits were presented to farmers. The product description is that of the crop insurance (weather index insurance) package provided by GAIP. The premium rate for this product is charged at 10% of the total production cost of the farmer, which has been estimated for maize and rice farmers as GHc 57.40 and GHc 180.00 respectively (Munkaila, 2015).

By employing the contingent valuation dichotomous choice technique, farmers were asked if they were interested in the product after which questions on farmers' willingness to pay for different amounts for the contract were presented only to farmers who indicated their interest in the insurance scheme. Farmers responded to their willingness to pay for these bids (amounts) with a Yes or No indicating their willingness or lack of willingness to pay for insurance.

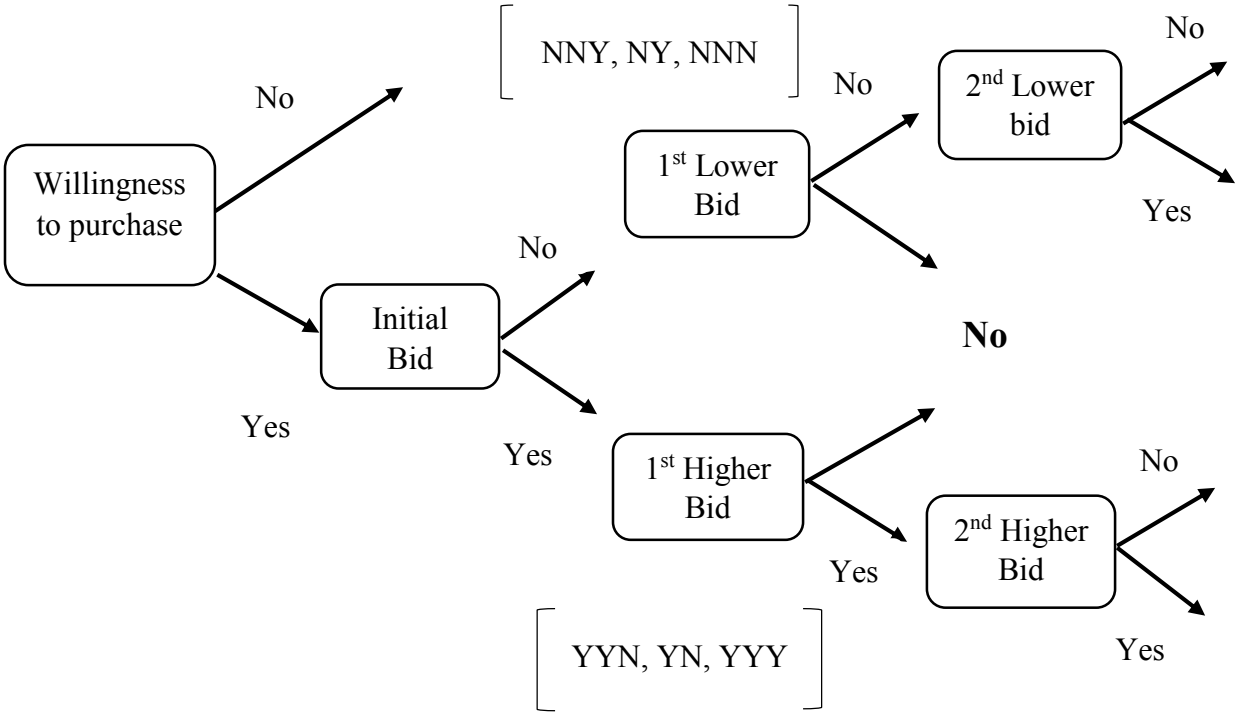
All farmers were asked if they were willing to pay a 10% premium rate (since this is the current premium rate used by GAIP), a follow up question depending on their response to the initial bid. If they answered Yes a higher bid was again offered to the farmer while if they responded No, a lower one was offered to the farmer. The maximum bid with a positive response is taken as the amount the farmer was willing to pay. Three consecutive bids were therefore presented to farmers with the third bid contingent on the second bid and that bid being contingent on the first bid. The initial bid was set at GHc 57.40 and GHc 180.00 (i.e. 10% premium rate) for maize and rice respectively per Ha for a maximum pay-out of GHc 574.00 and GHc 1,800.00 per Ha for the respective crops. The follow up lower and upper bids are shown in the table below as well as the possible responses of the bidding game.

Table 2: Bid design

Bid levels	Premium rate	Maize	Rice
2nd Lower bid	2%	11.48	36.00
1st Lower bid	5%	28.70	90.00
Initial bid (GAIP rate)	10%	54.40	180.00
1st Higher bid	12%	68.88	216.80
2nd Higher bid	15%	86.10	270.00

Source: Mukaila (2015)

Figure 2: Possible responses to the bidding game



3.6 Justification for Methodological Framework

Many analytical methods have been applied in WTP studies depending on the focus of the study. A majority of WTP studies have estimated the factors influencing the farmer's decision to purchase with very few authors going further to estimate the factors influencing the amount that farmers are willing to pay. Most studies that concentrated only on the farmers' purchasing decision have been studied by means of Logit or Probit models (Gallenstein *et al.,* 2015; Hill *et al.,* 2013; Abdullah *et*

al., 2014). A number of authors have analyzed the factors influencing the amount farmers' are willing to pay by addressing farmers' participation and the amount they are willing to pay independently or with a two-stage model.

Aidoo *et al.,* (2014) employed Logit and multivariate models in evaluating the factors influencing crop farmers' willingness to purchase insurance and the characteristics affecting the amount farmers were willing to pay. Ali (2013) noted the distinction between farmers' willingness to participate and willingness to pay for crop insurance. The Probit and Poisson models were thus independently used to determine factors influencing both decisions. Danso-Abbeam *et al.,* (2014) employed the independent double hurdle in analyzing the WTP for cocoa price insurance. The authors used a binary Probit model for farmers' participation decision and a censored truncated regression for estimating farmers' WTP amount. The dependent variable estimated in the model was measured as the last bid value offered to farmers. A first-stage binomial Logit and a second-stage two-limit Tobit was conducted by Liu *et al.,* (2015) to estimate Chinese farmers' interest in and WTP for rainfall index insurance.

The Heckman two-stage model has been used in different research areas for data analysis by various authors. The authors expected that not all the sampled farmers' would be interested in the insurance scheme which could lead to sample selectivity bias since farmers' without interest in the scheme will be excluded from the analysis. The model is thus used to account for the problem of sample selection bias with the authors maintaining that the Heckman two-stage model successfully deals with the problem and therefore assures the estimation of consistent regression results. Basarir *et al.,* (2009) analyzed farmers' willingness to pay for high quality irrigation water using the Tobit and Heckman sample selection model. The Tobit was employed to address the zero amounts reported by farmers who were not willing to pay after conducting a first-stage Probit analysis. Kuoame and Komenan (2012) modelled the WTP for price insurance using the Heckman two-stage approach. The probability of participating in the scheme and the WTP premium were both estimated with the Probit model.

Ramasubramanian (2012) observed that farmers' WTP for the weather index insurance scheme fell in the category of farmers being definitely willing to join the plan. The first stage of the model was estimated using the ordered Probit model and an interval regression for the second stage to study the factors that affect the amount farmers were willing to pay. The interval regression is used

in the study due to the lower and upper bounds of WTP bids. Chantarat *et al.,* (2009) modelled farmers' demand for livestock insurance as a sequential decision on the choice of coverage and WTP amount conditional on the coverage of choice. The Heckman two-stage approach with an ordered Probit and a likelihood-bounded model in the first and second stage of the model respectively was used. Long *et al.,* (2013) carried out two estimations to determine farmers' interest and decision to buy crop insurance with or without a subsidy by applying the Heckman approach. The first and second stage of the Heckman model was estimated with the Probit model and Ordinary Least Square technique respectively.

3.6.1 Rationale underlying a two stage model

A farmer's decision to participate in an insurance scheme and the amount they are willing to pay are two different decisions which are likely to be affected by different factors. The two-stage model enables this type of analysis to be conducted by allowing different factors to influence each decision process. One advantage with the Heckman two-stage model is that it not only acknowledges the distinction in a farmer's participation and WTP decisions but also proposes the possibility of a sample selection problem resulting from the exclusion of unwilling participants from the analysis. The exclusion of a sub set of the entire sample leads to the use of a non-random data for statistical analysis which could produce distorted results. This is an econometric problem that is likely to occur and is therefore should be anticipated. The model doesn't only assume the occurrence of this eminent problem but also incorporates a technique into the analysis to deal with the problem and is therefore widely used (Winship and Mare, 1992). This study investigated the major factors affecting farmers' willingness to participate in crop insurance programs and the actual amount they are willing to pay based on a Probit model and an Interval regression model in a Heckman two-stage procedure.

3.7 Analytical tools and framework

Data obtained were analyzed using descriptive statistics, multinomial logit regression model and the Heckman two-stage technique. The descriptive statistics employed involve 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. T-tests were used to test for the difference in descriptive characteristics between farmers. The data

entry and preliminary analysis were conducted using the Statistical Package for Social Scientist (SPSS) and STATA package was used for model analyses.

3.7.1 Choice of explanatory variables and their description

The theoretical expectations of the variables used in the analysis for the determinants of farmers' willingness to purchase insurance in terms of their signs are addressed in this section. These variables were chosen based on a literature review.

Gender of household head: This is a dummy variable which is equal to 1 if the household head is a male and 0 if otherwise. Male household heads are more likely to adopt insurance because they are more exposed to new information and have greater access to extension services (Wan, 2014). A positive effect on the willingness to purchase insurance is hypothesized in this study.

Age of household head: This is a continuous variable measured in numbers, as the age increases the probability to adopt decreases. The reason being that older farmers would want to use old methods because they are risk averse to new innovation. Age and the willingness to purchase insurance is hypothesized to be negatively related. (Falola *et al.,* 2013).

Education: This is a continuous variable measured in terms of years of schooling. Farmers' with a higher level of education are better able to acquire and understand information presented on crop insurance. Education is expected to have a positive influence on willingness to purchase insurance (Falola *et al.,* 2013).

Farm size: This is a categorical variable with three different groups where 1 represents farmers who belong to a particular group (small, medium and large farm size) and 0 if otherwise. Farmers with large farm sizes may purchase insurance because they are likely to have more income. Also they experience higher levels of economic welfare and have a higher probability to insure to increase productivity. The study hypothesizes a positive effect on farmers' willingness to purchase insurance (Nimoh *et al.,* 2011).

Access to credit: It is a dummy variable representing 1 if the household has credit and 0 otherwise. Farmers' access to credit is hypothesized to affect the willingness to purchase insurance positively (Abdumalik *et al.,* 2013) with the idea being that access to credit serves as an indication of farmers' ability to purchase insurance.

Access to extension: It is a dummy variable representing 1 if the farmer has access to extension services and 0 if otherwise. Extension services provide farmers with information on agricultural

practices and technologies. Farmers with access to extension services are likely to have information about crop insurance as a risk management strategy. This is expected to have a positive effect on the willingness to purchase insurance (Falola *et al.,* 2013)

Marital Status: It is a dummy variable representing 1 if the household head is married and zero if otherwise. It is expected that married individuals are more likely to purchase insurance since they have more responsibilities and would want to reduce the family's vulnerability to risk. The study hypothesizes a positive influence on farmers' willingness to purchase insurance (Danso-Abbeam *et al.,* 2014).

Household size: This is a continuous variable, measured in numbers. The larger the household size, the higher the responsibility to reduce potential farm losses especially because rural households depend on farming as the major source of livelihood. This is expected to have a positive effect on farmers' willingness to purchase insurance (Kwadzo *et al.,* 2013).

Other Occupation: This indicates whether the farmer has other occupations apart from farming and therefore is measured as a dummy variable. Farmers could have a source of security from receiving income from other sources and are therefore less likely to insure their farms. This has a negative a priori expected sign associated with the willingness to purchase insurance (Nimoh *et al.,* 2011).

Household income: This is a continuous variable measured by the total amount of money earned by the household. It is expected that households with more income will be willing to purchase insurance due to their ability to pay for the premium. Income is therefore expected to have a positive effect on the willingness to purchase insurance (Sundar and Ramakrishan, 2013) as well as on the amount farmers are willing to pay for insurance.

Ownership of radio: This a dummy variable measured as 1 if the farmer owns a radio and 0 if otherwise. Farmers with a radio can access information on various agricultural subjects more easily than those without a radio. This increases their awareness about issues such as crop insurance and enhances their ability to understand the information provided. The study hypothesizes a positive relationship between ownership of a radio and insurance purchase (Abebe and Bogale, 2014).

Farming experience: This is a continuous variable measured as number of years involved in farming. Farmers with more years in farming are likely to be more confident and content with their current management practices and will be less likely to adopt a new strategy. This has a negative

a priori expected sign associated with the willingness to purchase insurance (Danso-Abbeam *et al.,* 2014).

Major occupation: This is a dummy variable measured as 1 if the farmer engaged in agriculture as a major occupation and 0 if otherwise. It is included in the regression analysis to determine if farmers who engaged mainly in agriculture are more willing to purchase insurance since they are more likely to protect their investments against uncertainties and production risks. The study hypothesized a positive relation between major occupation and the willingness to purchase insurance.

Crop type: This is measured as a dummy variable, 1 if the respondent cultivates maize and 0 if rice. Different crops are faced with different perils since they respond differently to weather conditions and other infestations and yield well in different soil conditions. It is expected that the rice farmers will be more willing to purchase crop insurance since they rely heavily on rainfall/moisture.

Experience with risks: This a dummy variable measured as 1 if the major risk faced by the farmer is weather variations and 0 if otherwise. Farmers' experience with risks instills the consciousness of the changes in climate, the threatening weather conditions and its effect thereby, providing an indication of the necessity of an effective risk management tool. Therefore farmers who indicated weather variability as the major risk are expected to be more willing to purchase insurance (Long *et al*., 2013).

Awareness of insurance: This is a dummy variable measured as 1 if the farmer is aware of crop insurance and 0 if not. The lack of information is a major constraint to the purchase of insurance. Farmers who are aware of insurance have much more information than farmers who do not. A positive relationship is thus expected between the awareness of insurance and the willingness to purchase insurance (Danso-Abbeam *et al.,* 2014).

Coping Strategy: Farmers existing coping strategies are likely to deter farmers from purchasing crop insurance. A negative relationship between the adoption of coping strategies and the willingness to purchase insurance is hypothesized in this study (Ramasubramanian, 2012). This is due to the fact farmers may be more inclined to relying on past coping strategies to deal with shocks rather than adopting new strategies.

3.8 Model of Specification

3.8.1 Objective One: Delineate the profile characteristics of farmers

This overview was presented to have a comprehensive understanding of the households' characteristics and welfare. The econometric estimation of WTP gives a general idea of the factors influencing a farmer's decision but doesn't provide a careful description of the household's livelihood in the study area. Analyses include a description of socioeconomic characteristics, farm characteristics, production risks, employment sources and income. It then concludes with a comparison of farmers who were willing and those who were not willing to purchase crop insurance. Knowledge of a household's sources of employment and income provides some insight into the welfare of farmers. Analyzes of the production risks present an understanding of the risk environment of the farmer. This objective was addressed with the use of descriptive statistics, percentages, frequency, tables, charts and t-tests.

3.8.2 Objective 2: Factors influencing the coping strategies used by farmers

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 (Demurger *et al.,* 2010; Adepoju and Obayelu*,* 2013). 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.

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

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).

$$\pi_{ij} = \frac{exp\{\eta_{ij}\}}{\sum_{k=1}^{J} exp\{\eta_{ik}\}} = \text{Prob}(Y_i = j) = \frac{e^{\beta'_j x_i}}{\sum_{k=0}^{j} e^{\beta'_j x_i}} \qquad \text{j=0,1,…….,J}$$

Hypothesis

Farmers with large household sizes, small farm sizes and low farm incomes are more likely to indulge in different activities to minimize the effect of risk on their livelihood.

3.8.3 Objective Three: Willingness to pay

3.8.3.1 Percentage of income farmers' are willing to spend on insurance purchase

Purchasing a weather index insurance in itself is a risk not only due to the challenges associated with it such as the basis risk but also because it is setting aside money which could be used to cater for immediate financial needs to purchase insurance which may or may not pay out depending on whether there will be a drought or not. Nevertheless, this group of farmers who are generally rural and poor would still weigh their options being conscious of production risk and its effect as well as their income constraints and take the risk in offering to pay for it. The percentage of income farmers are willing to spend on purchasing insurance was therefore calculated from information gathered on the premium they were willing to pay.

3.8.3.2 Demand Curve

A hypothetical demand curve for insurance was derived to determine the relationship between the demand for insurance and the price premium farmers were willing to pay. A survey was designed to determine how much farmers were willing to pay for different insurance coverage levels. This was used in deriving a demand function for a range of premium prices. In the derived demand curve, the prices were defined as the various premium rate or insured values and the quantities were defined as percentage of farmers who are willing to pay those prices. A demand curve was derived for different premium rates for the two groups of farmers.

3.8.4 Econometric framework

3.8.4.1 Determinants of willingness to pay (WTP)

Farmers' WTP for index based crop insurance was modeled using the discrete model framework in this study. A two-stage model was employed with the assumption that the farmers' decision to purchase insurance and the amount they are willing to pay are two different and sequential decisions. Therefore, in this model different latent variables were used to model each decision process. Some farmers within the sampled group may make the decision to purchase and at the same time pay for insurance while others will not, possibly leading to sample selection bias. Farmers who are willing to pay for insurance are a subset of the total number of sampled farmers leading to a non-randomly selected sample from the entire set of farmers. Sample selection occurs when a non-random sub sample from the entire population is used for analysis.

Sample selection issues come about when observations selected are not independent of the outcome variable and may lead to biased inferences. Each observation in each stage of the two-stage model has a set of unknowns which can lead to biased estimates if unobservable variables in the first stage are correlated to those in the second stage after the selection is made. This would result in inefficient, inconsistent and biased parameter estimates of the regression model analyzed based only on the sub sample. Factors influencing farmers' participation decisions are likely to determine their WTP amount, assuming the likelihood of some unobserved characteristics influencing both decisions is quite logical. An important consideration in the empirical analysis is that, it is expected that not all households will be interested in crop insurance leading to biased estimates if unwilling households are excluded (Long *et al.,* 2013).

Observations on the amount farmers are willing to pay and their corresponding demographic characteristics are available only for those willing to purchase insurance. Results will therefore represent the influence of factors on farmers WTP amounts conditional on being selected into the population of farmers willing to pay for insurance (Bushway *et al.,* 2007). The problem of sample selectivity bias influences the WTP variable but will not be observed for the whole sample. This is because not all the observations will be captured in the analysis. Ruling out farmers who are not willing to pay, the data becomes censored and the sum of residuals is no longer zero as expected. To draw conclusions on the entire population of farmers as well as the sub population of farmers from which WTP amounts were solicited, the Heckman two-stage procedure for a continuous decision variable is used. The model assumes that both decisions are made concurrently and therefore the assumption that the error terms of the two equations could be correlated is made. The model was applied to deal with the problem of sample selection bias following Kuoame and Komenan (2012).

The Heckman two-stage model is specified as;

Selection equation

z * (unobserved) $= \gamma' w + u \quad u \sim N(0,1)$ Equation 1 (1st stage)

$z = 1$ if $z^* > 0$

$z = 0$ if $z^* \leq 0$

Regression/ Observation equation

$y = \beta' x + e \quad e \sim N(0, \sigma^2)$ Equation 2 (2nd stage)

y observed only if *z* is equal to 1. The variance of *u* is normalized to 1 because *z** is not observed but only *z* is observed. *u* and *e* are the error terms and are assumed to be bivariate and normally distributed with the γ and β as parameter vectors.

The Heckman two-stage model first estimates the impact of several characteristics on the probability of purchasing crop insurance and additionally analyses the factors influencing the amount farmers are willing to pay. A binary choice probit model was used in estimating the first stage of the model (selection equation), the dependent latent variable is 1 if the farmer is willing to purchase crop insurance and 0 if otherwise. A normal distribution of ε, mean of zero and a variance of σ^2 is assumed with the use of the probit model (Greene, 2002). The model was chosen due to the binary nature of the dependent variable. In the second stage the model analyzed the factors influencing farmers' WTP amounts using the interval regression model.

Farmers WTP amounts were only solicited from those who were willing to pay and therefore the second stage equation was calculated for only this group of farmers (only a selected subset of the Probit model). Sample selection bias is controlled by the Heckman two-stage model and accounted for with the inverse Mills ratio (estimated expected error) which was generated from parameter estimates in the first equation. The inverse Mills ratio (IMR), λ_i, indicates the selectivity problem and is incorporated into the second stage of the model as an additional explanatory variable. The Mills ratio reflects the probability that an observation belongs to a selected sample. It is a procedure to identify and eliminate the selection bias problem by removing the part of the error term that correlates with the explanatory variable.

The higher the Mills ratio, λ_i, the lower the probability of all potential observations being sampled. The lower the Mills ratio, the higher the probability of sampling all potential observations (Jarbi, 2010). If the inverse Mills ratio is not statistically significant in the model, then the sample selectivity bias is not a problem (Kuoame and Komenan, 2012).The problem associated with the inverse Mills ratio not being incorporated into the second stage of the model leads to the probability of violation of the Gauss-Markov assumption and therefore inconsistent regression estimates (Greene, 2002). The estimation equations characterizing the model are shown above and described as follows:

Equation (1) is the participating function where *w* represents the factors influencing WTP for insurance or not. The Mills ratio is determined from this function and used in the second stage as a parameter estimate, regressed on *y*. Equation (2) represents the factors influencing the amount

farmers are willing to pay which is determined by the significance of β. *y is* WTP amount, *x* represents the explanatory variables.

Hypothesis

Willingness to purchase insurance and the amount farmers are willing to pay depends positively on farmers' education and income levels. Risk management strategy adopted by farmers has a negative influence on farmers' willingness to pay for insurance. Farmers who are aware of crop insurance as a risk management strategy are more willing to pay for insurance.

3.8.4.2 Empirical Model

Farmers' willingness to purchase crop insurance was estimated by means of a Probit model using maximum likelihood method based on information on farmers who are willing and not willing to purchase insurance, followed by an Interval regression analysis to estimate premiums farmers are willing to pay.

Probit Model

This regression model has been observed from the literature as the most frequently used in determining the factors influencing the willingness to purchase insurance. The model is suitable for the dichotomous nature of the dependent variable (Mfungwe, 2012). The general Probit model is expressed as follows:

$$Yi^* = \beta_0 + \sum_{i=1}^{n} \beta_n X_i + \mu_i$$

Where Yi^* is a latent variable not observed, a dummy variable defined by Yi is what is observed.
Where Yi is the dichotomous dependent variable expressed as
Yi = 1, if farmer is willing to purchase crop insurance
Yi = 0, if farmer is not willing to purchase crop insurance
βo = is the intercept
ßi = the regression coefficients that explains the probability to farmers willingness to purchase insurance.
Xi = independent variables, it is therefore assumed that ßnXi are normally distributed random variable.

μi = the stochastic error term.

The dependent variable is the willingness to purchase crop insurance. Explanatory variables include socio-economic and farm characteristics specified above.

The coefficients that are estimated from the probit model give only the direction of the relationship between the explanatory variables and the dependent variable. To interpret the relationship in terms of the willingness to purchase or not, the marginal effects were used. The marginal effect for the estimated coefficients is expressed as;

$$\frac{\partial pr(y_i = 1|x_i;\beta)}{\partial x_{ij}} = \frac{e^{x'\beta}}{[1+e^{x'\beta}]^2}.\beta_j$$

After the marginal effects have been estimated following the probit estimation, the next step is to estimate the mills ratio which is incorporated into the WTP model (Interval regression).

$$\lambda_i = \Phi(p + \partial X_i)/\varphi(p + \partial X_i)$$

Where

λi = Mills ratio variable

Xi = the vector of the factors that influence the willingness to participate

Φ = the density function of a standard normal variable

φ = the cumulative distribution function of a standard normal distribution

δ, ρ are parameters of explanatory variables

Interval regression analysis

The interval regression was used to estimate the price premium farmers were willing to pay for crop insurance denoted by WTP_i. Farmers who were willing to pay chose from a range of premium rates which gave an indication of their maximum WTP for the product. In the bidding game each individual provided one of six responses (YYY, YYN, YN, NNY, NNN, NY) to the premium rates offered. Assuming a functional form for WTP specified by Ramasubramanian, (2012) as:

$$WTP_i^* = x_i'\beta + \varepsilon_i \qquad \text{where} \quad \varepsilon_i \sim (0, \sigma^2)$$

x_i is an independent variable, β is a vector of parameter and ε_i is the random error term with mean of zero and variance σ^2. If t^0 is the first bid, t^L is the third lower bid and t^H is the third higher

bid. The WTP_i^* can be defined as follows WTP $\geq t^H$ for yes-yes responses; $t^0 \leq$ WTP $< t^H$ for yes-no responses; $t^L > WTP \geq t^0$ for no-yes responses; WTP $< t^L$ for no-no responses. WTP responses therefore fall in a range with an upper and lower bound, for instance for yes-yes responses, the lower limit is the second higher bid and the upper limit is positive infinity.

For yes-yes-no responses, the lower limit is the first higher bid and the higher limit is the second higher bid and for no-no-no responses the lower limit is zero and the upper limit is the second lower bid. The lower (upper) bound shows the minimum (maximum) premium price the farmers are willing to pay for insurance. Farmers' responses to a sequence of contingent valuation questions enabled the classification of respondents WTP into various premium price intervals (Wu *et al.,* 2011). Since it is possible that the farmers' WTP lies between the bids provided in the bidding game, that is between a lower and upper bound and therefore within an interval, an interval regression model estimated using the maximum likelihood method was employed to analyze farmers WTP.

If L and U are the lower and upper bounds of WTP, the final likelihood function is defined as follows (using the framework in Wu *et al.,* 2011), then the probability of the farmers' premium falling into the range is expressed as:

$$P\ (L \leq WTP_i^* \leq U) = (P \ln(L) - \sum_{j=1}^{n} \beta_j\, x_j \leq \varepsilon_i \leq ln(U) - \sum_{j=1}^{n} \beta_j\, x_j)$$

Assuming the random error term (ε_i) follows a normal distribution with zero mean and variance σ^2 with ϕ being the standard normal distribution function, the WTP now takes the form

$$P\ (L \leq WTP_i^* \leq U) = \phi\left(\frac{\ln(U) - \sum_{j=1}^{n} \beta_j x_j}{\sigma}\right) - \phi\left(\frac{\ln(L) - \sum_{j=1}^{n} \beta_j x_j}{\sigma}\right)$$

Chapter 4 RESULTS AND DISCUSSION

4.0 Introduction

The results of the study are presented and discussed in this chapter. The demographic variables that were hypothesized to influence farmers' willingness to pay (WTP) for insurance are presented in Section 4.1. Section 4.2 identifies the major production risks faced by farmers. The next section investigates the various management strategies farmers have used to address production risk. Section 4.4 analyzes the factors that influence whether or not a farmer would be willing to participate in the crop insurance program. The next section investigates the various individual, institutional and farm characteristics that influence the choice of risk management coping strategy adopted by farmers. Section 4.6 estimates the mean willingness to pay taking into account sampling bias and the factors that influence that amount. Finally, the chapter ends with some policy recommendations.

4.1 Characteristics

The data that was used in this analysis was not originally gathered for this study but for a similar research study by Munkaila (2015). However, permission was granted to use the data set for this present study. A total of 208 respondents were interviewed for the study, out of this sample 110 (52.9%) were willing to purchase crop insurance while 98 (47.1%) were not willing to purchase crop insurance (Munkaila, 2015). Of the total respondents, 74.0% were males while 26.0% were females (Table 3). 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 *et al*., 2014).

The majority of the survey respondents, 161 were married with the rest of the respondents distributed as follows: single 14, divorced 9, widowed 17 and other 7. The majority of the widowed respondents (94.1%) were not willing to purchase insurance. Distribution of households based on their religion shows that a majority of the farmers were Christians (137), 53 of them were Muslims, 14 were traditional and 4 of them had other religions. Among the Christian farmers, 50.4% were willing to purchase crop insurance while 49.6% were not. 62.3% of the Muslims were willing to purchase crop insurance, while 71.4% of farmers in the traditional religions were not (Table 3).

Most of the respondents, 91 had only basic education, 57 had further education and 60 had no formal education. Out of the respondents willing to purchase insurance, 50% had basic education. 70% of individuals with no formal education were not willing to pay for insurance, while 72.5% of secondary educated respondents were willing to pay for insurance. Educated respondents were more willing to purchase insurance compared to uneducated respondents (Table 3). Out of 188 respondents who owned a radio, 104 were willing to purchase crop insurance while 84 were not willing to purchase insurance (Table 3). Of the farmers who did not own a radio, 70.0% were not willing to pay for insurance. All male respondents, except one, owned a radio while 19 out of the 54 female respondents did not own a radio.

Table 3: Difference in socioeconomic characteristics of respondents' willing and not willing to pay for crop insurance

Variable			**Not Willing To Pay**		**Willing to Pay**	
		Number of Respondents	**Number of Respondents**	**(%)**	**Number of Respondents**	**(%)**
Gender	Male	154	62	40.3	92	59.7
	Female	54	36	66.7	18	33.3
Marital Status	Single	14	3	21.4	11	78.6
	Married	161	71	44.1	90	55.9
	Divorced	9	2	22.2	7	77.8
	Widower	17	16	94.1	1	5.9
	Other	7	6	85.7	1	14.3
Religion	Christian	137	68	49.6	69	50.4
	Muslim	53	20	37.7	33	62.3
	Traditional	14	10	71.4	4	28.6
	Other	4	0	0.0	4	100
Education	No formal education	60	42	70.0	18	30.0
	Basic education	91	41	45.1	50	54.9
	Secondary education	40	11	27.5	29	72.5
	Tertiary education	17	4	23.5	13	76.5
Radio Ownership	Owned Radio	188	84	44.7	104	55.3
	Do not Own radio	20	14	70.0	6	30.0

Source: *Field Survey data, 2015*

4.1.1 Household characteristics

A major proportion of the household heads in the sample, 118 respondents were middle aged, that is between the ages of 31and 50 years. 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 (Table 4). The mean age was 46.7 years with a minimum of 25 and a maximum of 78 years. Of the middle age group, 51.7% were willing to purchase insurance. A sizable proportion of the respondents who were younger than 30 (77.8%) and above 50years (51.9%) were willing to purchase insurance. The mean ages for those willing to purchase insurance and not willing to purchase insurance was 45.7 and 47.7 years, respectively.

The majority of the younger farmers had household sizes between 2 and 4 while older farmers (>50yrs) had household sizes between 3 and 15. The middle aged farmers had household sizes between 2 and 10. The mean household size was 5.43. The average family sizes of those willing to pay for insurance and not willing to pay for insurance was 5.44 and 5.41 respectively.

Table 4: Difference in household characteristics of respondents' willing and not willing to pay for insurance

Variable			Not Willing to Pay		Willing to Pay	
		Number of Respondents	Number of Respondents	(%)	Number of Respondents	(%)
Age	≤ 30	9	2	22.2	7	77.8
	< 31- 50	118	57	48.3	61	51.7
	>51	81	39	48.2	42	51.9
Household Size	0 - 3	37	14	37.8	23	62.2
	4 - 6	115	57	49.6	58	50.4
	7 - 10	50	25	50.0	25	50.0
	11 - 15	6	4	66.7	2	33.3
Farming Experience	< 5	5	2	40.0	3	60.0
	5 – 10	55	23	41.8	32	58.2
	11 – 15	60	27	45.0	33	55.0
	16 – 20	40	24	60.0	16	40.0
	21 -30	40	17	42.5	23	57.5
	>30	8	5	62.5	3	37.5

Source: *Field survey data, 2015*

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. The mean farming

experience of the sample was 15.47 years. Thus the farmers in the study area were quite experienced in grain production. Over half of the farmers with 11 to 15 years of experience (55.0%) were unwilling to purchase crop insurance. More than 60.0% of farmers with less than 5 farming experience were willing to pay for insurance (Table 4).

4.1.2 Farm Characteristics

Most of the respondents, 169 out of 208 respondents, had small size farms, 26 respondents had medium size farms and 13 respondents had large size farms (Table 5). 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. Of the small size farm owners, 50.0% were willing to purchase crop insurance. 58.0% and 77.0% of the medium and large size farms owners respectively were willing to pay for insurance.

The majority of the farmers in the study were maize famers; 166 respondents out of 208. The maize farmer group contained 113 males and 53 females. The sample of rice farmers was made up of 41 male headed households and only 1 female household head. Out of the 42 rice farms, 83.3% were small size farms, 14.3% medium size 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. A high percentage of both maize (51.0%) and rice farmers (62.0%) were willing to purchase insurance. Out of the farmers willing to purchase insurance, 76.4% were maize farmers and 23.6% rice farmers.

Table 5: Distribution of farm characteristics according to respondents' willingness to purchase insurance

Variable			Not Willing to Pay		Willing to Pay	
		Number of Respondents	Number of Respondents	(%)	Number of Respondents	(%)
Farm Size	Small Size	169	84	50.0	85	50.0
	Medium Size	26	11	42.0	15	58.0
	Large Size	13	3	23.0	10	77.0
Crop Type	Maize	166	82	49.0	84	51.0
	Rice	42	16	38.0	26	62.0

Source: Field survey data, 2015

4.1.3 Institutions

The institutions in this study were agricultural extension and farmer organizations. Both of these institutions affect a farmer's willingness to purchase crop insurance. Of the sampled farmers, 160 respondents were members of a farmer based organization (FBO), 108 respondents had contact with extension agents while 141 respondents received extension visits by a colleague farmer. Whether or not a respondent was a member of an FBO did not seem to impact whether they purchased insurance. This is similar to whether or not a farmer received an extension visit from a colleague. The area where there seems to be a difference is when the farmer is visited by an extension agent. In this case, when one had a visit from an extension agent, 61.1% of the respondents were willing to purchase insurance, while if there was no visit only 44.0% were willing to purchase insurance (Table 6).

Table 6: Distribution of respondents' institutional characteristics according to insurance purchase

Variable			Not Willing to Pay		Willing to Pay	
		Number of Respondents	Number of Respondents	(%)	Number of Respondents	(%)
FBO membership	No	48	22	45.8	26	54.2
	Yes	160	76	47.5	84	52.5
Extension visit from colleague	No	67	33	49.3	34	50.7
	Yes	141	65	46.1	76	53.9
Extension visit from agent	No	100	56	56.0	44	44.0
	Yes	108	42	38.9	66	61.1

Source: Field survey data, 2015

4.1.4 Economic Welfare

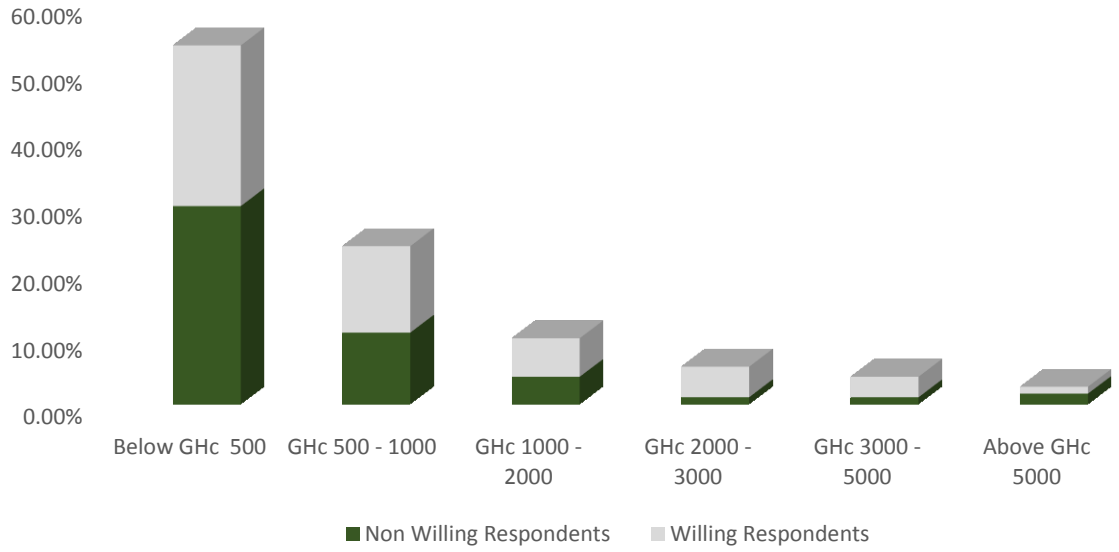
An overview of the household income, farmers' major occupation and access to credit are presented in this section. An analysis of the income levels of individuals who were willing or unwilling to purchase insurance are illustrated below. In addition, information on the type(s) of employment(s) household heads were engaged in; variation between their income levels, if any; and which group of farmers have access to credit is given.

Household Income

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;

approximately 52.6% of the survey sample (Figure 3). Approximately, 25.5% of the farmers earned between 500 and 1,000 GH cedis, 9.1% earned incomes between 1,000 and 2,000 GH cedis and 5.3% of them earned between 2,000 and 3,000 GH cedis. Approximately 6.2% of the farmers earned above 3,000 GH cedis on a monthly basis. Approximately, 44.7% of the farmers with incomes less than 500GH cedi were willing to purchase insurance. Although farmers earning more than 1,000 GH cedis per month did not constitute a major percentage of the total respondents, the majority of these farmers were willing to purchase insurance (65.1%). This suggests that households with higher income levels were more willing to purchase crop insurance.

Figure 3: Respondents' willingness to pay for insurance by household income category



Note: 1 GHC = 0.34 Canadian dollars

The survey results indicate that 67.2% of the non-educated farmers had incomes below 500 GH cedis. Approximately, 36.9% of the educated farmers had income between 500 GH cedis and 2,000 GH cedis while 16.8% had income above 2,000 GHC. For farmers whose income was less than 500 GH cedis per month, 63.0% had small size farms, 26.9% had medium size farms and 7.7% had large size farms (Table 7). A higher percentage of the large size farm owners (46.2%) had incomes above 2,000 GH cedis as compared to small (9.6%) and medium size farm owners (7.6%).

Table 7: 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

Credit

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. 59.3% of the respondents who had access to credit were willing to purchase insurance (Table 8). While 48.8% of the farmers without credit were willing to purchase insurance. This indicates that farmers without access to credit were less willing to purchase insurance.

Table 8: Relationship between respondents' willingness to pay for insurance and their access to credit

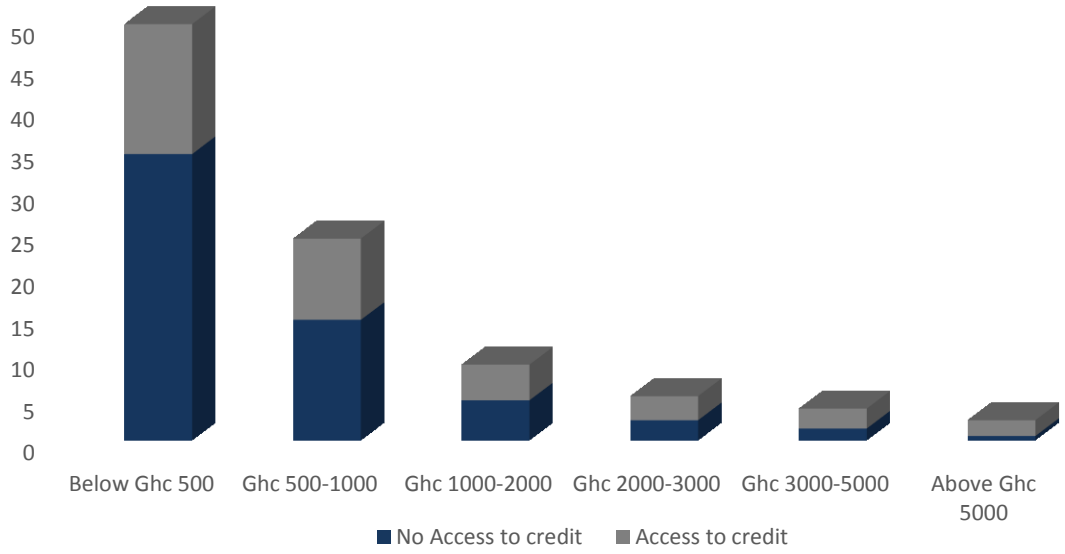
Variable		Not willing to pay		Willing to pay	
	Number of Respondents	Number of Respondents	(%)	Number of Respondents	(%)
Access to credit	81	33	40.7	48	59.3
No access to credit	127	65	51.8	62	48.8

Source: Field survey data, 2015

The majority of the farmers with higher incomes had access to credit as compared to those with lower incomes (Figure 4). 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. 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 4: Respondents' access to credit in relation to their monthly income levels



Occupation

Most of the respondents had other occupations apart from cereal production. 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, 15 were craftsmen, 18 were salaried workers, 6 were retired, 28 worked in the service sector, and 3 engaged in other occupations (Table 9). Farmers with major occupations outside of agriculture engaged in agricultural activities not solely to earn income but to provide food for their family. 53.9% of respondents who engaged in agriculture as their major occupation were willing to purchase insurance. A higher percentage of sales workers (73.7%) and individuals involved in craftsmanship (60.0%) were not willing to insure their crops.

Table 9: Relationship between respondents' willingness to pay and their major occupation

Variable		Not Willing to Pay	Willing to Pay
	Number of Respondents	(%)	(%)
Agriculture	115	46.1	53.9
Sales	23	73.7	26.1
Craftsmanship	15	60.0	40.0
Salaried worker	18	22.2	77.8
Retired	6	33.3	66.7
Services	28	42.9	57.1
Other	3	33.3	66.7

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. 62.3% of the respondents who indicated their awareness of climate change were willing to purchase insurance while 71.9% of the farmers unaware of climate change were not willing to purchase. Also 52.0% of the farmers experiencing crop failure were willing to purchase insurance (Table 10).

Table 10: Awareness of climate change

Variable		Total (No.)	Not willing to Pay (%)	Willing to pay (%)
Awareness of climate change	Yes	151	37.7	62.3
	No	57	71.9	28.1
Crop failure experience	Yes	200	48.0	52.0
	No	8	25.0	75.0

Source: Field survey data, 2015

The major sources of risks faced by maize and rice farmers were largely production risks (Table 11). The most identified risk was variability in rainfall followed by cyclones, floods, drought, bush fires, crop pests and disease, in that order. This is consistent with the findings of Falola *et al.,* (2013) and Aidoo *et al.,* (2014) 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. Non-availability of inputs was very much of a concern for rice farmers who ranked it as the 3rd most important risk factor compared to maize farmers who ranked it as 5th. With respect to each risk and its level of importance, the majority of the respondents were willing to purchase insurance with more than 50% of the individuals who ranked rainfall variability, droughts and floods as the most important risk willing to insure their crops.

Table 11: Major risks faced by respondents

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 12). 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 (Table 12). 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 et al., 2013). These farmers could also be receiving assistance or remittances from family, friends or other support groups. Deressa *et al.,* (2010) and Apata (2011) 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 majority of the farmers who were willing to purchase crop insurance were mainly those who adopted crop diversification, had bank loans, used savings and marketing or production contracts or used other strategies. On the other hand, most of the farmers who borrowed from friends were not willing to insure. There was a statistically significant difference between farmers who were willing and those unwilling to purchase insurance with respect to taking bank loans, borrowing and engaging in other risk management strategies. 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 adopted by farmers suggest that other strategies farmers sometimes adopt are social support or networking, seeking off farm opportunities, engaging in mixed farming, planting trees, irrigation, mulching, making ridges and labor exchange (Apata, 2011; Kuoame, 2010; Deressa *et al.,* 2010; Berman *et al.,* 2013).

Table 12: Risk management strategies adopted by sampled households

Management Strategy		Not Willing to insure		Willing to insure		
	Number of Respondents	Number of Respondents	%	Number of Respondents	%	χ^2
Crop diversification	96	42	43.8	54	56.2	0.810
Bank Loan	3	0	0.0	3	100	2.712*
Savings	32	14	43.8	18	56.2	0.172
Marketing/ Production contracts	10	3	30.0	7	70.0	1.235
Borrowing from friends/family	47	35	74.5	12	25.5	18.232***
Sales of fixed assets	3	1	33.3	2	6.7	0.232
Others	15	2	13.3	13	86.7	7.404***
None	2	1	50.0	1	50.0	0.007

*Source: Field survey data, 2015; note ***, **, * represents 1%, 5% and 10% respectively.*

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%).

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 5). 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.

Figure 5: Distribution of risk management strategies according to occupation

Farmers' with incomes less than 500GH cedi engaged mainly in crop diversification or borrowed from friends. Farmers with monthly income above 500GH cedis nevertheless adopted mainly crop diversification or used saving as risk management strategies. This category of farmers constituted the majority of the sampled farmers who had access to bank loans and marketing contracts. It was noted that farmers with incomes above 2,000GH cedis did not borrow from friends or sell fixed assets (Table 13).

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. However, only small size farm owners indulged in the selling of assets as a management strategy (Table 14).

Table 13: Relationship between risk management strategies and household income levels

Income	Crop Diversification	Bank Loans	Savings	Marketing contracts	Borrowing	Sales of assets	Other	None	Total
	(No.)	(No.)	(No.)	(No.)	(No.)	(No.)	(No.)	(No.)	
Below Ghc 500	50	0	8	0	37	3	7	1	106
Ghc 500-1000	24	3	9	2	8	1	4	1	52
Ghc 1000-2000	8	1	6	1	4	0	1	0	21
Ghc 2000-3000	5	0	4	2	0	0	2	0	13
Ghc 3000-5000	2	0	3	5	0	0	0	0	10
Above Ghc 5000	2	0	2	1	0	0	1	0	6

Source: Field Survey data, 2015

Table 14: Relationship between risk management strategies and farm size

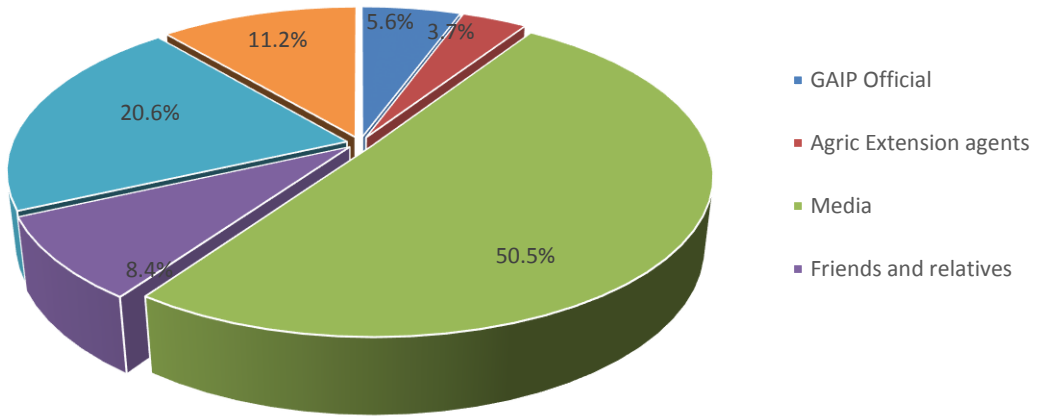
Farm Size	Crop Diversification	Bank Loans	Savings	Marketing contracts	Borrowing	Sales of assets	Other	None	Total
	(No.)	(No.)	(No.)	(No.)	(No.)	(No.)	(No.)	(No.)	
Small size	82	0	25	8	42	3	8	1	169
Medium size	12	2	4	0	3	0	4	1	26
Large size	2	1	3	2	2	0	3	0	13

Source: Field Survey data, 2015

4.4 Insurance participation decision

The term crop insurance is not new to farmers because 111 of the respondents had knowledge of it as opposed to 97 who were not aware of it. Of the total respondents, 51.4% were aware of the Ghana Agricultural Insurance Program (GAIP) while 48.6% had no knowledge of GAIP. The respondents who were aware of GAIP obtained the information through the media (50.5%), from banks or financial institution (20.6%) and FBO, NGO and other institution (11.2%). Approximately 8.4% indicated they had heard about it from friends/relatives, 5.6% indicated that they obtained the information from GAIP officials while 3.7% heard of GAIP through extension agents (Figure 6).

Figure 6: Sources of information received by respondents



Farmers who were aware of crop insurance were mostly males and educated. More than 70.0% of the females were not aware of crop insurance and GAIP compared to 38.0% of the males who were not aware of the insurance and GAIP. 60.0% of the educated farmers were aware of the insurance, 72.0% of the farmers with no education were not aware of crop insurance and the GAIP.

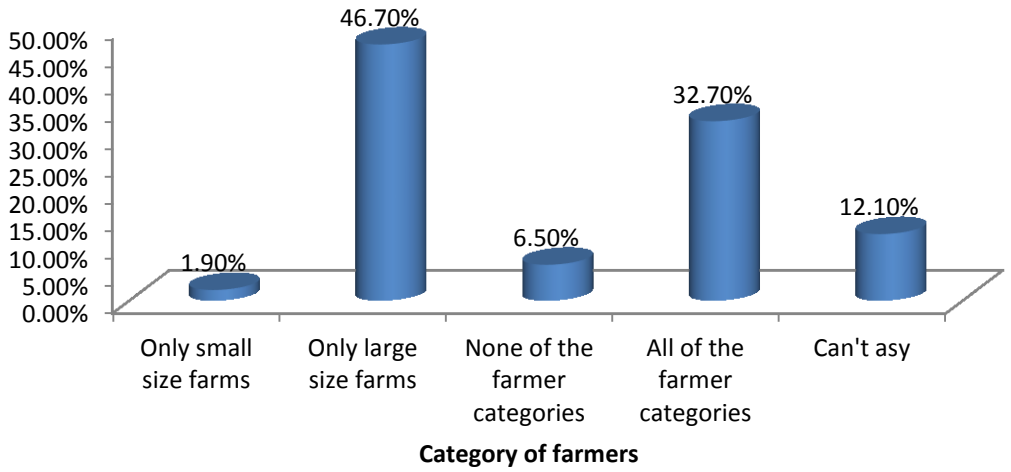
Approximately 58.0% and 55.9% of farmers who owned a radio were aware of crop insurance and GAIP, respectively. Of the total number of farmers who did not own a radio, 90.0% were not aware of crop insurance and GAIP. There was a statistically significant relation between radio ownership and willingness to pay; i.e. a p–value of 0.031 (< 0.5) was obtained from the Chi-square test. This suggests that the ownership of a radio plays a significant role in farmers' access to information on crop insurance and their willingness to purchase it. 66.7% of the farmers who were aware of agricultural insurance and 67.3% of the respondents who were aware of GAIP were willing to pay insurance. On the other hand, 62.9% of the total number of farmers who were not

aware of insurance and 62.4% of those who were not aware of GAIP were not willing to insure their crops.

Perception of farmers with regards to crop insurance

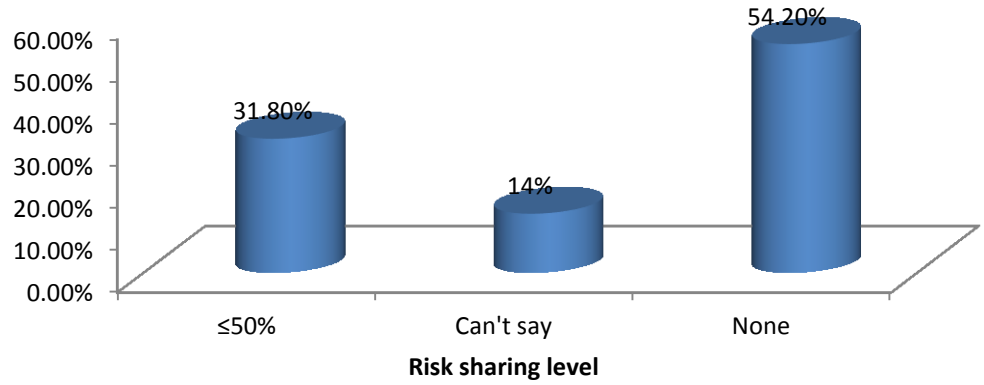
Some of the respondents had some knowledge about crop insurance and GAIP, and were asked about their perception of crop insurance. 46.7% of the farmers who responded to this question were of the view that the crop insurance offered by GAIP satisfied only the needs of large sized farm owners while 32.7% indicated that it satisfied the needs of all groups of farmers (Figure 7). 1.9% of the farmers stated that it satisfied only the needs of small sized farm owners, 6.5% indicated that it did not apply to any of the farmer categories, and 12.1% did not have any idea which farmer groups' needs were satisfied by crop insurance.

Figure 7: Respodents' perception of crop insurance



According to 54.2% of the farmers, crop insurance did not cover any risks (Figure 8). This suggests that the farmers did not have adequate knowledge about crop insurance even if they were aware of it. The media could play a tremendous role in providing information about GAIP but currently farmers do not seem to obtain detail and accurate information from this source. For example, 53.7% of the farmers who received information from the media were of the opinion that insurance covered no risks while 25.9% of these farmers thought that it covered up to 50% of the risks. The majority of the respondents who received information from friends and NGOs were also of the opinion that insurance covered no risks.

Figure 8: Respondents' perception of risk sharing level



On the other hand, 54.5% of the farmers who received information from financial institutions thought that insurance covered up to 50% of the risk. Contrary to expectation, most of the farmers who received information from GAIP officials (66.7%) and all those who received information from extension agents believed that insurance covered no risks. Approximately half of the educated farmers thought that insurance covered no risks. 27.3% of the large size farm owners thought that insurance covered up to 50% risks compared to 34.1% of the small size farm owners. Farmers who were willing to purchase insurance were made up of 30.6% of individuals who thought that insurance did not cover any risks, 56.9% of those who were of the view that it covered up to 50% of the risk and 12.5% of those who had no opinion on the percentage of risk that was covered by crop insurance.

4.5 Willingness to Pay Analysis

In the survey, there were specific questions designed to estimate the amount (premium rate) farmers would be willing to pay for the scheme using the contingent valuation method. GAIP's current premium rate was offered to farmers as the initial bid after which a follow up bid which was either higher or lower than the initial bid was proposed to farmers depending on the response to the initial bid. Three successive bids were therefore presented to the farmers depending on whether a negative or positive response was obtained from the previous bid. The proposed bid which the farmer agreed to as the amount he/she was willing to pay was taken as the maximum WTP amount. A high percentage (52.9%) of the farmers indicated their interest and willingness to pay for crop insurance which shows that a majority of the farmers were interested in insuring their

crops from production risks and uncertainties. However, previous section noted that few farmers said insurance covered risk. Another 47.1% of the respondents were unwilling to accept and pay for crop insurance.

Approximately 52.0% of the farmers who were not willing to purchase crop insurance offered a number of reasons for their decision. A large number of farmers (23.1%), indicated that they did not have enough information about the GAIP's insurance program. 8.7% of the respondents indicated that they did not have the funds to purchase insurance, 9.7% mentioned high premium rates, 3.4% were of the opinion that the compensation time might be delayed and 6.7% of the farmers signaled that they needed time to decide. A number of these reasons were similar to those observed by Nimoh *et al.,* (2011), who reported that 9% and 2% of the sampled farmers were not willing to insure due to a lack of income and inadequate knowledge respectively.

Table 15 presents a description of the number and percentage of farmers who accepted to pay for each bid or premium rate. The description is provided separately for maize and rice farmers to determine the percentage of farmers who were willing to pay GAIP's current premium rate and those who were willing to pay below or above it.

Of the total number of maize farmers who were willing to purchase insurance, 19.0% of them were willing to pay at the current premium rate of 10% of production costs. 76.2% were willing to pay below the current GAIP premium rate and only 4.8% were willing to pay above this rate. The number of farmers willing to purchase insurance decreased as the premium rate increased. The distributions observed for maize farmers was not different from those observed for rice farmers. The majority of the rice farmers (65.4%) were willing to pay lower bids than the current premium rate of 10% while 23.1% were willing to pay the current premium. Generally, farmers who were willing to purchase crop insurance were willing to pay premium rates lower than the current premium rate offered by GAIP. It can be inferred that the insurance premium charged by GAIP may be out of reach for the sampled farmers since on average most of them were willing to pay lower bids.

Table 15: Distribution of respondents' maximum WTP amount

Premium Rate	Farmers	Bid values	Maize farmers		Bid Values	Rice Farmers	
(%)	(%)		Number of respondents	(%)		Number of respondents	(%)
2	38.2	11.48	33	39.3	36.00	9	34.6
5	35.5	28.70	31	36.9	90.00	8	30.8
10	20.0	57.40	16	19.0	180.00	6	23.1
12	4.6	68.88	3	3.6	216.00	2	7.7
15	1.8	86.10	1	1.2	270.00	1	3.8
Total	**100**		**84**	**100**		**26**	**100**

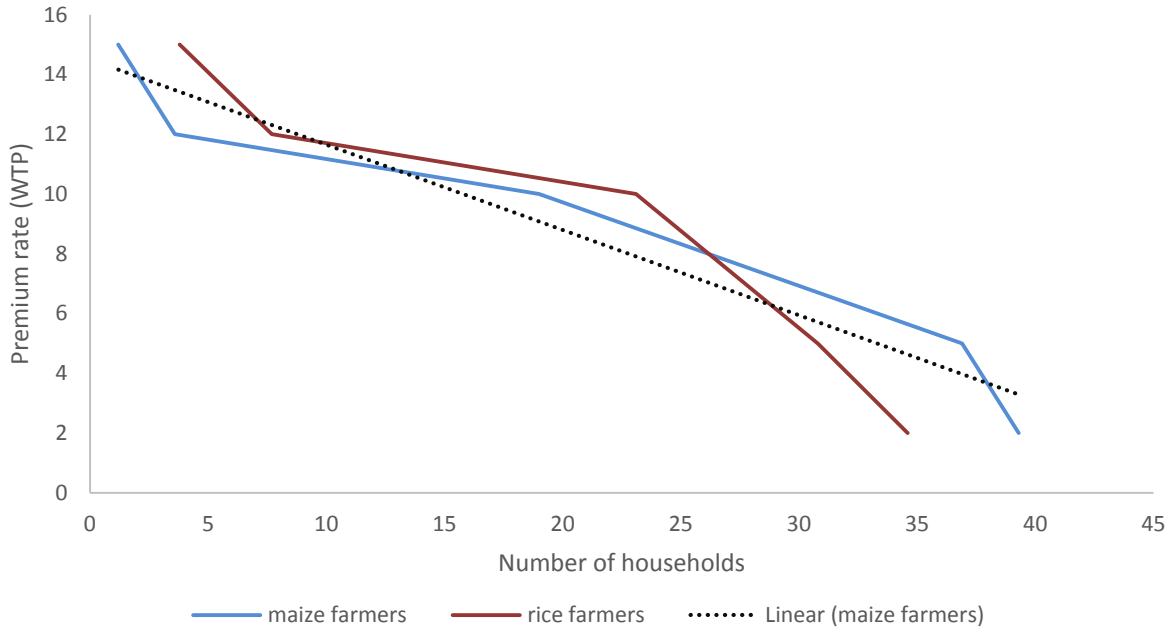
Source: Field survey data, 2015.
Maize and rice farmers are presented with the same premium rates as a percentage of the cost of production, however, the absolute values differ because the cost of production for each crop differs. The cost of production for rice is substantially higher than for maize.

For both crop farmers, less than 5% were willing to pay the highest bid or premium (15%). Only approximately 20% were willing to purchase insurance at the current premium values of 10% of the cost of production. Approximately, 34.5% and 38.2% of the farmers responded positively to the first and second lower bids, respectively. Also, 4.6% and 1.8% of farmers responded positively to the first and second higher bids, respectively (Table 15).

4.5.1 Derivation of a demand curve

The aggregate demand curves were derived using the various amounts farmers were willing to pay per hectare and the number of respondents willing to pay the different amounts. The points on the curve represents the households who would prefer to pay for crop insurance at the corresponding premium price on the WTP axis (Figure 9).

Figure 9: Estimated demand curve for crop insurance



Both curves are downward sloping indicating that crop insurance is a normal good. The demand for crop insurance decreased as the premium price increased. Similar findings were observed by Abebe and Bogale (2014) and Ramasubramanian (2012) who found the demand for index based insurance to be downward sloping.

4.5.2 Estimating Average WTP from household monthly income

The percentage of income farmer's were willing to spend on crop insurance was estimated. This was done based on information on household income and the different amounts farmers were willing to pay as a premiums (Table 16). The first column shows the monthly income intervals of farmers. The second column is the estimated percentage of income farmers were willing to spend on premium payments. This calculation was made for farmers within each income group with respect to the bid amounts they were willing to pay. The third column provides the percentage of farmers in each income group who were willing to pay the specified premium rates. The rest of the columns provide this information for different premium rates.

Therefore for the first row, it can be observed that 73.0% of maize farmers with monthly income lower than 500 GH cedi were willing to purchase insurance at the 2% premium rate i.e. 2% of their cost of production. This premium rate corresponds to an amount of 11.48 GH cedi and

therefore it was estimated that the percentage of this amount out of 500 GH cedi was 2.3. The results indicate that lower income farmers who earned less than or equal to 500 GH cedi per month who agreed to purchase insurance at the 2% premium rate were willing to spend at least 2.3% of their income on crop insurance.

Similarly, 95.0% of maize farmers with income between 500 and 1,000 GH cedi were willing to pay for insurance at the 5% premium rate. These farmers were thus willing to pay 28.7 GH cedi for insurance which is between 3% and 6% of their monthly income. Hence, the results show that maize farmers in this income group who were willing to purchase insurance with a 5% premium rate were willing to spend at most 6% of their income on crop insurance (Table 16).

The results show that the majority of the farmers with lower incomes were willing to pay for crop insurance at a lower premium rate. Maize farmers who were willing to pay the current rate offered by GAIP had income levels above 1,000 GH cedis while rice farmers who were willing to pay this amount had income levels between less than 500 GH cedis to 3,000 GH cedis. The bid amounts both groups of farmers were willing to pay increased with income. A majority of the farmers were willing to spend on average, less than or equal to 5% of their monthly income on crop insurance.

Generally, rice farmers were willing to spend a higher percentage of their income on insurance than maize farmers. Farmers with lower incomes were found to spend a higher percentage of their incomes on insurance although they opted mostly for lower bids. Maize farmers with incomes above 5,000 GH cedis were willing to spend at least 1.7% of their income on crop insurance while rice farmers with incomes between 3,000 GH cedis and 5,000 GH cedis were willing to spend a minimum of 5.4% of their income on insurance.

Table 16: Percentage of respondents' willing to pay each premium rate stratified by monthly income

Income intervals (GHc)	Premium rates									
	2%		5%		10%		12%		15%	
	Share of income	% of farmers	Share of income	% of farmers	Share of income	% of farmers	Share of income	% of farmers	Share of income	% of farmers
	Maize farmers									
< 500	> 2.3	73.0	> 5.7	27.0	-	0	-	0	-	0
501-1000	1.2-2.3	5.0	2.9-5.7	95.0	-	0	-	0	-	0
1001-2000	-	0	1.4-2.9	12.5	2.9-5.7	87.5	-	0	-	0
2001-3000	-	0	-	0	1.9-2.9	100.0	-	0	-	0
3001-5000	0.2-0.4	20.0	-	0	1.2-1.9	20.0	1.4-2.3	60.0	-	0
> 5000	-	0	-	0	1.0-1.2	50.0	-	0	< 1.72	50.0
	Rice farmers									
< 500	> 7.2	77.8	> 18	11.1	> 36	11.1	-	0	-	0
501-1000	3.6-7.2	11.0	9.0-18.0	78.0	18.0-35.9	11.0	-	0	-	0
1001-2000	-	0	-	0	9.0-18.0	67.0	10.8-21.9	33.0	-	0
2001-3000	-	0	-	0	6.0-9.0	66.7	7.2-10.8	33.3	-	0
3001-5000	-	0	-	0	-	0	-	0	< 5.4	100
> 5000	-	0	-	0	-	0	-	0	-	0

Source: Field survey data, 2015. Note: 2% premium is 2% of cost of production

4.6 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 17. 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.

Table 17: 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)

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

*Source: Field survey data, 2015 ***, **, * Significant at 1%, 5% and 10%*
Values in parenthesis are standard errors

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.

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.

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.

4.7 Mean difference between variables of purchase decision groups

The independent samples T-test and chi-square test were used to test the mean difference for continuous variables and the frequency of discrete values with respect to farmers' choice to purchase insurance respectively. The estimated test values showed whether there was a statistically significant difference between farmers who were willing and unwilling to purchase insurance with respect to the different characteristics. In relation to the continuous variables, the characteristics of farmers who were willing and unwilling to purchase insurance were similar since none was found to be significant. On the other hand, with regards to the variables with multiple categories, the percentage of males and females who were willing to purchase insurance was significantly different from the percentage of males and females who were not willing to purchase insurance. Also, the percentage of educated and uneducated farmers who were willing to purchase insurance versus the percentage of educated and uneducated individuals who were not willing to purchase insurance was significantly different (Table 18). The results therefore show some differences between farmers who were willing to purchase insurance and those who were not willing to purchase insurance with respect to certain characteristics.

Table 18: Comparison of characteristics between respondents who were willing to and unwilling to purchase insurance

Variable		Willing	Not willing	Significance
Continuous variables		**Mean**	**Mean**	**t-test**
Age	Average years	45.72	47.72	-1.447
Farming experience	Average years	14.86	16.15	-1.253
Household size	Mean household size	5.44	5.41	0.103
Categorical variables		**(%)**	**(%)**	**Chi square test**
Gender	Male	59.7	40.3	11.189***
	Female	33.3	66.7	
Marital status	Single	78.6	21.4	2.713*
	Married	55.9	44.1	
Religion	Christian	50.4	49.6	1.023
	Others	57.7	42.3	
Education	Educated	62.0	38.0	17.938***
	Uneducated	29.3	70.7	
Income	< 500 GHC	44.7	55.3	5.421**
	>500 GHC	61.3	38.7	
Farm size	Small size	50.3	49.7	2.424
	Others	64.1	35.9	
Crop type	Maize	50.6	49.4	1.718
	Rice	61.9	38.1	
Extension service	Yes	61.1	38.9	6.101**
	No	44.0	56.0	
Access to credit	Yes	59.3	40.7	2.164
	No	48.8	51.2	

*Source: Field survey data, 2015 ***, ** and * implies significant at 1%, 5% and 10%, respectively*

4.8 Econometric Results of the Heckman two-stage Model

The estimated outcome of the Probit selection used to analyze farmers' willingness to purchase crop insurance contracts is presented in Table 19 below. The interpretation of the results are also provided in this section. The analytical statistics showed that the estimated model has a good fit with a chi-square value statistically significant at the 1% level. This indicates that farmers' socioeconomic characteristics are relevant in explaining the adoption decisions of farmers in the study area. Another measure of good fit is the Pseudo R^2 value of 0.2108 which indicates that 21.08% of the variations in the farmer's decision to purchase insurance was explained by the explanatory variables in the model. This is quite reasonable considering that the data for the study were obtained from a cross sectional survey of selected farmers in the study area. The log

likelihood indicates that the explanatory variables included in the model jointly explain the probability of farmers' decision to purchase insurance.

Individual and farm characteristics

Marital status was found to be significant at the 1% significance level and positively correlated with farmers' willingness to purchase insurance. This conformed to the a-prior expectation and is also consistent with other studies (Danso-Abbeam *et al.,* 2014). Marital status is represented by the variables single which was measured as 1 if the farmer was single and 0 if otherwise, i.e. if the respondent was married, divorced or widowed. The married variable was measured as 1 if the respondent had a spouse and 0 if the farmer was single, widowed or divorced.

Married farmers have the responsibility of reducing their household's vulnerability to risks and the resulting negative impacts and are therefore more likely to purchase a crop insurance policy. Farmers who are single were also observed to be willing to purchase insurance which could be due to the fact that with limited responsibility of catering for other individuals, these farmers are more likely to set aside money to purchase insurance. This was consistent with the findings of Munkaila (2015) among cereal farmers in Ghana. Most studies do not distinguish between the purchasing decision of married and single farmers in response to crop insurance. This study therefore takes this into account and establishes that both statuses had a positive and significant effect on insurance purchase based on different possible reasons.

The coefficient for education was positive and statistically significant at the 5% significance level and was also in line with previous studies by Ali (2013) and Falola *et al.,* (2013). The positive effect on the willingness to purchase insurance implies that better educated farmers are more likely to receive and understand the insurance policy and are thereby more willing to purchase insurance compared to those with lower educational levels. This finding, however, was contrary to findings by Kwadwo *et al.,* (2013) who observed a negative correlation between farmers' educational level and the willingness to purchase market based insurance explaining that these farmers were more exposed to sophisticated management practices.

Income had a negative and insignificant relationship with farmers' willingness to purchase insurance. This was contrary to a-prior expectation. This implies that farmers with higher household incomes are probably less vulnerable to production risks and its effects on their welfare and therefore have a lower willingness to purchase insurance. These farmers tend to be less risk

averse compared to lower income farmers. Falola et al., (2013) also established a negative and insignificant correlation between income and farmers' willingness to purchase insurance and indicated that farmers with higher income levels are likely to adopt other coping strategies.

Table 19: Probit regression estimates of respondents' willingness to purchase crop insurance

Variable	Coefficients	Std Error	P-Value
Constant	-1.419824	0.7514365	0.059
Individual/Farm Factors			
Single	1.307516***	0.4734448	0.006
Married	0.865154***	0.2928332	0.003
Education	0.0544138**	0.0230625	0.018
Income	-0.0328991	0.0621687	0.597
Crop type	-0.447713*	0.2516642	0.075
Medium size	-0.0236218	0.3003424	0.937
Large size	0.2130821	0.4735089	0.653
Farm experience	0.1712289	0.2199987	0.436
Major occupation	0.0625728	0.2079084	0.763
Institutions			
Extension service	0.543269**	0.2660043	0.041
Access to credit	-0.2667648	0.2691257	0.322
Risk/Coping Strategy			
Weather Variation	0.2404156	0.2045329	0.240
Borrowing	-0.8678956***	0.2680025	0.001
Savings	-0.4593909*	0.2708054	0.090
Marketing contracts	0.0369573	0.5325026	0.945
Awareness/Information			
Aware of crop insurance	0.5635645**	0.2240927	0.012
Number of Obs.	= 208	Wald Chi2 (17)	= 55.75
Pseudo R^2	= 0.2108	Prob > chi2	= 0.0000
Log likelihood	= -113.5143		

*Note: Robust standard errors. ***, ** and * indicate significance level at 1%, 5% and 10% respectively.*

The relationship between crop type and the willingness to purchase crop insurance was observed to be negative and statistically significant at the 10% significance level. This suggests that there is a lower probability for maize farmers to purchase insurance compared to rice farmers. Although both crops require moisture (rainfall/irrigation) to thrive, rice crops require more water and thus are likely to have a higher negative impact in the event of a drought. Also, the cost of rice production is high and therefore the potential loss would be much higher compared to maize farmers. Thus rice farmers will be more likely to purchase crop insurance especially since the scheme that was presented to farmers is a weather index insurance scheme. In addition, it is more

difficult for rice farmers to diversify as a risk management strategy due to the nature of rice production and therefore these farmers are more likely to manage risk by insuring their crop.

Farming experience, large size farms and major occupation had a positive correlation to the willingness to purchase insurance but these were not statistically significant.

Institutions

Access to agricultural extension services was significant at the 1% significance level and positively affected farmers' willingness to purchase insurance. Extension services provide farmers with important information concerning farming practices, modern technologies and management strategies and thereby influence their purchasing decision positively. In accord with a prior expectation, the more farmers had access to these services, the higher the probability of engaging in crop insurance. This result is consistent with that of Falola *et al.,* (2013) who reported a positive relationship between extension services and the willingness to purchase insurance among Nigerian farmers.

It was expected that farmers with access to credit have the ability to purchase insurance contracts. The coefficient for access to credit was negative but statistically insignificant. The negative sign on the coefficient could mean that credit acts as a buffer against risks but does not impact the insurance purchase decision.

Risk and Coping Strategy

The weather variation variable is a measure of farmers' susceptibility to hazard and risks. The majority of the farmers ranked weather variation as the major source of loss and this had a positive effect on farmers' willingness to purchase insurance. This suggests that the more farmers perceived a likelihood of being susceptible to this risks the higher the probability of purchasing crop insurance. Nevertheless, weather variation did not have a statistically significant influence on farmers' willingness to purchase insurance in this study. This is similar to the results by Long *et al.,* (2013) who investigated farmers' willingness to pay for insurance in rural Vietnam.

In line with a prior expectation, farmers' adoption of various risk management strategies particularly borrowing and savings had a significant and inverse relationship with the willingness to purchase insurance. From the results, borrowing and savings were found to be significant at the 1% and 10% significance levels respectively. Thus, individuals who borrowed or used savings were less willing to insure their crops. Farmers who use borrowing as a risk management strategy may have a lower ability to pay for insurance premiums while farmers who use savings may be

obtaining security from this strategy thereby decreasing the likelihood of purchasing insurance as a risk management strategy. These farmers could be more dependent on themselves to cope with risks rather than on external factors and therefore may be less willing to purchase insurance. There was consistency between this results and findings by Ramasubramanian (2012) who evaluated the effects of savings and borrowing on farmers' insurance purchasing decision. Nevertheless, using marketing contracts had a positive effect on the willingness to purchase insurance although it was not found to be significant. This suggests that the experience in acquiring contracts increases the likelihood to understand the terms of the insurance scheme and influence their purchasing decision.

Awareness/Information

Awareness of crop insurance was a significant factor in influencing farmers' willingness to purchase crop insurance. Farmers who had knowledge about GAIP and the crop insurance scheme that was being offered had a higher probability of purchasing insurance compared to their counterparts who didn't have any information. This was in line with findings obtained by Munkaila (2015) who observed a positive correlation between awareness of insurance and willingness to purchase. This shows that the more information farmers receive about crop insurance the higher the likelihood of taking up a crop insurance policy as a risk management strategy. Creating awareness through the media and extension services is likely to increase farmers' willingness to purchase insurance if farmers are provided with detailed and accurate information about the importance and benefits of insurance. Furthermore, the participation of GAIP officials in the dissemination of information about crop insurance is necessary to convince farmers of the credibility of the insurance scheme which will promote the development of crop insurance in Ghana.

4.8.1 Amount farmers were willing to pay for insurance

The interval regression model was employed in the second stage Heckman model to assess the factors influencing the amount farmers were willing to pay conditional on a positive decision to purchase insurance. The estimated results are shown in Table 20. The inverse mills ratio (IMR) was statistically significant at 1% implying that employing the two stage procedure was appropriate and justifies the use of the Heckman model (Arasheibani and Lau, 1999; Chen and Hamori, 2008). This indicates that the sample selection problem (dependence of error term on

outcome models) is evident in the model and thus estimating the determinants of the amounts farmers were willing to pay using an ordinary interval regression model would be inaccurate and have yielded biased estimates. From the regression estimates, it can be observed that the coefficient of the Inverse Mills Ratio is negative and shows that the selection problem would have provided a downward biased estimates (Irfan, 2011). This was in line with a number of studies authored by Chantarat *et al.,* 2009; Ramasubramanian, 2012; Mfungwe, 2012; Khitarishvili, 2009.

Individual and Farm Characteristics

The amount farmers were willing to pay increased significantly with age which was contrary to the first stage results on farmers' decision to purchase. Older farmers were mostly risk averse and would not want to adopt new innovations but this characteristic could also explain their willingness to pay a higher premium when a positive decision with respect to adoption was made. This suggest that older farmers were willing to pay higher amounts probably because they were quite confident that the scheme could enable them to manage risks especially since they have lifelong experience with weather risk. This reduces the need to search for and try out alternative risk management strategies. Earlier studies by Abebe and Bogale (2014) found contradicting results.

Farmers with higher education were more willing to pay a lower amount for insurance contracts which was demonstrated by the negatively significant relationship between education and farmers WTP amount. Educated farmers are likely to have other risk management strategies or have opportunity to engage in a secondary occupation which provides them with additional income. This reduces the incentive to pay for crop insurance as a risk management strategy and was consistent with work done by Aidoo *et al.,* (2014). In contradiction to this study, Danso-Abbeam *et al.,* (2014) found a positive relationship between education and WTP amount among cocoa farmers in Ghana. Also a positively significant correlation was observed between marital status and farmers WTP amount indicating that married individuals had a higher probability of paying a higher amount for crop insurance. Married individuals are more likely to have larger households and thus more responsibilities and would be willing to pay more for insurance to reduce their vulnerability to risk and secure their households.

Household income positively and significantly influenced the amount farmers were willing to pay to insure their crops. This means that higher income farmers were more willing to pay a

higher amount to insure their crops as expected. Farmers with lower incomes were therefore more willing to pay a lower amount for insurance since they tend to have a lower payment capacity. Hence, it can be concluded that although lower income farmers would be willing to purchase insurance to better manage risk, and secure their welfare, however they may not be able to afford it. This was similar to results of Abebe and Bogale (2014) who observed that the probability that farmers would pay a higher amount for insurance increased if they had higher incomes (Table 20).

Table 20: Interval regression estimates of the premiums respondents were willing to pay

Variable	Coefficients	Std Error	P-Value
Constant	3.819512	0.808434	0.000
Individual/Farm Factors			
Age	0.3053125*	0.1768141	0.084
Education	-0.1402301*	0.0761001	0.065
Marital status	0.3249409**	0.131671	0.014
Income	0.128338***	0.0350526	0.000
Other Occupation	0.1369576	0.1190657	0.250
Farm experience	-0.0261521***	0.0070826	0.000
Medium size	0.1334337	0.0974702	0.171
Large size	0.3386458***	0.0917068	0.000
Crop Type	-0.9633848***	0.1460578	0.000
Institutions			
Extension service	-0.3273955**	0.1771104	0.065
Access to Credit	0.1974964	0.1244234	0.112
Risk/Coping Strategy			
Weather variation	-0.1865922**	0.0826617	0.024
Savings	0.4714187***	0.1402218	0.001
Borrowing	0.631917***	0.2447612	0.010
Marketing contracts	0.2038149*	0.1227498	0.097
Awareness/Information			
Aware of crop insurance	-0.3522729**	0.1704707	0.039
Mills Ratio	-1.194255***	0.4574923	0.009
Ln Sigma	-1.110259	0.1222888	0.000
Number of Obs.	= 110	Wald Chi2 (17)	= 393.24
Log likelihood	= -115.17277	Prob > chi2	= 0.0000

*Note: Robust standard errors. ***, ** and * indicate significance level at 1%, 5% and 10% respectively.*

It was observed that farm experience was statistically significant and had a negative relationship with the amount farmers were willing to pay for insurance. Cereal farmers with more

experience were less willing to pay a higher amount for insurance compared to those with much less experience. This observation could be evidence of a lower desire to fully accept and participate in a new intervention as a result of possibly previous unsatisfactory experience with other innovations. Furthermore, individuals with more experience in farming may tend to rely on their experience in managing risks over the years and therefore will be less willing to pay a higher amount to adopt a new risk management strategy (Table 20).

Farm size was found to have a positive correlation with the amount farmers were willing to pay for crop insurance with the variable large farm size having a statistically significant influence on the WTP amount at the 1% significance level. This means that farmers with larger farms who were willing to purchase insurance were more likely to pay a higher premium per hectare. This is not only due to the fact that these farmers face severe risk when there is a hazard but also because they have higher incomes and can afford to pay more. In other studies (Aidoo *et al.,* 2014), a negative correlation was found between the amount maize farmers were willing to pay for insurance and farm size.

The type of crop produced by the farmer was found to have a negative and significant relation with the amount farmers were willing to pay to insure their crops. Maize farmers were willing to pay a lower amount for insurance premiums compared to rice farmers. This could be because rice farmers would be impacted more in the case of a hazard, such as a drought or flooding, due to the nature of rice production and would want to protect themselves. Therefore it can be observed that rice farmers were more willing to purchase insurance and also more likely to pay a higher amount for insurance premiums.

Institutions

Unlike the Probit results, a negative and significant relation was observed between WTP amount and extension services. Farmers who had received extension services were less willing to pay more to insure their crops. Farmers who have access to extension services are more likely to have information on different types of risk management strategies and therefore are exposed to a number of options in managing risk. This is likely to have a negative influence on farmers' willingness to pay more for insurance as a risk coping strategy. The information obtained from extension agents about insurance may have had an influence on the amount farmers may be willing to invest in a

new institution. In the absence of adequate and detailed information on insurance, farmers will not be entirely confident in investing their money into an insurance program.

Risk and Risk Management Strategies

Weather variation had a negative and significant effect on farmers WTP amount. It was expected that since a majority of farmers reported weather variations as their major source of risk they would be willing to pay a higher premium to secure themselves but this was not observed. Although these farmers were willing to purchase insurance they were less likely to pay a higher amount for it. It can be argued that the negative effect of this variable could be a reflection of households' limited willingness to experiment with a new product. This could probably be due to a lack of trust or bad past experiences. Long *et al.,* (2013) observed that experiencing shocks positively and significantly affected the amount farmers are willing to pay for insurance which is contrary to the findings obtained in this study.

The current risk management strategy adopted by farmers had a positive and significant impact on the amount farmers were willing to pay for crop insurance. There was a lower probability for farmers with other coping strategies to purchase insurance but a higher probability to pay more for insurance when a positive decision was made. Farmers who used savings as a coping strategy were likely to pay more for insurance. This is in line with findings by Aidoo *et al.,* (2014) but contradictory to that of Ramasubramanian (2012) who observed a negative effect of savings on farmers WTP for insurance. Premium payments will be made either with current or saved income and therefore farmers who save are more capable of obtaining funds to purchase insurance.

Adopting borrowing and marketing contracts as a risk management tool was also found to have a positive correlation with farmers WTP amount. Farmers who borrowed were expected to be willing to pay less to insure their crops especially since they were likely to have a lower probability of purchasing insurance and also because of inadequate income and lack of savings. However, it can be argued that the positive effect suggests that farmers were aware of the negative effect of borrowing and thus were more likely to pay more for an alternative risk management strategy. The effect of the use of marketing contracts on farmers' willingness to purchase insurance and the amount they were willing to pay was not contradictory if the farmers use the insurance as a risk aversion vehicle. Farmers who acquire marketing contracts were willing to pay more to

insure their crops. Ramasubramanian (2012) observed that farmers who had adopted other coping strategies were willing to pay less for insurance but this study concludes otherwise.

Awareness/Information

In terms of farmers' awareness about insurance, the results observed in this analysis were contradictory to findings obtained in the Probit analysis. Having information about insurance had a negative and significant relationship with the premium the farmer was willing to pay. Awareness of insurance which was mostly from the media may have served as an incentive to influence farmers' willingness to purchase insurance but it didn't seem to be enough motivation for farmers to pay more for crop insurance. This could be due to the quality of information obtained from this source and also the credibility of the various sources from which farmers obtained information about GAIP and the crop insurance scheme that was being offered.

Simple interval regression results of the factors influencing the amount farmers were willing to pay for insurance.

An interval regression model was estimated without accounting for the selection problem and provided in Appendix (5) to show the effect of the presence of selection bias. It was observed that education, extension and being aware of insurance had a negative effect on the WTP amount which was contrary to the results observed in the Heckman model. Also, variables such as education, marital status, weather variation, extension service, borrowing and aware of GAIP were not significant in the model. This implies that in the presence of selection bias, farmers' educational level and marital status were less likely to be concluded as factors influencing the amount farmers were willing to pay.

4.8.2 Mean Willingness to Pay

The Mean WTP for cereal farmers who were willing to pay for crop insurance was estimated using the fitted values from the interval regression. In this study, only the significant values were used in computing the mean WTP for insurance. This was done for scenarios where the sample selection problem was accounted for using the inverse mills ratio in the Heckman model and not accounted for with the use of a simple interval regression model. The results show that the Mean WTP for farmers are different depending on whether the selection bias is taken into account.

The mean WTP estimate when the selection bias problem was taken into account was significantly higher than the estimated mean WTP without accounting for selection bias. Not taking the selection bias into account results in a lower WTP amount for insurance (Table 21).

Table 21: Mean WTP for cereal farmers

Variable	WTP	Std. error	z	P>z	[95% Conf. Interval]	
			Absence of Selection bias			
Mean	69.58467	32.80078	2.12	0.034	5.296319	133.873
			Presence of Selection bias			
Mean	29.84569	24.73672	1.21	0.228	-18.63738	78.32877

Cereal farmers in the Eastern region were willing to pay a premium of approximately 69.58 GH cedi for protection coverage for each cropping season. This is relatively low compared with the study by Kwadzo *et al.,* (2013) who reported that food crop farmers in the Kintampo North Municipal of Ghana were willing to pay a maximum of GHc 80.00 as a premium for crop insurance. In another study by Aidoo *et al.,* (2014), farmers in the Sunyani Municipality of Ghana were willing to pay between GHc 19-24 on average for crop insurance which was rather low in comparison with the amount farmers in this study were willing to pay to insure their crops.

4.9 Policy Implications

If the crop insurance program is expensive and unpopular, it may not be sustainable. The following recommendations are thus proposed by the study. Household income and WTP amount were positively related, development policies should aim at increasing income of households particularly low income smallholder farmers. Furthermore, the WTP analysis revealed that maize and rice farmers were willing to pay an average of 69.58 GH cedi for insurance, 73.6% of both crop farmers were willing to pay for insurance at a lower premium rate relative to the 10% premium rate charged by GAIP. Accordingly, there is a need to empower farmers economically to improve their WTP and demand for the scheme. Government subsidies should also be considered to assist farmers with premium payments. Access to information on crop insurance increases the probability of being aware of insurance and thus purchasing crop insurance. Thus, to enhance farmers demand for insurance, awareness campaigns through extension services and different Medias as well as the content of information on crop insurance and its mode of presentation to

farmers should be of high importance in the implementation of crop insurance in Ghana. This is necessary to reduce farmers' risk aversion and provide them with the skills to understand the role of crop insurance in risk management.

It is essential for GAIP in collaboration with the government and other stakeholders to formulate a strategic plan to convince farmers of the credibility of the insurance program and the insurance provider. Policies should target the access to education and extension services on crop production, information on climate and coping strategies. Informal social networks and farmer organizations should be encouraged and strengthened since these provide financial support to farmers and promote the flow of information. It is recommended that GAIP in partnership with other financial institutions should consider making insurance compulsory for farmers who take loans. This has the advantage of increasing the demand for insurance and encouraging farmers to take loans which provide funds to pay for insurance premiums and invest in crop production.

Chapter 5 Summary, Conclusions and Recommendations

5.1 Summary

Agricultural and cereal production in rain fed areas in Ghana are susceptible to numerous risks especially climate related risks. Given the various production risks faced by crop farmers, the inefficient coping strategies currently being adopted, and the negative impact on their livelihood, crop insurance may be a viable risk management strategy. In view of this, the government of Ghana and other stakeholders have recently implemented a crop insurance program to assist farmers in managing their production risks more efficiently. Nevertheless, improving the risk coping strategies adopted by farmers is heavily dependent on farmers' willingness to adopt these strategies. Although the country's new focus appears to be on crop insurance, it's not clear if farmers are interested in participating and purchasing crop insurance products. This study assessed the demand for crop insurance by cereal farmers in the Eastern region of Ghana. This was achieved by estimating farmers' willingness to purchase crop insurance and the amount they were willing to pay for an insurance premium.

To address these objectives, the Heckman two stage model (Kuoame and Komenan, 2012) was employed and consisted of a first stage Probit model and a second stage interval regression model. The first stage Probit model was used to determine the factors influencing farmers' willingness to purchase crop insurance. The interval regression model was employed to determine the factors influencing the amount farmers were willing to pay as a premium. Using a triple bounded dichotomous choice model, this analysis was undertaken based on information gathered on the different amounts farmers were willing to pay as a premium. The Heckman two stage model was used to deal with the problem of sample selection bias which is likely to occur when a non-random sub sample from the entire population is used for analysis. Cross sectional data was obtained using a structured questionnaire to gather information through personal face-to-face interviews with 208 cereal farmers (Munkaila, 2015). The study further evaluated the relationship between farmers' socioeconomic variables and the coping strategies adopted by applying the multinomial logit regression. The findings from this study were consistent with available empirical literature (Long *et al*., 2013: Kwadzo *et al*., 2013: Danso-Abbeam *et al*., 2014; Ajewole, 2013).

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 test statistics also showed significant difference between farmers who were willing and unwilling to purchase insurance with respect to gender, education, income and access to extension services. 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 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 results provide evidence 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.

From the survey, 52.9% of the sampled farmers were willing to purchase crop insurance while 47.1% were not. The majority of the farmers were aware of crop insurance and more than 50% obtained the information through the media. Approximately 46.7% of the farmers who were aware of crop insurance were of the view that insurance was suitable for only large size farm owners. The Probit regression model revealed that the significant factors influencing farmers' willingness to purchase crop insurance were marital status, education, access to extension service, crop type, borrowing, savings and awareness of insurance. Of these factors, being educated, married and aware of crop insurance positively influenced the decision of farmers to insure their crops.

Crop insurance was established to be a normal good with a downward sloping demand curve. The results showed that willingness to pay declined with higher premiums. It was estimated that cereal farmers' average willingness to pay (WTP) was 69.58 GH cedis as a premium per hectare. The interval regression model employed in the second stage of the Heckman analysis showed that age, farm size, income, marital status, savings, borrowing and contracts were the critical factors that positively and significantly influenced the WTP amount. Education, years of experience, crop type, access to extension services, weather variability and awareness of insurance had a negative and significant effect on the amount farmers were willing to pay as a premium for cereal crop insurance. The results provided evidence that the factors that are likely to influence farmers' decision to purchase crop insurance are different from the factors that influence the amount they are willing to pay to insure their crops.

5.2 Conclusion

The study established that the crop insurance scheme offered by GAIP; which is a weather index insurance scheme, will be an appropriate alternative risk management strategy for cereal farmers in the Eastern region. This conclusion is based on the major risks that were identified by farmers in the study area. 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. However, the majority of the farmers were willing to purchase crop insurance to mitigate the negative effects of weather variability. This revealed the farmers need and desire to adopt crop insurance to manage risks. The results indicated that there was a considerably high demand for crop insurance because more than 50% of the farmers were willing to purchase insurance.

Generally, cereal farmers who were willing to purchase and pay more for insurance were married, cultivated larger farms and had farming as their major occupation. The factors identified to affect demand for insurance were education, access to extension services and awareness of insurance. Education is key because knowledge about insurance and the ability to understand the concept of insurance plays an important role in farmers' participation in the insurance program. In addition, the kind of information farmers had obtained and their perception about insurance may discourage farmers from purchasing insurance. This is because it was observed that the majority of the farmers who had information from extension agents and GAIP officials were of the view that insurance did not cover any risks and was suitable for only large size farm owners.

The proportion of farmers who were not aware of crop insurance (46.6%) and GAIP (48.6%) was high and shows that the disseminating of information to farmers about these opportunities needs to be enhanced. Farmers with higher incomes, access to credit and those who adopted other coping strategies such as savings were less willing to purchase insurance. Further, past experiences with innovations and the limited desire to experiment with new products could be a negative factor with respect to farmers' decision to participate and fully involve themselves in the crop insurance program. Crop insurance was less attractive to low income farmers as the premium rate increased to 10% of the cost of production, although low income farmers were more willing to purchase crop insurance at lower premium rates. This implies that the more expensive the insurance premium, the higher its income share for low income farmers which lowers farmers' willingness to purchase crop insurance. The majority of the farmers were willing to pay for crop

insurance at premium rates lower than the current rate of 10% of the cost of production offered by GAIP.

Although willingness to pay studies do not represent actual behavior, there are a number of benefits of using this approach. First, they help to know the kind of households who will be interested in the product. Second, they can serve as a guide in putting product design and implementation measures in place (Hill *et al.*, 2013). This study distinguishes between the decision to purchase and the WTP for crop insurance. This information bridges the gap between the hypothetical and actual case. Although households are more likely to participate in the insurance program, this does not always translate into real purchases. For instance, educated farmers were more willing to purchase crop insurance but had a higher probability of paying a lower amount for it. Also higher income farmers were less willing to purchase insurance but were more likely to pay higher amounts to insure their crops.

5.3 Discussion and Policy Recommendations

This study investigates the demand for crop insurance in a developing country context, in the Eastern region of Ghana. The following points are suggestions in regards to the effective implementation and development of crop insurance in the country. The study provides insights into specific policy areas to facilitate demand, lower adoption costs and improve the welfare of farmers. The study recommends that MoFA, GAIP and private entities should take into account the factors influencing farmers' willingness to pay in the design and implementation of crop insurance schemes.

First, to stimulate adoption of the scheme, it is imperative for GAIP to ensure that farmers are aware of the crop insurance program and the benefits of acquiring insurance. The lack of information can make crop insurance seem like a very risky venture for farmers thus deterring participation. Knowledge dissemination to farmers through the media particularly through radio broadcasts and in the form of extension services offers the prospect of increasing the awareness of the benefits of crop insurance. This could increase the participation rate. Based on farmers' perception about crop insurance, GAIP's periodic training sessions should emphasize the main objective of crop insurance that is to decrease production risk, and the company's client base i.e. all farm sizes. Also, the inefficiency of informal risk management strategies as well as the benefits of crop insurance should be provided to farmers.

Awareness campaigns by GAIP and MoFA should incorporate farmer to farmer discussion groups were the higher educated farmers who have the capacity to better understand the concept of crop insurance are trained to communicate their knowledge to other farmers in their communities. Further, farmers who are already enrolled in the program should be encouraged to communicate the advantages and benefits through interviews which could be played to non-participants through video.

Secondly, farmers' ability to pay for crop insurance may discourage actual demand for insurance even if there is a higher willingness to participate in the program. The government should formulate policies aimed at increasing farm income, encouraging off farm income generation and promote savings in order to increase the demand for crop insurance. This can be done through forming small business groups and facilitating savings and credit cooperatives. Further, polices should be made to increase the access to off farm activities which could be facilitated through collaboration with non-profit organizations and international agencies who dedicate their resources to agricultural productivity and the welfare of farmers. In addition, policies should be put in place to increase extension services by the government and MoFA to enable farmers to acquire knowledge, skills and resources to improve on farm and off-farm productivity.

One key recommendation of this study is that the current GAIP insurance rate is higher than the amount cereal farmers in the Eastern region are willing to pay. GAIP should consider alternative insurance premium rates so that more farmers can participate in the insurance program. However, the insurance premium should be set so that the program is actuarially sound but not generate excess profits or deficits for the private sector providers. It is recommended that insurance providers (GAIP) should focus on building trust between farmers to further increase demand and the WTP amount. Farmers' should be convinced of the credibility of GAIP and this should be accomplished by using the right tools and approaches especially given the negative past experiences farmers have had with other innovations. The Government of Ghana should consider offering premium subsidies to farmers to attract more farmers to insure their crops. This is necessary because lower income farmers who are more willing to purchase insurance, offered to pay lower amounts for insurance.

Efforts should also be made to ensure collaboration between the insurance providers (GAIP), financial and agricultural institutions and the government as well as other stakeholders to provide demand oriented and sustainable insurance products to farmers. An example would be to

include agricultural technology packages or credit with crop insurance. There should be collaboration with research institutions or the creation of an institution whose function would be to assess the impact of insurance, communicate the observed constraints and provide adequate resources to address those challenges and satisfy the needs of farmers.

Finally, it is worth noting that crop insurance is not a panacea for all production hazards, since it may not be suitable for all groups of farmers. There is a need for MoFA in collaboration with district chief executives to complement this program with other infrastructure, products and services that suit the country's diverse climate, topography, cropping system and the needs of varied crop and livestock farmers. The government could benefit from the results of this study by gaining more understanding on farmers behavior towards agricultural insurance. Although crop insurance is new, it has the possibility of transforming production and the lives of farmers.

5.4 Limitations of the study

The scope of this study covers the willingness to pay for crop insurance and examines the demographic and institutional characteristics that significantly influence farmers WTP. The research was based on selected communities in one region in the country. This was because the data used for the analysis was not originally gathered for this study and it focused on only a limited number of communities due to time and resource constraints (Munkaila, 2015). Also, the data gathered for the study is cross sectional data and therefore may not generate a great deal of information about changes over time since they are not considered. The cross sectional data assessed farmers' behavior at a specific period of time but evaluating farmers' behavior over time could present different results and much more robust findings. In addition, using a larger sample size and covering only one type of agriculture crop production would have improved the results. This was a limitation as the present study used data obtained from only 208 maize and rice farmers.

The data solicited on risk management did not take into account the fact that farmers used a range of coping strategies and not just one which would have been the ideal way of gathering information to assess the factors likely to influence the adoption of risk management strategies. Moreover, other factors which could explain adoption behavior were not incorporated into the study owing to the lack of observations for those variables or the lower number of observations. Some of the factors are farm income, off-farm income, farmers' perception about crop insurance, FBO membership and sources of information about crop insurance. The study is subject to the

limitations associated with the bidding methodology employed, such as strategic bias, information bias, starting point bias and, interviewer and respondent bias (Abebe and Bogale, 2014).

5.5 Future research areas

This regional level research can provide insights for future research among crop farmers in other parts of the country. The findings from this study can also be compared to other related studies to draw constructive inferences. Conclusions based on this study cannot be generalized to estimate the WTP for crop insurance by farmers in Ghana. This is because farmers across the country have different climatic and geographic characteristics as well as household and farm characteristics. A survey of a larger and more diversified farm population in different agro-ecological zones is required to provide a better understanding of the demand for crop insurance in Ghana. The WTP should be assessed based on the crop grown and the risk associated with it. Different regions with different risks would have different WTP for crop insurance. Hence, farmers WTP for crop insurance should be based on the crop and the region. This will provide a considerably fair or extensive view of the demand for crop insurance in the country.

Furthermore, comparative studies that assess the variation in the different economic, social, institutional and environmental determinants influencing the demand for crop insurance should be undertaken. This comparison can be among farmers who grow the same crop across different regions or different crop farmers in a particular locality or region. In addition, the demand for different types of agricultural insurance schemes should be assessed to shed light on the types of risks farmers would want to insure their crops against. Farmers' willingness to pay for crop or livestock insurance as a single or bundled product as well as their choice of bundle can be assessed to determine the appropriate product distributing channel and provide farmers with demand oriented insurance contracts.

It is worth noting that offering crop insurance involves more than one party, it includes farmers, financial institutions, private and government institutions. However, the study offered an empirical analysis from only the farmers' perspective. It is recommended that research be undertaken on financial institutions and other related stakeholders to determine their willingness in this and other programs.

Further studies should investigate the appropriate percentage of total production cost farmers should pay as the crop insurance premium to take into account the production risks associated with weather. This would require time series data on weather hazards, climate risk and

the cost of production of the various crops. GAIP's current premium rate is 10% of farmers' production cost. Undertaking the proposed study would either confirm GAIP's approach or provide insight on a more feasible or alternative method of estimating insurance premiums and also on the suitable premium charge (percentage of total cost of production) farmers would have to pay.

The current crop insurance program covers weather production risk that pays the producers their cost of production when the risk occurs. Other crop insurance programs can be developed that insure crop revenue or farm income. These other types of insurance programs should be investigated to determine their feasibility and acceptability by farmers.

Tadesse *et al.*, (2015) found that farmers in Northern Kenya were willing to pay for insurance in kind by participating in insurance-for-work programs such as offering labor in tree planting. Further studies can therefore be undertaken to determine if farmers in Ghana would be willing to participate in crop insurance in exchange for a proportion of their produce or by offering a service. It is further recommended that an impact analysis should be undertaken to assess the effectiveness and constraints of the crop insurance scheme after an appreciable number of years. This is necessary to ensure that the scheme is satisfying the needs of farmers and to improve on the development of the scheme by addressing any detected challenges and constraints. Preferably time series data should be utilized for such assessment to provide insights on whether crop insurance has influenced farmers' income, consumption, farm investments and yields, use of coping strategies, purchasing behavior, other factors that are time invariant and overall change in welfare over time. A time series data set would provide additional information on the impact of the crop insurance program.

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Appendices

Appendix A1: Description of explanatory variables

Variables	Description	Mean	Std. Dev
Treatment Variable			
Willingness to participate	1=willing to participate 0= Otherwise	0.53	0.500
WTP Amount	In GH cedi, upper and lower bounds of WTP	Lb47.972	51.197
		Ub75.569	58.574
Percentage of income farmers are willing to spend on insurance	The different percentages of income each farmer is willing to spend	7.290777	8.167148
Explanatory variables			
Bids	Bids for the crop insurance contract	46.46073	48.6196
Household characteristics			
Gender	1=male 0=female	0.74	0.439
Age	Age of household head in years	46.66	10.006
Marital Status	Dummy 1 if household head is married	2.24	0.828
Education	Level of education	2.07	0.898
Household size	Number of household members	5.43	2.237
Farming experience	number of years	15.74	7.418
Farm characteristics			
Crop type	1 if the farmer produces maize 0 if rice	1.20	0.402
Medium scale	1 if the farmer has a medium scale farm 0 if not	0.125	0.332
Large scale	1 if the farmer has a large scale farm 0 if not	0.063	0.243
Contact with extension personnel	Contact within 12 months Yes=1 No=0	0.52	0.501
Wealth indicators			
Access to credit	Dummy 1 if access to credit 0 if otherwise	0.39	0.489
Major Activity	Dummy 1 if household head's major activity is farming	2.39	1.90
Off farm activity	Dummy 1= Yes if farmer engages in other activity 0=No	1.11	0.308
Household income	Average income of farmers	912.4643	1160.086
Awareness and knowledge on insurance			
Source of Information			
Aware of GAIP	Dummy 1 if the farmer is aware of GAIP 0 if otherwise	0.514	0.5010
Risk and Risk coping strategy			
Weather Variation	Dummy 1 if major risk faced weather variation	0.668	0.472
Enterprise Diversification	Dummy 1 if the farmer uses this strategy 0 if otherwise	0.4615	0.4997
Bank Loans	Dummy 1 if the farmer uses this strategy 0 if otherwise	0.0144	0.1195
Savings	Dummy 1 if the farmer uses this strategy 0 if otherwise	0.1538	0.3617
Marketing &Production Contracts	Dummy 1 if the farmer uses this strategy 0 if otherwise	0.0481	0.2144
Borrowing from friends/relatives	Dummy 1 if the farmer uses this strategy 0 if otherwise	0.2260	0.4192
Sale of fixed assets	Dummy 1 if the farmer uses this strategy 0 if otherwise	0.0144	0.1195
Other	Dummy 1 if the farmer uses this strategy 0 if otherwise	0.0721	0.2593

Appendix A2: Background of the cereal production industry

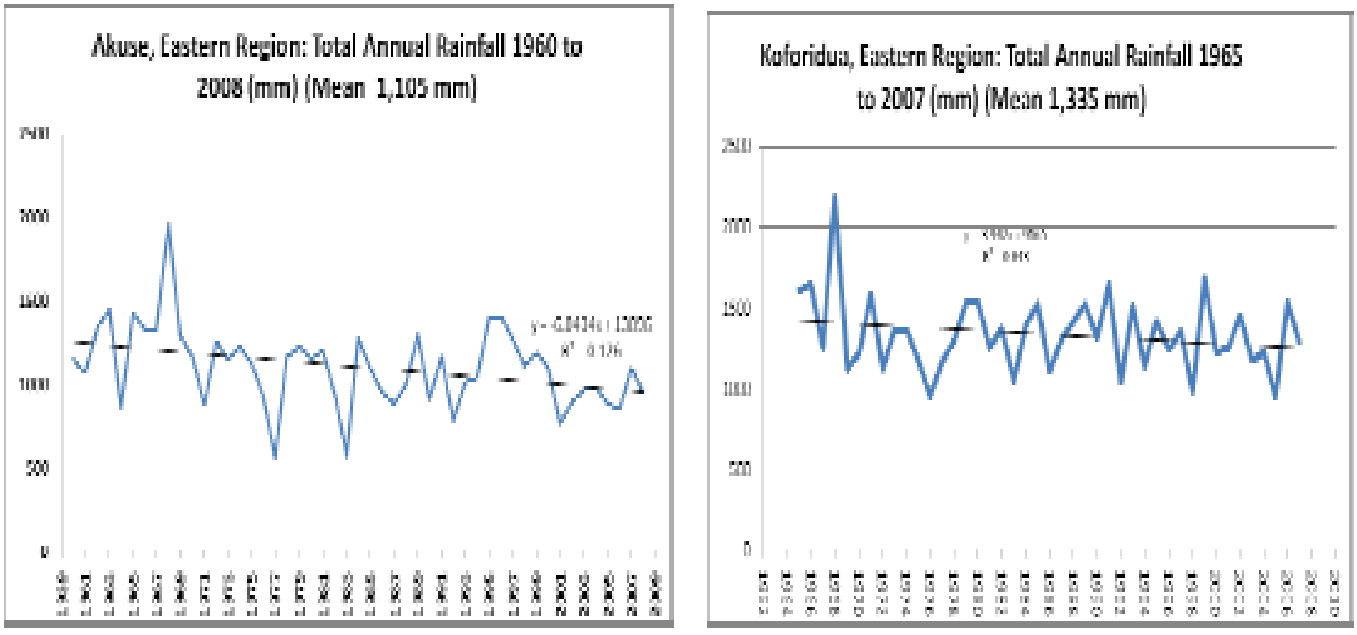
Maize is one of the most important staple crops in the country, constituting a major part of food consumption and therefore plays a very significant role in food security. Apart from human consumption, maize is also used as feed for livestock thereby increasing its demand. Rice is the second important grain to maize and most imported cereal in the country. Imports are mostly from Thailand, China and other countries to fill up the demand. A significant number of households cultivate maize and rice in Ghana and in the Eastern region. About 379,055 and 2,331 households are into maize and rice production respectively in the study area (MoFA, 2010).

Table 22: Cereal production and consumption in Ghana

Cereal	Gross Production (MT)	Total production available for consumption	Total Imports
Maize	1,871,695	1,310,187	18,000
Rice	294,962	256,617	283,000

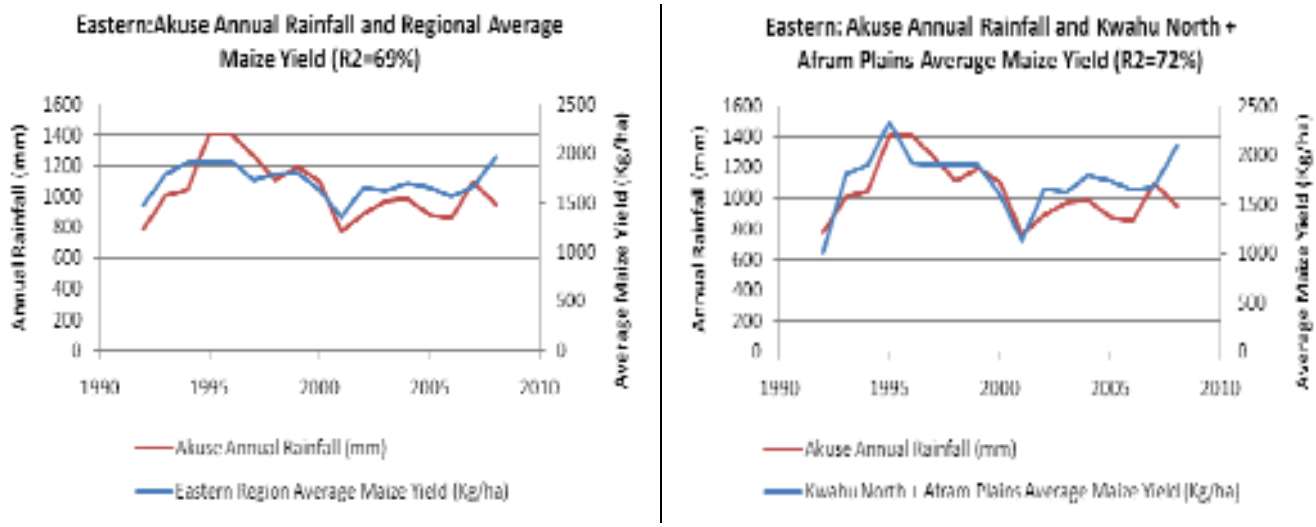
Source: MoFA (2011)

Figure 10: Annual rainfall in selected districts in the Eastern region



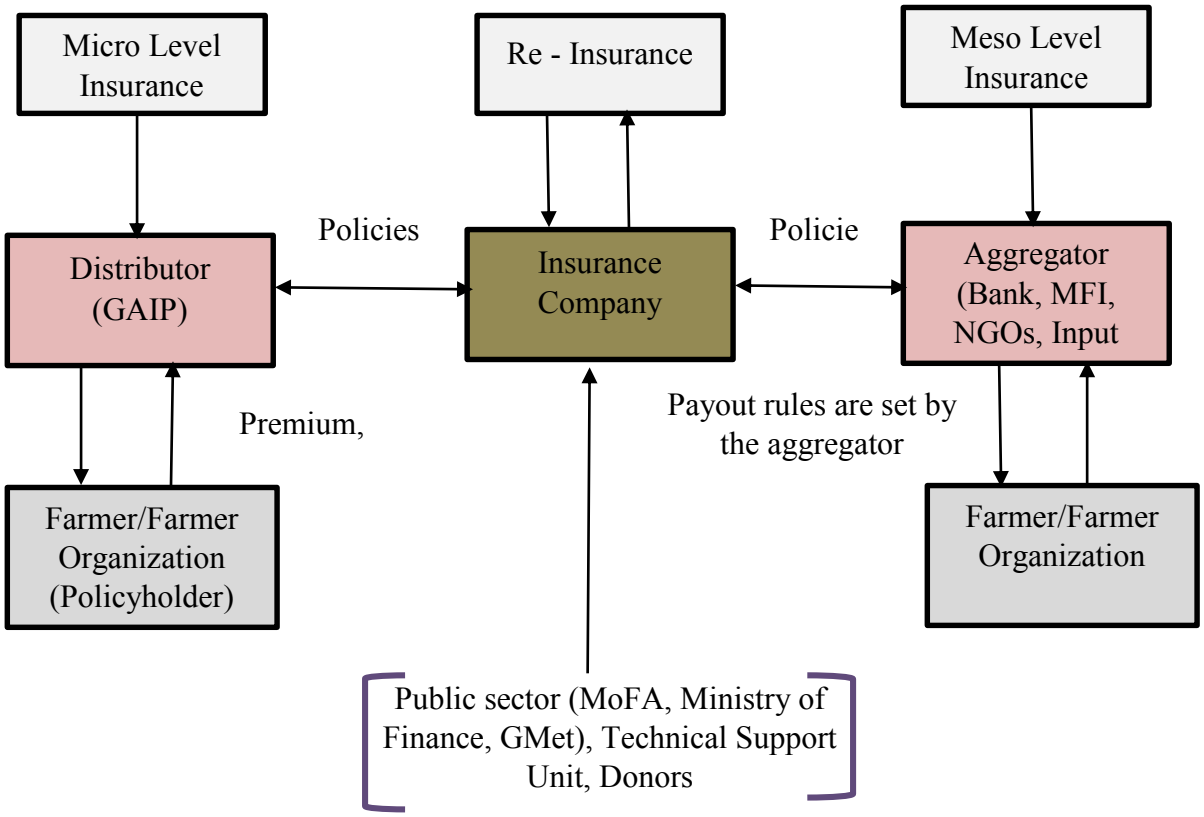
Source: Stutley, 2010

Figure 11: Correlation between maize yields and annual rainfall in the Eastern region



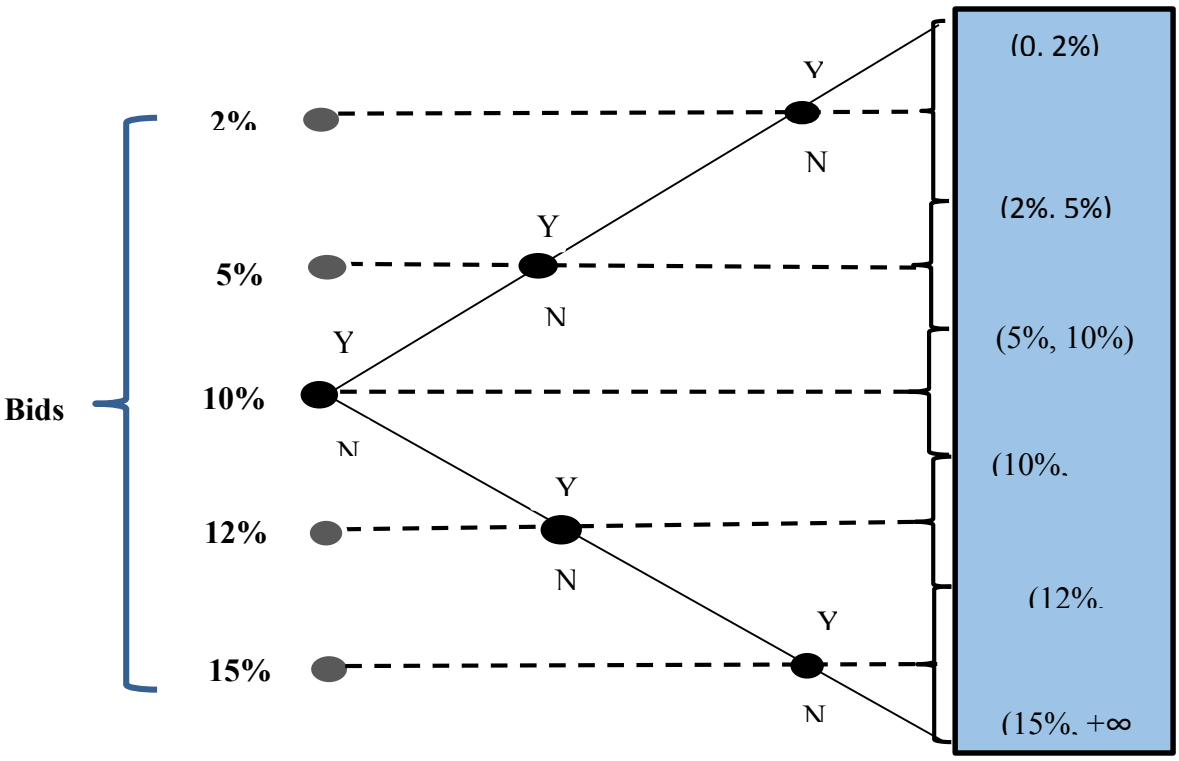
Source: Stutley, 2010

Appendix A3: Framework for Crop (Weather based index) Insurance in Ghana



Source: Author, adapted from CRMG (2009) and Dick (2009)

Appendix A4: Structure of triple Bounded CV Method



Source: Field Survey Data, 2015.

Appendix A5: Interval regression results (without accounting for sample selection problem)

Number of obs = 110
Wald chi2(16) = 344.96
Prob > chi2 = 0.0000

Log pseudolikelihood = -118.15617

	Coeff.	Std. error	z	P>z	[95% Conf.	Interval]
Age	.3926504	.1798064	2.18	0.029	.0402364	.7450645
Education	.0254347	.0463674	0.55	0.583	-.0654437	.1163131
Marital status	.0027878	.0656791	0.04	0.966	-.1259409	.1315164
Income	.1096053	.0401108	2.73	0.006	.0309895	.188221
Other Occupation	.1443426	.1202599	1.20	0.230	-.0913625	.3800477
Crop type	-1.257752	.0950698	-13.23	0.000	-1.444085	-1.071418
Farm experience	-.0179488	.0069762	-2.57	0.010	-.0316218	-.0042758
Medium scale	.1530191	.0969556	1.58	0.115	-.0370104	.3430486
Large scale	.466174	.0891315	5.23	0.000	.2914795	.6408685
Extension service	.0349595	.0975094	0.36	0.720	-.1561555	.2260745
Access to Credit	.006735	.1000744	0.07	0.946	-.1894072	.2028772
Weather variation	-.0869338	.0820971	-1.06	0.290	-.2478411	.0739736
Savings	.1896685	.1112924	1.70	0.088	-.0284607	.4077976
Borrowing	.0157831	.1264492	0.12	0.901	-.2320527	.263619
Marketing contracts	.2569258	.1311407	1.96	0.050	-.0001052	.5139568
Aware of GAIP	.0439182	.0812648	0.54	0.589	-.1153579	.2031942
Constant	2.632704	.6164003	4.27	0.000	1.424581	3.840826