UNIVERSITY OF CAPE COAST

DROUGHT INDEX INSURANCE POLICY SUBSCRIPTION AMONG CEREAL FARMERS IN THE NORTHERN REGION OF GHANA

BY

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DECLARATION

Candidate's Declaration

I hereby declare that this thesis is the result of my own original research and that no part of it has been presented for another degree in this university or elsewhere.

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Supervisors' Declaration

We hereby declare that the preparation and presentation of the thesis were supervised in accordance with the guidelines on supervision of thesis laid down by the University of Cape Coast.

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ABSTRACT

The study analyses the subscription to the drought index insurance policy among cereal farmers in the Northern Region of Ghana. The survey design and a choice experiment were used to elicit the hypothetical drought insurance policy preference for cereal farmers. A multi-stage sampling approach was used to randomly select 424 cereal farmers. Kendall's coefficient of concordance, Heckman's two-stage selection and Conditional logit model was used to analyse the data. The age of farmers, farm size, income, level of education and contact with an insurance extension agent statistically explained the determinants of insurance subscription whiles farming experience, farm size and off–farm income explained the intensity. Cereal farmers preferred a hypothetical drought index insurance policy with a premium of GhȻ35 per acre, rainfall data from the Ghana Meteorological Agency weather stations, non-bank payment method for indemnity payout, credit interlinked with insurance, reduction of next season's premium when farmers do not experience loss and subsidy on the insurance premium. Farmers are willing to pay extra on the premium for an index insurance policy that is interlinked with credit, the next season's premium is reduced when loss does not occur and subsidized premium. In ranking constraints faced in subscribing to the insurance policy, the level of agreement between subscribers (11.1%) was however slightly higher than non-subscribers (10.7%). This suggests that the criteria used by subscribers for their ranking were relatively more homogenous as compared to the non-subscribers. The study suggests, among others the need for government to subsidize the premium on agricultural insurance.

KEY WORDS

Subscription

Drought

Index

Insurance

Policy

Cereal

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LIST OF ACRONYMS

AYII	Area Yield Index Insurance
CLM	Conditional Logit Models
DCE	Discrete Choice Experiment
DII	Drought Index Insurance
GAIP	Ghana Agricultural Insurance Pool
GIZ	Gesellschaft für Internationale Zusammenarbeit
GLM	Generalized Linear Models
GMA	Ghana Meteorological Agency
GMNL	Generalized Multinomial Logit
IBLI	Index Based Livestock Insurance (IBLI)
IBRI	Index Based Rainfall Insurance
IPA	Innovations for Poverty Action
IPACC	Insurance Products for the Adaptation to Climate Change
ISSER	Institute of Statistical, Social and Economic Research
MCPI	Multi-Peril Crop Insurance
MoFA	Ministry of Food and Agriculture
MoFEP	Ministry of Finance and Economic Planning
NGO	Non-Governmental Organization
NIC	National Insurance Commission
OECD	Organization for Economic Co-operation and Development
OLR	Ordinal Logistic Regression
OLS	Ordinary Least Squares regression

PPP	Public-Private Partnership
RUT	Random Utility Theory
SEMs	Structural Equation Models
SRID	Statistics Research Information Directorate
TMU	Technical Management Unit
USD	United States Dollars
WII	Weather Index Insurance

CHAPTER ONE

INTRODUCTION

Overview

This chapter presents the background of the study, research problem under investigation, objectives of the study as well as the significance of the study. Also contained in the chapter is the delimitations and limitations as well as definition of terms and how the entire study is organised.

Background of the Study

In Ghana, agriculture is the most important sector of the economy, contributing around about 19% of the total national output and utilizing 70% of the work force (World Bank Group, 2018). Despite the fact that this sector has been noteworthy in the financial improvement of Ghana, it has throughout the years been bothered with difficulties that have brought about a much slower development rate. This is clear in the nation's agricultural sector development rate from 7.6% (2009); 5.3% (2010); 0.8% (2011); 2.3% (2012); 5.7% (2013); 4.6% (2014); to 2.4% (2015) (Institute of Statistical, 2016).

Farmers are progressively faced with floods, diseases, pests, theft, fire and hailstorms, which negatively affect agricultural productivity and welfare of family units that rely on upon farming for their very existence. A study conducted in 2013 in Ghana showed that poor household often rely on small-scale and rain-fed agriculture for their livelihood. Such practices normally caused farmers to encounter significant income and yield risk which are also attributed to the idiosyncrasies of individual farmers and inseparable risk linked with the production environment (Etwire, Al-Hassan, Kuwornu, & Osei-Owusu, 2013). The majority of farmers in Ghana encounter poverty traps and subsistence consumption constraints, making it difficult to mobilize savings to cope with weather shocks.

Farmers are progressively faced with floods, diseases, pests, theft, fire and hailstorms, which negatively affect agricultural productivity and welfare of family units that rely on farming for their very existence. In recent times, Ghana and other developing countries have experienced weather variations which have negatively impacted their agricultural economy (Etwire, Al-Hassan, Kuwornu, & Osei-Owusu, 2013). Research has demonstrated that around 5.5% of the national value of major food crops worth USD 228 million is lost every year because of a blend of all climatic, biological and natural peril (Mahul & Stutley, 2010). Studies conducted by (Thornton, Jones, Ericksen, & Challinor, 2011) and (Harvey et al., 2014) showed that the recurrence and the seriousness of same, has resulted in crop failure and livestock mortality stemming from climate related perils are expanding and their unfavourable impacts are turning out to be more uncontrolled. Smallholder farmers who remain the main source of food supply in most developing countries and account for two-thirds of the poor are not the only agricultural value chain actors affected by risk, however, it also affects actors in the entire local economy who depend on the fortunes of agriculture through the inter-sectorial linkages and final demand effects (Carter, Janvry, Sadoulet, & Alexandros Sarris, 2017).

Many Ghanaian farming households manage weather and other related risk by resorting to self-insurance (Thornton et al., 2011) approaches which are ineffective and costly for large weather shock as a result of the inefficiencies in the financial systems. Although indemnity-based insurance policy has the capability to address the problem of risk, uptake of the insurance policy is low. This is because the cost of lost adjustors assessing the damage of thousands of dispersed smallholder farmers for the requisite indemnity payment to be payed is expensive.

To help mitigate the effect of agricultural related risk in Ghana, the Ghana Agricultural Insurance Pool (GAIP), an organization of sixteen Ghanaian insurance companies whose formation was facilitated by the German Agency for International Cooperation (GIZ) and Insurance Products for the Adaptation to Climate Change (IPACC) initiative was established. GAIP's primary mission is to assist members in creating, designing, rating and marketing index insurance and multi-peril insurance products in Ghana. GAIP launched a rainfall deficit index insurance product in the year 2011 for maize, soya, sorghum and millet, as well as multi-peril insurance tailor-made to cover the various risks experienced by commercial and plantation farmers (Ghana Agricultural Insurance Pool (GAIP), 2012). The policy is based on rainfall measured data at weather stations operated by the Ghana Meteorological Agency (GMA) and other rainfall data obtained from satellite sources. The policy assumes that the weather conditions at farms and weather stations are all the same. Payments of indemnities are triggered when weather stations within the Region register dry spells that are slightly above the pre-defined thresholds set out in the policy contract. If rainfall data measured at the weather stations are below the threshold (i.e. 25mm in a dekad) then the payout for all insured farmers within the 20km radius of the weather stations is triggered. The rainfall measured at a weather station is thus used as a proxy for determining the basis for claims payment. The drought index insurance policy has been sold in the Northern, Upper East and Upper West Region of Ghana to farmers, input dealers, aggregators, nucleus farmers, financial institutions by Ghana Agricultural Insurance Pool (GAIP).

Statement of the Problem

(Brush, 2013) acknowledges that, historically farmers have managed risk by turning to a blend of traditional agricultural practices, community institutions and state for support. Farmers have also mitigated risk through the act of "diversity management" and the utilization of crops derived from endemic plant species that are relatively resilient to local stresses. Other traditional risk management mechanisms include conventional micro-insurance, crop insurance and formal methods such as loans, savings or informal measures like gifts, donations, safety nets and mutual insurance networks with neighbours. However, these are less effective in covering farmers' losses (Santos, Sharif, Rahman, & Zaman, 2011).

A study in the Northern part of Ghana (Etwire, Al-Hassan, Kuwornu, & Yaw Osei-Owusu, 2013) suggests that the effects of climate change leading to increased frequency of drought and occasional flooding are taking a massive toll on farmers. Farmers have seriously been affected by catastrophic weather events like droughts, floods and bush fires in 1983, 1997, 2002, 2007 and 2009 (Logah, Bekoe, & Kankam-Yeboah, 2013). Households have therefore resorted to consumption-smoothing risk coping mechanisms such as self-insurance and precautionary savings; and income-smoothing risk management strategies like diversification and low-risk activity taking; others are informal group-based risk-sharing and loans are used to climatic risks, economic fluctuations and individuals-specific shocks (Dercon, Hill, Clarke, Outes-Leon, & Seyoum Taffesse, 2014). However, these risk management strategies used by farmers are not effective in addressing the array of risk confronting them; therefore, risk transfer approaches in a form of formal insurance were found to be an appropriate instrument to transfer risk, eradicate the fear of risk, encourage investment and spread of covariate risks. Formal insurance has the capacity to pool and transfer risk frequently faced by smallholder farmers (Awel & Azomahou, 2015). A notable exception is a study of individually marketed index-based rainfall insurance (IBRI) in Northern Ghana which found that 40 to 50% of the target population of smallholder farmers purchased insurance contracts at actuarially fair prices (Karlan, Osei, Osei-Akoto, & Udry, 2014). However, these results reduced drastically (to 5%) in years following the initial study when changes to the marketing strategy were adopted, confounding the initial results. Binswanger-Mkhize (2012), Carter, de Janvry, Sadoulet, & Sarris, (2014) and Miranda & Farrin, (2012) also assert that, notwithstanding continued pilot testing of weather index insurance products in low income countries, its actual uptake has been far below expectations.

In spite of these prospective benefits, there is a much lower uptake of index-based insurance products than initially expected (Binswanger-Mkhize, 2012). Poor household who are mostly risk averse and could derive enormous benefit from micro insurance products were found hesitant in the adoption of weather index insurance, unless premiums are linked with other benefits or subsidized in such a manner that insurance becomes quasi-compulsory (Clarke, Mahul, Rao & Verma, 2012) and (Miranda & Farrin, 2012). The disparity emanating from the anticipated and actual demand among smallholder farmers is attributable to limited trust, lack of insurance experience and liquidity constraints during the time of planting (Cole et al., 2013) and (Hill, Hoddinott & Kumar, 2013). Basis risk has been cited by other studies as a major issue for weather index insurance (Norton, Turvey & Osgood, 2013), (Elabed, Bellemare, Carter & Guirkinger, 2013) and (Jensen, Barrett & Mude, 2016). Serfilippi, Carter & Guirkinger, (2015) also reported that though payment of insurance rebates was in the future, farmers still opted for it.

Various field experimental research was conducted in order to have a better understanding of the insurance demand of farmers as well as what determines such demands (Norton et al., 2014) and (Takahashi, Ikegami, Sheahan & Barrett, 2016). Nevertheless, the preference and the willingness to pay for specific attributes of weather index insurance products have barely been analysed. Such knowledge could be beneficial in the adjustment of policies and contractual agreement for smallholder farmers. An observation of how farmers respond to changes in a drought index insurance policy would be intriguing. Nonetheless, observational data with variations in the insurance policy and contract are unavailable. This study, therefore seeks to bridge this knowledge gap in Ghana's agricultural insurance space.

Main Objective

The main objective of this study is to analyse the subscription of cereal farmers to drought index insurance policy in the Northern Region of Ghana.

Specific Objectives

1. To determine factors influencing subscription to drought index insurance policy and intensity among cereal farmers in the Northern Region of Ghana.
2. To determine the hypothetical optimal drought index insurance policy for cereal farmers in the Northern Region of Ghana.
3. To estimate cereal farmers' willingness to pay for the attributes of hypothetical optimal drought index insurance policy in the Northern Region of Ghana.
4. To ascertain the level of agreement on the constraints to drought index insurance policy subscription among cereal farmers in the Northern Region of Ghana.

Research Questions

1. What are the factors influencing subscription to drought index insurance policy and intensity among cereal farmers in the Northern Region of Ghana?
2. What is the hypothetical optimal drought index insurance policy for cereal farmers in the Northern Region of Ghana?
3. Are cereal farmers in the Northern Region of Ghana willing to pay for the attributes of the hypothetical optimal drought index insurance policy?

4. What is the level of agreement on the constraints to drought index insurance policy subscription among cereal farmers in the Northern Region of Ghana?

Significance of the Study

The study was conducted in the Northern region. The choice for the study area emanates from the fact that Northern region is one of the regions where the sensitisation, piloting and advocacy of the drought index insurance programme started and therefore a good choice for this study.

Research suggests that agricultural insurance has the potential to unravel other key services in the agricultural sector to enhance productivity. However, the conventional indemnity-based type of crop insurance is inadequate to protect smallholders because of the associated adverse selection weakness, moral hazard and the confounding insurance administration cost, especially when dealing with over-dispersed population of smallholders (Carter, Galarza and Boucher, 2007). Ghana Agricultural Insurance Programme (GAIP), Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), the National Insurance Commission (NIC), Insurance companies and other stakeholders' institutional drought index insurance policy to enhance farmers' access to formal insurance services and innovations in financial derivative insurance products.

The study has provided empirical evidence on the factors influencing subscription to drought index insurance policy and intensity, determined the hypothetical optimal drought index insurance policy, estimated willingness-to-pay for the attributes of hypothetical drought index insurance policy and the level of agreement on constraints to drought index insurance policy subscription among cereal farmers. The information of this kind is critical and provides the direction for future index insurance research and agricultural policy in Ghana.

Finally, this study has important implications for Ghanaian policy makers and insurance providers who seek the best way to support the livelihood of farmers' against climate resilience relief programmes that in the case of Ghana have to balance monetary profits and social objectives in their business operations.

Delimitations

The study was conducted in six districts and one metropolitan assembly, namely, Tolon, Nanton, Central Gonja, Sangnerigu, Kumbungu and Savelugu and Tamale Metropolitan Assembly out of twelve districts and one metropolitan assembly in the Northern Region of Ghana. The study was conducted using cereal farmers only without the other actors along the cereal value chain.

Limitations

Financial constraints and time were the main reasons for the selection of study districts and metropolitan assembly. The data provided by farmers were mainly based on memory recall. There is the likelihood that farmers may omit some responses to some items in the data collection instrument due to information overload.

Organisation of the Study

The thesis was organised into eight chapters. The first chapter introduces the study and provides a background and a statement of the problem, research objectives and questions, significance of the study, delimitation and limitations.

The second chapter looks at literature review as well as the conceptual and theoretical underpinnings of the study. Literature of constraints to the subscription of index insurance, determinants of the subscription of index insurance, Random Utility Theory, Utility Maximization Theory, Lancaster's Theory and willingness-to-pay was reviewed.

Chapter three presented procedures used for the study and their justification. The chapter describes the research design, study area, population, sampling procedure, data collection instruments, data collection procedures, data processing and analysis employed.

Chapter four presents and discusses results of socioeconomic characteristics of cereal farmers and the constraints to drought index insurance policy subscription among cereal farmers in the Northern region of Ghana.

Chapter five presents and discusses the results on determinants of drought index insurance policy subscription and intensity. Furthermore, the hypothetical optimal drought index insurance policy was presented and discussed in chapter six. Chapter seven, presented the attributes of the hypothetical drought index insurance policy which gave cereal farmers, the utility or maximum satisfaction.

Chapter seven presented the results and discussions on the willingness of farmers to pay for the attributes of the hypothetical drought index insurance policy. It shows how much, cereal farmers and prospective clients may be willing to pay or otherwise, for the hypothetical optimal drought index insurance policy.

Chapter eight presents the main findings of the research as well as the conclusions. The chapter specifically looks at the summary, conclusion, recommendation, implications for agricultural extension work and suggestions for further research.

CHAPTER TWO

LITERATURE REVIEW

Overview

The literature in this chapter covers the theoretical and conceptual underpinnings for subscription to drought index insurance policy. Importance was placed on Random Utility Theory, Utility Maximization Theory and Lancaster's Theory on the subscription to drought index insurance policy. Literature was also reviewed in the following areas; Concept of Risk, Concept of Uncertainty, Overview of Agricultural Insurance, History of Crop Insurance in the World, History of Agricultural Insurance in Ghana, Current State of Agricultural Insurance in Ghana, Problems of Agricultural Insurance in Ghana, Index-Based Insurance Products. The chapter also reviewed literature on the constraints to the subscription of drought index insurance policy, determinants of drought index insurance policy subscription and willingness-to-pay for the drought index insurance policy. The chapter ends with the Conceptual framework underpinning the study.

The Concept of Risk

Within agricultural economic management domain, risk can be referred to as the array of judgement and probabilities which will occur in the future production which is dependent to their former's experiences and related knowledge (Knight, 1921). Nehme (2007) perceived risk as anything that can lead to the reduction of consumption below sufficient levels. On the hand, Hardaker et al., (2015) enforced the perspective of Knight's on the concept of uncertainty when they defined risk as imperfect knowledge with unknown probabilities.

According to Anafo (2011), risk and uncertainty are part of agriculture. A study by Knight (1921) posits that, when probabilities can be allotted a chance of loss it is known as risk. He further advanced the argument that uncertainty prevails if probabilities cannot be assigned to a situation. Ellsberg (2001) in trying to bring an understanding to the issue of risk added that there is risk when states of nature are apportioned with subjective or objective probabilities. However, studies by Atkins & Bates (2007) argues that the work of Knight (1921) accentuated more on the negative of risk since it indicates negative outcomes however positive outcomes reflect the positive aspect of risk. There is some level of inadequacy in the definitions advanced by Knight (1921), Ellsberg (2001) and Atkins & Bates (2007) because they indicate pure risk (there is a chance of loss or break-even but no possibility of gain) whiles ignoring speculative risk where gains can be made.

According to Ellsberg (1961) and Chevas (2004), there is a distinction between fuzzy set theory, risk, uncertainty and ambiguity. They opined that ambiguity and uncertainty are related to information as well as the reliability, unanimity amount and type of information. The position of Knight (1921) was accentuated by Ellsberg (2001) who argued that the situation of uncertainty is established by the inadequacy of information to estimate the probability of uncertainty and when a decision maker behaves in a manner to warrant the non-existence of a well-defined objective or subjective belief distribution. According to

Fuzzy set theory, individuals may not have the capacity to distinguish between alternative prospects (Chavas, 2004).

The Concept of Uncertainty

The understanding of uncertainty may differ among individuals which is related to their subjective judgement, beliefs and emotions. Even when there is no existence of that probability, individuals try to measure, calculate and remove the uncertainty Denis (2006). The concept of 'uncertainty' can be described differently under different circumstances (Smithson 2012). A study by Walker et al. (2003), defines uncertainty as a departure from the unachievable ideal of completely deterministic knowledge of the important system. According to Jian and Rehman, (2017), uncertainty is the indeterminate result from the unpredictable future, therefore the probability and the event's appearance of each kind of the probability condition in completely uncertainty situation cannot be known. Uncertainty may be divided into two sources: (i) Objective uncertainty based on epistemological or ontological uncertainty, such as not-known; (ii) Subjective uncertainty is because of moral or rule reasons, such as ignorance.

Overview of Agricultural Insurance

Agricultural insurance products have been used in many countries, and has been largely successful in China and other developed countries (Sandmark et al. 2013). The first agricultural insurance product was developed in Germany in 1700 (Sandmark et al. 2013) which later emerged in Japan, Canada and United States, and today different types of this product are common in most parts of Europe.

According to Smith and Glauber (2012), agricultural insurance markets started in Europe over 200 years ago offering protection against livestock mortality and named peril events on a private basis. However, it is only in the last 50 years that there has been rapid development and expansion in the range and scope of insurance products offered to producers. Most of these expansions were accounted for by an extensive range of government supports, including subsidized premiums, subsidized delivery and loss adjustment expenses, and the public provision of reinsurance services (Smith & Glauber, 2012).

By the year 2007, premium subsidies among high income countries totalled almost $12 billion, with the United States, accounting for $3.8 billion (Mahul & Stutley, 2010). Since 2007, the United State of America's program has grown rapidly, with total liability in 2011 topping $115 billion and premium subsidies totalling almost $7.5 billion (Glauber 2013). The United State of America's crop insurance program is the world's largest in premium volume. Similar programs operate in Spain, Canada, Italy and Japan and programs have recently been introduced or are being expanded in several other countries such as France, Austria, Slovenia, and the Netherlands. Recent proposals within the European Union would broaden rural development support to include risk management programs such as crop, animal and pest insurance.

Crop Insurance in the Global Context

Agricultural insurance products have been used in many countries, and has been largely successful in China and other developed countries (Sandmark et al. 2013). Crop and livestock insurance have a long history in Western Europe. Crophail insurance was offered in Germany as early as the late 1700s (Mahul & Stutley, 2010) and by the late 19th century in many European countries, as well as the United States. Livestock insurance was offered in Germany in the 1830s and in Sweden and Switzerland by 1900. Early insurance schemes were largely provided by small mutual companies offering coverage for single or named perils. Limited attempts to sell multiple peril crop insurance largely ended in failure (Gardner & Kramer, 1986). Government involvement in multiple peril crop insurance began in the late 1930s in the United States. Federal crop insurance was first authorized in Title V of the Agricultural Adjustment Act of 1938 (Benedict 1953). The program was offered on a pilot basis and initially covered only wheat; in 1939, about 165,000 wheat policies were issued on approximately 7 million acres in 31 states (Rowe & Smith, 1940). For its first 40 years, federal crop insurance was offered for a limited number of crops and in a limited number of counties. County crop programs were often withdrawn if heavy losses were experienced and coverage levels were adjusted to limit loss exposure. By 1980, only about half of the nation's counties and twenty-six crops were eligible for insurance coverage (Chite, 1988).

The Federal Crop Insurance Act of 1980 made crop insurance the primary form of catastrophic protection available for producers (Glauber & Collins, 2002). This act eliminated standing disaster programs for producers if crop insurance programs were available in their county; to increase participation, premiums were to be subsidized. Prior to the 1980 act, agricultural producers paid the full premium to the risk of loss, but delivery and loss adjustment costs were paid by the government. The 1980 act provided an additional subsidy that covered up to 30%

of the premium costs. Lastly, the 1980 act puts a delivery of crop insurance in the hands of private insurance companies to enhance policy sales. Nevertheless, in the 1980s and early 1990s, the program exhibited only slow growth, and by 1994 less than 100 million acres were enrolled. Successive reform acts passed in 1994 and 2000 increased premium subsidy levels, particularly at higher levels of coverage. By the year 2011, over 265 million acres were enrolled in the program. Concurrently, liability grew from $14 billion in 1994 to almost $115 billion in 2011.

Japan implemented a multiple peril crop insurance program in 1939 that provided nationwide coverage for paddy rice, wheat, barley and mulberries, and subsidized 15% of premium costs (Yamauchi 1986). Canada passed legislation authorizing multiple peril crop insurance in 1959. After the Second World War, multiple peril crop insurance programs were gradually introduced throughout much of Europe, with subsidized programs implemented in Austria in 1955, Italy in 1970, Spain in 1980, and France in 2005 (Mahul & Stutley 2010; OECD, 2011).

Agricultural Insurance in Ghana

Innovations for Poverty Action (IPA), 2008, 2009a, 2009b, 2010; Karlan et al., (2012) reported that in the year 2009, Innovations for Poverty Action (IPA) under an action research program piloted an informal weather index insurance program that provided insurance cover for maize against rainfall deficit and excess rainfall in some selected communities within the Northern Region of Ghana. A study into the underinvestment in agriculture in some selected communities led to the design of drought index insurance policy. In 2009, a study by IPA offered a free deficit and excess rainfall insurance cover called "Takayu rainfall insurance" to 260 farmers who volunteered to participate. In order to ascertain the willingness to pay and the ability to afford a crop insurance premium, different premium rates were introduced to farmers in the year 2010. The premium introduced by IPA ranged from GH¢1 per acre for a Gh¢100 payout to GH¢14 per acre (Stutley, 2010; IPA, 2008, 2009a, b, 2010). IPA came out with an actuarially fair rate of between 8 to 10% of the cost of production.

Table 1 below shows the statistics of farmers' subscription to actuarially fair rate of excess or deficient rainfall deficit in the year 2010

Table 1: Statistics of Farmers' Subscription to Actuarially Fair Rate of Excess Rainfall or Rainfall Deficit Index Insurance Policy

Premium per acre (GH¢)	% of farmers
1.00	88.00
4.00	72.00
8.00 – 9.50	40.00
12.00	19.00

Source: Stutley, (2010)

In December 2009, with funding from the German Federal Ministry for the Environment, Nature Conservation, and Nuclear Safety the Innovative Insurance Products for the Adaptation to Climate Change (IIPACC) project was initiated (Stutley, 2010). The (IIPACC) project was implemented by the National Insurance Commission of Ghana (NIC) and Gesellschaft für Internationale Zusammenarbeit (GIZ) (Stutley, 2010). German Development Cooperation (GIZ) in 2011 initiated an actuarially fair price agricultural insurance product through the IIPACC project. The rationale for this project was to build and implement demand-driven and economically sustainable insurance products to cover farmers, aggregators, agricultural input dealers and other players along the value chain against crop failure and financial loss emanating from harsh weather conditions.

GIZ and its implementing partners in 2011 established the Ghana Agricultural Insurance Program (GAIP) with the aim of implementing Weather Index Insurance (WII) on a commercial basis for maize in the Northern, Upper East and Upper West region. A research based Non-Governmental Organisation (NGO) and three financial institutions became beneficiaries of the weather index insurance for over three thousand farmers in the Northern, Upper East and Upper West region. During the 2012 farming season, the weather index insurance program was extended to the Eastern, Ashanti and Brong Ahafo region.

Current State of Agricultural Insurance in Ghana

The GIZ team helped develop the agricultural insurance system to offer protection for stakeholders within the agricultural value chain. According to Smith and Barry (2010) and Stutley, (2010), the team that designed the agricultural insurance system concluded on a Public-Private Partnership (PPP) approach in the provision of insurance for farmers and other stakeholders along the agricultural value chain. Figure 1 Illustrates the Organisational Chart of Ghana Agricultural Insurance Program (GAIP).

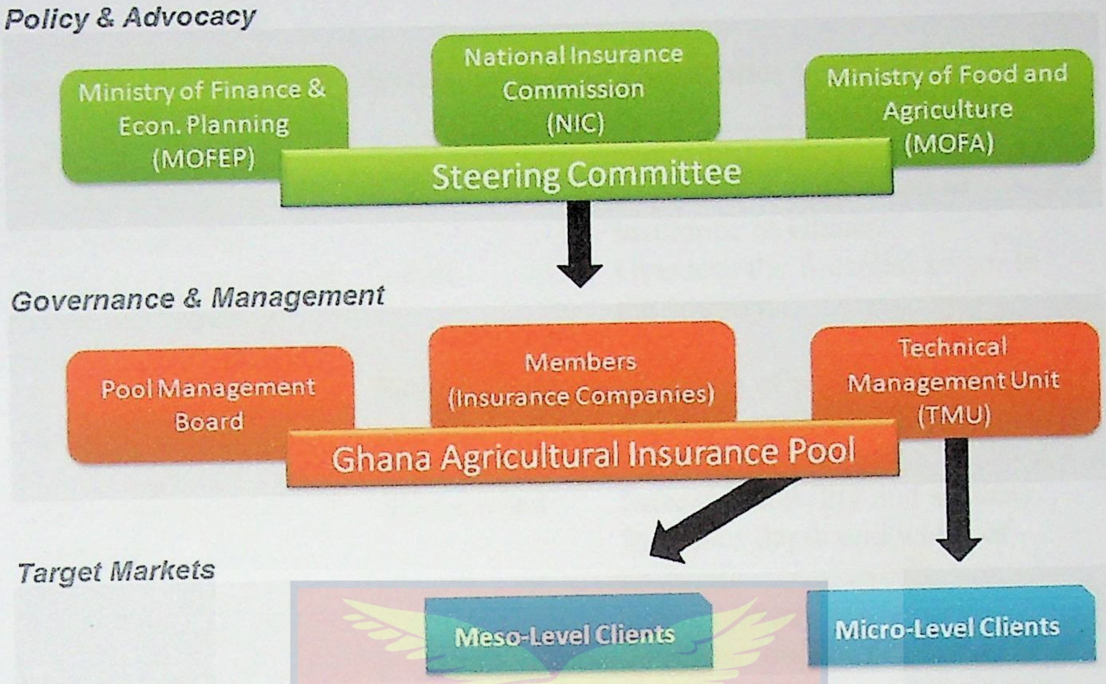


Figure 1: Organisational Chart of Ghana Agricultural Insurance Program (GAIP)

Source: GAIP Brochure (2012)

The Steering Committee of GAIP is authorized to give policy and advocacy direction that will bring about the needed development in agricultural insurance. The Steering Committee consist of fundamental stakeholders who ensure the efficient delivery of agricultural insurance in Ghana. The committee meets to provide directions for implementation.

Table 2: Mandates of Key Stakeholders that Constitutes the Steering Committee

Stakeholders	Type of Sector	Functions of the Stakeholders
National Insurance Commission (NIC)	Public	Regulates the provision of insurance in Ghana.
Ministry of Finance and Economic Planning (MoFEP)	Public	Oversees the financial sector in the country.
Ministry of Food and Agriculture (MoFA)	Public	Provision of policy direction for the development of the agricultural industry.
Ghana Reinsurance Company	State-owned	Increases stability and security. Increases depth and width of coverage. Assist primary insurance company understand and coordinate its reinsurance needs.
Ghana Meteorological Agency (GMA)	State-owned	Provide up-to-date meteorological data and information.
Ghana Insurers Association (GIA)	Private	Bringing all insurers under one umbrella and streamline their activities
Stanbic Bank and Agricultural Development Bank	Private	Represents the banking sector.
Farmers Representative	Private	Represent and take decisions on behalf of farmers.
GIZ	Development partners	Coordinate the planning, design and implementation of the crop insurance initiative in Ghana.
World Bank	Development partners	Financing and provision of technical advice.

Source: GAIP Brochure (2012)

The Ghana Agricultural Insurance Pool (GAIP) consists of 16 non-life insurance companies and Reinsurance Companies with Hollard Insurance Company Ltd as the Lead Insurer for the Pool. GAIP mandated by its constitution to establish a Technical Management Unit (TMU) that is responsible for the design rate, market sales, underwriting and claims settlement. An eight (8) member

Technical Committee comprising of senior underwriters drawn from Pool member companies supports the TMU by serving as an advisory body. The management board manages the pool.

Stutley (2010) added that the Ghana Coinsurance Pool provides different types of insurance products. Some examples of these products are Drought Index Insurance (DII), Area Yield Index (AYII), Multi-Peril Crop Insurance (MCPI), and Named Peril Insurance for rubber, forestry and plantation crops. The index insurance for millet, maize, sorghum and soya was the first product to be designed. The index is a variable (rainfall, humidity, sunshine, measured yield) that is easy to measure and has a high correlation with the loss or success of the insured crops. The first index insurance product i.e. weather index insurance which is drought specific, uses estimates of rainfall measured by a satellite data provider or GMet at a weather station located within a determined radius as a basis for determining whether an insured farm experienced drought or otherwise. A payout is triggered when insured farmers record rainfall below an agreed threshold in the season. The drought index insurance product is available for farmers in the Northern, Upper East, Upper West, Brong Ahafo, Ashanti, Eastern and Volta region. The Area Yield Index Insurance (AYII) which is the second index insurance product provides insurance cover for farmers by using the average yield estimate of the district where the farm is located. The average yield is estimated by Statistics Research Information Directorate (SRID) of the Ministry of Food and Agriculture (MoFA).

The administrative cost of index-based insurance is reduced, leading to a reduction in premium rate. This can be attributed to the fact that field loss assessment is not a requirement compared to traditional indemnity-based insurance. Despite the merits of index-based insurance, there is a problem of basic risk which arises when the index activates a payout while on the farm, conditions are favourable and vice versa. Burke, de Janvry and Quintero (2010) admits that there are challenges with how products can easily be explained to farmers in the course of product marketing and sensitisation process as well as the transparency and accuracy of the use of satellite data.

GAIP has “traditional indemnity based” crop insurance, which is often available for commercial farms with the ability to provide data on production and sales for a number of years. Some examples of the traditional indemnity-based crop insurance are Named Peril Damaged Based Cover, Multiple Peril Crop Insurance etc. With this type of insurance product, an on-farm loss assessment is carried out to ascertain the actual loss and substantially a commensurate compensation to the farmer. The problem of basic risk is curtailed, but insurance companies often suffer from moral hazard.

GAIP is putting the necessary structures in place to help develop the requisite insurance products tailored towards the needs of stakeholders in the agricultural supply value chain. The stakeholders are smallholder farmers, input dealers and meso-level clients (processors, commercial farmers, banks, exporters and agricultural based non-governmental organisations). Widespread sensitization and marketing framework/system as well as effective systems of distribution to help improve the penetration rate of the product.

Problems of Agricultural Insurance in Ghana

The problem of agricultural insurance in Ghana are: lack of development and roll out of product, lack of access to insurance, slow response from state institutions, lack of access to consistent and reliable data, lack of active involvement in local practitioners and lack of local rating capacity and expertise. GAIP is confronted with the challenge of obtaining good data and information. The Technical Management Unit (TMU) requires data on production, agronomy (planting time, plant growth information) climate (rainfall, wind speed etc.) that can help in the design of agricultural insurance products (Burke et al. 2010).

Over the years GMet has provided data for the design of the weather index insurance products. However, obtaining data on farm yields, farm risk etc. has been difficult. In circumstances where the data are available, they are not cleaned, packaged and stored in a readily useable form. This leaves GAIP with no choice than to adjust the data. The unavailability of data as well as the adjustment of poorly packaged data hampers the design of new, innovative and sustainable agricultural insurance products for various crops and stakeholders within the agricultural value chain (Miranda & Farrin, 2012).

The government of Ghana is playing a passive role in the provision of agricultural insurance. MoFA and MoFEP hold policy discussions on behalf of the government of Ghana. The nonexistence of subsidy to farmers, policy and direction, investment in research and data generation as well as lack of government institution taking up the role of sensitizing the populace about the benefit of agricultural insurance.

The level of agricultural insurance provision in Ghana is low as a result of low level of awareness among stakeholders and erroneous perception about insurance. Additionally, the agricultural insurance premium is relatively higher because the cost of sensitization, marketing and the delivery of the insurance product are born by GIZ and the private companies. A redraw of support by GIZ and the private companies will result in the passing on of cost to prospective consumers by means of premium loading since the government does not subsidize agricultural insurance premium. The actors within the agricultural value chain attest to the importance of agricultural insurance products, higher premium rate prevents them from subscribing to the insurance policy. Currently the premium rate for the WII is relatively higher and averaging between 8% and 12%.

Index-Based Insurance Products

Over the past ten years, non-governmental organisations, researchers, national governments and international multilateral organisations have shown interest and directed efforts towards the development of microinsurance to serve the needs of the poor-to cover weather shocks associated with smallholder farmers (Patt et al. 2009). Index-based insurance allows for the removal of structural problems associated with conventional agricultural insurance systemic risk, moral hazard and adverse selection (Dercon et al. 2008). In an index-based insurance product scheme, a formal claim from the insured nor an individual check is not a prerequisite for processing indemnification. Under this scheme, an independently monitored weather index that is based upon an objective event that causes loss and that is strongly correlated with the variable of interest (for example, the amount of rainfall, crop yield etc) is used to trigger payouts. (Di Marcantonio and Kayitakire, 2017). There are three main types of index-based insurance products namely:

Area-yield index insurance: In the early 1950s, Sweden developed the first area-yield index insurance product. This product was implemented in India in 1979 and the United States in 1993. The index is an average over a large area, e.g. a district. Indemnities are determined as a function of the difference between the longer-term average yield and the area yield for the current season in the same area (Di Marcantonio and Kayitakire, 2017).

Commercially, weather index-based insurance has been underwritten since 2002. This type of policy use amount of rainfall or temperature as proxies to trigger indemnity payouts the insured. Intensive technical inputs, skills, high quality weather data and infrastructure are required to operationalise this product (Di Marcantonio and Kayitakire, 2017).

The indexes of remotely-sensed index-based insurance is constructed by employing a remote sensing data and are alternatives of either weather index-based or area-yield insurance schemes. The purpose of these products was to resolve the problems of insufficiency of weather stations in remote rural areas. The lack of reference data makes it difficult to link the index to losses when calibrating the model (Rojas et al. 2011).

Theoretical Framework

The theoretical framework in this session clearly described the specific theories related to the study. Random Utility Theory, Utility Maximization Theory and Lancaster's Theory were the theories reviewed. The paragraph below discusses how the study fits within the various theories.

Random Utility Theory

According to Lancsar and Louviere (2008), the discrete choice experiment (DCE) approach encapsulates the random utility theory (RUT), experimental design theory, consumer theory, and econometric analysis. The RUT posits that some components of preferences are unobservable to the researcher and therefore treated as random (Manski 1977; McFadden 1974). Random utility choice models are robust when dealing with violations of compensatory decision-making and strictly additive (i.e. 'main effects only') utility functions (Louviere, Hensher, and Swait 2000). Random utility choice models are widely accepted because of the (welfare) economic axioms, formal tractability and empirical performance emanating from strong econometric foundations. The RUT-based model requires the decomposition of utility into random or the unexplainable component and system or explainable component (Louviere, et al., 2000).

The expanding theory of choice was advanced by McFadden (2001) by taking the Extreme Value Type I errors into consideration. This leads to conditional logit models (CLMs). Utility for each attribute (i.e. premium, basis risk, mode of claims payout, interlinking credit with insurance, no claim discount payment and subsidy) is separated into random and systematic components. Typically, the systematic component is specified as a generalized regression function of attributes of alternatives, fixed coefficient and covariates associated with individual choosers. A study by Train (2009), acknowledges that the parameters of the generalized regression functions may vary across the individuals in some systematic way reflecting an underlying (continuous) distribution of preferences. According to Fiebig, Keane, Louviere, and Wasi (2010), the Generalized Multinomial Logit (G-MNL) model assume that individuals differ in preferences and error variances and/or that error terms and/or preference parameters can covary.

Individuals' preferences can be modelled by a "mixed" logit model approach (McFadden and Train 2000; Dube et al. 2002). The utility for an individual d and alternatives i at choice occasion t is given as

$$u_{d,i,t} = \eta x_{d,i,t} + e_{d,i,t} \tag{1}$$

where $x_{d,i,t}$ denotes the vector of observed covariates, η is a vector of utility weights assumed distributed over individuals with means that are not necessarily zero; $e_{d,i,t}$ is an independently and identically distributed "idiosyncratic" error. Over the population of individuals, the vector η is assumed to be a multivariate random variable, and the variance-covariance matrix Σ is assumed diagonal. According to Fiebig et al. (2010), the choices are independent of each individual, but the mixing effect of η across individuals implies that each individual will have unique and enduring preferences over repeated choices.

According to Keane (1997), introducing a vector of latent variables ξ as a factor analytic representation, with $\eta = \gamma\xi$ where γ denotes a matrix of factor weights and the covariates in x can be attributes of alternatives or characteristics of individuals (Yáñez, Raveau, & Ortúzar, 2010; Bolduc and Daziano 2010; Hess and Stathopoulos 2011). More generally $\eta = \gamma\xi + \varepsilon$; hence, Σ is not diagonal even if the variance-covariance matrix of the vector of latent variables ξ is diagonal. The factor analytic approach is further extended to allow links between latent variables in the vector ξ of the form $\xi = \beta\xi + \delta$ where β is a matrix of regression parameters. The factor analytics combined attributes to form latent variables representing the main components of utility. This can be observed by taking cognizance of the fact that in some DCEs the a priori patterns in attributes are obvious.

Assumptions

The random utility theory is based on the hypothesis that individuals are a rational decision-maker, maximizing utility relative to their choices. The assumptions of Random Utility Theory are:

1. the generic decision-maker i, in making a choice, considers m_i mutually exclusive alternatives which make up the individuals choice set. The choice set may be different for different decision-makers;
2. the decision-maker i, assigns to each alternative j from the individual choice set a perceived utility, or "attractiveness" U_j^i and selects the alternative maximizing this utility;
3. the utility assigned to each choice alternative depends on a number of measurable characteristics, or attributes, of the alternative itself and of the

decision-maker, $U_j^i = U^i(X_j^i)$, where X_j^i is the vector of the attributes relative to alternative j and to decision-maker i;

4. the utility assigned by decision-maker i to alternative j is not known with certainty by an external observer (analyst), because of a number of factors that will be described later and must therefore be represented by a random variable.

Based on the assumptions above, it is not usually possible to predict with certainty the alternative that the generic decision-maker will select. It is also possible to express the probability of selecting alternative j conditional on the individuals choice set I^i as the probability that the perceived utility of alternative:

$$p^i\left[j / I^i\right] = Pr\left[U_j^i > U_j^i \forall k \neq j, k \in I^i\right] \quad (2)$$

The perceived utility U_j^i can be expressed by the sum, the systematic utility V_j^i, which represents the mean or the expected value of the utilities perceived by all decision-makers having the same choice context as decision-maker i (same alternatives and attributes), and a random residual, ε_j^i, which is the (unknown) deviation of the utility perceived by the user i from this value:

$$U_j^i = V_j^i + \varepsilon_j^i \quad \forall j \in I^i \quad (3)$$

The next paragraph hinges on utility maximization theory.

Utility Maximization Theory

The theory of utility maximization posits that obtaining the highest level of utility from the consumption of goods or services is a process. The process of maximizing utility is a key assumption underlying consumer behaviour which has a bearing on consumer demand theory. It is assumed that consumers make choices, especially concerning the purchase of goods, in order to obtain the highest possible level of satisfaction. Utility maximization can be achieved at the peak of the total utility curve. Utility maximization is the guiding notion underlying consumer choices analysed with consumer demand theory and utility analysis.

The Utility Maximization rule states that consumers decide to allocate their money so that the last dollar spent on each product purchased yields the same amount of extra marginal utility.

The utility maximization theory is built based on the following assumptions:

1. Consumers are assumed to be rational, trying to get the most value for their money.
2. Consumers' incomes are limited because their individual resources are limited. They face a budget constraint.
3. Consumers have clear preferences for various goods and services, thus they know their maximum utility for each successive unit of the product.
4. Every item has a price tag. Consumers must choose between alternative goods with their limited money incomes.

The criticisms of the utility maximization theory are:

1. It is so general that it can explain anything; consequently, its explanatory power in specific instances is diminished.

2. It depends on additional or auxiliary assumptions to generate specific results.
3. The notion of utility maximization is so extensive that it goes beyond the parameters of human decision.
4. It sustains an epistemic critique by neglecting the problem of explaining the causes of behaviour and also fudges the question of the individual development of capacities and dispositions.
5. It fails to address the problem of explaining behaviour, by reference to psychology or other matters.
6. It fails to demonstrate that utility maximization is a useful causal account of behavioural motivation.

The next chapter discusses Lancaster's theory and its relevance for the study.

Lancaster's Theory

The Lancaster theory provides a multidimensional orientation to offer a framework to link the economic theory of consumer behaviour to multi-attribute models developed by the behavioural science. The theory assumes that consumption is an activity in which goods, singly or in combination, are inputs in which the output is a collection of characteristics (Lancaster, 1966). Utility or preference orderings are assumed to rank collections of characteristics and only to rank collections of goods indirectly through the characteristics possessed by the goods. The richness of Lancaster theory is that a single good possesses more than one characteristic and simple consumption activity is characterized by joint outputs.

Furthermore, the same characteristic may be part of joint outputs of many consumption activities. The technical novelty of Lancaster theory is that it breaks away from the traditional approach that goods are the direct objects of utility. Instead, it proposes that the attributes or characteristics of the goods are the basis for which utility is derived.

The assumptions under Lancaster theory are summarized below:

1. Good or service, per se, does not give utility to the consumer; instead the attributes or characteristics which make up the said good or service give rise to utility.
2. In general, a good will possess more than one characteristic and many characteristics will be shared by more than one good.
3. A combination of goods may possess characteristics different from those pertaining to each good when separated. Strotz (1955) used the "utility tree" and other ideas associated with a particular good to explain a particular type of utility. The third assumption, of activities involving complementary collection of goods, has been made by Morishima (1959) in the context of single-dimensioned utility. The theory emphasized that it is only by moving to multiple characteristics can many of the intrinsic qualities of individual goods be incorporated.

The limitations of Lancaster's theory are that it ignores the perception process. The notion of 'perceived characteristics' may well differ from the physical properties of products and that some perceptual dimensions results from social-psychological cues produced by advertising, consumer education and word-of-mouth communication.

Variety seeking individuals play a role in many consumers purchasing decisions. The independent value of the variable is not accommodated in the Lancaster's theory (Bowbrick, 1996). It is possible that a consumer acquires utility from the consumption of many different items in addition to the consumption of the characteristic levels implied by the combinations of items.

The study hinges on the theories reviewed. Random Utility Theory (RUT) has a relationship with choice experiment model. The discrete choice experiment (DCE) approach was chosen because it combines Random Utility Theory (RUT), Utility Maximization Theory and Lancaster's theory. This helped in explaining why all things being equal, cereal farmers in the Northern Region of Ghana will opt for a particular hypothetical drought index insurance policy among a number of index insurance policy options when it gives them maximum utility or satisfaction. Therefore, the need to determine the hypothetical optimal drought index insurance policy for cereal farmers. Furthermore, the random utility theory in conjunction with utility maximisation theory and Lancaster's theory etc helped to explain the cereal farmers' willingness to pay for the attributes of the hypothetical optimal drought index insurance policy. The cereal farmer first derives utility from the attributes (premium, basis risk, claims payout, interlinking credit with insurance, no claim discount payment and subsidy) of the hypothetical drought index insurance policy. A combination of the attributes which gives maximum utility to the cereal farmer eventually becomes the hypothetical optimal drought index insurance policy. Cereal farmers would appreciate a hypothetical optimal drought index insurance policy before eventually being willing to pay for the attributes which consolidates to form the resultant hypothetical optimal drought index insurance policy.

The utility maximization theory is based on rationality and that farmers, being economic agents would at all-time seeks maximum utility when subscribing to an index insurance policy. In other words, cereal farmers will be willing to pay for insurance premiums that are equal to the marginal utility derived from the index insurance policy. By way of explanation, it is expected that cereal farmers will evaluate the marginal gains and compared it to the marginal cost of an index insurance policy and would be willing to pay for the policy. The application of utility maximization theory in the study is that there is an economic justification why farmers may or may not be willing to subscribe to a drought index insurance policy.

Lancaster's theory emphasized that a good or service, per se, does not give utility to the consumer; it possesses characteristics or attributes, and these characteristics or attributes give rise to utility. The basis of Lancaster's theory suggests that farmers would be willing to subscribe to a drought index insurance policy based on some specific attributes that are attached to the policy. For instance, the mode of indemnity payout, the source of rainfall data, subsidy are the attributes that a farmer is likely to consider before subscribing to an index insurance policy.

Determinants of Drought Index Insurance Policy Subscription

Age of farmer

A research by Sherrick, Barry, Ellinger, and Schnitkey, 2004 (as cited in Lefebvre et al. (2014), found that younger farmers are more responsive to modern approaches of risk management like insurance as compared to their older counterparts. Kakumanu et al. (2012) reported that age has a negative and significant relationship on the farmer's willingness to pay for Weather-Based Crop Insurance Scheme. Sadati, et al. (2010) found that adoption of crop insurance was negatively related to age. A study of insurance acceptance by farmers in Indonesia using a binomial logistic regression, found age to have a negative effect on the acceptance of agricultural insurance (Sujarwo, Hanani, Syafria, & Muhaimin, 2017). Another study showed a negative effect of age on insurance take-up reported by Cole, et al. (2012b). A similar study in Ethiopia revealed that the likelihood of younger household heads with official positions to purchase crop insurance is high (Dercon, Hill, Clarke, Outes-Leon, & Taffesse, 2014). Similarly, a study conducted by Aidoo, Mensah, Wie, and Awunyo-Vitor (2014) also alluded to the fact that a farmer's willingness to adopt crop insurance is negatively influenced by age.

On a contrary, Lefebvre et al. (2014) found older farmers to be more likely to get insured but with a small marginal effect. That is, older farmers were unwilling to subscribe to agricultural insurance. Finally, it was found that age increases the likelihood of index insurance purchase Gaurav et al. (2011). To accentuate this assertion, Ntukamazina et al. (2017) reported that the willingness to adopt insurance products decreases by 0.058 with an increase in the age of a farmer.

Farming experience

A study conducted by Ye, Liu, Wang, Wang, and Shi (2016) points out that irrespective of the limited years of farming, cereal farmers are more able to understand the potential risks in farming based on information they have received. Jin, Wang, and Wang (2016) using a logistic model reported a positive effect of farming experience on the decision to take up weather index insurance. A study from Tanzania (Namwata, Welamira, and Mzirai, 2010) and Ghana (Baffoe-Asare, Danquah, and Annor-Frempong, 2013) found that farmers with more farming experience have the improved skills and the capacity to make adoption related decisions that are analytical in nature.

On the contrary, Wairimu, Obare, and Martins, (2016) asserted that farming experience was negatively significant at 10% alpha level, implying that there is a decreased probability of weather-based crop insurance scheme uptake resulting from the increased years of farming experience by household head. Inadequate knowledge of the weather index insurance policy could be a possible reason for this observation.

Level of education

A study by Ye et al. (2016) reported that the educational level of an individual is considered as a good indicator to understand and use financial insurance tools. This assertion agrees with the study by Gebre (2014) which reported that an increase in years of schooling increases households' willingness to purchase weather index insurance approximately by 0.24 times. However, households who received an informal education (church/mosque schools, adult literacy program and other literacy program) though, were more willing to pay for weather index insurance than those without any form of education but their willingness was statistically not significant. Another finding by Gine, Townsend, and Vickery (2007) shows that the probability of a farmer to buy an index insurance product is higher when the household is better educated. This is consistent with the role of financial literacy education and training in increasing awareness of, and changing attitudes towards, formal financial products (Carpena, Cole, Shapiro, & Zia, 2011). Studies by (Aidoo, Mensah, Wie, and Awunyo-Vitor, 2014) and (Arshad, Amjath-Babu, Kächele, and Müller, 2015) reported that literacy has a positive relationship with a farmer's willingness to adopt the agricultural insurance scheme. Other research by Koloma, (2015) and Lin, et al. (2015) suggest that there exist a positive relationship between literacy and the willingness of farmers to adopt agricultural insurance policy. De Angelis (2013) also reported that farmers who were more interested and willing to pay higher premiums for rainfall insurance policy were more literate.

On the contrary, Njue, Kirimia, and Mathengea (2015) reported that the amount of crop insurance premium paid is negatively and significantly influenced by years of formal education. This agrees with Aidoo, et al. (2014) who found that less money is spent on insurance premium by well-educated individuals who consider farming as an auxiliary activity because they have an opportunity to earn substantial income from formal work. Clarke and Kalani (2011), found that basic level of literacy matters most and not the education or years of schooling.

Farm size

A study by Karlan, Osei, Osei-Akoto, & Udry (2012) found that farmers with insurance cover allocated a larger acreage of land to rainfall sensitive crops, thereby increasing both yield and land cultivated with maize by 9% in Northern Ghana. Another study conducted in France and Italy by Enjolras, Capitanio, and Adinolfi (2012) found that, farm size (cultivated area) and diversification (number of cultivated crops), are key factors in the insurance purchase decision. Cai (2013) explained that in China; tobacco farmers in the area of household financial and production decisions suggest that the introduction of insurance increases the area of production by about 20% and decreases production diversification. Similarly, Kaczała and Wiśniewska (2015) found that farmers who own bigger farms are more likely to purchase the index insurance product than farmers with smaller farms. In that report, 21% of farmers owning more than 20 ha were likely to purchase as compared to 10.7% of farmers owning less than 7 ha. Also, in an adoption study, Osipenko, Shen, and Odening (2015) reported a positive correlation between farm size and the amount farmers are willing to pay for an agricultural technology.

On the contrary, research in Kenya by Wairimu et al. (2016) using the double hurdle model, reported that household farm size did not have significant influence on the uptake weather-based crop insurance. Aidoo et al. (2014) found that the premium a farmer was willing to pay in order to have a crop insurance cover is negatively influenced by the farmer's farm size. Also, Ntukamazina et al. (2017) reported that the willingness to adopt insurance products decreases by 0.167 with an increase in farm size.

Income

A study by Wang, Ye, and Shi (2016) hypothesized that richer farmers would have a higher demand for the insurance. But the decision to have the farm covered by crop insurance is affected by many factors. Rather than subscribing to insurance, richer farmers could recover through other means like off-farm investments, if their farms are destroyed by devastating weather conditions.

A research conducted in Ghana showed that averagely, there was an increase in over 20% for farm income (net of insurance premiums and indemnity payments), part of which can be accounted for by changes in production strategies apparently induced by a reduction in uninsured risk exposure (Karlan et al. 2014). Patt et al. (2009) found that the impact of the household income level on rainfall index insurance is minor. Moreover, the demand for rainfall index insurance could be reduced significantly as a result of liquidity constraints (Gine 2015, McIntosh, Sarris, and Papadopoulos, 2014) and their adjustment to the farmers' needs could increase the take-up by 34%. Finally, a research by Cole et al. (2012) reported that, there is a correlation between the wealth of a farmer and the uptake of insurance. Jensen, Barrett, and Mude (2014b) maintain that in Kenya, Index Based Livestock Insurance (IBLI) generally increased the income from milk production.

On the contrary, Clarke (2011) points out that the relationship between wealth and demand for index insurance is not monotonic for most reasonable utility functions in such environments. However, a contradictory evidence from an empirical study suggest that demand increases (Cole et al. 2013; Mobarak, and

Rosenzweig, 2012) or decreases (McIntosh, Sarris, and Papadopoulos, 2014) in variables associated with wealth.

Off-farm income

A study by Gebre (2014) reported that though an increase in off-farm income of households increases the willingness to purchase weather index insurance but not statistically significant. On the contrary, a study of soybean and corn farmers in Illinois, Indiana and Iowa by Velandia, Rejesus, Knight, and Sherrick (2009) using multinomial probit found that off-farm income negatively and significantly affected access to agricultural insurance.

Contact with insurance extension agent

A research conducted in Kenya by Wairimu et al. (2016) reported that access to extension services has a positive effect on the adoption of weather-based crop insurance scheme and increased the uptake by 0.5%. Abdullah, Auwal, Darham, and Radam (2014) found that receiving of agricultural extension service has a positive and significant influence in the willingness to pay for weather index insurance. Also, a recent research in Nigeria on cocoa insurance using a probit model, found the availability of agricultural extension service to be a favourable factor for the insurance (Falola, Ayinde, & Agboola, 2013).

Risk aversion

Empirical studies of index insurance demand conducted by (Cole et al. 2013) found a monotonic relationship existing between risk aversion and demand. However, these activities that turns to lower the risk of farmers' results in a lower return on investment (Janzen & Carter, 2013). A study in the northern Ghana using a randomised control trial found that riskier agricultural production choices were made by smallholder farmers as a result of weather index insurance (Karlan et al., 2014). Another randomized experiment conducted in India reported that, farmers were able to decrease self-insurance and switch to high-yield yet riskier production methods where rainfall index insurance was offered to farmers (Mobarak & Rosenzweig, 2013). Clark and Kalani (2011) found that a research in Ethiopia found historical risk exposure to have a positive influence on the uptake rates of indemnity insurance. A study in Southern Ethiopia by Hill and Viceiza (2011), reports a positive link between risk aversion and the purchase of insurance.

On the contrary, these earlier assertions disagree with the study by Gebre (2014) who reported that an increase in risk aversion, reduces the probability of selection of insurance products. A study in Ethiopia reports that under specific conditions, risk aversion and willingness to pay (WTP) are negatively correlated (Hill et al., 2013). An experiment carried out in Southern Mali by Elabed and Carter (2015) suggest that the index-insured risk is seen as a compound lottery with some degree of uncertainty around the insured risk and uncertainty around how well their losses (basis risk) will be reflected by the index. They found that 60% of farmers are compound risk averse.

Claim payout

A two-year panel studies by Karlan, Kutsoati et al. (2011) also show that people in rural Ghana are more likely to purchase if they or people in their social networks received payouts in the previous year. According to Stein, 2010 (as cited in Cole, Stein, and Tobacman, 2014), found that the repurchase decision on agricultural insurance products is influenced by the receipt of payout. Hill et al. (2013) also reported that insurance payout has positive effects on future purchasing in India. Cole, et al. (2014) agrees that for the insurance purchasers themselves (who received payouts) and the non-purchasers (who did not receive payouts); there is a large and significant effect of having insurance payouts in a village on purchasing decisions the next year. Similarly, Hill et al. (2013) acknowledge that there is a strong positive correlation between the purchase of insurance and receipt of payout with the decision to purchase insurance in the subsequent season.

On the contrary, Cai, et al. 2014 (as cited in Cai, de Janvry, and Sadoulet, 2016) found a gradual decline in the demand for insurance as well as a dwindled perception about the significance of an insurance cover when premiums are paid without clients experiencing payouts. Cole et al. (2014) reported that the effects of a household purchasing an insurance product as a result of payout persist for multiple seasons but decreases over time.

Premium

Mobarak and Rosenzweig (2012) found that the demand for a weather index insurance product decreases with increases in price. A weather insurance study in India by Hill, Robles, and Cebellos (2013) reported that near weather stations where basis risk is presumed lower, there is an increase in the price sensitivity of demand. Cole et al., (2013) found that a high insurance price coupled with credit constraints is essential determinants of insurance adoption.

On the contrary, Cole et al. (2013) found that the demand for rainfall insurance is price-sensitive, therefore lower prices alone is unlikely to start extensive index insurance adoption in the short term. Elabed and Carter, (2014) empirically confirmed that the effect of price on demand for drought index insurance is inconsistent across all research.

Basis risk

Basis risk is an attribute of index insurance policy that reduces its demand, therefore an instrument to eliminate or reduce basis risk should be welcomed. Research by (Clarke 2011; Miranda and Farrin 2012; Binswanger-Mkhize 2012), found that the demand for index products is reduced by basis risk for the intuitive reason that a product with higher basis risk gives less true insurance coverage to prospective clients. The unwillingness to pay is also inconsistent with recent studies on estimates of basis risk that posits that basis risk for index products can be considerable (Clarke et. al 2012; Jensen, Barrett and Mude 2014a) and that basis risk (or proxies for it) reduces demand for index products (Hill, et al., 2013; Jensen, Mude & Barrett 2014b; Karlan et al. 2014; Mobarak & Rosenzweig 2012). Elabed & Carter (2015) suggested that in view of the already negative impact of basis risk on demand been increased by compound risk aversion, index insurance products should be remodelled.

Hill et al. (2016) found that there is an 18% decrease in the demand for index insurance when the distance to the reference weather station is doubled. Furthermore, a willingness to pay study in Ethiopia by Hill et al. (2013), found an inverse relationship between the demand for index insurance and basis risk when prices are high. Gommes and Kayitakire, (2013) found that a distance less than 20km from the reference weather station to the insured fields to be acceptable for weather derivative insurance without having an effect on the correlation of indices with insured risk.

Financial literacy

In some rural areas, the level of financial literacy has been often low. If farmers do not trust insurers to make payment and or understand how insurance works, it is likely to drive down the demand for insurance. These may be attributed to limited experience and trust in financial institutions.

There is a possibility of reducing the level of financial illiteracy of farmers and their social contacts when appropriate financial education materials are used and this could subsequently lead to an increase in the up-take of insurance products (Gine, Karlan, & Ngatia, 2013). Cole et al, (2013) admitted that households with bank account are perceived to be financially literate and have trust with financial intermediaries therefore they are more likely to be assertive to insurance. Similarly, Cole et al. (2013) in India, Cai, de Janvry, and Sadoulet, (2014) in China gave evidence of the significance of household financial literacy in the uptake of insurance. Insurance purchases increased by 84% in India (Hill et al., 2011) and 43% in China (Cai, 2012) when they received intensive financial training rather than basic training.

On the contrary Gaurav et al. (2011) found that demand for rainfall insurance increased by 5% points with a two-day rain insurance educational program using a simulation game. Cole, et. al (2013) reported that short rainfall insurance education does not significantly affect the demand for insurance.

Social networks

Hill et al., (2013) reported that prospective clients are more likely to subscribe to an index insurance policy if the subscription is done in groups especially when the potential subscriber is uneducated. Cai (2013) also found that social networks have an effect on the decisions to purchase crop insurance in rural China for rice farmers. Similarly, Karlan (2010) reported that people in the social network of clients who receive insurance payouts showed a higher probability to purchase insurance the subsequent year.

On the contrary, Mobarak and Rosenzweig (2012) found that farmers in networks with strong informal risk sharing that already protects them against aggregate weather shocks purchase less insurance than other farmers.

Willingness to Pay for Drought Index Insurance Policy

Basis risk

Several studies have shown that basis risk is an attribute of index insurance policy that reduces its demand, therefore an instrument to eliminate or reduce basis risk should be welcomed. Research by (Clarke 2011; Miranda and Farrin 2012; Binswanger-Mkhize 2012), presumed that demand for index products is reduced by basis risk for the intuitive reason that a product with higher basis risk gives less true insurance coverage to prospective clients. The unwillingness to pay is also inconsistent with recent studies on estimates of basis risk that posits that basis risk for index products can be considerable (e.g., Clarke Mahul, Rao, & Verma, 2012; Jensen, et al., 2014a) and that basis risk (or proxies for it) reduces demand for index products (Hill et al., 2013; Jensen et al. 2014a; Karlan et al. 2014; Mobarak & Rosenzweig 2012).

Hill et al. (2016) found that there is an 18% decrease in the demand for index insurance when the distance to the reference weather station is doubled. Furthermore, a willingness to pay study in Ethiopia by Hill et al. (2013), found an inverse relationship between the demand for index insurance and basis risk when prices are high. Similar studies by Gommes and Kayitakire (2013) acknowledge a distance less than 20km from the reference weather station to the insured fields to be acceptable for weather derivative insurance without having an effect on the correlation of indices with insured risk.

Elabed and Carter (2015) pointed out that for farmers in Southern Mali, a study of their willingness-to-pay shows that the levels of compound risk aversion observed could reduce demand for index insurance by half under moderate basis risk. Serfilippi, Carter, and Guirkinger (2015) also reported that a reframe of the terms of an index insurance contract can increase the willingness-to-pay among those that are uncertainty averse and also avoid the uncertainty penalty placed on indemnity payments.

Interlinking drought index insurance with credit

Studies by (Dercon and Christiaensen, 2011; Karlan et al. 2014) found that, often time farmers in low income countries are constrained by cash, which disqualifies them to access, micro-credit-however the risk is increased by uninsured loan. A study of rural Ethiopian farmers suggests that taking a loan is equivalent to falling into an inescapable abyss (Tadesse 2014). In risk-prone regions, interlinking credit with insurance may possibly improve access to modern agricultural technologies (Clarke & Dercon, 2009). Away from curtailing the fears of lenders, service providers are empowered to use one distribution medium that may help with extra reduction of insurance premiums and interest rates when insurance is linked with credit. Shee and Turvey, (2012) reported that lenders will be eager to take advantage of the rural financial markets when credit is covered by insurance. A study in Ethiopia by McIntosh et al. (2014) suggest that households that engage in index-based weather insurance schemes linked with credit have a higher possibility to use chemical fertilizers compared to those who subscribed to insurance scheme which is not linked with credit.

On the contrary, a study in Malawi found the demand for insured loans to be lower than uninsured loans Giné & Yang (2009). This could be as a result of loan being taken along with extra fees to cover insurance, which is normally paid up front may be very expensive for some household. Additionally, although there is a theoretical justification for interlinking credit with insurance, there is no empirical evidence clarifying declines in the interest rates of the insurance premium or loan as a result of the interlinkage (Miranda & Farrin, 2012).

Shee and Turvey (2012) reported that the addition of insurance risk premiums to the interest rates of base loan and by extension the necessity to buy insurance up front which is a primary problem of cash constraint farmers is avoided when drought index insurance is interlinked with credit.

Subsidy

The demand for index insurance products is price sensitive, but usually price inelastic, where estimates range from -0.35 to -1.16, and generally remains very low, even when premiums are significantly subsidized (Bageant & Barrett, 2015; Cole et al. 2013; Hill, et al., 2013; Jensen, Mude, & Barrett, 2014; Mobarak & Rosenzweig, 2012). Cole, et al. (2014) reported that even after five years of the availability of index insurance product, a slight reduction in substantial subsidies led to the demand for index insurance products being reduced.

Constraints to the Subscription of Drought Index Insurance Policy

Inaccessibility to credit

A field experimental study on agricultural decisions after relaxing credit and risk constraints in northern Ghana, found that larger investment in agriculture stemmed from the subscription to index insurance (Karlan, Osei, Osei-Akoto, & Udry, 2014). Cai (2013) found that, the credit demands of farmers with insurance cover increased by 25%. Carter, Cheng and Sarris, (2011) reported that the fear of the repercussions emanating from their inability to repay, makes household hesitant to access the credit markets resulting in households' inability to use requisite inputs. A study in Ethiopia Ketema and Bauer (2011) reported that the likelihood of households to use fertilizer available on credit is less when they do not have adequate capacity to manage income risk. This account goes to buttress the fact that inaccessibility to credit, whether in a form of agricultural inputs or cash is a constraint toward the uptake of index insurance policy and future up-scaling.

Access to credit was positively significant at on the uptake of weather-based crop insurance scheme (Wairimu et al., 2016).

On the contrary, Kakumanu et al. (2012) found that a farmer's willingness-to-pay for weather-based crop insurance scheme is not significantly affected by access to credit.

Basis risk

Basis risk is the imperfect correlation between the index trigger by the insurer and the actual loss to the policy holder. This often leads to the unjustified payment and non-payment on the part of insurers and policy holder respectively. It is assumed that the micro climatic condition within a geographical area is the same or similar. It is most often expected that communities with a 20km radius should all experience rainfall, drought, humid weather condition, etc. almost at the same time and same quantity. However, in some instances, it is different. Farmers residing within the 20km radius expect to receive an indemnity payout when there is drought. Due to possible differences in the micro-climatic condition within the same area, some farmers will receive indemnity payout whiles others will not. When this occurs, farmers who did not receive indemnity payout feel short changed. When this occurs, farmers are discouraged to subscribe to the drought index insurance policy. Elabed, Bellemare, Carter, and Guirkinger (2013) reported that to reduce basis risk, an index insurance product for cotton uses multiple strikes at different scales. Chantarat, Mude, Barrett, & Carter, (2013) found that in Kenya, in order to statistically reduce basis risk of an index-based livestock insurance (IBLI) product, historic household level data and econometric methods are needed.

According to Clarke, (2011) and Mobarak and Rosenzweig, (2012) reported that the optimal level of coverage found in basis risk for some index insurance product sold is 9.6% of the agricultural wealth when the product is actuarially fairly priced

A study conducted in India by Mobarak and Rosenzweig (2012) found basis risk to significantly hinder the up-take of index insurance with its effect thus basis risk having a wide variation with farmers' risk-sharing arrangements. A study in Ethiopia reported that the demand for index insurance products by farmers would reduce by 30% points with the incidence of basis risk (Hill, Ouzounov, Robles, Chatterjee, Isaacs & Shankar, 2011). Dercon et al., (2014), found that the demand for index insurance escalated by 50% when the product was sold to groups encouraged to mitigate the effects basis risk by sharing payouts.

Hill et al., (2011) found that in India, the demand for index insurance product increased by 17% for each kilometre the distance was reduced with the installation of new weather station closer to villages where clients have insurance coverage. De Nicola, 2011 (as cited De Nicola, 2015) and Bryan (2011) reported that basis risk plays an essential role in the reduction of insurance demand. Studies conducted by Clarke (2011) also agree that low demand for index insurance mainly results from basis risk which has a negative effect on livelihood.

Liquidity constraints

Normally, there may be two antagonistic effects of financial constraint. On one side, households that are financially constraint may have a high regard for the stabilization effect of income by reducing income volatility. This reduces their consumption smoothing capacity ex-post. On the other hand, household that is constraint financially have to choose between purchasing insurance and investing in production. There is a strong expectation of liquidity constraint to have an effect on insurance when there is a reduction in the capacity of the farmer through lower yields and revenue. It is therefore necessary to use the empirics to ascertain the effect of financial constraint on insurance up-take.

Granting that risk averse households would benefit from insurance purchase, the shadow value of liquid assets in this situation would be very high and therefore the decision to invest in production (Awel & Azomahou, 2015). Rampini and Viswanathan (2010) reported that the liquidity driven constraints poses a considerable obstacle to the demand of rainfall insurance. Mobarak and Rosenzweig (2012) found that lack of cash was the main reason why Indian farmers did not buy index insurance product. Binswanger-Mkhize (2012), Cole, et al., (2012) found that smallholder farmers do not have the requisite financial liquidity to pay for weather index insurance. Gine (2015) and (McIntosh, et al., 2014) reported that liquidity constraints will possibly reduce the demand for index insurance product significantly. Cole et al (2012b) found that in a randomized experiment where money is given to households in advance (relaxing liquidity constraint) before the decision to purchase index insurance is made, uptake of index insurance increases. Also, Norton, et al. (2011) used an experimental game in the study of Ethiopian farmers reported that a relaxed liquidity constraint increased the households' up-take on index insurance.

On the contrary, Cole et al. (2013) and Jensen, Mude, and Barrett (2014) reported that liquidity constraints are evident across an array of products and populations, suggesting that the commercial use of index insurance to aid the poorest sub-populations has great limitations. Another study by Enjolras and Sentisas 2011 (as cited in Lefebvre et al. 2014) found that there is a high expectation for more liquidity constraint farmers to have more insurance cover.

Inadequate education on the insurance policy

A limited understanding of how insurance works and limited financial literacy is one of the main reasons for low subscription. In order to increase demand, education of potential buyers is one of the many ways to go. Product education on index insurance, plays a significant role that is geared towards complementary investments in marketing and extension and the requisite regulatory framework to warrant index insurance policy quality (Cole et al. 2013; Dercon et al. 2014). An experimental study reported that a better understanding of the product is an essential factor that affect the demand for index insurance product (Cai et al., 2014; Jensen et al., 2014). Empirical research has shown that insurance is a complex product therefore an improvement in its understanding is key to increasing demand. When farmers do not understand the product being sold, the likelihood and the willingness to pay for it is less (Hill et al., 2011). A study by (Gaurav et al. 2011 and Hill et al., 2013b) found that educational or experimental games increases the up-take of insurance policy or product. Cai, et al., (2014), Cai and Song, (2013) and Gaurav, et al., (2011) found that a better knowledge of the product increases uptake of index-based insurance products. Chantarat, et al. (2013) reported that low uptake of agricultural insurance products as a result of its complexity.

On the contrary, Gine (2015) found that knowledge about an insurance product has no effect on demand, but research by (Patt, et al., 2009, Cole et. al, (2013) reported that the likelihood of farmers to purchase an insurance product is higher provided there is a better understanding of the product.

High premium

Generally, index-based insurance policy has lower cost of implementation compared to the traditional insurance policy since it has low administrative cost, no loss adjustment, moral hazard and adverse selection. However, there is low uptake because of price. Several studies have accentuated the fact that the demand for index-base insurance is highly price sensitive. The premium paid to the insurance company in this situation GAIP, is a 10% of the cost of production for the crop (crop budget).

Research by (Cole et al. 2013) and (McIntosh, et al. 2014) reported that rainfall index insurance demand is significantly price-sensitive. Other studies by (Cole et al., 2013; Karlan, Osei, Osei-Akoto, and Udry, 2014) found that price is an essential factor subduing demand. Research in Ethiopia by Takahashi (2016) reported that a temporal reduction in premium paid through randomly distributed discount coupons, immediately had a positive impact on the uptake of Index Based Livestock Insurance (IBLI) without dampening the demand of subsequent periods due to reference-dependence associated with price anchoring effects. Finally, a study by Arshad, et. al. (2015) reported that there is a decline in the level agricultural insurance programs by 0.03% when the premium rate increases.

On the contrary, Fisher, McConnell, Karlan, and Raffler (2014) found that there is a potential threat of a one-time price reduction serving as a price reference which reduces index insurance demand in subsequent periods, however there is no evidence of an anchor effect.

Lack of trust in the insurer

Trust in the insurance provider is a major issue when contracting insurance in developing countries for which Ghana is no exception, because of the few legal recourses in retrieving insurance payments. When it comes to index insurance, expected payout is even more difficult because there is a little or non-correlation between weather and loss. Similarly, in an information asymmetry situation, clients (farmers) depend on the insurer to set a fair price. These issues have an influence in the uptake or subscription to index insurance. A number of studies have shown that the decision to subscribe or purchase index insurance policy is influenced by both economic and non-economic factors. Trust is one of the non-economic factors. Trust encapsulates the trust in the insurer, policy or product and in the clients' capability to choose satisfactorily.

A study by Kaczała and Wiśniewska (2015) holds the view that, the decision to subscribe or purchase index insurance is influenced by both economic and non-economic factors. Another study conducted by Cole et al. (2014), found out that the likelihood for households to purchase index insurance policy is higher when clients learn about the quality of the product and trustworthiness of agents or underwriters as well as the payment of indemnity to known community members. Cole et al. (2013) and Gine (2015) reported that, trust in the organisation involved in the insurance program can enhance take-up by 11%. (Gine 2015) and Patt et al. (2009) found that, there is an increase in the level of trust for the agricultural insurance institution executing the insurance program when farmers are members and former clients. Similarly, Cai (2015) reported that trust in the insurance product can improve take-up decisions substantially. Additionally, studies by (Cai (2009), Cai (2015), Cole et al (2013), Cole, et al. 2014) found that a client's personal or non-personal experience about payment of insurance claims becomes essential with respect to trust. Finally, a study in India reported that an endorsement of an insurance product by a known and trusted third party has shown to increase demand by 36% Cole, Stein, & Tobacman, 2011 (as cited in Cole, Giné & Vickery, 2017)

Analytical Framework and Methodologies for the Studies

Framework and methodologies for analysing data were discussed based on the research objectives to be addressed.

Examining the Determinants and Intensity of Index Insurance Use

Several studies have used Logit, Probit or Linear probability models (Amudavi et al., 2008; Nambiro and Okoth, 2013) to determine the factors that influence the adoption of agricultural technologies. The Logit and Probit models are unable to estimate the extent of technology adoption. The decision to subscribe to a drought index insurance policy can be made separately or jointly by the farmer. To address the weakness in the Logit, Tobit and Probit models, some studies (Kinuthia, Owuor, Nguyo, Kalio, and Kinambuga, 2011; Wachira, Gerald, Wale, Darroch, and Low, 2012; Ramaekers Micheni, Mbogo, Vanderleyden, and

Maertens, 2013) employed Heckman two-stage model to examine the determinants and extent of agricultural technology adoption. Studies by (Komarek, 2010; Koch and Ground, 2007; Bellemare and Barrett, 2004; Sigelman and Zeng, 1999) used to censor regression models like Double hurdle and Tobit model to investigate household participation.

The Tobit model holds the assumption that the subscription to drought index insurance and intensity decisions are determined by the same parameters therefore it has a limitation regarding its ability to separate the two subscription hurdles. The intensity of subscription cannot be directly estimated using a standard censored Tobit model. The outcome variable for cereal farmers that did not subscribe will be unobserved therefore using the Tobit model will result in estimates that are biased and inconsistent. Similarly, an erroneous assumption of the Tobit model is that the decision to subscribe and how much to subscribe are affected by same covariates in the same way.

For that reason, estimating the intensity of subscription rigorously, calls for an econometric model to correct for the censoring of the dependent variable where the outcome variable is conditional on subscription being observed. To address the weakness in the Logit, Probit and Tobit models, some studies (Kinuthia et al., 2011; Wachira et al., 2012; Ramaekers et al., 2013) employed Heckman two-stage model to examine the determinants and extent of agricultural technology adoption. The Heckman two-stage sample selection model was employed since it allows for the decision to subscribe and the intensity of subscription to be modelled separately (Heckman 1978; Wooldridge 2002). An empirical study of adoption models by

Amare, Asfaw, and Shiferaw (2012) identify and used distance to the agricultural extension office and the perception of farmer as appropriate instruments in the two-stage selection model.

Discrete Choice Experiment

Discrete choice analysis is more extensive and complicated than the conjoint analysis. There are two types of discrete choice studies: stated preference and revealed preference. The stated preference discrete choice study entails an experimental design and a questionnaire in which consumers choose their preferences from among a set of alternatives. The treatment design aids in the development of the fictional alternative products or situations just as in conjoint analysis. Ordinarily, these products do not exist in the market, but could likely exist. However, a revealed preference discrete choice study does not employ the fictionalized alternative products or situations from an experimental design. This study adopted the stated preference discrete choice approach (SAS Institute Incorporated, 2016).

In the real market, consumers have the opportunity to choose one product or service from a number of products or services (SAS Institute Incorporated, 2016). However, in conjoint analysis consumers only state their like or dislike for a product or service in isolation from other products.

According to Lusk and Shogren (2007), discrete choice experiment is essential when an observed transaction of good or service does not occur because they are based on hypothetical choice sets and can be used to estimate demand for new products, services or technologies. Mangham, Hanson, and McPake (2009) admit that discrete choice experiment (DCE) is a quantitative technique for eliciting the preferences of individuals which aids in uncovering how individuals value selected attributes of a product, service or programme by asking them to state their choice over different hypothetical alternatives.

Choice experiments have been used in the international agricultural and environmental development contexts. Birol, Smale, and Yorobe Jr. (2012) estimated Filipino farmer's willingness to pay for the Bt maize seed. Ortega, Wang, Olynk, Widmar, and Wu (2014) examined Chinese aquaculture farmer's willingness to adopt good agricultural practices; Roessler et al., (2008) used choice experiments to assess farmers' preferences for pig breeding traits in different production systems in Vietnam; Ward, Ortega, Spielman, and Singh (2014) measured Indian farmer preferences for drought tolerant rice and Ruto, Garrod, and Scarpa (2008) evaluated Kenyan cattle producer and trader preferences for indigenous breeds in the pastoral livestock market. Studies by (Liebe, Maart, Mußhoff, and Stubbe, (2012) and Liesivaara and Myyrä, (2014) employed choice experiments to examine the attitudes of farmer towards weather index insurance in Finland and Germany. Recent studies in Ethiopia and Bangladesh by Castellani, Viganò, and Tamre, (2014) and Ward, Spielman, Ortega, Kumar, and Minocha (2015) applied choice experiment in the estimation of farmers' willingness to pay for weather index insurance. Similarly, DCEs have repeatedly been employed in agriculture and environmental valuation in order to have a better understanding of preferences of consumers and producers in a multi-attribute choice problem

(Schipmann & Qaim, 2011; Veettil, Speelman, Frija, Buysse, & Van Huylenbroeck, 2011; Kouser & Qaim, 2015).

In Discrete Choice Experiments, choices are made over a set of hypothetical alternatives whereby each alternative is described by several characteristics, known as attributes, and responses are used to infer the value placed on each attribute which resembles a real-world decision (Mangham et al., 2009). Hall, Viney, Haas, and Louviere (2004) confirmed that DCE method derives its theoretical foundation from the random utility theory and hinge on the assumptions of economic rationality and utility maximization. In stating a preference there is an assumption that individuals select the alternative that produces the highest individual utility. Moreover, it is assumed that utility produced by an alternative depends on the utilities associated with its composing attributes and attribute levels (Lancaster, 1966).

Willingness-to-Pay (WTP)

When it comes to the payment for crop insurance, most farmers are unwilling to pay fair prices. A study in 1986 by Hazell, Pomereda and Valdes observed that with the exception of a few, farmers in developed and developing countries do not have the willingness to pay the full cost all-risk crop insurance (Hazell, Pomereda & Valdes, 1986). After a quarter of a century later there is still no evidence that their assessment was wrong. Studies by (Bardsley, Abey and Davenport 1984; Patrick 1988), laid much emphasis on the willingness to pay for rainfall insurance by farmers in the high risk, semi-arid regions of Australia. Another study by Patrick (1988) examined multiple peril crop insurance products where indemnities are tied to the farmers' losses. (McCarter 2003) and (Sarris Krfakis, & Christiaensen, 2006) examined the willingness to pay for rainfall index-based crop insurance in Morocco and Tanzania respectively.

According to Sakurai and Reardon (1997), preliminary empirical studies on the willingness to pay for crop insurance use a latent demand approach based on the risk management strategies and stated production decisions of farmers. Current studies are based on stated preference or revealed preference. Firstly, the preferences are drawn out via survey-based techniques, like a discrete choice experiment, conjoint methods or as contingent valuation methods (Akter et al., 2009; Heenkenda, 2011). Secondly, data are collected using randomized controlled trials, experimental games or pilot projects (Clarke & Kalani, 2011; De Janvry & Sadoulet, 2013; Dercon et al., 2014; Galarza & Carter, 2008; Giné et al., 2008; Hill & Robles, 2011; Hill et al., 2011; Norton et al., 2011; Shawn et al., 2013).

An experiment was used to address the issue of WTP. The pros and cons of experiments are highlighted by the adopters and users of alternative methods. The robustness of the experimental approach is challenged by studies where the results of experiments of real life related to WTP show little correlation, as in the case of Hill & Robles (2011) or McIntosh et al. (2014). Norton et al. (2011, 2012) find the opposite. Regardless of these cautions, Hill and Veceisza (2011) indicated that small-scale field experiments are conducted in an environment where disturbing effects, like credit constraints or trust issues, are absent. Patt et al. (2009) emphasised that the experimental games trigger a learning process which may increase financial literacy and trust.

In this study, data from the discrete choice experiment where farmers were asked to choose a drought index insurance policy out of a choice set was used. Discrete choice method is anchored on random utility models and allow for heterogeneity in the decisions of consumers (Hensher & Green, 2005). The research assesses the viewpoint of the farmers and not the supplier's viewpoint. The rational is to have an initial understanding of the prospective subscribers or buyers and estimate the willingness to pay for a drought index insurance policy or product.

Constraints Analysis

According to Eboli and Mazzulla (2009), surveys are generally conducted using ordinal verbal scales of measurement. It is most appropriate since ordinal verbal scales of measurement were used to measure the level of agreement on the constraints to drought index insurance policy subscription among cereal farmers in the Northern region of Ghana. Ordinal logistic (OLR) regression models have been largely applied in the sector of economics, medicine and social sciences. Though the ordinal logistic regression model is robust, the survey data are not uniformly distributed therefore does not permit the use of OLR.

The literature has shown that Friedman's two-way analysis of variance; Garrett's ranking techniques; Spearman rank correlation; Pearson's correlation coefficient and Kendall's coefficient of concordance are some of ranking techniques. These tests are capable of overcoming the shape of the distribution of scores by ranking the data. The Pearson's correlation is mostly used for interval data; however, Kendall's correlation coefficient or Spearman rank correlation tests are employed when the normal distribution under consideration is in the interval or ordinal form. Also, a close relationship exists between Friedman's test and Kendall's coefficient of concordance (Legendre, 2005). The Friedman's test emphasises more on the item being ranked whiles Kendall's test takes into consideration, the individual doing the ranking. They address hypotheses concerning the same data table and use the same χ^2 statistic for testing. The only difference between these two statistical tests is the formulation of their respective null hypothesis.

On the other hand, Garrett's ranking score techniques utilise the average score of an individual ranking the items under investigation and reports them in either ascending or descending order. The deficiency of the Garrett's ranking technique is that it does not examine the level of agreement between the individual doing the ranking and it also involves a lot of steps. Following the weakness of Friedman's and Garrett's test which lack the ability to test for agreement of the cereal farmers among their ranking. The Kendall's coefficient of concordance has the capability to address the weaknesses. In the computation of Kendall's coefficient, the actual observations are not converted to ranks, but used in its original state. Also, the interpretation procedure of Kendall's coefficient of concordance is less complex than Spearman coefficient (Field, 2014).

Conceptual Framework

With reference to this study, household characteristics of the cereal farmers consist of age, sex, farming experience, education, household size, dependency ratio, farmer association membership. Wealth indicators comprised of farm size, number of livestock (Tropical Livestock Unit (TLU), income, off–farm income and access to market and information is made up of variables such as access to inputs, distance to the district centre, contact with insurance agent etc.

Household characteristics, wealth indicators and access to market and information factors (variables) are hypothesized to have a positive or negative influence on the subscription to drought index insurance policy among cereal farmers in the Northern Region of Ghana and consequently the intensity or extent to which a cereal farmer will subscribe to the insurance policy.

To determine the intensity of subscription to a drought index insurance policy, cereal farmers must first subscribe to the policy. The proportion of the farmers' land covered by the insurance policy gives meaning to the intensity of subscription to a drought index insurance policy. From Figure 2, the decision of a farmer to subscribe to a drought index insurance policy or otherwise is dependent on household characteristics, wealth indicators, access to market and information etc. which has a positive or negative influence on the hypothetical optimal drought index insurance policy and the willingness to pay for same.

The determination of the hypothetical optimal drought index insurance policy for cereal farmers involved the use of discrete choice experiment approach which combines Random Utility Theory, Utility Maximisation Theory, Lancaster's Theory, Consumer Theory, Experimental Design Theory and econometric analysis. The cereal farmers derive utility or satisfaction from the attributes of the drought index insurance policy and not the actual policy per se. The attributes and their corresponding attribute levels are premium (level 1: GhC35 and level 2: GhC40), basis risk (level 1: rainfall data from Ghana meteorological weather station and

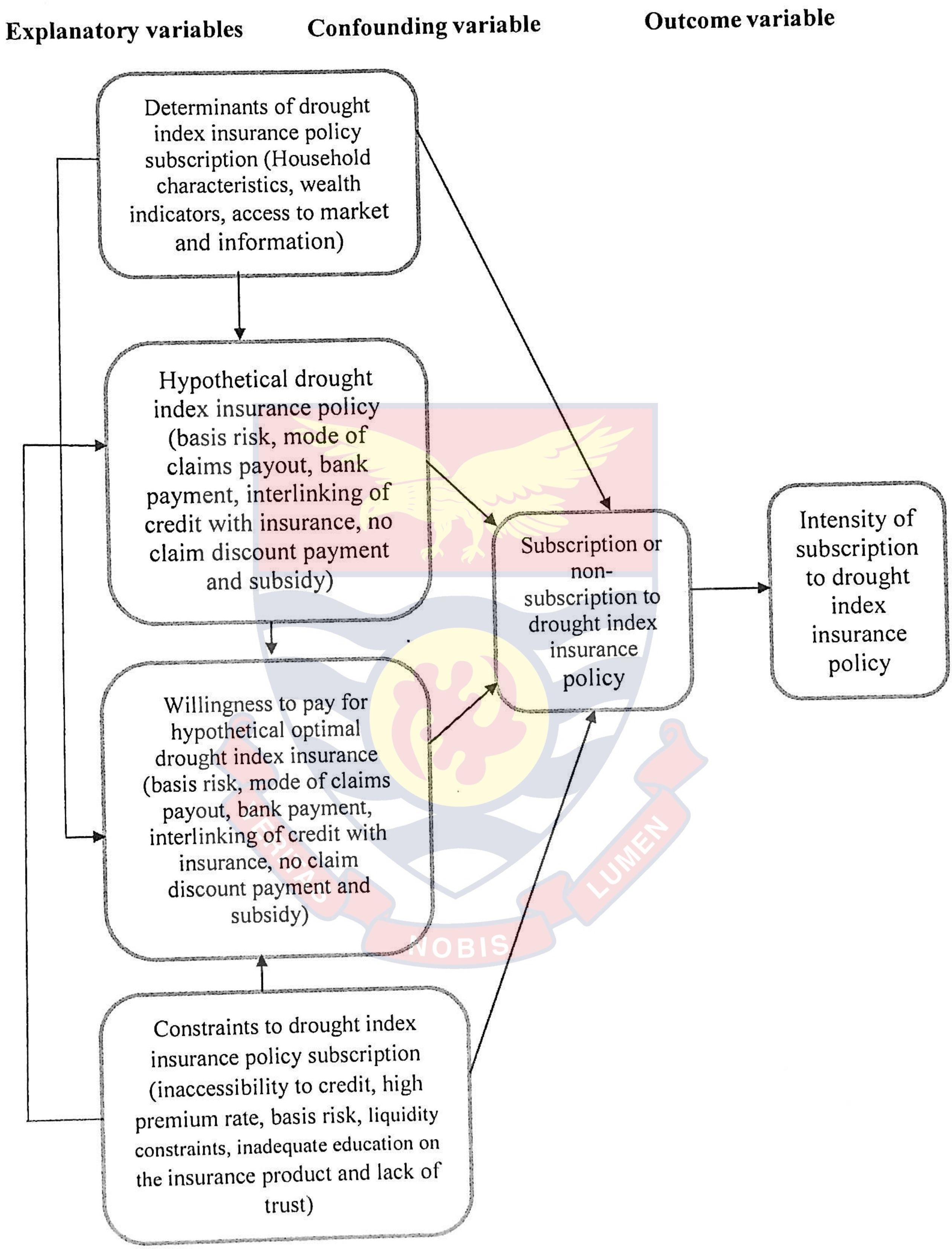


Figure 2: Conceptual Framework for the Analysis of Subscription to Drought Index Insurance Policy among Cereal Farmers in the Northern Region of Ghana.

Source: Authors construct, Boateng-Gyambiby (2017) level 2: rainfall data from a satellite), mode of claims payout (level 1: non-bank payment and level 2: bank payment), interlinking of credit with insurance (level 1: credit not interlinked with insurance 2: credit interlinked with insurance), no claim discount payment (1: payout at the end of the next season 2: reduction of next seasons premium) and subsidy (level 1: subsidy on agricultural inputs only and level 2: subsidy on drought index insurance policy premium only). Cereal farmers consider the utility to be derived from these attributes when they are present in a hypothetical drought index policy alternative. The hypothetical optimal drought index insurance policy for the cereal farmers have an influence on the willingness to pay as well as the subscription or non-subscription to the drought index insurance policy and the intensity of subscription. This is because all other things being equal, cereal farmers will pay for the index insurance policy that gives them the highest utility.

The willingness to pay also employed the discrete choice experiment approach. Cereal farmers will be willing to pay for the highly preferred attributes which encapsulates of the hypothetical optimal drought index insurance policy. The willingness to pay will have an influence on the subscription or non-subscription to drought index insurance policy as well as the intensity of subscription. The attributes that cereal farmers may be willing to pay for are: basis risk (level 1: rainfall data from Ghana meteorological weather station and level 2: rainfall data from a satellite), mode of claims payout (level 1: non-bank payment and level 2: bank payment), interlinking of credit with insurance (level 1: credit not interlinked with insurance 2: credit interlinked with insurance), no claim discount payment (1:

payout at the end of the next season 2: reduction of next seasons premium) and subsidy (level 1: subsidy on agricultural inputs only and level 2: subsidy on drought index insurance policy premium only).

The constraints (inaccessibility to credit, high premium rate, basis risk, liquidity constraints, inadequate education on the insurance product and lack of trust) to drought index insurance policy subscription have an influence on the hypothetical optimal drought index insurance policy and the willingness to pay for same. These constraints have an influence on the decision to subscribe or not to subscribe to the policy and consequently the intensity of subscription.

Finally, the determinants of drought index insurance policy subscription, hypothetical optimal drought index insurance policy for cereal farmers and prospective cereal farmers, willingness-to-pay for same and constraints to the subscription of drought index insurance, may all have a resultant influence on the decision to subscribe or otherwise to drought index insurance policy as well as the intensity of subscription. These may lead to an increase or decrease in agricultural productivity, agricultural investment, technology adoption, proportion of land insured etc.

CHAPTER THREE

RESEARCH METHODOLOGY

Overview

This chapter describes the research design, study area, population, sampling procedure, data collection instruments, data collection procedures, data processing and analysis. Also included in the chapter is the analytical framework used in finding answers to each research question.

Research Design

Frankfort-Nachmias and Nachmias (2008) posit that research design links theory and practical findings from empirical evidence and or other methods or strategies. According to Saunders, Lewis, & Thornhill, (2012) it is the overall strategy employed to answer research questions. Research design is also about cohesive collection of substantive concepts, variables and problems with corresponding methodological approaches and tools (Flick 2009).

A research design is a comprehensive approach that is used to integrate the different components of the study in a coherent and logical way, thereby, ensuring that the research problem is effectively addressed. Research design focuses on the end-product and all the steps in the process to achieve the outcome of research. In this regard, a research design is considered as the functional plan in which certain research methods and procedures are linked together to obtain a reliable and valid body of data for empirically grounded analyses, conclusions and theory formulation. Research design provides specific direction for the procedures in the research study (Creswell, 2014).

Several studies have used cross-sectional survey design. A study of farmers in California (Schenker, Orenstein, & Samuels, 2002) used a cross-sectional survey to evaluate the association between personal protection equipment use and common agricultural workplace exposure hazards. The study found that self-reported behaviour of protection from the sun and use of hearing protection devices was low. However, the use of personal protective equipment was above fifty percent. Another cross-sectional survey by Kearney, Xu, Balanay, Allen, and Rafferty (2015) employed a univariate and bivariate analyses to examine associations between personal protective equipment (PPE) behaviour and workplace hazards, health-related concerns, and wearing and purchasing PPE in Eastern North Carolina. The study revealed that farmers are well aware of the risks associated with occupational hazards and recognize concern for health and safety protection in the workplace.

Similarly, a cross-sectional household survey was used in the study of 330 villages in a drought-prone rural district of India in order to investigate the determinants influencing domestic water consumption using simple descriptive measures, analysis of variance, Post hoc tests, and multivariate regression analysis. Principal component analysis was used to assess the socioeconomic status of households on the basis of assets they hold (Basua, Hoshinoa, Hashimotob, & DasGuptab, 2017). Additionally, a cross-sectional survey conducted in an epidemiological study using the data on cattle poisoning, to determine the mortality rate due to poisoning in cattle in Spain and to assess the influence of the type of farming, age, sex, time of year, year and region. Linear correlation and Pearson's Chi-square was employed (García-Arroyo, Míguez, Hevia, & Quiles, (2015).

Finally, a similar community based cross-sectional study was carried out at work-related injuries among farmers in the eastern region of Nepal indicated that the prevalence of injury among farmers was high, employing a bivariate analysis using a chi - square test (Bhattarai, Singh, Baral, Sah, Budhathoki, & Pokharel, 2016).

The study sought to analyse the subscription of cereal farmers to drought index insurance policy in the Northern Region of Ghana and therefore employed cross-sectional survey design. According to Cohen, Manion, and Morrison (2007), cross sectional survey design permits the gathering of a large-scale data from a sample that is representative of the population as possible to affirm with a measure of statistical confidence. This ensures that certain observed characteristics occur with a degree of regularity, or that certain factors cluster together or that they correlate with each other (correlation and covariance), or that they change over time and location or regression analysis to use data from one variable to predict an outcome on another variable.

This study aligns itself with the positivism paradigm since it embraces a scientific method to human affairs and excludes all non-empirical concerns from its preview. Positivism which emphasizes an Objectivist approach to studying social phenomena gives importance to research methods focusing on quantitative analysis, surveys, experiments, etc. The strengths of positivism paradigm are its clarity, precision, rigour, standardisation and generalizability (Ernest, 1994). On the other hand, it has certain inherent weaknesses in some of its measurement process since it is seen to be artificial and false rather than real (Bryman, 2008). Additionally, it fails to separate social sciences from the natural sciences, thereby treating human beings like natural objects and denies human uniqueness and individuality (Bryman, 2008). To minimise the weaknesses associated with aligning with this positivism paradigm, the researcher and enumerators strictly followed the ethical protocols regarding the use of human beings as research subjects.

The research paradigm for this study enabled the researcher to have an in-depth understanding of constraints to the subscription of drought index insurance policy, intensity of drought index insurance subscription and the determining factors, optimal drought index insurance policy and farmers' willingness to pay for the drought index insurance policy.

Study Area

The Northern region is divided administratively into twenty-four districts, one metropolitan assembly and one municipal assembly with Tamale as the regional capital. The region differs greatly from the central and southern Ghana in terms of climate, religion, language and culture. The Northern region occupies an area of about 70,383 square kilometres and shares boundaries with the Upper East and the Upper West regions, to the north, Brong Ahafo and Volta Regions to the south, and the Republic of Togo to the east, and La Cote d' Ivoire to the west. The land is mostly low lying except in the north-eastern corner where the Gambaga escarpment joins the western corridor. The region is endowed with the Black and White Volta rivers and their tributaries. Other big rivers are Nasia and Daka.

The land area is about 29.5 percent of the total land area of Ghana and almost the same land area as the Western, Greater Accra, Volta and Eastern Regions put together (28.1 percent) or the Brong Ahafo, Ashanti and Greater Accra Regions combined (28.2 percent). The population of the people in Northern Region is almost the same as that of Brong Ahafo and slightly larger than that of the Volta and Central Regions of Ghana. The region currently has a population of 1.820,806, representing 9.6 percent of the total population of the country (GSS, 2014).

The region has a relatively dry climate, with a single rainy season that begins in May and ends in October. The annual mean rainfall recorded varies between 750mm and 1,050mm. The dry season starts in November and ends in March/April with maximum temperatures occurring towards the end of the dry season (March-April). The minimum average temperatures experienced in December and January. The Harmattan winds, which occur in December to early February, have considerable effect on the temperatures in the region. Temperatures vary between 14°C at night and 40°C during the day. Humidity, however, is very low and mitigates the effect of the daytime heat. The vast area is still under populated and under cultivated. The region has a vast area of grassland, interspersed with the guinea savannah woodland, characterised by drought-resistant trees such as the acacia, baobab, Shea nut, dawadawa, mango, and neem.

The Northern region has a population of 2,858,793 (1,403,352 being males and 1,455,441 females) The estimated number of households in the country is 6.6

million with a mean household size of 4.0 compared to 4.4 obtained from the 2010 Population and Housing Census. The northern region has about 491,700 households with an average household size of 5.4 making it the second highest in the nation with Upper West and Upper East has a household size of 5.5 and 4.5 respectively (GSS, 2014).

Agriculture, forestry and hunting are the main economic activities in the region, which accounts for 71.2 percent of employment of the economically active population (aged 15 years and older). About 7.0 percent of the economically active people in the region are unemployed. About 83.4 percent of the economically active population is absorbed by the private informal sector. An additional 11.5 percent are in the private formal sector, leaving the public sector with only 4.3 percent. About 40.5 percent that are not economically active are homemaker and 24.4 percent are students. About 14.8 percent is not working because of old age. About 2.2 percent are not working because of disability and about 1.2 percent is pensioners who are on retirement while 16.95 percent are classified as others. Almost 68 percent of the economically active population is classified as self-employed, while 22.9 percent is unpaid family workers; only about 6.1 percent are employees. There are traces of this regional pattern in all the districts. The proportion of the self-employed ranges from 50.8 percent in Zabzugu-Tatale, to 79.9 percent in Savelugu-Nanton. The proportion of unpaid family workers varies from 5.2 percent in the Tamale municipality to 45.3 percent in Zabzugu-Tatale. The high level of unpaid family workers, recorded in some of the districts can be attributed to a high proportion of the population in the agricultural sector (GSS, 2014).

The proportion of adults 15 years and older who have ever attended school in the region is 49.2 male and 28.6 female. The region has the lowest school attendance rate of 50.4 in Ghana. On the average 22 percent of the population that are 15 years and older, are literate. This figure varies from 12.0 percent in Gushiegu-Karaga to about 43.0 percent in the Tamale municipality. East Gonja is the next highest, with about 20.0 percent literacy rate, considerably lower than the rate for the Tamale municipality. Overall, the proportion literate is 12.0 percent higher among males than females (GSS, 2014).

Study Population

Population describes persons who appeal to the interest of the researchers and can generalize the results of the study (Trochim, 2004); the total number of units (individuals, organizations, events, objects, or items) in which samples are drawn for measurement (Parahoo, 2014), and complete set of cases from which samples are drawn (Saunders et al., 2012).

The population for this study comprises twelve districts and one municipal assembly in the Northern region where there was sensitisation, advocacy, sale of the drought index insurance policy to cereal farmers.

Sampling Procedure

The sampling started with the determination of a sample size. According to Krejcie and Morgan (1970) a representative sample size can be determined for an infinite or unknown population by either employing the sample size determination formula or sample size determination table. The sample size formula for infinite population is expressed as follows:

$$n = \frac{Z^2 * P(1-P)}{M^2} \tag{4}$$

Where:

n = Sample Size for infinite population

Z = Z value (e.g. 1.96 for 95% confidence level)

P = population proportion (expressed as decimal) (assumed to be 0.5 (50%)

M = Margin of Error at 5% (0.05)

$$n = \frac{1.96^2 * 0.5(1-0.5)}{0.05^2}$$

$$n = 384$$

The appropriate sample size for the study was 384 when the sample size formula for infinite population was applied. However, the sample size was increased to 430 in order to increase the precision in the estimation of unknown parameters and also have confidence that the survey result will be representative of the population. Another reason for the increase in sample size is to improve the response rate and also correct for sampling errors.

A multi-stage sampling procedure was used to select the cereal farmers for the study. A multi-stage sampling is a process in which sampling is done in several stages using the simple random technique in each of the stage. The multi-stage was used because:

(i) It allowed for the establishment of a sample that is directly related to the research objective.

(ii) It enabled the researcher to have good representation of the population.

(iii) The observations from a multi-stage sample may be used for inferential purpose.

(iv) It was easier to administer than most single stage designs mainly because of the fact that sampling frame under multi-stage sampling is developed in partial units.

(v) A large number of units can be sampled for a given cost under multi-stage sampling because of sequential clustering, whereas this is not possible in most of the simple designs.

At the first stage, seven (7) out of thirteen (13) administrative assembly, where advocacy and piloting of the drought index insurance policy had taken place in the Northern Region of Ghana was randomly sampled using the lottery method. The selected administrative assemblies were Tolon, Nanton, Central Gonja, Sangnerigu, Kumbungu, Savelugu districts and Tamale Metropolitan assembly. The list of cereal farmers within the seven randomly sampled administrative assemblies were obtained from the regional office of the Ministry of Food and Agriculture. The list revealed that about 60 percent of the cereal farmers in the randomly sampled administrative assembly had subscribed to drought index insurance policy while 40 percent had not.

At the second stage, thirty-four communities were randomly sampled from sixty-one communities representing the seven (7) administrative assembly that were randomly sampled at the first stage.

At the third stage, 60 percent of cereal farmers who subscribed to drought index insurance policy and 40 percent who have not was sampled from the sixty-one communities using the proportion to size approach. At the end of the sampling procedure, 430 cereal farmers from the population constituted 263 and 167cereal farmers who had subscribed and those who had not subscribed to the drought index insurance policy respectively.

The sampling procedure shows that about 95 percent of the randomly sampled cereal farmers were household heads. In the situation where the sampled cereal farmer cannot provide some of the information required during the interview session, any member of the household can provide the information, or the respondent can inquire from other household members to ensure validity of the data been collected.

The districts, metropolitan assembly and communities sampled for the survey in 2017 are captured in Table 3.

Table 3: Districts, Metropolitan Assembly and Communities Sampled for the Study

Districts and Metropolitan Assembly	Communities
Tolon	Tingoli, Waribugu kukuo, Chayoli No. 2, Jakpahi and Kpalisogu
Kumbungu	Kochim, Gumo, Kpilo, Wuba and Zangbalum
Savelugu	Kplung, Sandu, Guno, Botingli and Napresi
Nanton	Jana, Sindigu and Nagdigu
Tamale Metropolis	Nyeshei, Kogni and Sorugu
Central Gonja	Bagyili, Balanpusu, Galinzegu and Dawunyili
Sangnerigu	Nyeshei, Kumbuyili, Dugsheigu, Katariga, Dabugushe, Chang Nayili, Bogu, Dungu and Kpinjinga

Source: Field Survey, Boateng-Gyambiby (2017)

Data Collection

A content validated pretested structured interview schedule was used to collect data for the study. A structured interview schedule was developed based on questions and objectives of the study and was used to collect precise data to answer the research questions and objectives. The structured interview schedule was deemed appropriate because it allowed for the testing and explanation of relationships between variables as well as cause-and-effect relationships (Saunders et al., 2012).

The first section was made up of choice experiment, survey questions which were used to determine optimal drought index insurance policy and also estimate the willingness-to-pay for the policy.

Design of Discrete Choice Experiment

Discrete choice experiment is more extensive and complicated. Stated preference and revealed preference are the two types of discrete choice studies. The stated preference discrete choice study entails an experimental design and a questionnaire in which consumers choose their preferences from among a set of alternatives. The treatment design aids in the development of the fictional alternative products or situations just as in conjoint analysis (SAS Institute Incorporated, 2016). Ordinarily, these products do not exist in the market, but could likely exist. However, a revealed preference discrete choice study does not employ the fictionalized alternative products or situations from an experimental design. This study adopted the stated preference discrete choice approach.

Discrete choice experiment involves the construction of an experimental design to study the effects of the attribute levels on the stated preference (or dependent variable). Four steps were involved in the design of a choice experiment. These are the establishing attributes, assigning attribute levels, designing the choice sets, generating and pre-testing the experiment.

Establishing of attributes

According to Ryan, Bate, Eastmond, and Ludbrook (2001) and Hensher et al., (2005), identification of attributes that are relevant to the research objective and allotting levels to the attributes or characteristic is the first stage in Discrete Choice Experiment (DCE). This stage is hypercritical since the attributes and attribute levels provide a good description of the hypothetical scenarios. Coast and Horrocks (2007) admit that the literature explaining how attributes and attribute levels are established is inadequate.

According to DeShazo and Fermo (2002), the number of attribute that can be included in the DCE is not restricted. In practice, most DCE contains less than ten attributes in order to ensure that cereal farmers have the capacity to take all listed attributes into consideration. There is a greater cognitive difficulty in completing a DCE when the numbers of attribute are more. Participants often apply a simple rule in which responses are based on a single or a subset of attributes when attributes are too many. The avoidance of conceptual overlap between two or more attributes (inter-attribute correlation) is necessary in order to ensure the accurate estimation of the main effect of a single attribute on the dependent variable.

Studies by (Clarke et al. 2012) and (Miranda & Farrin, 2012) found that poor households are hesitant to adopt weather index insurance unless it subsidized or bundled with other benefits. Other researches by (Norton et al., 2013), (Elabed et al., 2013) and (Jensen et al., 2016) have cited basis risk as one of the main problems of weather index insurance products. A study by Serfilippi et al., (2015) found that the non-payment of insurance rebates also contributes to the low uptake of index-based insurance. The attributes of the drought index insurance policy that were included in the design of the hypothetical drought index insurance policies were premium, basis risk, mode of claims payout, interlinking of credit with insurance, "no claim discount" payment and subsidy. This forms the basis for their inclusion as attributes for the choice experiment study.

Assigning of attribute levels

Establishing realistic and meaningful attributes and attribute levels increases the precision of parameter estimates (Hall et al., 2004). Table 4 summarises the attributes and attribute levels used in the design of the drought index insurance policies.

Table 4: Attributes and Levels of Hypothetical Drought Index Insurance Policy

Attributes	Levels
Premium	1. GhȻ35
	2. GhȻ40
Basis risk	1. Rainfall data from the GMet weather station
	2. Rainfall data from a satellite
Claims payout	1. Non-bank payment
	2. Bank payment
Interlinking credit with insurance	1. Credit not interlinked with insurance
	2. Credit interlinked with insurance
"No Claim Discount" payment	1. Payout at the end of the next season
	2. Reduction of next seasons premium
Subsidy	1. Subsidy on agricultural inputs
	2. Subsidy on drought index insurance policy premium

Source: Field Survey, Boateng-Gyambiby (2017)

Design of choice set

The experimental design is a combination of the attribute levels that is used in the construction of alternatives (drought index insurance policy alternatives or options) included in the choice sets. A full factorial design includes all possible combinations of the attribute levels. It allows for the estimation of main and interaction effect independent of one another. The main effect is the direct effect of each independent variable (the difference in attribute levels) on the dependent variable (choice variable). The interaction effect is the effect of interaction between two or more independent variables (by varying two or more attribute levels together) on the dependent variable.

To obtain the number of drought index insurance policy options, A^n where n and A denotes the number of attributes and the attribute levels of the drought index insurance policy respectively. The design has six attributes, each with two levels, generated sixty-four possible alternatives (2^6). The number of combinations of a full factorial was too large to be examined by cereal farmers; therefore, a fractional design was employed. The fractional factorial design is a sample of the full factorial design which allows for the estimation of all the relevant effects for the researcher. The following are reasons for the use of fractional factorial:

1. To prevent respondent fatigue
2. To limit the cognitive burden
3. To avoid inconsistent choice
4. To avoid lexicographic choice behaviour
5. To limit the consequences of lexicographic choice behaviour etc.

Full or fractional factorial designs can be blocked into different versions to which responses are randomly assigned in order to reduce cognitive complexity.

Properties of efficient choice design

A fractional factorial design for a choice experiment should be both orthogonal and balanced (Kuhfeld, 2005). In ensuring that there is orthogonality in the fractional factorial designs, the parameter estimates in the linear model are uncorrelated. This implies that the attributes of the design are statistically independent of each other (Hensher et al. 2005; Kuhfeld 2005). To ensure a balanced design, each attribute level should be occurring often equally in order to minimize the variance in the estimate of the parameters (Kuhfeld 2005). Orthogonal arrays are achieved when fractional factorial designs that are both orthogonal and balanced (Burgess & Street 2005). Orthogonal arrays exist for certain combinations of attributes and attribute levels (Kuhfeld 2005). Other combinations have a trade-off between the degrees of orthogonality and balance. However, the most efficient design can be obtained by using the D-efficiency measure. (Carlsson and Martinsson 2003; Burgess and Street 2005; Kuhfeld 2005; Street et al. 2005).

A third property that characterizes efficient choice designs is minimal overlap (Huber and Zwerina 1996; Maddala et al. 2003). Each attribute level is only meaningful in comparison to others within the choice set, or in other words, no information is obtained on an attribute's value when its levels are the same across all alternatives within a choice set. Researchers should, therefore, seek to minimize the probability that an attribute level repeats itself in each choice set. Finally, Huber and Zwerina (1996) have argued for the importance of utility balance, which refers to balancing the utilities of the alternatives offered in the choice set, though in practice the lack of prior information on the utility of attributes limits the applicability of this criterion (Huber and Zwerina 1996).

The attributes and their levels of the hypothetical drought index insurance policy in Table 4 were short texted and pictorially represented for a better appreciation of the attribute that constitutes the policy.

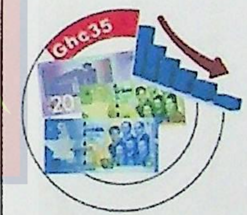
Attributes of drought index insurance policy	Premium	Basis risk	Claims payout	Interlinking credit with insurance	"No Claim Discount" payment	Subsidy
Attribute level one (1) of drought index insurance policy	 GhC35	 Rainfall data from the GMet weather station	 Non-bank payment	 Credit not interlinked with insurance	 Payout at the end of the next season	 Subsidy on agricultural inputs
Attribute level two (2) of drought index insurance policy	 GhC40	 Rainfall data from a satellite	 Bank payment	 Credit interlinked with insurance	 Reduction of next seasons premium	 Subsidy on drought index insurance policy premium

Figure 3: Pictorial Representation of Attributes and Attribute Levels of the Hypothetical Drought Index Insurance Policy

The JMP (SAS) software was used in the design and analysis of the hypothetical drought index insurance policies. In all, six choice set was generated. Each choice set has two policy options or alternatives. However, the respondent is not obliged to choose any of the hypothetical policies within the choice set. This is because in the real market, clients or buyers have the free will to choose the type of policy which gives them maximum satisfaction. The refusal of a respondent to subscribe to any of the policy options within a choice set due to inadequate satisfaction was considered as a choice. Therefore, the choice not to choose any of the hypothetical policy within the choice set is considered as a third hypothetical policy option. That is cereal farmers may opt for policy option one, policy option two and policy option three (i.e. None of the policy options). Each respondent selected a policy option per choice set. After the experiment, one respondent was required to select six drought index insurance policies that provided maximum satisfaction or utility.

Table 5 shows the hypothetical drought index insurance policies

Table 5: Hypothetical Drought Index Insurance Policies

Choice set	Premium	Basis risk	Mode of claims payout	Interlinking credit with insurance	"No Claim Discount" payment	Subsidy
1	GhȻ40	Rainfall data from a satellite	Non-bank payment	Credit not interlinked with insurance	Reduction of next seasons premium	Subsidy on drought index insurance policy premium
1	GhȻ35	Rainfall data from the GMet weather station	Bank payment	Credit interlinked with insurance	Payout at the end of the next season	Subsidy on agricultural inputs
2	GhȻ35	Rainfall data from the GMet weather station	Bank payment	Credit not interlinked with insurance	Payout at the end of the next season	Subsidy on drought index insurance policy premium
2	GhȻ40	Rainfall data from a satellite	Non-bank payment	Credit interlinked with insurance	Reduction of next seasons premium	Subsidy on agricultural inputs
3	GhȻ35	Rainfall data from the GMet weather station	Non-bank payment	Credit not interlinked with insurance	Reduction of next seasons premium	Subsidy on agricultural inputs
3	GhȻ40	Rainfall data from a satellite	Bank payment	Credit interlinked with insurance	Payout at the end of the next season	Subsidy on drought index insurance policy premium
4	GhȻ35	Rainfall data from a satellite	Bank payment	Credit interlinked with insurance	Reduction of next seasons premium	Subsidy on drought index insurance policy premium
4	GhȻ40	Rainfall data from the GMet weather station	Non-bank payment	Credit not interlinked with insurance	Payout at the end of the next season	Subsidy on agricultural inputs

Table 5 Continued

Choice set	Premium	Basis risk	Mode of claims payout	Interlinking credit with insurance	"No Claim Discount" payment	Subsidy
5	GhȻ40	Rainfall data from the GMet weather station	Bank payment	Credit interlinked with insurance	Reduction of next seasons premium	Subsidy on drought index insurance policy premium
5	GhȻ35	Rainfall data from a satellite	Non-bank payment	Credit not interlinked with insurance	Payout at the end of the next season	Subsidy on agricultural inputs
6	GhȻ40	Rainfall data from a satellite	Bank payment	Credit not interlinked with insurance	Reduction of next seasons premium	Subsidy on agricultural inputs
6	GhȻ35	Rainfall data from the GMet weather station	Non-bank payment	Credit interlinked with insurance	Payout at the end of the next season	Subsidy on drought index insurance policy premium

Source: Field Survey, Boateng-Gyambiby (2017)

The hypothetical drought index insurance policies in Table 5 were short texted and pictorially represented in order to ensure that cereal farmers have a better appreciation of the policies and the experiment to be conducted.

With each choice set, there are three hypothetical drought index insurance policies a respondent can choose from. Figure 4-9 shows the policy options.

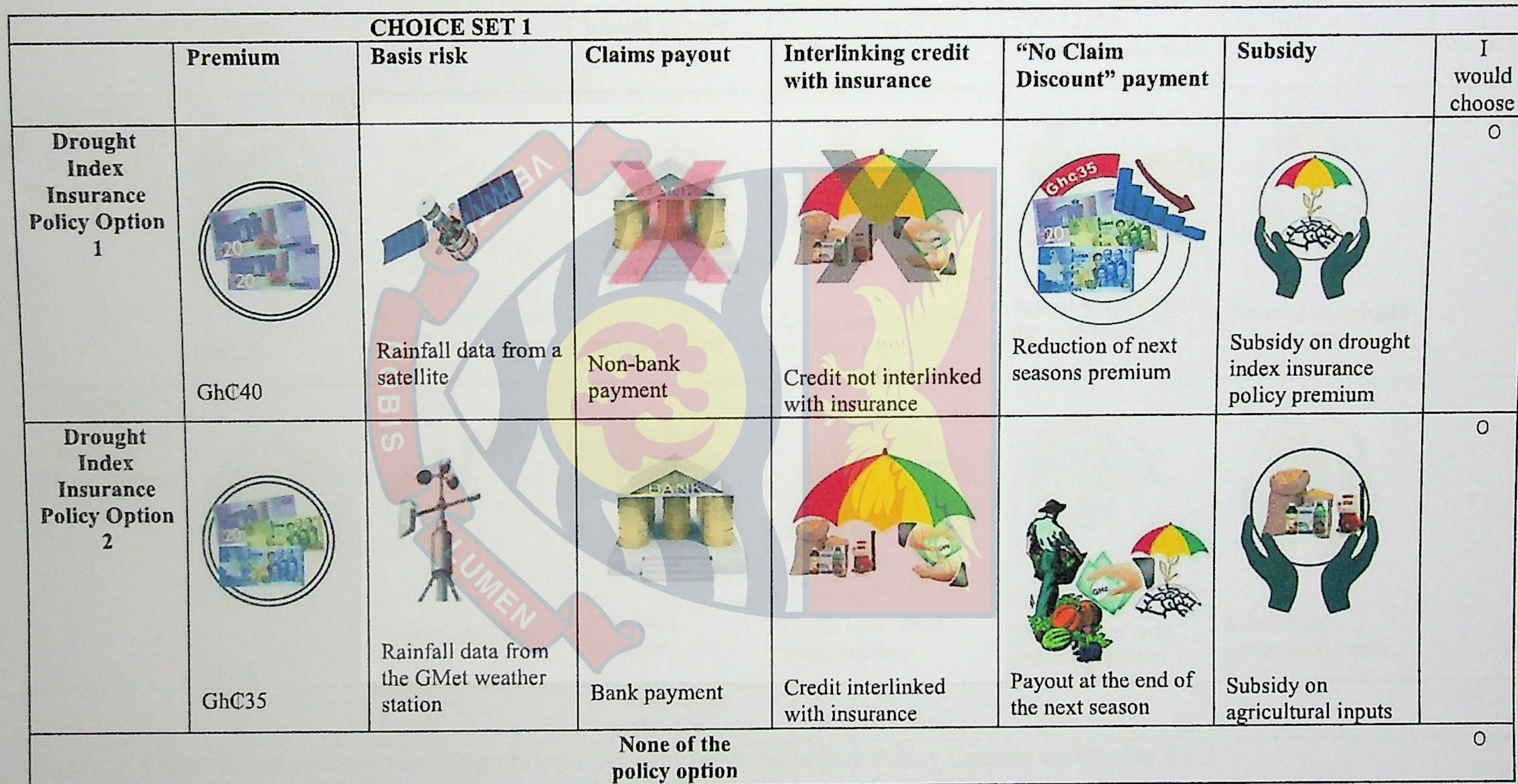


Figure 4: Pictorial Representation of the Hypothetical Drought Index Insurance Policy Options on Choice Set 1

CHOICE SET 2							
	Premium	**Basis risk**	**Claims payout**	**Interlinking credit with insurance**	**"No Claim Discount" payment**	**Subsidy**	I would choose
Drought Index Insurance Policy Option 1	 GhC35	 Rainfall data from the GMet weather station	 Bank payment	 Credit not interlinked with insurance	 Payout at the end of the next season	 Subsidy on drought index insurance policy premium	O
Drought Index Insurance Policy Option 2	 GhC40	 Rainfall data from a satellite	 Non-bank payment	 Credit interlinked with insurance	 Reduction of next seasons premium	 Subsidy on agricultural inputs	O
None of the policy option							O

Figure 5: Pictorial Representation of Hypothetical Drought Index Insurance Policy Options on Choice Set 2

CHOICE SET 3							
	Premium	**Basis risk**	**Claims payout**	**Interlinking credit with insurance**	**"No Claim Discount" payment**	**Subsidy**	I would choose
Drought Index Insurance Policy Option 1	GhȻ35	Rainfall data from the GMet weather station	Non-bank payment	Credit not interlinked with insurance	Reduction of next seasons premium	Subsidy on agricultural inputs	O
Drought Index Insurance Policy Option 2	GhȻ40	Rainfall data from a satellite	Bank payment	Credit interlinked with insurance	Payout at the end of the next season	Subsidy on drought index insurance policy premium	O
None of the policy option							O

Figure 6: Pictorial Representation of Hypothetical Drought Index Insurance Policy Options on Choice Set 3

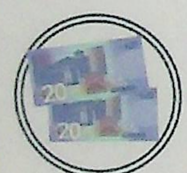
CHOICE SET 4							
	Premium	**Basis risk**	**Claims payout**	**Interlinking credit with insurance**	**"No Claim Discount" payment**	**Subsidy**	I would choose
Drought Index Insurance Policy Option 1	 GhȻ35	 Rainfall data from a satellite	 Bank payment	 Credit interlinked with insurance	 Reduction of next seasons premium	 Subsidy on drought index insurance policy premium	O
Drought Index Insurance Policy Option 2	 GhȻ40	 Rainfall data from the GMet weather station	 Non-bank payment	 Credit not interlinked with insurance	 Payout at the end of the next season	 Subsidy on agricultural inputs	O
			None of the policy option				O

Figure 7: Pictorial Representation of Hypothetical Drought Index Insurance Policy Options on Choice Set 4

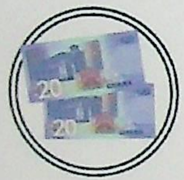
CHOICE SET 5							
	Premium	**Basis risk**	**Claims payout**	**Interlinking credit with insurance**	**"No Claim Discount" payment**	**Subsidy**	I would choose
Drought Index Insurance Policy Option 1	 GhȻ40	 Rainfall data from the GMet weather station	 Bank payment	 Credit interlinked with insurance	 Reduction of next seasons premium	 Subsidy on drought index insurance policy premium	O
Drought Index Insurance Policy Option 2	 GhȻ35	 Rainfall data from a satellite	 Non-bank payment	 Credit not interlinked with insurance	 Payout at the end of the next season	 Subsidy on agricultural inputs	O
			None of the policy option				O

Figure 8: Pictorial Representation of Hypothetical Drought Index Insurance Policy Options on Choice Set 5

CHOICE SET 6							
	Premium	**Basis risk**	**Claims payout**	**Interlinking credit with insurance**	**"No Claim Discount" payment**	**Subsidy**	I would choose
Drought Index Insurance Policy Option 1	GhȻ40	Rainfall data from a satellite	Bank payment	Credit not interlinked with insurance	Reduction of next seasons premium	Subsidy on agricultural inputs	O
Drought Index Insurance Policy Option 2	GhȻ35	Rainfall data from the GMet weather station	Non-bank payment	Credit interlinked with insurance	Payout at the end of the next season	Subsidy on drought index insurance policy premium	O
			None of the policy option				O

Figure 9: Pictorial Representation of Hypothetical Drought Index Insurance Policy Options on Choice Set 6

The second section focused on risk and drought index insurance questions. The section sought to understand the cereal farmers' level of knowledge of drought index insurance and experiences with drought related loss. It also sought to understand the coping strategies of household to the effect of drought linked loss etc.

The third section was made up of questions that sought the opinion of cereal farmers on the constraints (inaccessibility to credit, basis risk, high premium rate, inadequate education on the insurance product, liquidity constraints, lack of trust and nature of the insurance cover) to drought index insurance policy subscription. These perceived constraints were assessed on an ordinal verbal 5-point scale ranging from "very low agreement", "low agreement", "moderate agreement", "high agreement" and "very high agreement". The fourth section consisted of describing questions on socio-demographic characteristics of cereal farmers (Appendix A).

An interview schedule was used as the key research instrument for gathering data from the cereal farmers through a face to face interview in the local dialect by well-trained enumerators.

Validity of Data Collection Instrument

The content and construct validity of the instrument for data collection was ensured. Content validity of an instrument measures the degree to which items on an instrument extensively cover the significant aspects of the area under investigation. Saunders et al. (2012) confirmed that content validity of the instrument is essential in that it ensure that the measuring questions on the questionnaire provide ample coverage of the research questions. The drought index insurance experts in the Ghana Agricultural Insurance Pool and supervisors of the study ensured the content validity of the instrument. First, they ensured that detailed and relevant literature was reviewed on the instrument. Furthermore, they ensured that significant and necessary questions were contained in the structured interview schedule to measure the variables.

Construct validity measures the extent to which the instrument measures what it is intended to measure and performs the function it is purported to perform accurately (Patten, 2012). Tsai et al. (2013) further stated that, construct validity confirms the hypothesised relationships between the measurement scale and construct that are conceptually distinct. A measure can claim construct validity if its theoretical constructs are valid. The drought index insurance experts, supervisors and insurance experts ensured the construct validity of the instrument. This was done through two construct validation process, namely convergent and divergent validity. They tested for convergence across different measures of the same items as well as testing for divergence across different measures of related by conceptually distinct items. With convergent validity, the experts ensured that measures of a similar construct in the instrument were related to each other. Also, all items in the instrument had high inter-item correlation. Concerning the divergent validity, the experts ensured that items that measures construct validity theoretically were not related or observed to be related to each other.

In other words, there was a low correlation between the instrument items of different construct. Awang, (2014) & Hair et al., (2013) both concur that the two most commonly accepted forms of construct validity are divergent and convergent validity.

Pre-Testing

The effectiveness of a research instrument and data collection related issues can be assured through the conduct of pre-testing and pilot (Saratakos, 1993). Morse and Field (1996) concluded that pre-testing is an essential tool in the methodological process of a research since it improves the quality of questions and tools for data collection.

The aim of the pre-testing is to certify the clarity of the questions and the related instructions, examine the required duration for administering the data collection instrument, participants responses to the questions, and obtain a feedback from the respondent on pertinent issues for which validity, reliability, content, clarity, content relevance and content specificity will be ascertained (Church, Waclawski, & Kraut, 2007; Fink, 2009). The feedback obtained based on the pre-testing was used to improve and refined the questions, responses and format of the structured interview selection in order to enhance its effectiveness and efficiency.

The instrument was administered to thirty-eight cereal farmers in West Mamprusi District who were also involved or had subscribed to the drought index insurance policy. Some questions were modified and whilst other variables were refined to enhance the internal consistency.

Reliability of the Data Collection Instrument

An instrument is said to be reliable when a variable or set of variables exhibit consistency in what it intends to measure. Reliable instrument produces same results when multiple measurement of the set of variables are taken (Hair, Black, Babin, & Anderson, 2013). According to Mitchell (1996) and Saunders et al., (2012), internal consistency; test re-test; and alternative form are the three common approaches in assessing the reliability of the instrument. Statistically, reliability is measured by Cronbach Alpha values. The Cronbach's Alpha ranges from 0 to 1 and a value less than 0.6 is considered unreliable (Burns & Burns, 2008; Gill & Johnson, 2010; Klenke, 2008). A Cronbach's Alpha value ranging from 0.70 to 0.90 are considered satisfactory for most instruments (McMillan & Schumacher, 2001).

After pre-testing the instrument in the West Mamprusi district, it was peer-reviewed and expert's opinions were sought. Data collection instruments from empirical literature was modified and adapted.

Table 6: Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	No of Items
0.818	0.818	7

Source: Field Survey, Boateng-Gyambiby (2017)

Table 6 shows a Cronbach's Alpha value of 0.818 for a 5-point Likert type scale items ranging from very low agreement to very high agreement shows that the items are reliable. This is a proof of the reliability of the scale in data collection instrument.

Data Collection Procedure

A brief report and introductory letter from the researcher about the research, the research objectives and benefits expected for the farmers for participation was given to the enumerators to obtain permission of cereal farmers. In addition, consent forms, seeking their consent to be interviewed and also assuring cereal farmers (cereal farmers) about the confidentiality of the collated data was signed by cereal farmers.

Face-to-face interview sessions were conducted from 4th February, 2017 to 25th February, 2017 between the hours of 8:00 am to 5:00 pm in the homes of cereal farmers by the researcher and enumerators. The well-trained enumerators were used because the majority of the farmers could not read and understand the English language as well as the technical nature of some aspects of the data collection instrument.

Data Processing and Analysis

After the data collection, a total number of 424 cereal farmers (consisting of 258 household heads who had subscribed to the drought index insurance policy and 166 cereal farmers who did not were available for interview). Five of the selected farmers who subscribed to the drought index insurance policy and one who had not, travelled out of the community and could not be reached. This gave a response rate of 98.6 percent.

Data collected from the study area was edited on a daily basis when researcher and enumerators returned from the communities. Data coding and data entry template was designed by the researcher. Data was entered into the SPSS software by the researcher. However, STATA and JMP as well as SPSS were used to generate appropriate statistics for the study.

Analytical Frameworks and Estimation Techniques for Determining the Factors Influencing Subscription to Drought Index Insurance Policy and Intensity

Various analytical frameworks and estimation techniques based on conceptual and theoretical underpinnings used to analyse each research objective are discussed.

The Heckman two-stage probit model was used to identify the determinants and estimate the intensity of drought index insurance policy subscription among cereal farmers in the Northern region of Ghana. Two-decision levels; the choice to subscribe or not to subscribe to a drought index insurance policy. Intensity of subscription was analysed in term of (proportion of the farmers' land covered by drought index insurance).

The sample selection Heckman (1979) was employed to address the problem of missing data in the outcome equation which emanate from incidental truncation arising from responses in the selection equation.

The Heckman model is appropriate because it accounted for the non-random nature of the sample by computing a selection term in the first equation which is then included as one of the repressor in the second hurdle to correct for self-selection (Olwande, 2011).

A farmer i will subscribe to a drought index insurance policy if the utility received in a form of a drought index insurance policy cover (S^*_i) is greater than the utility when there is no drought index insurance policy cover.

The theoretical model of subscription based on the index insurance policy cover function of subscription was stated as:

$$S_i^* = \gamma'(\pi_S - \pi_{NS}) \quad (5)$$

where S_i^* is the latent unobservable utility received. The subscription decision of a farmer i is observed as a binary decision S_i. Therefore, the observed subscription dummy variable takes the value for $S_i^* > 0$, and $S_i = 0$ for $S_i^* \leq 0$. π represents index insurance policy, and the subscripts represents subscribers (S) and non-subscribers (NS).

The study assumed that if each farmer makes the subscription decision to have a maximum insurance cover, the reduced drought index insurance subscription decision is given by:

$$S_i = f(x_i, z_i, v_i; \beta) + \mu_i, \quad (6)$$

where S_i is subscription decision, x_i is a vector of farmer characteristics, z_i is a vector of wealth indicators of the farmer i, v_i is the institutional characteristics, β is the vector of coefficients, and μ_i is the farmer-specific random error term which is independent and identically distributed.

The empirical model which is basically the decision to subscribe to a drought index insurance policy is estimated using the probit regression model:

$$S_i = \beta_x x_i + \beta_z z_i + \beta_v v_i + \mu_i \quad (7)$$

The variable x_i is a vector of a farmer characteristics such as sex, age, years of formal education and farming experience; and farm characteristics such as availability of family labour, assets, income and farm size of household i (Asfaw, Di Battista & Lipper, 2016).

The wealth indicator vectors z_i are livestock, income, off–farm, farm size and income which influence the subscription or non-subscription of the index insurance policy.

v_i denotes the vector for community-level characteristics such as distance to district, nature of the road and access to insurance agents.

The intensity of subscription was analysed as the proportion of farm size covered by the drought index insurance policy at the second stage of the analysis.

The decision to subscribe and how much to subscribe are not made simultaneously by the farmer and may be influenced by different factors.

There is the need to approach the non-subscribers in the sample as a sample selection issue making the sub sample of the subscribers not to be random.

Therefore, the Heckman two-stage sample selection model was employed since it rigorously models the intensity of subscription separately.

The outcome equation given by a latent variable is observable if and only if Equation (5) is greater than zero: $S_i^* = \gamma'(\pi_S - \pi_{NS}) > 0$.

Thus, the second stage (intensity of subscription) is given structurally conditional on the subscription decision being positive as:

$SI_i^* = \alpha X_i + \varepsilon_i$, if $S_i^* > 0$; otherwise $SI_i^* = 0$, (8)

where X_i denotes the vector of exogenous variables and ε_i is the error term. Simply put, to obtain consistent coefficient estimates of Equation (8), the inverse Mills' ratio are calculated from the maximum likelihood Probit estimates of Equation (6) and then included in the second-stage OLS estimation. The inverse Mills' ratio (λ_i), is calculated as:

$$\lambda_i = \frac{\phi(\beta' X_i)}{1-\Phi(\beta' X_i)}, \tag{9}$$

Where ϕ is the probability density function and Φ is the cumulative distribution function, and β' is the associated parameter vector estimated in Equation (6).

The empirical OLS regression equation fitted for the intensity of subscription of drought index insurance policy-conditional on subscription being positive is then given as follows:

$$SI_i \mid S_i^* > 0 = \alpha_x x_i + \alpha_z z_i \gamma_\lambda \lambda_i + \varepsilon_i, \tag{10}$$

Where SI_i is proportion of farm covered by insurance, λ_i is the inverse mills ratio, α and are parameter vectors to be estimated, and ε is a normal random error with mean 0 and variance δ_ε^2.

Assumptions of the Heckman two-stage model

The Heckman model uses the following assumptions:

$$(\varepsilon,u) \sim N(0,0,\sigma^2_\varepsilon, \sigma^2_u, `\rho_{\varepsilon u}) \tag{11}$$

That is both error terms are normally distributed with mean 0, variance as indicated and the error terms are correlated where $\rho_{\varepsilon u}$ indicates the correlation coefficient.

$$(\varepsilon, u) \quad (12)$$

The error terms are independent of both sets of explanatory variables.

$$\text{Var}(u) = \sigma^2{}_u = 1 \quad (13)$$

The variance of the error term is constant.

A study by Bushway, Johnson, and Slocum (2007) explained that when the same covariates are used in the selection and outcome equation, the results from the Heckman estimation may still be biased and report standard errors that are large and inflated.

To correct this inefficiency, an exclusion restriction is introduced in order to reduce the possible correlation between the exogenous predictors and the inverse Mills ratio. The rationale for the inclusion of the exclusion restriction is synonymous to instrumental variables where factors that affect the first equation (selection equation) but not the second stage (outcome regression) are identified.

In this research, contact with an agriculture insurance agent may correlate with the farmer access to information on drought index insurance policy thus having an influence on the decision to subscribe but not the intensity of subscription. Therefore, contact with an agriculture insurance agent was used as the exclusion restriction variable.

Variables for Analysis

Two dependent variables; discrete choice to subscribe to a drought index insurance policy (yes or no response) in stage one and the proportion of land on the farmers' land under drought index insurance policy cover in the second stage was employed by the model. Table 7 outlines the dependent and explanatory variables used to model the drought index insurance policy uptake and intensity decisions.

Table 7: Variables for Heckman Two-Stage Model Analysis

Variables	Description	Unit of measurement	Expectation
Dependent Variables			
Insurance subscription	The decision to participate in drought index insurance or not	1 = yes, 0 = no	
Land insured	Proportion of land insured	Percentages	
Independent Variables			
Age	Age of farmer	Number of years	-
Education	Educational level of farmer	Number of years of schooling	+/-
Experience	Years of farming experience	Number of years	+
Household size	Household size farmer	Number of household members	+/-
Dependency	Dependency ratio	Number of people above 18years /Number of people below 18years	-
Farm size	Size of farm under insurance drought index insurance cover	Hectare(s)	+
Livestock-Tropical Livestock Unit (TLU)	Livestock ownership	Number of livestock owned by cereal farmers multiplied by the corresponding	+
Income	Household income	Ghana cedis (Gh¢)	+

Table 7 Continued

Off-farm income	Off-farm income of farmer	Ghana cedis (Gh¢)	+
Distance	Distance to district Centre (km)	Km	-
Contact	Contact with insurance or extension agent	1 = yes, 0 = no	+

Source: Field Survey, Boateng-Gyambiby (2017)

Conditional Logit Estimation in a Discrete Choice Experiment

Based on the random utility theory, the study adopted the choice experiment approached. A discrete choice model was employed to aid in the determination of the optimal drought index insurance policy because it mimics real market choices made by clients as compared to conjoint analysis that does not mimic real market situations because they are not made up of choices. Secondly, discrete choice models are founded on the fundamental economic theory of consumer utility maximization whereas conjoint studies are not (Louviere, Flynn, & Carson, 2010).

In discrete choice models, a choice is made from a set of possible choices and the probability of that choice is modelled as a nonlinear function of the utility of that product. Whereas is conjoint models, the preference rating is observed and modelled as a linear combination of the attributes of the product.

Model estimation

To explain consumer choice within a utility maximising framework, it is necessary that Choice Modelling integrates the Lancasterian model of consumer behaviour with random utility theory (RUT) developed by McFadden (1974).

Random Utility Theory presupposes that an individual's utility can be divided into an observable deterministic component (V_i) and an unobservable random stochastic component (ε_i) (Holmes & Adamowicz, 2003). Assuming these two components are additive, a generalised utility expression for each alternative i can be expressed by equation (13) (Boxall, Adamowicz, Swait, Williams, & Louviere, 1996).

$$U_i = V_i + \varepsilon_i \quad (14)$$

The attributes included in the Choice Model explains the deterministic component of utility. Holmes and Adamowicz, (2003) argue that imperfect information about all the determinants of utility can result in a random component situation. This leads to the inclusion of an error term to capture the effect of these unobserved influences (Louviere, 2001).

According to Hensher, Rose, and Greene (2005), the deterministic component of the utility can be further decomposed and expressed as:

$$V_i = ASC + B_{1i}f(X_{1i}) + B_{2i}f(X_{2i}) + B_{3i}f(X_{3i}) + \ldots B_{Ki}f(X_{Ki}) \quad (15)$$

Where there are K attributes and B_{1i} represents the parameter coefficient relating to attribute X_1 alternative i and ASC is an alternative specific constant. The attributes are premium, basis risk, mode of claims payout, interlinking credit with insurance, "no claim discount" payment and subsidy. The Alternative Specific Constant (ASC) captures the average influence of all unobserved factors on utility. This representative portion of utility is often assumed to be linear in attributes for computational ease but can also be represented in quadratic or logarithmic form.

The coefficients show the relative importance of each attribute and their effect on utility (Hensher, et al., 2005).

Concerning the error component, a number of maintained assumptions exist and collectively known as the independently and identically distributed (IID) conditions. Hensher, et al., (2005) point out that the IID condition assumes that all error terms are derived from the same underlying distribution and are uncorrelated with other error terms.

Specifically, when applying Random Utility Theory to the choice model, each individual selects an alternative which maximises their utility. The inherent uncertainty caused by the random element ensures that there is a restriction to modelling the probability of an individual choosing a particular alternative (Hensher, et al., 2005). The probability of an individual selecting alternative i over alternative j can be expressed as (Hensher, et al., 2005):

$$\text{Prob}_i = \text{Prob}[(V_i + \varepsilon_i) \geq (V_j + \varepsilon_j) \forall_j \in J = 1, \ldots, J; i \neq j] \quad (16)$$

Where J represents the entire choice set. The fact that the error term cannot be measured, transforms a consumer's standard utility maximisation rule to a random utility maximisation rule. Rearranging Equation (15) expresses this as (Hensher, et al., 2005):

$$\text{Prob}_i = \text{Prob}[(\varepsilon_j - \varepsilon_i) \leq (V_i - V_j) \forall j \in j = 1, \ldots, J; i \neq j] \quad (17)$$

Expression (16) states that the probability of an individual choosing alternative is equal to the probability that the difference in the unobserved sources of utility is less than or equal to the difference in the observed sources of utility (Hensher, et al., 2005). Assuming the error term exhibits an extreme value type 1 or Gumbel distribution, a conditional logit model (CLOGIT) can be used for Choice Modelling purposes.

A Conditional logit model was employed because the probability is conditioned on the choices shown and the client making the choice. Also, when three or more alternative choice options are available to the individual, conditional logit model is the most commonly used specifications. The probability of a respondent's selecting alternative is given in equation (18) (Hensher, et al., 2005).

$$\text{Prob}_i = \frac{expV_i}{\Sigma_{j=1}^{J} expV_i}; j = 1, \ldots, i, \text{J}\, i \neq j \quad (18)$$

The independence of irrelevant alternatives (IIA) which is a restriction or an assumption is a behavioural condition in the MLA. This condition states that the probability of a respondent selecting an alternative is independent of the presence or absence of other alternatives in a choice set. A result of the IID assumption, the IIA condition implies that the unobserved attributes are identical for each alternative (Hensher, et al., 2005).

Farmers could decide not to make a choice: delay a choice; stay with their current drought index insurance policy. This is known as None option. This None option was added in order to make the model realistic and mimic the choice situation or the real market. The None option is specified by modifying the probability to be:

$$\Pr r\,(j \text{ is selected}) = \frac{e^{V_{ij}}}{1 + \sum_{k=1}^{J} e^{V_{ik}}} \quad (19)$$

Where the "1" in the denominator is the None choice option. The probability of selecting None is:

$$\Pr r\,(j \text{ is selected}) = \frac{1}{1+\sum_{k=1}^{J} e^{V_{rk}}} \quad (20)$$

Willingness-to-Pay for Hypothetical Optimal Drought Index Insurance Policy in a Discrete Choice Experiment

The study adopted the choice experiment approach which is rooted in random utility theory. The Conditional logit model was employed in Discrete Choice Experiment to estimate farmers' willingness to pay for the drought index insurance policy by cereal farmers' in the Northern region of Ghana. The willingness-to-pay is analysed as a change in price needed to maintain the same level of utility after changes in a non-price attribute.

Considering the situation where a non-price attributes, X, (basis risk, mode of claims payout, interlinking credit with insurance, "no claim discount" payment and subsidy) is continuous or discrete. Assume that, systematic utility is given by:

$$V = \beta_1 P + \beta_2 X \quad (21)$$

where P is the price. Then for a change in X we have

$$\frac{\Delta V}{\Delta X} = \beta_1 \frac{\Delta P}{\Delta X} + \beta_2 \quad (22)$$

where $\Delta V / \Delta X$ represents the change in systematic utility due to a unit change in X.

$\Delta P / \Delta X$ denotes the amount that the price changes for that change in X. This is the extra amount prospective clients will be willing to pay for the change in X so $\Delta P / \Delta X = WTP$.

To keep the systematic utility constant, $\Delta V / \Delta X = 0$ so the clients is no better off and no worse off as a result of the attribute change (SAS Institute Incorporated, 2016). This means that:

$$\beta_1 * WTP = -\beta_2 \Rightarrow WTP = -\frac{\beta_2}{\beta_1} \tag{23}$$

Accordingly, the willingness-to-pay is expressed as the negative of the coefficient for the *X* attribute divided by the coefficient for price. The utility of the price is expected to be negative, thus as price increases, utility decrease. *WTP>0* if the attribute has a positive effect on utility. If the attribute has a negative effect on utility, *WTP<0.*

The numerator for WTP has units "utility per unit attribute while the denominator has units "utility per dollar." As a result, the *WTP* ratio has units "dollars per unit attribute" which is a price (i.e., *WTP*) per unit of the attribute (SAS Institute Inc. 2016).

It is the monetary amount prospective clients will pay for a said attribute. To determine the new price, a prospective client is willing-to-pay for a said attribute of the drought index insurance policy, the monetary amount can be added to or subtracted from (SAS Institute Inc. 2016).

Table 6 shows the attributes and levels incorporated into the model for the estimation of willingness to pay for the drought index insurance policy.

Table 8: Attributes and Levels for Willingness to Pay for Drought Index Insurance Policy

Attributes of drought index insurance policy	Attribute levels
Basis risk	1. Rainfall data from the GMet weather station
	2. Rainfall data from a satellite
Claims payout	1. Non-bank payment
	2. Bank payment
Interlinking credit with insurance	1. Credit not interlinked with insurance
	2. Credit interlinked with insurance
"No Claim Discount" payment	1. Payout at the end of the next season
	2. Reduction of next seasons premium
Subsidy	1. Subsidy on agricultural inputs only
	2. Subsidy on drought index insurance policy premium only

Source: Field Survey, Boateng-Gyambiby (2017)

Constraints to the Subscription of Drought Index Insurance Policy

The Kendall's concordance analysis was therefore employed to investigate the agreement between the ranked constraints to drought index insurance policy subscription because it aided in the establishment of the degree of agreements among responses. W is an index that measures the ratio of the observed variance of the sum of ranks to the maximum possible variance of sum of ranks. The Kendall's W takes values from zero to one, where zero represents no concordance (agreement) at all among farmers and one represents a perfect agreement.

Mattson (1986) admits that the variability among sums will be a maximum if the rankings are in perfect agreement. The constraints with the least score are ranked as the most compelling whilst the one with the highest score is ranked as the least compelling with respect to the computation of the total rank score for each constraint to drought index insurance policy. The degree of agreement in the rankings is measured by computing the total rank score, which is subsequently used to calculate the coefficient of concordance W (Field, 2014).

The formula for the coefficient of concordance W is then given by:

$$W = \frac{(\Sigma T^2 - (\Sigma T)^2 / n) / n}{m^2(n^2 - 1) / 12} \tag{24}$$

The formula is further simplified as follows:

$$W = \frac{12[\Sigma T^2 - (\Sigma T)^2 / n]}{nm^2(n^2 - 1)} \tag{25}$$

where;

T = sum of ranks for each constraint being ranked.

m = number of cereal farmers ranking the barriers to the subscription of drought index insurance policy and

n = number of constraints being ranked.

The Kendall's W takes values from 0 to 1 where 0 represents no concordance (agreement) among cereal farmers and 1 represents a perfect agreement.

In order to analyse constraints to the subscription of drought index insurance policy data, each point on the Likert scale has conventional equidistant numbers assigned to it, according to the assumption that these points have the same distance from a semantic point-of-view.

The next chapter presents the results and discusses the on constraints to the subscription of drought index insurance policy.

CHAPTER FOUR

FACTORS INFLUENCING THE SUBSCRIPTION TO DROUGHT INDEX INSURANCE POLICY AND INTENSITY AMONG CEREAL FARMERS

Introduction

This chapter presents the results and discussion on the description of the socioeconomic characteristics of cereal farmers and also examined the determining factors influencing the subscription to drought index insurance policy and intensity among cereal farmers in the Northern region of Ghana.

Socioeconomic Characteristics of the Cereal Farmer in the Northern Region

This section presents a description of the socioeconomic characteristics of the cereal farmers. This was discussed in terms of age, level of education, household size, dependence ratio, farming experience, farm size, access to credit, number of livestock (Tropical Livestock Unit (TLU), income per annum, off-farm income per annum, extension contact and distance to the district centre. The socioeconomic characteristics of the cereal farmers give essential information about the population being studied.

Table 9 presents the results that led the discussions on the socioeconomic characteristics of the cereal farmers in this study.

The results of the study as reported in Table 9, shows the descriptive characteristics of the cereal farmers. Of the 424 households interviewed, 258 cereal farmers had subscribed to the drought index insurance (DII) policy and 166 had not subscribed. Age of farmers ranged from 18 years to 76 years with a mean age of about 40 years, which is consistent with the national distribution of farmers (GSS 2016). The mean household size and dependency ratio is 11 and 1.5 respectively. Farm size ranged from 1 to 40 acres with a mean size of 6 acres, which is consistent with the national distribution of farms (GSS 2016).

Table 9. Socioeconomic Characteristics of Cereal Farmers

Variable	Mean (N= 424)	Subscribers (N= 258)	Non-subscribers (N= 166)
Age of farmer (years)	39.6934	41.6938	36.5843
Education of farmer (years)	1.5472	1.6860	1.3313
Household size	10.9528	11.2132	10.5482
Dependence ratio	1.4953	1.5736	1.3735
Farming experience (years)	16.1509	17.5698	13.9458
Farm size (acres)	5.6002	5.9806	5.0090
Access to credit	0.3750	0.3837	0.3614
Livestock (TLU)	1.5519	1.6124	1.4578
Income (GhȻ)	1116.2677	887.7229	1471.4759
Off-farm income/annum (GhȻ)	1785.1887	2043.9147	1383.0723
Extension contact	0.8160	0.9496	0.6084
Distance to district centre (km)	13.3986	13.1512	13.7831

Source: Field Survey, Boateng-Gyambiby (2017)

A comparison of subscribers and non-subscribers to DII policy revealed that, in terms of household size, access to credit, extension contact, livestock ownership and distance to the district centre, adopters differ significantly from non-adopters. Also, adopters had more extension contact, livestock (tropical livestock units–TLU), farming experience and off-farm income in the study. However, non-subscriber had more income and also travelled more distance when moving to the district centre than subscribers.

This section discusses the results of the objective which sought to determine the factors influencing subscription to drought index insurance policy and intensity among cereal farmers using the Heckman Two-Step Model.

The discussion was sectioned into three as follows:

1. general overview of the results from the Heckman Two-Step Model indicating the determining factors influencing the subscription of drought index insurance policy and intensity.
2. Factors influencing the subscription of drought index insurance policy among cereal farmers.
3. Factors influencing the intensity of drought index insurance policy subscription.

Table 10 was used as reference for these discussions.

Determining the Factors Influencing the Subscription of Drought Index Insurance Policy and Intensity using the Heckman Two-Step Model.

Table 10 presents the first-step of the subscription to drought index insurance policy decision, and the second-step subscription intensity regression estimates. The Heckman two-step was modelled on the assumption that the decision to subscribe to the drought index insurance policy and the intensity are two distinct decisions. The rho value indicates the correlation coefficient between error terms. The Wald test indicates that the model is fit for the data.

With the exception of farm size, the selectivity model result shows that the variables influencing the subscription of drought index insurance policy decision are different from the ones that influenced the intensity.

From Table 10, five variables namely: age, farm size, income, contact with insurance agent and level of education in the selection equation (the decision to subscribe or not to subscribe to drought index insurance policy) explained the subscription of drought index insurance policy. Age, farm size, income and contact with insurance or extension agent were statistically significant at 1% confidence level whiles level of education was significant at 5% confidence level.

The outcome equation shows that three variables, namely: farming experience, farm size and off–farm income significantly affected the intensity of drought index insurance subscription. Farming experience and off–farm income were statistically significant at 10% confidence level whiles farm size was significant at 1% confidence level.

Table 9: Heckman Two-Step Regression Results on Determinants of Drought Index Insurance Policy Subscription and Intensity

Selection equation				
Variable	**Coef.**	**Std. Err.**	**Z**	**p-values**
Insurance subscription status				
Household characteristics				
Age (years)	0.02583	0.00769	3.36	0.001***
Farming experience	-0.00660	0.00892	-0.74	0.459
Level of education (years)	0.04565	0.02175	2.1	0.036**
Household size	-0.00805	0.01513	-0.53	0.594
Dependency ratio	0.13595	0.09919	1.37	0.171
Wealth indicators				
Farm size (acres)	0.06948	0.01964	3.54	0.000***
Livestock (TLU)	-0.02260	0.03002	-0.75	0.452
Income (GhC)	-0.00028	0.00006	-4.78	0.000***
Off–farm income (GhC)	0.00002	0.00002	1.06	0.288
Access to market and information				
Distance to district centre (km)	-0.00059	0.00444	-0.13	0.894
Contact with insurance or extension agent	1.48657	0.19818	7.5	0.000***
_cons	-2.07968	0.35170	-5.91	0.000

Table 10: Continued

Outcome equation				
Variable	**Coef.**	**Std. Err.**	**Z**	**P>|z|**
Proportion of land insured (acres)				
Household characteristics				
Age of farmer (years)	0.08881	0.20738	0.43	0.668
Farming experience	-0.39216	0.20981	-1.87	0.062*
Level of education (years)	0.10907	0.52335	0.21	0.835
Household size	-0.02529	0.36754	-0.07	0.945
Dependency ratio	0.07590	2.08653	0.36	0.716
Wealth indicators				
Farm size (acres)	-2.17382	0.45935	-4.73	0.000***
Livestock (TLU)	0.78627	0.77939	1.01	0.313
Income (GhȻ)	-0.00118	0.00188	-0.63	0.528
Off–farm income (GhȻ)	0.00049	0.00027	1.82	0.068*
Access to market and information				
Distance to district centre (km)	-0.05649	0.10395	-0.54	0.587
_cons	74.93929	10.85262	6.91	0.000
Rho	0.18732			

Source: Field Survey, Boateng-Gyambiby (2017)

*Significant at 10%, **Significant at 5% and ***Significant at 1% confidence level

Rho = 0.18732, Wald chi^2 (10) = 61.25 and Prob > chi2 = 0.000

Factors Influencing the Subscription of Drought Index Insurance Policy among Cereal Farmers

Age of respondent

Age shows a positive effect on the subscription of drought index insurance policy at 1% significance level. The coefficient value of 0.026 shows that a unit increase in the age of a respondent is likely to result in an increase in the subscription to drought index insurance policy. This implies that age has a significant positive effect on the subscription to drought index insurance policy. There is the probability that an increase in age would influence the drought index insurance policy subscription. An increase in age increases awareness of various risk sources and management strategies hence this is not surprising.

The risk aversion of older farmers is high and therefore they are more likely to adopt risk management tools. The respondent's age was expected to have a negative effect on the subscription of drought index insurance policy. The rationale for this occurrence is that older farmers may have acquired the requisite knowledge and skills to cope with risk without resorting to the use of insurance. Similarly, older farmers may have encountered a series of losses in their farm business and may have acquired some experience and expertise in handling such loses when it occurs.

This observation is likely as a result of the fact that older cereal farmers subscribed to drought index insurance because there is the likelihood that they have directly or indirectly experienced the devastating effect of drought and other forms of disasters that led to massive forms of crop failure, high livestock mortality rate than the younger cereal farmers and therefore the decision to purchase the drought index insurance policy cover.

The finding agrees with Gaurav, Cole, and Tobacman (2011) who found that age increases the likelihood of index insurance policy purchase. Jehu-Appiah (2011) also found that the greater an individual's age, the more likely the purchase of an insurance policy. Lefebvre, Nikolov, Gomez-y-Paloma and Chopeva, (2014) concluded that older farmers are more likely to get insured but with a small marginal effect.

The finding is contrary to Sherrick, Barry, Ellinger, and Schnitkey (2004) as cited in Lefebvre, et al (2014) who found that younger farmers are more responsive to modern approaches of risk management (insurance) compared to older counterparts. Sujarwo, Hanani, Syafria and Muhaimin (2017) found age to have a negative effect on the acceptance of agricultural insurance. Older farmers were unwilling to subscribe to agricultural insurance.

Kakumanu et al. (2012) also reported age to have significantly negative influence on the willingness of farmers to pay for weather-based crop insurance scheme. Aidoo et al. (2014) also alluded to the fact that a farmer's willingness to adopt crop insurance is negatively influenced by age. Cole, et al. (2012b) reported a negative effect of age on insurance take-up. Another study in Ethiopia revealed that the likelihood of younger household heads with official positions to purchase crop insurance is high (Dercon, Hill, Clarke, Outes-Leon & Taffesse, 2014). To accentuate this assertion, Ntukamazina et al. (2017) reported that the willingness to adopt insurance products decreases with an increase in the age of a farmer.

Level of education

Education shows a positive effect on the subscription of drought index insurance policy at 5% significance level. The coefficient value of 0.046 shows that a unit increase in the years of schooling of a respondent is likely to result in an increase in the subscription to drought index insurance policy. This implies that years of schooling have a significant positive effect on the subscription to drought index insurance policy. There is the probability that an increase in years of schooling would influence the drought index insurance policy subscription.

This is expected because, educational and training level is mostly used as a proxy for financial literacy and understanding of the insurance product. The effect of education and training on the uptake of insurance can be positive, negative and often insignificant. Also, well-educated farmers have a better appreciation for insurance contract and therefore are more likely to partake in the insurance program. As expected, the coefficient on the farmer's education level is positive and significant.

The finding concurs with Ye, Liu, Wang, Wang, and Shi (2016) who reported that the educational level of an individual is considered as a good indicator to understand and use financial insurance tools. Gebre (2014) concluded that an increase in years of schooling increases a household's willingness to purchase weather index insurance. Gine, Townsend, and Vickery (2007) also reported that the probability of a farmer to buy an index insurance product is higher when the household is better educated. Similarly, Carpena, Cole, Shapiro, and Zia (2011) found that financial literacy education and training has a role in increasing awareness and changing attitudes towards formal financial products. De Angelis (2013) also reported that farmers who were more interested and willing to pay higher premiums for rainfall insurance policy were more literate. Other research by Koloma (2015) and Lin, et al., (2015) suggest that there exists a positive relationship between literacy and the willingness of farmers to adopt agricultural insurance policy. Studies by (Aidoo et al., 2014) and (Arshad et al., 2015) reported that literacy has a positive relationship with a farmer's willingness to adopt agricultural insurance scheme.

On the contrary, Njue, Kirimia and Mathengea, (2015) found that the amount of crop insurance premium paid is negatively and significantly influenced by years of formal education. Clarke and Kalani (2011) reported that basic level of literacy matters most and not education or years of schooling. Aidoo, Mensah, Wie, and Awunyo-Vitor, (2014) concluded that less money is spent on insurance premium by well-educated individuals who consider farming as an auxiliary activitiy because they have an opportunity to earn substantial income from formal work.

Farm size

Farm size indicates a positive effect on the subscription of drought index insurance policy at 5% significance level. The coefficient value of 0.069 shows that a unit increase in the farm size of a respondent is likely to result in an increase in the subscription to drought index insurance policy. This implies that farm size has a significant positive effect on the subscription to drought index insurance policy.

The probability of farm size of cereal farmers having an influence on drought index insurance policy subscription would be higher with increased number of number acres of land owned. The size of a farm serves as a proxy for wealth since larger farm size has appreciable collateral value. Farmers with large farm size can lease or sharecrop portion of the land to raise extra revenue to purchase index insurance policy.

The finding agrees with Karlan, Osei-Akoto, Osei, and Udry (2012) who found that farmers with insurance cover allocated a larger acreage of land to rainfall sensitive crops, thereby increasing yield and land cultivated with maize by 9% in Northern Ghana. Similarly, Enjolras, Capitanio, and Adinolfi (2012) in a study in France and Italy, found that, farm size (cultivated area) and diversification (number of cultivated crops), are key factors for insurance purchase decision. Cai (2013) also reported that among tobacco farmers in China, the introduction of insurance increases the area of production by about 20% and decreases production diversification. Similarly, Kaczała and Wiśniewska (2015) found that farmers who own bigger farms are more likely to purchase the index insurance product than farmers with smaller farms. In that report, 21% of farmers owning more than 20 ha were likely to purchase as compared to 10.7% of farmers owning less than 7 ha. Osipenko, Shen, and Odening (2015) also reported a positive correlation between farm size and the amount farmers are willing to pay for an agricultural technology.

On the contrary, Wairimu, Obare, and Martins (2016) reported that in Kenya the household farm size did not have significant influence on the uptake weather-based crop insurance. Aidoo et al. (2014) concluded that the premium a farmer was willing to pay in order to have a crop insurance cover is negatively influenced by the farmer's farm size. Ntukamazina et al. (2017) stated that the willingness to adopt insurance products decreased by 0.167 with an increase in farm size.

Income

Income indicates a negative effect on the subscription of drought index insurance policy at 1% significance level. The coefficient value of 0.00028 shows that a unit increase in the income of a respondent is likely to result in a decrease in the subscription to drought index insurance policy. This implies that income has a significant negative effect on the subscription to drought index insurance policy. The reverse was expected to be true; however, a possible explanation to this occurrence was because cereal farmers who had low income often do not have assets they can easily liquidate when the unforeseen happen. This is a likely reason why cereal farmers with low income are subscribing to index-based policy have a safe haven in case drought occurs. Another reason for this finding may be because cereal farmers are unlikely to have other sources of income or appropriate unconventional risk management structures in place to deal with the unforeseen peril.

Wang, Ye, and Shi (2016) conjectured that richer farmers would have a higher demand for insurance. The researchers further argued that richer farmers have the capacity to recover from the effects of harsh weather conditions because may use other counter measures like off-farm investments.

The finding is contrary to Gine, (2015) and McIntosh, Sarris, and Papadopoulos, (2014) who found that the demand for rainfall index insurance could be reduced significantly as a result of liquidity constraints. Similarly, Jensen, Barrett, and Mude, (2014b) in a study in Kenya, found that, Index Based Livestock Insurance (IBLI) generally increased the income from milk production.

Contact with insurance agent

Contact with insurance agent indicates a positive effect on the subscription of drought index insurance policy at 1% significance level. The coefficient value of 1.49 shows that a unit increase in the contact a respondent has with an insurance agent is likely to result in an increase in the subscription to drought index insurance policy. This implies that contact with insurance agent has a significant positive effect on the subscription to drought index insurance policy. This implies that the likelihood of the respondent subscribing to drought index would be higher when there is an increased number of contact time with insurance agents.

Cereal farmers who have contact with insurance agent are more likely to subscribe to drought index insurance. This suggests that households with access to or contact with insurance agent are more likely to be well informed about the availability and benefits of the drought index insurance policy and thus increase the likelihood of drought index insurance policy subscription. Insurance agents help in the transfer of information. The insurance agents play a frontline role in the area of information circulation and sales of insurance policy to farmers and other stakeholders. These roles played by the insurance agents probably increased their presence, interaction and therefore the likelihood to influence the farmers' decision to subscribe to the index insurance policy.

The finding is in agreement with Wairimu et al. (2016) who found that in Kenya access to extension services has a positive effect on the adoption of weather-based crop insurance scheme and increased the uptake by 0.5%. Abdullah, Auwal, Darham, and Radam (2014) reported that receiving of agricultural extension service has a positive and significant influence in the willingness to pay for weather index insurance. Similarly, Falola, Ayinde, and Agboola (2013) using a probit model to study cocoa insurance, found the availability of agricultural extension service to be a favourable factor for the insurance.

The next discussions will focus on the variables that influenced the intensity of subscription of drought index insurance policy with reference to Table 10.

Factors Influencing the Intensity of Drought Index Insurance Policy Subscription.

Farming experience

Farming experience shows a negative effect on the intensity of subscription of drought index insurance policy at 10% significance level. The coefficient value of 0.392 shows that an extra year experience in the farming of the respondent will lead to 0.392 acre decrease in the proportion of land insured. This implies that farming experience has a significant negative effect on the intensity of subscription to a drought index insurance policy.

It is likely that cereal farmers with less farming experience ensured that a greater percentage of their farm was covered by the drought index insurance policy.

This finding may be resulting from the fact that cereal farmers who have not been involved in farming for a long time may not have experienced crop failure emanating from the effects of drought. Therefore, cereal farmers within the less experienced category subscribe to drought index insurance as a precautionary measure to guard against possible drought and drought associated disasters. This measure helps farmers to recoup some of their investment in the event of any possible drought. Another reason for this finding may be ensuing from the fact that less experienced cereal farmers may have inadequate experiential knowledge of agro-climatic conditions so as to enable them handle external variables like drought. Therefore, there is the need to rely on insurance as a means to curtail the aftereffect of possible drought. Finally, although cereal farmers with less years of farming experience may not have experienced crops losses or damages; they may be privy to information about the devastating effect of past drought and its related effects.

The finding agrees with Wairimu et al. (2016) who found that the farming experience was negatively significant, implying that the decrease probability of weather-based crop insurance scheme uptake resulted from the increase years of farming experience by household head. Ye et al. (2016) found that irrespective of the limited years of farming, cereal farmers are more able to understand the potential risks in farming based on information they have received.

On the contrary, Jin, Wang, and Wang (2016) reported a positive effect of farming experience on the decision to take up weather index insurance. Similarly, a previous study from Tanzania (Namwata, Welamira, and Mzirai, 2010) and

Ghana (Baffoe-Asare, Danquah and Annor-Frempong, 2013) which diverges with the outcome of the research found that farmers with more farming experience have the improved skills and the capacity to make adoption related decisions that are analytical in nature.

Farm size

Farm size shows a negative effect on the intensity of subscription of drought index insurance policy at 1% significance level. The coefficient value of 2.17 shows that an extra acre increase in the farm size of a respondent will lead to about 2.17 acre decrease in the proportion of land insured. This implies that farm size has a significant negative effect on the intensity of subscription to a drought index insurance policy.

There is the likelihood that cereal farmers with smaller farm size are unable to diversify the crops they cultivate. The crops cultivated by the cereal farmers have different water requirement for proper growth and development. However, the cereal farmers do not have control over these external climatic conditions coupled with their small farm size. They therefore resort to the purchase of adequate drought index insurance policy to cover a greater percentage of their farm. Also, cereal farmers with larger farm size will prefer to insure a small percentage because ensuring all the farm land may be expensive because the premium to be paid per acre is dependent on the cereal farmers' crop budget per acre. There is still no consensus in the literature as to the effects of farm size on the subscription to index insurance policy.

The finding disagrees with a study in northern Ghana which points out that an acre increase in the size of land cultivated increases the probability of insurance purchase by 2% (Haruna, 2015). Sherrick, Barry, Ellinger, and Schnitkey, (2004) (as cited in Wang, Ye, and Shi, 2016), reported that larger farm sizes and intentions to expand shows a good managerial capacity and the application of risk management practices. This literature disagrees with the results of the study. Enjolras and Sentis (2011) reported that the size of a farm has a positive effect on the purchase of crop insurance policies. Similarly, Velandia (2009) found that the size of the farm is a positive indicator for the total production risk and as a result, an adoption of crop insurance policy.

Off–farm income

Off-farm income shows a positive effect on the intensity of subscription of drought index insurance policy at 1% significance level. The coefficient value of 0.00049 shows that an extra Gh¢ increase in the off-farm income of a respondent will lead to a 0.00049 acre increase in the proportion of land insured. This implies that off-farm income has a significant positive effect on the intensity of subscription to a drought index insurance policy.

This finding may be as a result of cereal farmers having extra income from the off-farm activities. However, higher ratios of off-farm income are also regarded as negative indicators of crop insurance decisions because cereal farmers may consider the off-farm income received as enough security to take care of disaster and its associated effects.

The findings agree with Gebre (2014) who found that though an increase in off-farm income of households increases the willingness to purchase weather index insurance but not statistically significant.

On the contrary, Velandia, Rejesus, Knight, and Sherrick (2009) using multinomial probit, found that soybean and corn farmers in Illinois, Indiana and Iowa that off-farm income negatively and significantly affect access to agricultural insurance.

Chapter Summary

This section described the socioeconomic characteristics of the cereal farmers and also presented the Heckman two-stage probit model results. The results showed that in the selection equation age of farmers, farm size, income and contact with insurance or extension agent and level of education were statistically significant. The outcome equation showed that three variables, namely: farming experience, farm size and off–farm income was statistically significant.

The next chapter presents results and discussions on the determination of the hypothetical optimal drought index insurance policy for cereal farmers.

CHAPTER FIVE

HYPOTHETICAL OPTIMAL DROUGHT INDEX INSURANCE POLICY FOR CEREAL FARMERS IN THE NORTHERN REGION OF GHANA

Introduction

This chapter presents results and discussions on the determination of the hypothetical optimal drought index insurance policy for cereal farmers.

Discrete Choice Estimation Results of Drought Index Insurance (DII) Policy for Cereal Farmers

Table 11 presents results of the choice experiment conducted to discover attributes of the hypothetical drought index insurance policy farmers prefer.

Table 10: Summary of Attributes of Hypothetical Optimal Drought Index Insurance Policy choices

Attributes	LogWorth	P value
Subsidy	43.773	0.000
Interlinking credit with insurance	37.738	0.000
No choice indicator	36.163	0.000
Premium	19.383	0.000
"No claim discount" payment	13.471	0.000
Mode of claims payout	4.962	0.00001
Basis risk	3.425	0.00038

Source: Field Survey, Boateng-Gyambiby (2017)

The a priori for the choice model was set at 5% confidence level. The LogWorth shows that values in order of significance from high to low. The p-values of the attributes are small and therefore difficult to arrange in a descending order. It is therefore rounded to five decimal places. A transformation called logWorth, $-\log_{10}(p-value)$ which allows for a more effective ranking. The log to the base

10 was used and p-values vary between 0 and 1, taking the base 10 log of p-value yields a negative number. The minus sign in the transformation simply makes the log a positive number. The logWorths are displayed in a descending order with the most significant effects being at the top and the least significant at the bottom.

Table 11 shows the p-value for each attribute of the drought index insurance policy. At an a priori of 5% confidence level, all the attributes were statistically significant at 1% confidence level. From Table 11, subsidy is the most significant attribute, followed by interlinking credit with insurance, no choice indicator, premium, no claim discount payment, mode of claims payout and basis risk. The no choice indicator was also treated as an attribute in the model. The no-choice indicator demonstrates that the cereal farmers have preference for other attribute alternatives which are not present in the current hypothetical drought index insurance policy. The cereal farmers determine the utility or the satisfaction to be derived from each option and choose the no-choice option because none of the alternatives offer sufficient utility. Consequently, the meaning of the no choice option in this study is that none of the alternatives meet the requirements of the cereal farmers, signifying that they prefer to continue to look for better hypothetical drought index policy alternatives.

Table 11: Parameter Estimates for Drought Index Insurance Policy Attributes in the Conditional Logit Model

Attributes	Estimate	Std. Error
Premium	-0.21782	0.02442
Basis risk [Rainfall data from a satellite]	-0.09502	0.02678
Mode of claims payout [Bank payment]	-0.16589	0.03819
Interlinking credit with insurance [Credit not interlinked with insurance]	-0.33641	0.02680
"No claim discount" payment [Payout at the end of the next season]	-0.20038	0.02678
Subsidy [Subsidy on agricultural inputs only]	-0.51604	0.03940
No Choice Indicator	-11.33904	0.92318

Source: Field Survey, Boateng-Gyambiby (2017)

Table 12 shows the parameter estimates of the drought index insurance policy attributes. The parameter estimates for the attribute levels in the parentheses namely: rainfall data from a satellite, bank payment, credit not interlinked with insurance, payout at the end of the next season and subsidy on agricultural inputs are negative. This implies that the probability of the attribute levels influencing the cereal farmers to choose them (attribute levels) when this attribute levels are seen in a drought index insurance policy during a discrete choice experiment would be lower.

The attribute level (GhȻ40) for premium shows a negative coefficient value which implies that increased premium has a negative effect on the satisfaction of the respondent. This is expected because consumers would want goods and services with the highest utility at a lower price.

An attribute level (rainfall data from a satellite) for basis risk shows a negative coefficient value. This implies that an insurance policy with the attribute, i.e. rainfall data from a satellite will have a negative effect on the cereal farmers' satisfaction. This may be as a result of respondent's inability to relate to a satellite in orbit, providing rainfall data that will determine whether they will receive indemnity or otherwise.

An attribute level (bank payment) for mode of claims payout shows a negative coefficient value. This implies that an insurance policy with the attribute, i.e. bank payment will have a negative effect on the cereal farmers' satisfaction. This may be as a result of cereal farmers not having banks located close to their communities. Therefore, transacting business at the bank comes with an extra cost which cereal farmers may not be ready to incur.

Another attribute level (credit not interlinked with insurance) for interlinking credit with insurance indicates a negative coefficient value. This implies that an insurance policy with the attribute, i.e. credit not interlinked with insurance will have a negative effect on the cereal farmers' satisfaction. The likely reason is that cereal farmers do not want to loss assets to a loan default payment.

The attribute level (payout at the end of the next season) for "no claim discount" payment indicates a negative coefficient value. This implies that an insurance policy with the attribute, i.e. payout at the end of the next season will have a negative effect on the cereal farmers' satisfaction. The possible reason is that cereal farmers receiving payout on the next season may not help address their liquidity constraints.

The attribute level (subsidy on agricultural inputs) for subsidy indicates a negative coefficient value. This implies that an insurance policy with the attribute, i.e. subsidy on agricultural inputs will have a negative effect on the cereal farmers' satisfaction.

Following the responses from the cereal farmers on the hypothetical drought index insurance policies contained in the six choice sets that were used in conducting the choice experiment, Figure 10 below shows the hypothetical optimal drought index insurance policy for the cereal farmers.

From Figure 10, the attribute levels in red letters are the attributes of the hypothetical drought index insurance policy that provided the cereal farmers with the utmost satisfaction. A combination of these attributes in the design of a drought index insurance policy will produce the hypothetical optimal drought index insurance policy.

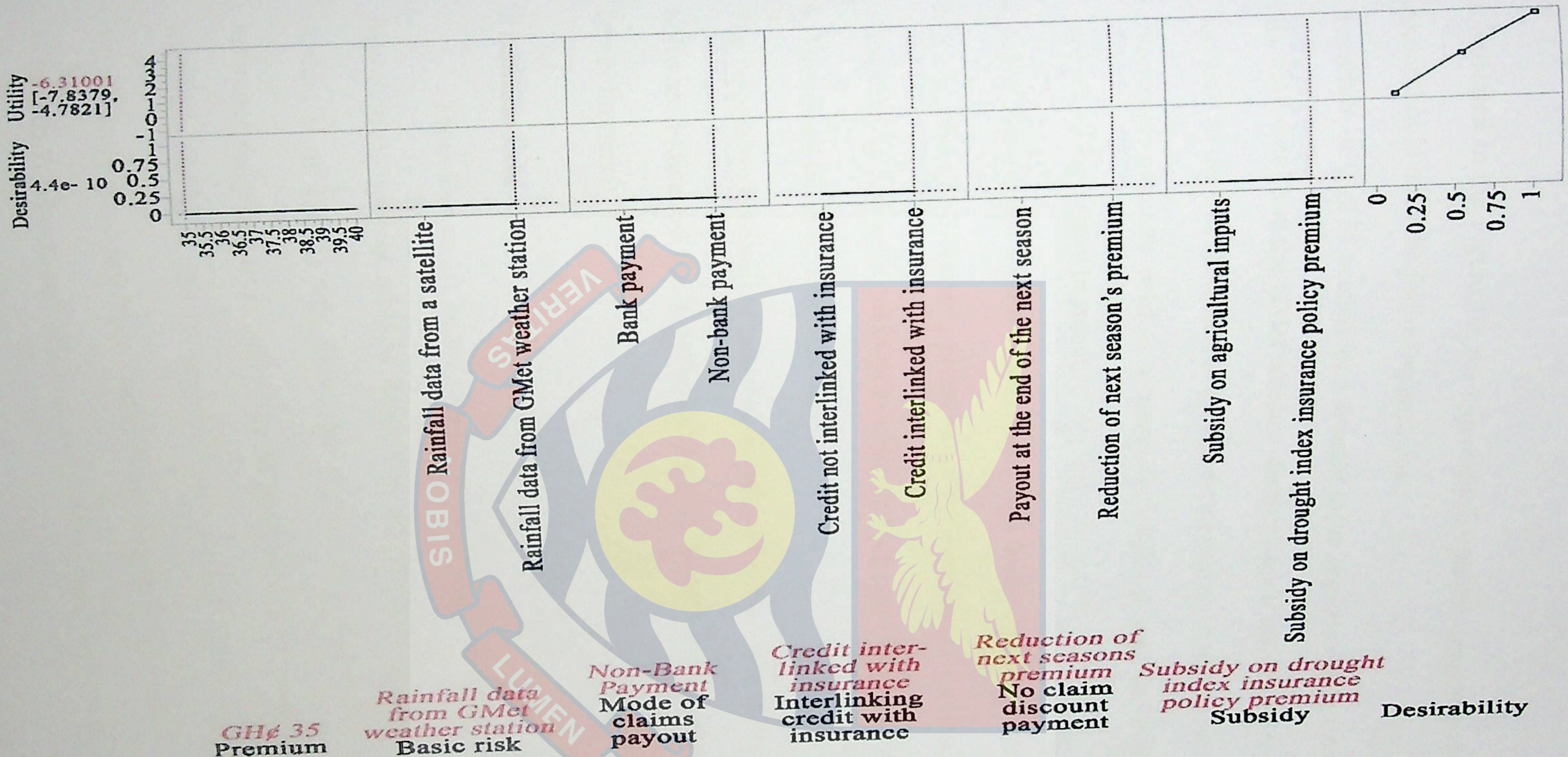


Figure 10: **Output from JMP (SAS) Software showing the Hypothetical Optimal Drought Index Insurance Policy for Cereal Farmers**

As indicated in the Figure 10, the hypothetical optimal drought policy for cereal farmers should have the following attributes:

1. Premium of GhȻ35 needed for a drought index insurance policy cover.
2. Rainfall data from the GMet weather stations placed within 20km radius should be used in the determination of an indemnity payout or otherwise.
3. Non-bank payment used as a means for claims payout for farmers' who are receiving indemnity payment.
4. Agricultural credit should be interlinked with the drought index insurance policy.
5. A reduction of a farmer's premium for the next season's when farmers do not experience loss spelt out in an insurance policy cover document and
6. The premium should be subsidized.

The discussion here will be based on Figure 10, i.e. the output from the JMP (SAS) Software indication the hypothetical optimal drought index insurance policy for cereal farmers.

Premium rate

From Figure 10, cereal farmers prefer to pay a premium of GhȻ35 for the hypothetical optimal drought index insurance policy. The finding concurs with Arshad et al. (2015) who found that there is a decline in the level agricultural insurance programs from 0.03 when the premium rate increases. Cole et al. (2013), McIntosh et al. (2014) reported that rainfall index insurance demand is significantly price-sensitive. Furthermore, it agrees with (Cole et al., 2013; Karlan et al. 2014) who found price as an essential factor subduing demand for index insurance policy uptake.

On the contrary, Cole et al., (2013) reported that the demand for rainfall insurance is price-sensitive, therefore lower prices alone is unlikely to start extensive index insurance adoption in the short term.

Takahashi et al. (2016) also found that a temporal reduction in premium paid through randomly distributed discount coupons, immediately had a positive impact on the uptake of index-based livestock insurance without dampening the demand of subsequent periods due to reference-dependence associated with price anchoring effects.

Rainfall data from GMet weather station

From Figure 10, cereal farmers prefer to receive rainfall data from GMet weather station located in the district. This is because cereal farmers can easily relate to the weather station as compared to satellite in orbit which most farmers may find it difficult to appreciate. Basis risk occurs when there is an imperfect correlation between actual losses experienced by the index insurance policyholder and the indemnity payments made by an index policy insurer. It often results in unindemnified losses and unjustified indemnity payments. When an insured risk is highly correlated with the index, basis risk is minimized and subsequently uptake or subscription of drought index insurance policy is improved.

The finding agrees with Hill et al. (2013b) who found that the closer a farm is located to a weather station; there is a higher elasticity of the demand of weather index insurance policy and vice versa. Mobarak and Rosenzweig (2012) reported that the demand for a weather index insurance product decreases with increases in distance to the weather station. Hill et al. (2013) reported that near the weather station where basis risk is presumed lower, there is an increase in the price sensitivity of demand. Furthermore, this finding agrees with Mobarak and Rosenzweig (2012) suggest that the likelihood of people of cost sharing idiosyncratic risks to buy insurance than people from cast not sharing idiosyncratic risk increases with increase in basis risk. Similarly, Ward and Makhija (2016) employing the use of discrete choice experiment reported in Eastern India that for every 1 percent increase in basis risk, farmers would need a compensation of 3-4 percent reduction in the insurance.

Non-bank payment

From Figure 10, cereal farmers prefer a non-bank payment method as the mode of claims payout than bank payment when receiving indemnity payout resulting from crop loss. A greater number of farmers are deterred by projects linked to financial institutions. The preference for non-bank payment method may be as a result of respondent perception about the cumbersome and bureaucratic nature of the activities of some banks and financial institutions. Farmers would avoid getting caught in that web.

Additionally, some of the farmers are "bank phobia" which has resulted in the preference for that attribute (non-bank payment). Similarly, financial institutions are not located in and around the communities where the farmers reside. Therefore, transacting business with the financial institutions becomes a cost which most farmers are not willing to bear. As a result, farmers prefer non-bank payment to bank payment.

The majority of the farmers do not have bank accounts, therefore accepting to receive an indemnity payout through that medium is impossible. Cereal farmers showed preference for a non-bank payment because they are with the view that they may not have access to the funds from the financial institutions when needed.

Finally, the rampant incidence of some financial institutions mobilizing huge amount of savings from farmers under the pretense of giving higher interest rates on savings and lower interest rate on loans. However, soon they later abscond with the savings of farmers making them to shy away from the banks and other financial institutions.

Interlinking credit with drought index insurance

From Figure 10, cereal farmers would prefer credit interlinked with the drought index insurance policy as an attribute. A likely explanation is that index insurance reduces the loss of properties used as collateral. A high default rate is lowered when the drought index insurance policy is purchased by farmers to protect investments made on the farm.

Farmers bear all the risk of losing their collateral when they take loans without insurance. Farmers who have experienced loss took credit interlinked with insurance, their investment is secure. The purchase of an insurance policy interlinked with credit is beneficial to both borrowers and lenders. Drought index insurance policy interlinked with credit functions well than index insurance policy not interlinked with credit (stand-alone index insurance policy). This is because it results in a better use of technology for both low and high levels of collateral. However, drought index insurance policy interlinked with credit results in a better use of risk management innovation for high levels of collateral as compared to self-insurance.

The findings agree with Cheng (2014) who used experimental game to study the effects of index-based insurance to risk rationed household and found that more than half of the risk rationed farmers decide to apply for credit when insurance is available to them. Furthermore, about two-thirds of credit diverters invest the acquired loan productively rather than on consumption. Giné and Yang (2009) reported that in Malawi, farmers preferred an insured loan over the stand-alone loan.

On the contrary, Carter et al. (2011) reported that a low collateral farmer does not receive additional benefits with the purchase of a stand-alone insurance policy or product. Groh and McKenzie (2016) found that, at risk rationing which tested whether the offer of insurance translates into an increase in the likelihood of loan renewal. It suggests that irrespective of the high demand for insurance, there was no effect on borrowing behaviour of farmers. Similarly, Karlan et al. (2014) reported that, there is a negative effect of capital grants and insurance on investment and welfare among Ghanaian farmers.

Reduction of the drought index insurance policy premium for next season

Figure 10 indicates that cereal farmers would opt for a reduction of next season's index insurance premium than receiving an indemnity payout at the end of the next season. Reductions of next season's premium and an indemnity payout at the end of the next season are the attributes of the drought index insurance policy to encourage drought index insurance policy uptake. This allows the price-elasticity of demand to be calculated, and to evaluate the trade-off between providing reduction of next season's premium and a payout at the end of the next season. Cereal farmers opted for a reduction of next season's premium rather than a payout at the end of the next season since it helps address liquidity constraints at the time of insurance purchase to commence the farming season.

Furthermore, individuals place more premium on the present than the future, and therefore the immediate benefit of a reduction of next season's premium would be a preferred option than a payout at the end of the next season. Similarly, cereal farmers may have preference for the reduction of next season's premium considering the fact that an indemnity payout at the end of the next season is in the future which is full of uncertainty.

Irrespective of the uncertainty, the promise of a future payment may be attractive to some farmers.

The finding agrees with Serfilippi et al., (2016) who reported that though payment of insurance rebates was in the future, farmers still opted for it.

Subsidy on drought index insurance policy premium

Figure 10 indicates that cereal farmers would prefer that premium on the drought index insurance policy will be subsidized than subsidizing agricultural inputs. Subsidizing the premium of index insurance policy has a positive influence on the adoption of technology. Therefore, subsidizing index insurance premium may encourage farmers to adopt riskier but efficient and productive farm technologies which can better the livelihood of farmers and their families.

The finding concurs with Clarke et al. (2012) and Miranda and Farrin (2012) found that with weather index insurance policy adoption, poor households who are risk averse are hesitant unless the index insurance policy is bundled with other benefits or the premiums subsidized thereby making insurance quasi-compulsory. Greatrex et al. (2015) reported that in India, farmers pay premium between 25% and 40% whiles the remainder is paid by the government. Similarly, the outcome of the study concurs with a research by Takahashi et al. (2016) found that the reduction of subsidies reduced the demand for index insurance policy.

On the contrary, Marenya, Smith, and Nkonya (2014) using a framed choice experiment study reported that farmers in Malawi have a high preference for fertilizer subsidies to index insurance contracts that have no basis risk coupled with subsidized premium.

Chapter Summary

The hypothetical optimal drought index insurance policy for cereal farmers was determined which showed that the cereal farmers would prefer a hypothetical drought index insurance policy sold at GhȻ35, rainfall data from the GMet weather stations placed within 20km radius should be used in the determination of an indemnity payout or otherwise, non-bank payment used as a means for claims payout for farmers' receiving indemnity payment, credit interlinked with drought index insurance policy, reduction of a farmers premium for the next season's when farmers do not experience loss spelt out in an insurance policy cover document and premium subsidized on hypothetical drought index insurance policy.

The next chapter presents results and discusses on the estimation of farmers willingness to pay for the attributes of hypothetical drought index insurance policy by cereal farmers' in the Northern region of Ghana.

CHAPTER SIX

WILLINGNESS TO PAY FOR DROUGHT INDEX INSURANCE POLICY BY CEREAL FARMERS IN THE NORTHERN REGION OF GHANA

Introduction

This chapter presents and discusses results on objective three of the study. The objective sought to estimate the cereal farmers' willingness to pay for the attributes of the drought index insurance policy. It showed the drought index insurance policy attributes farmers are willing or not willing to pay for.

Willingness-to-Pay for Attributes of Drought Index Insurance Policy

The amount a cereal farmer is willing to pay for a marginal change in the characteristic of an attribute is very essential. Willingness-to-pay is a change in price needed so as to maintain the same level of utility after changes in a non-price attribute. A price variable is required in estimating the willingness-to-pay.

The p-values from Table 13 show that all the attributes of the hypothetical drought index insurance policy are statistically significant. However, the basis risk and mode of claims payout are slightly statistically significant. From Table 13, the new price of basis risk (rainfall data from a satellite) and mode of claims payout (bank payment) is lower as compared to the base price of GhȻ35 whiles interlinking credit with insurance (credit interlinked with insurance), "no claim discount" payment (reduction of next seasons premium) and subsidy (subsidy on drought index insurance premium only) is higher than the base price.

Table 12: Willingness to Pay for Attributes of a Hypothetical Drought Index Insurance Policy

Attributes	Attribute Setting	Estimate	Std. Error	P value	New Price	Price Change (MWTP)
Basis risk	Rainfall data from a satellite	-0.09502	0.30337	0.00038	GhȻ34.13	GhȻ0.87
Mode of claims payout	Bank payment	-0.16589	0.23689	0.00001	GhȻ33.48	GhȻ1.52
Interlinking credit with insurance	Credit interlinked with insurance	-0.33641	0.31395	0.000	GhȻ38.09	GhȻ3.09
"No claim discount" payment	Reduction of next seasons premium	-0.20038	0.2278	0.000	GhȻ36.84	GhȻ1.84
Subsidy	Subsidy on drought index insurance premium only	-0.51604	0.31551	0.000	GhȻ39.74	GhȻ4.74

Source: Field Survey, Boateng-Gyambiby (2017)

From Table 13, basis risk and mode of claims payout have the lowest Marginal Willingness to Pay (MWTP). Table 13 reported that the new premium when accounting for the effects of rainfall data from satellite (i.e. an attribute level of basis risk) and bank payment (i.e. an attribute level of mode of claim payment) is lower as compared to the base premium of GhȻ35).

The new premium when accounting for the effects of credit interlinked with insurance (i.e. an attribute level of interlinking credit with insurance), reduction of next seasons premium (i.e. an attribute level of "no claim discount" payment) and subsidy on drought index insurance policy premium (i.e. an attribute level of subsidy) is higher as compared to the base premium of GhȻ35).

Rainfall data from a satellite

Basis risk occurs when the correlation between indemnity payments made by an index policy insurer and actual losses experienced by the index insurance policyholder is imperfect. However, when insured risk is highly correlated with the index, basis risk is minimized and subsequently uptake or subscription of drought index insurance policy is improved.

Results from Table 13 showed that cereal farmers will not be willing to pay GhȻ0.87 more on the premium of a hypothetical drought index insurance policy that obtains rainfall data from the satellite. However, cereal farmers will prefer a hypothetical drought index insurance policy which uses rainfall data from Ghana Meteorological Agency weather stations (i.e. an attribute level of basis risk). Therefore, the new price (premium) to be paid for the hypothetical drought index insurance policy which uses rainfall data obtained from the satellite will be GhȻ34.13.

The results show that cereal farmers will be willing to pay for a hypothetical drought index insurance policy with reference weather stations installed within a 20km radius of the cereal farmers' farm. This is as a result of the cereal farmers being able to identify with the reference weather station than satellite in terms of receiving rainfall data to determine indemnity payout. Similarly, the respondent's inability to comprehensively appreciate the mode of operation of the satellite infrastructure can be attributed to their unwillingness to pay an extra GhȻ0.87 in addition to the premium for the hypothetical drought index insurance policy.

Rainfall data from a satellite is an attribute level of index insurance policy that reduces its demand, therefore an instrument to eliminate or reduce its effect will be encouraged. However, the findings of this research show that cereal farmers are unwilling to pay for a solution, i.e. use of rainfall data from satellite embedded within the hypothetical drought index insurance policy, which can tackle the problem of basis risk.

The finding concurs with studies of (Clarke 2011; Miranda and Farrin 2012; Binswanger-Mkhize 2012) which found that demand for index products is reduced by basis risk for the intuitive reason that a product with higher basis risk gives less true insurance coverage to prospective clients. Clarke et. al, (2012), Jensen et al. (2014a) in recent studies on estimates of basis risk reported that basis risk for index products can be considerable and that basis risk (or proxies for it) reduces demand for index products. Elabed and Carter (2015) found that in view of the already negative impact of basis risk on demand been increased by compound risk aversion, index insurance products should be remodelled.

Hill et al. (2016) reported an 18 percent decrease in the demand for index insurance when the distance to the reference weather station is doubled. Furthermore, Hill et al. (2013) in a willingness to pay study reported that in Ethiopia an inverse relationship between the demand for index insurance and basis risk when prices are high. Similarly, Gommes and Kayitakire (2013) found that a distance less than 20km from the reference weather station to the insured fields to be acceptable for weather station to the insured field to be acceptable for weather derivative insurance without having an effect on the correlation of indices with insured risk

Non-bank payment method

The results from Table 13 shows that a respondent subscribing to the hypothetical drought index insurance policy will not be willing to pay GhȻ1.52 more on the premium of a hypothetical drought index insurance policy that uses bank payment as the mode of paying out indemnity. However, they will prefer a non-bank payment method (i.e. indemnity payment honoured with "physical cash" and not through the banks, mobile money services etc.). The new premium for the hypothetical drought index insurance policy which uses bank payment (i.e. an attribute level of mode of claims payout) as the mode of claims or indemnity payout will be GhȻ33.48.

A likely reason for the unwillingness of cereal farmers to pay extra on the premium for a policy which utilizes a bank payment option as a method of indemnity payout may be attributed to the fact that banks and financial institutions are often not located around the community of the cereal farmers. Also, micro-finance institutions sometimes mobilize savings from farmers with the promise of higher interest rates on savings and lower interest rate on borrowing in return.

However, some of them later run off with the savings of clients, therefore making them disinterested in doing business with the micro-finance institutions. Another reason is the transportation cost incurred by the clients when transacting business with the financial institution. Most cereal farmers are not willing to bear the cost. For this reason, clients will show preference for non-bank payment (payment with "physical cash"). Also, a lot of the cereal farmers do not have bank accounts, therefore an indemnity payout through that medium will be opposed by them.

Finally, cereal farmers do not want a payout through the bank as a method for claims payout because of the notion that financial institutions may not give them easy access to their savings at the time and amount needed when they have financial needs to address.

Credit interlinked with insurance

A respondent subscribing to the hypothetical drought index insurance policy which interlinks credit with the insurance policy, will be willing to pay GhȻ3.09 more on the premium which has a base price of GhȻ35.00. The new premium for the drought index insurance policy interlinked with credit (i.e. an attribute level of interlinking credit with insurance) will be GhȻ38.09.

The cereal farmers, opting for a hypothetical drought index insurance policy interlinked with credit is as a result of the cereal farmers acknowledging the fact that there is a higher probability of defaulting on the loan repayment when the requisite climatic conditions are unfavourable. Therefore, a financial instrument to aid in the transfer of the risk from the cereal farmers to another entity and at the same time make credit accessible becomes a one stop shop. Also, the burden associated with cereal farmers having to think about how to repay loans and resources, cereal farmers commit into getting loans repaid can be channelled into more profitable production activities.

Insurance has the potential to unlock credit, which can result in huge investment. However, this could result in some undesired side effect, including higher rates of loan default and moral hazard. A greater number of researches find a positive relationship between accesses to insurance interlinked with credit and the demand for insurance policy.

Studies by (Bogale, 2015; McIntosh et al., 2013; Hill et al., 2013a) suggest that access to credit results in a larger willingness-to-pay. In a related study, Clarke and Kalani (2011) found larger index insurance take up can be attributed to access to credit. Another study by Chantarat et al. (2009) also suggested that, household with credit constraints, purchase more insurance policies to protect farm investment against named perils. Farrin and Miranda (2013) found that microfinance institutions may be prevented from becoming insolvent in the situation of systematic default.

The finding agrees with a study McIntosh et al. (2013) and Elabed et al. (2013) who reported that credit constraints are limited when index insurance is employed in the agricultural credit scheme. Farrin and Miranda (2013) found that interlinked insurance policies or products do not have a higher default rate compared to situations where credit and insurance are not interlinked.

This may result from the fact that defaulting on an interlinked policy or product could thwart the efforts of household from accessing credit and insurance in the future. There is a high propensity for farmers to borrow more when credit is interlinked or bundled with index insurance policy or products.

On the contrary, studies by (Clarke and Dercon, 2009) reported that index-based insurance has a negative effect on credit supply, suggesting the possibility of a credit crowd-out if insurance changes the behaviour of borrowers. Another study by Farrin and Miranda (2013) confirms the possibility of banks unwillingness to lend more to borrowers with non-interlinked insurance cover, since insured borrowers have a lower repayment rate than uninsured borrowers.

Reduction of next seasons premium

The "no claim discount" payment which is an attribute of the hypothetical drought index insurance policy has two levels, namely: payout at the end of the next season and reduction of next season's premium. A respondent will be willing to pay GhȻ1.84 more on the premium of the hypothetical drought index insurance policy where the premium for next season subscription will be reduced if no indemnity payment is made as a result of favourable good rain. The new premium will be GhȻ36.84. The "no claim discount" payment incentive will be given to cereal farmers by reducing the premium to be paid for next season.

Some cereal farmers decide not to subscribe to the insurance policy when they do not receive an indemnity payment because weather conditions are favourable. In this situation, the "no claim discount" payment serves as an incentive for prospective clients who will not suffer any loss. On the other hand, insurers are equally assured of maintaining their old clients, all other things being equal. The insurance company will have the minimum number of clients which has a bearing on the minimum capital requirement regulators expect insurers to have. Also, there will be an increase in the uptake of drought index insurance policy.

This finding agrees with (Stein (2011), Karlan, Kutsoati, McMillan, and Udry, (2013), and Hill et al. (2013) who reported that payout by insurance companies has an influence on the uptake of index insurance.

Subsidy on drought index insurance policy

Subsidy as an attribute of the hypothetical drought index insurance policy has two levels, namely: subsidy on agricultural inputs and subsidy on drought index insurance policy premium. A respondent subscribing to the policy which has a subsidy component, will be willing to pay GhȻ4.74 more on the premium for an index insurance policy with a subsidized premium. In the circumstances, the new premium would be GhȻ39.74 (base premium of GhȻ35 plus GhȻ4.74 cereal farmers will be willing to pay on the premium when policy is improved) in the introduction of subsidy on premium.

The finding concurs with (Bageant and Barrett 2017; Cole et al. 2013; Hill et al 2013; Jensen, Mude and Barrett 2014c; Mobarak and Rosenzweig, 2012) who found that the demand for index insurance products is price sensitive, but usually price inelastic, where estimates ranges from -0.35 to -1.16, and generally remains very low even when premiums are significantly subsidized. Serfilippi et al. (2015)

reported that subsidizing an index insurance policy can increase the willingness-to-pay among those that are uncertainty averse and also avoid the uncertainty penalty placed on indemnity payments.

On the contrary, Cole et al. (2014) reported that even after five years of the availability of index insurance product, a slight reduction in substantial subsidies led to the demand for index insurance products being reduced. Furthermore, Elabed and Carter (2015) reported that for farmers in Southern Mali, a study of their willingness-to-pay shows that the levels of compound risk aversion observed in their sample could reduce demand for index insurance by half under moderate basis risk.

Chapter Summary

This chapter presented the discussed results on the estimate of the cereal farmers' willingness to pay for the attributes of the drought index insurance policy. The study showed that a respondent will be willing to pay more for a drought index insurance policy attribute in which: credit is interlinked with the insurance policy, the next seasons premium will be reduced if there is no indemnity payment and an index insurance policy with a subsidized premium.

However, for the same hypothetical drought index insurance policy, cereal farmers will not be willing to pay more for a policy that obtains rainfall data from satellites and bank payment as a means of indemnity payout.

The next chapter outlines the results and discusses the level of agreement on constraints hindering drought index insurance policy subscription among cereal farmers in the Northern region of Ghana.

CHAPTER SEVEN

LEVEL OF AGREEMENT ON CONSTRAINTS TO DROUGHT INDEX INSURANCE POLICY SUBSCRIPTION AMONG CEREAL FARMERS

Introduction

This chapter presents results and discussions on the level of agreement on the constraints to drought index insurance policy subscription among cereal farmers in the Northern region of Ghana.

Constraints to the Subscription of Drought Index Insurance Policy

The results of the Kendell's coefficient of concordance are presented in Table 14. The results are statistically significant at 1 percent level. The main constraints faced by subscribers and non-subscribers were found to be similar which includes inaccessibility to credit, high premium and basis risk. The level of agreement between subscribers (11.1%) was however slightly higher than the level of agreement between non-subscribers (10.7%). This suggests that the criteria used by subscribers for their ranking were relatively more homogenous as compared to the criteria used by non-subscribers. The Kendall's W^a values also shows that there may be other unmentioned constraints hindering the cereal farmers subscription to drought index insurance policy.

Table 13: Perceived Constraints to the Subscription of Drought Index Insurance Policy

Constraints	Subscribers	Non-subscribers	Mean Rank
Inaccessibility to credit	4.29	4.12	4.23
High premium	3.96	4.07	4.00
Basis risk	3.39	3.49	3.43
Liquidity constraints	3.34	3.42	3.37
Inadequate education on the insurance product	3.14	3.07	3.11
Lack of trust for the insurer	2.88	2.82	2.85
Number of observations, N	258	166	424
Kendall's W[a]	0.111	0.107	0.108
Chi-Square	142.99	88.74	229.26
Degree of freedom, df	5	5	5
Asymp. Sig.	0.000*	0.000*	0.000*

Source: Field Survey, Boateng-Gyambiby (2017)

*** Implies statistical significance at 1 percent level.

Inaccessibility of credit to farmers

Inaccessibility of credit to cereal farmers was found to be the most important constraint to the subscription of drought index insurance policy subscription among cereal farmers. The majority (62.5%) of the cereal farmers do not have access to credit therefore they are unable to subscribe to the drought index insurance policy since they are expected to make payment in the present, for an uncertain benefit in the future. The cereal farmers agreed that inaccessibility to credit is a constraint to the subscription of drought index insurance policy. Inaccessibility of credit to cereal farmers may therefore have negative effects on both the subscription and intensity of drought index insurance policy.

The finding concurs with Karlan et al. (2014) using a field experimental study on agricultural decisions after relaxing credit and risk constraints in Northern Ghana reported that larger investment in agriculture stemmed from the subscription to index insurance policy. Cai (2013) found that, the credit demands for farmers with insurance cover increased by 25%. Similarly, Wairimu et al. (2016) found that access to credit improved the uptake of weather-based crop insurance scheme.

High premium

High premium was the second most important constraint to the subscription of drought index insurance policy. The price of an insurance policy tends to be high for a number of reasons. Some of these reasons are the loading factor charged by the insurance companies, which is usually in the range of 50%. Another reason is the difficulty of assessing a fair price as a result of data scarcity, climate change and imperfection in data translate into uncertainty loadings.

The finding concurs with Cole et al., (2013) reported that rainfall index insurance demand is significantly price-sensitive. Cole et al., (2013) and Karlan et al. (2014) reported that price is an essential factor subduing demand. Similarly, Arshad et al. (2015) found that there is a decline in the level of agricultural insurance programs when the premium rate increases.

Basis risk

Basis risk is the third most important constraint facing the subscription to drought index insurance policy among cereal farmers. One reason for this observation may be that subscribers of the policy will be unwilling to invest appreciably in inputs and technology that will bring higher returns to their investment because of the uncertainty in receiving the actual indemnity when the unforeseen happens.

The result mirrors a study conducted in India by Mobarak and Rosenzweig (2012) who found basis risk to significantly hinder the up-take of index insurance. A study in Ethiopia maintained that the demand for index insurance products by farmers would be reduced by 30% points if basis risk exists (Hill, et al., 2011). The finding is similar to a study by Dercon et al. (2014), which concluded that demand for index insurance escalates by 50% when the product was sold to groups encouraged to mitigate the effects of basis risk by sharing payouts. The results also agree with a study in India by Hill et al. (2011) who found that the demand for index insurance product increase by 17% for each kilometre the distance was reduced with the installation of new weather station closer to villages where clients have insurance coverage. DeNicola (2011) and Bryan (2011) reported that basis risk plays an essential role in the reduction of insurance demand. Finally, Clarke (2011) also reported that low level of demand for index insurance mainly results from basis risk which has a negative effect on livelihood.

Liquidity constraints

Cropping seasons have long periods of time between seasons. However, clients are normally required to pay premium ahead of the season. It is essential to maintain liquidity from harvest to the beginning of the next season. But smallholder farmers are insufficient in savings. Liquidity constraint has two antagonistic effects which together with other factors militate against the uptake of drought index insurance policy. Results from Table 14 indicate that lack of liquidity was ranked fourth.

The finding agrees with Mobarak and Rosenzweig (2012) who reported that liquidity constraint was the main reason for the non-purchase of index insurance product policy by Indian farmers. Casaburi and Willis (2015) found that when payment of insurance premium among sugar cane producers in Kenya was postponed until harvest time, uptake was increased from 5%-72%.

Similarly, research by Binswanger-Mkhize, (2012) and Cole et al. (2012) found that smallholder farmers lack the required liquidity to pay for weather index insurance. Enjolras and Sentisas (2004) (as cited in Lefebvre, Nikolov, Gomez-y-Paloma and Chopeva, 2014), reported that there is a high expectation for more liquidity constraint farmers to have more insurance cover. Additionally, Gine, 2015, McIntosh et al. 2014) found that liquidity constraints will possibly reduce the demand for index insurance product significantly.

On the contrary, Cole, et al. (2012b) reported that where money is given to households in advance (relaxing liquidity constraint) before the decision to purchase index insurance is made, uptake of index insurance increases. Similarly, Norton, et al (2011) used an experimental game reported on Ethiopian farmers to conclude that a relaxed liquidity constraint increased the households' up-take on index insurance. Karlan et al. (2014) and Emerick et al. (2016) reported that irrespective of liquidity constraints, farmers can independently find liquidity to adopt profitable technological innovations which will consequently apply to uptake of quality index insurance.

Inadequate education on the insurance product

Inadequate education on the insurance product is the fifth highest ranked constraint to drought index insurance subscription among cereal farmers in the Northern Region of Ghana. When insurance is newly introduced, it is difficult to understand the concept. Farmers often expect insurers to pay premiums back to them when no loss occurs during the year.

The findings agree with (Cai, de Janvry and Sadoulet, 2011; Jensen, et al. 2014; Pratt et al. 2010) using an experimental study reported that a better understanding of the product is an essential factor that affect the demand for index insurance product. Hill et al. (2011) found that insurance is a complex product therefore an improvement in its understanding is key to increasing demand. When farmers do not understand the product being sold, the likelihood and the willingness-to-pay for it is less. Similarly, Gaurav et al., 2011 and Hill et al., 2013b) found that an educational or experimental game increases the up-take of insurance policy or product. Cai et al. 2013; Cai and Song, 2013; Gaurav et al. 2011) reported that a knowledge of the product increases uptake of index-based insurance products. Pat et al. 2009 and Cole et. al, (2013) found that the uptake of an insurance product is higher provided there is a better understanding of the product. On the contrary, Gine (2015) found that knowledge about an insurance product has no effect on its demand.

Lack of trust in the insurer

When money moved from clients to financial institutions, trust in the insurer becomes important for the uptake of insurance policy. Indexing of the peril removes trust in the insurer where loss assessment is not required in order for indemnity to be paid. Lack of trust is the lowest ranked constraint to drought index insurance policy subscription. Kaczałal and Wiśniewska (2015) who reported that both economic and non-economic factors have an influence on the decision to subscribe or purchase index insurance. Trust is one of the non-economic factors which encapsulate the trust in the insurer, policy and in the clients' capability to choose satisfactorily.

The finding agrees with Cole et al. (2014) who found that the likelihood for households to purchase index insurance policy is higher when clients learn about the quality of the product and trustworthiness of agents or underwriters as well as the payment of indemnity to known community members. Patt et al. (2009), Cole et. al. (2013) and Gine (2015) reported that, trust in the organisation involved in the insurance program has the capability to enhance take-up by 11%. Similarly, Gine (2015) and Patt et al. (2009) agrees that, there is an increase in the trust level of agricultural insurance institution executing the insurance program when farmers are members and former clients. Cai (2009), Cai, 2015 & Cole et.al, 2013) reported that trust in the insurance product can improve take-up decisions substantially.

Chapter Summary

The cereal farmers are aware of existing constraints to drought index insurance policy subscription. The cereal farmers indicated that, inaccessibility to credit was their first constraint, followed by high premium rate, basis risk, liquidity constraints, inadequate education on the insurance product. Lack of trust in the insurer was lowly ranked among the cereal farmers.

The next chapter outlines the summaries, conclusions, recommendations and implication of the study for agricultural extension.

CHAPTER EIGHT

SUMMARY, CONCLUSIONS, RECOMMENDATIONS AND IMPLICATIONS FOR AGRICULTURAL EXTENSION

Introduction

This chapter presents a summary of the research objectives, research questions, research methodologies employed and the major findings of the study. This study sought to analyse the subscription of drought index insurance policy among cereal farmers in the Northern Region of Ghana. The study also sought to answer the following research questions:

1. What are the factors influencing subscription to drought index insurance policy and intensity among cereal farmers in the Northern Region of Ghana?
2. What is the hypothetical optimal drought index insurance policy for cereal farmers in the Northern Region of Ghana?
3. Are cereal farmers in the Northern Region of Ghana willing to pay for the attributes of the drought index insurance policy?
4. What is the level of agreement on the constraints to drought index insurance policy subscription among cereal farmers in the Northern Region of Ghana?

To address the research questions, the researcher carried out the study in the Northern Region of Ghana. The choice for the study area emanates from the fact that Northern Region is one of the regions where the sensitisation, piloting and advocacy of the drought index insurance policy project started and therefore a good choice for this study. The researcher employed a quantitative approach to the study.

The population for the study was represented by cereal farmers in Tolon, Nanton, Central Gonja, Sangnerigu, Kumbungu, Savelugu and Tamale Metropolitan assembly. A total of 430 cereal farmers who have subscribed or not to the drought index insurance policy was randomly sampled using a multi-stage sampling procedure. The 430 randomly sampled farmers were constituted by 263 farmers who were randomly sampled from the list of farmers who purchased drought index insurance policy whiles the 167 farmers who did not purchase or subscribe to a drought index insurance policy or product. After the data collection, a total number of 424 cereal farmers (consisting of 258 household heads who had subscribed to the drought index insurance policy and 166 cereal farmers who did not were available for interview). Five of the selected farmers who subscribed to the drought index insurance policy and one who had not, travelled out of the community and could not be reached. This gave a response rate of 98.6 percent.

A structured interview schedule was developed taking into consideration the research objectives and the estimation techniques. The structured interview schedule (data collection instrument) was evaluated by insurance experts. The data collection instrument was pre-tested in the West Mamprusi District by administering it through an interview session in the local dialect to thirty-eight cereal farmers. Some items in the instrument were modified and refined to enhance its effectiveness and also to ensure that the instruments have the requisite level of internal consistency based on the feedback during the pre-testing. The reliability of the five-point Likert scale was measured and a Cronbach's Alpha value of 0.802

was obtained which is a proof of the reliability of the scale in the data collection instrument.

The well refined data collection instrument was administered in the local dialect by eight well-trained enumerators in a face to face interview sessions with cereal farmers. Data was collected from 4th February, 2017 to 25th February, 2017 between the hours of 8:00 am to 5:00 pm in the homes of cereal farmers. After the data collection exercise, the responses (data) of 424 farmers qualified to be cleaned, coded and keyed into the software. The data collected was analysed using the Statistical Package for the Social Sciences (SPSS), STATA and JMP (SAS) data analysis software.

Summary of Research Findings

The first research question posed was, "What are the factors influencing subscription to drought index insurance policy and intensity among cereal farmers in the Northern region of Ghana?" The study found that age, education, farm size, income and contact with insurance agent explained the subscription of drought index insurance policy whiles farming experience, farm size and off-farm income explained the intensity of subscription. The result showed that the model was fit for the data.

With respect to the second research question which was, "What is the hypothetical optimal drought index insurance policy for cereal farmers in the Northern Region of Ghana?" The outcome of the study shows that the hypothetical optimal or ideal drought index insurance policy should comprise: premium of

GhȻ35 per acre, rainfall data from the GMet weather stations placed within 20km radius of the farmers farm, non-bank payment used as the mode of claims payout for farmers' receiving indemnity, credit interlinked with drought index insurance policy, reduction of next season's premium when a farmer does not experience loss spelt out in insurance policy cover and subsidy on drought index insurance policy premium.

The third research objective of the study, considered cereal farmers willingness-to-pay for the attributes of the hypothetical optimal drought index insurance policy. At a base price of GhȻ35, the finding showed that cereal farmers will not be willing to pay GhȻ0.87 and GhȻ1.52 more on the premium for a hypothetical drought index insurance policy that obtains rainfall data from the satellite and use of bank payment as the means of indemnity payout to clients who have suffered a loss respectively. Cereal farmers will be willing to pay GhȻ3.09 more for a drought index insurance policy interlinked with credit and GhȻ1.84 more for a reduced premium on the next season subscription when no claim payout is made. Finally, cereal farmers subscribing to the drought index insurance policy will be willing to pay GhȻ4.74 more on a policy with a subsidized premium at a base rate of GhȻ35.

The fourth research objective sought to ascertain the level of agreement on the constraints to drought index insurance policy subscription among cereal farmers in the Northern Region of Ghana. The study found that the level of agreement between subscribers was however slightly higher than the level of agreement between non-subscribers suggesting that the criteria used by subscribers for their ranking of the constraints to the subscription of drought index insurance policy, were relatively more homogenous as compared to the criteria used by non-subscribers.

Conclusions

Firstly, the study sought to determine factors influencing the subscription of drought index insurance policy and intensity among cereal farmers. The results show that older farmers are more likely to subscribe to the drought index insurance policy because of the possibility of experiencing drought or other disaster. Therefore, the rationale for taking an insurance cover for their cereal. The educated cereal farmer is more likely to purchase a policy to cover. Access and control of large acres of land is a proxy for wealth and credit worthiness. Farmers with large acres of land are more likely to subscribe to a drought index insurance policy. Also, farmers with low income are more likely to subscribe to the drought index insurance policy. This is as a result of their inability to adequately manage the ramifications of drought and its associated perils therefore purchase of insurance policy cover offers adequate protection from drought and appendage effects. Cereal farmers who have frequent contact with insurance agent are more likely to subscribe to a drought index insurance policy.

Now considering the intensity of subscription to a drought index insurance policy, farmers with more farming experience will reduce the acres of farm insured. This observation is attributed to the fact that cereal farmers with less farming experience may not have experienced the devastating effects of drought. Therefore, insuring their farm becomes a precautionary measure against possible loss.

Secondly, the hypothetical optimal drought index insurance policy that cereal farmers should be sold at GhȻ35 per acre, premium subsidized, indemnity not paid via the bank, credit bundled with insurance, reduction of next seasons premium when indemnity is not recorded and using rainfall data from GMet weather stations to determine if the cereal farmer deserve an indemnity payment.

In estimating of cereal farmers' willingness to pay for the attributes of the hypothetical optimal drought index insurance policy, the results show that farmers will be willing to pay extra cedis for: drought index insurance policy interlinked with credit, a reduced premium on the next season subscription when no claim payout is made and subsidized premium. However, they will not be willing to pay extra cedis for a policy cover with satellite generated rainfall data and bank payment as a means to pay indemnity.

Finally, there is homogeneity in the level of agreement between subscribers and non-subscribers with respect to the constraints of drought index insurance policy uptake by cereal farmers.

Recommendations

Based on the findings of the study, the following recommendations were made with reference to the research objectives.

Research objective one:

1. GAIP should channel the publicity and advertisement programme more toward the older farmers because they are inclined to subscribe to a drought index insurance policy.

2. GAIP in conjunction with research institutions must build a strong GAIP-research-extension-farmer linkage to ensure that while cereal farmers interact with insurance and or extension agent, feedback mechanisms are instituted to convey the opinions and preferences of farmers to the other parties within the linkage to enhance ideal insurance policy design and uptake.

Objective two:

1. In order to ensure that uptake of the hypothetical optimal drought index insurance policy is increased, GAIP should subject the insurance policy to rigorous insurance policy development protocols. This will bring the best out of the policy and enhance the uptake.
2. The government should create the enabling environment for the funding of research in the area of agricultural insurance in order to help develop policy that will benefit all stakeholders in the agricultural sector.
3. Government in collaboration with MoFA, GAIP, farmers and other stakeholders along the value chain through an act of parliament should amend the current insurance law to include agricultural insurance.

Objective three:

1. GAIP should install automated weather stations in areas with high farmer population density to augment the already existing ones so as to eliminate or possibly reduce basis risk to its barest minimum. Finally, GAIP and other stakeholders should ensure that automated weather stations installed, overlaps within the 20km radius to help address basis risk.

2. Government should subsidize drought index insurance policy and by extension other agricultural insurance policies, so it becomes a disincentive for farmers and other stakeholder along the agricultural value chain not to purchase an insurance policy to cover farm businesses.
3. Government should ensure that a secondary backup or audit indices is established in order that if farmers report of failed primary index, then the secondary or back-up audit index can be employed.
4. Government in conjunction with GAIP and the district assembly should set up a local assurance fund where government as well as farmers should contribute to it. Under this arrangement, farmers who deserve an indemnity are decided by a local committee.
5. Government should facilitate the formation of a team at the community level to redistribute payments to farmers on the bases of direct observable losses.

Research objective four:

1. The outcome of the study showed that inaccessibility to credit was a constraint to the subscription of drought index insurance policy. Improving access to credit will increase the demand for drought index insurance subscription. This is likely to have a consequential effect on increased investment in agriculture. The government in conjunction with bank of Ghana and telecommunication operators should play a pivotal role in the establishment of branchless banks. This will ensure the presence of

financial institutions within farming communities in order to enhance farmers' access to credit and cash.

2. The high premium rate was a constraint to the subscription of drought index insurance policy. Agro-input companies, relief agencies, etc. should fund agricultural insurance activities with some part of their budgetary allocation slated for relief operations and corporate social responsibility to help reduce the premium rate.
3. Taking a technological approach to addressing basis risk, insurance regulatory body (National Insurance Commission) should ensure that modern automated weather stations are installed in communities with a lot of farmers. This will help reduce both the scale and the prediction error in the determination of indemnity payment.
4. Experimental or educational games should be incorporated into the advertisement and publicity programmes of GAIP to help improve understanding and better appreciation of the insurance policy. Finally, insurance companies should use existing social networks in the promotion and dissemination of insurance products.

Implications of the Study for Agricultural Extension

1. GAIP in collaboration with, agricultural extension service department, cereal farmers and other stakeholders along the value chain through an act of parliament, should push for the amendment of the current insurance law

to include agricultural insurance in order to ensure that agricultural risk is properly managed.

2. The publicity and advertisement programme of GAIP should be planned and implemented together with agricultural extension service department in order to ensure that appropriate extension delivery approaches are used. When not done, the uptake of drought index insurance policy will not improve.

3. GAIP should collaborate with the Research Extension Farmer Linkage Committee (RELC) in the evaluation and development of drought index insurance policy to ensure a good feedback mechanism are instituted to convey the opinions and preferences of farmers to the other parties within the linkage to enhance ideal insurance policy design and uptake. This when not properly done will result in low uptake of drought index insurance products.

Suggestions for Further Research

The findings of this research indicate that more research is needed in the area of drought index insurance policy. Future research may have to consider a discrete choice experiment where attributes like safety net and the payment of insurance premium with farm produce will be incorporated into a model in determining the optimal drought index insurance policy. Also, a study of the subject-effect interaction that considers an interaction between subjects (income difference, gender difference, education difference etc.) and the attributes of the drought index insurance policy. These interaction effects will enable insurance companies to design products that will meet market-segment preferences.

Further research may have to consider the factors influencing the willingness-to-pay for the drought index insurance policy. An identification of such factors will help inform policy direction on which factors to concentrate on and by what margins in order to increase uptake of insurance policy.

Finally, discrete choice experiment should be developed with other stakeholders (agro-input dealers, aggregators, nucleus farmers, out-growers etc.) along the value chain in mind. This may help in the design of contractual arrangement for various stakeholders along the value chain so the insurance company will escape from the temptation of classifying all stakeholders as a homogeneous entity.

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APPENDIX A

FARMERS QUESTIONNAIRE

DROUGHT INDEX INSURANCE POLICY SUBSCRIPTION AMONG CEREAL FARMERS IN THE NORTHERN REGION OF GHANA

Please be assured that all information provided during this survey will be kept private and confidential by the research team as described in the participant consent form. The consent form was designed to protect your privacy and confidentiality.

IDENTIFICATION PARTICULARS

Name of enumerator---------------------------------

Date of interview _ _/ _ _/2017

Name of respondent------------------------------

Questionnaire number______________ Region_____________

District ________________________

Community___________________

SECTION A – CHOICE EXPERIMENT

Instruction for Choice Experiment

Now we would like to ask you to make six (6) hypothetical decisions. Please remember that all decisions will be kept private and confidential by the research team as described in the participant consent form. In each decision you will see two alternative drought index insurance policies that you might subscribe to. The drought index insurance policies will differ based on the index insurance policy attributes of interest to the cereal farmer, whether or not you will pay GhC40 as premium, receive rainfall data from a satellite, whether they will receive a claim payout via bank payment, credit interlinked with an insurance policy, reduction of next seasons premium in the situation where a claim is made and finally subsidy on drought index insurance policy premium.

For each decision, you'll also have the option to choose neither of the drought index insurance policies. Please choose the alternative – drought index insurance policy 1, drought index insurance policy 2, or neither – that you would most prefer. Although the decisions are hypothetical, please make your choice – as best as you can – as if you were really deciding whether to subscribe to these drought index insurance policies.

Below is a choice set or card which we will indicate your choice by placing a checkmark in the appropriate box in the last column.

A1. Using the choice set provided below, please tick the hypothetical drought index insurance policy option you would prefer or if you do not prefer any

CHOICE SET 1

	Premium	Basis risk	Claims payout	Interlinking credit with insurance	"No Claim Discount" payment	Subsidy	I would choose
Drought Index Insurance Policy Option 1	 GhȻ40	 Rainfall data from a satellite	 Non-bank payment	 Credit not interlinked with insurance	 Reduction of next seasons premium	 Subsidy on drought index insurance policy premium	o
Drought Index Insurance Policy Option 2	 GhȻ35	 Rainfall data from the GMet weather station	 Bank payment	 Credit interlinked with insurance	 Payout at the end of the next season	 Subsidy on agricultural inputs	o
			None of the policy option				o

A2. Using the choice set provided below, please tick the hypothetical drought index insurance policy option you would prefer or if you do not prefer any.

CHOICE SET 2							
	Premium	Basis risk	Claims payout	Interlinking credit with insurance	"No Claim Discount" payment	Subsidy	I would choose
Drought Index Insurance Policy Option 1	 GhȻ35	 Rainfall data from the GMet weather station	 Bank payment	 Credit not interlinked with insurance	 Payout at the end of the next season	 Subsidy on drought index insurance policy premium	o
Drought Index Insurance Policy Option 2	 GhȻ40	 Rainfall data from a satellite	 Non-bank payment	 Credit interlinked with insurance	 Reduction of next seasons premium	 Subsidy on agricultural inputs	o
None of the policy option							o

A3. Using the choice set provided below, please tick the hypothetical drought index insurance policy option you would prefer or if you do not prefer any.

CHOICE SET 3

	Premium	**Basis risk**	**Claims payout**	**Interlinking credit with insurance**	**"No Claim Discount" payment**	**Subsidy**	I would choose
Drought Index Insurance Policy Option 1	 GhC35	 Rainfall data from the GMet weather station	 Non-bank payment	 Credit not interlinked with insurance	 Reduction of next seasons premium	 Subsidy on agricultural inputs	o
Drought Index Insurance Policy Option 2	 GhC40	 Rainfall data from a satellite	 Bank payment	 Credit interlinked with insurance	 Payout at the end of the next season	 Subsidy on drought index insurance policy premium	o
			None of the policy option				o

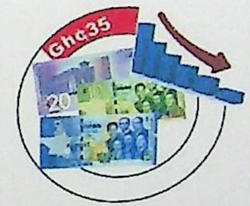
A4. Using the choice set provided below, please tick the hypothetical drought index insurance policy option you would prefer or if you do not prefer any.

CHOICE SET 4

	Premium	Basis risk	Claims payout	Interlinking credit with insurance	"No Claim Discount" payment	Subsidy	I would choose
Drought Index Insurance Policy Option 1	 GhȻ35	 Rainfall data from a satellite	 Bank payment	 Credit interlinked with insurance	 Reduction of next seasons premium	 Subsidy on drought index insurance policy premium	o
Drought Index Insurance Policy Option 2	 GhȻ40	 Rainfall data from the GMet weather station	 Non-bank payment	 Credit not interlinked with insurance	 Payout at the end of the next season	 Subsidy on agricultural inputs	o
None of the policy option							o

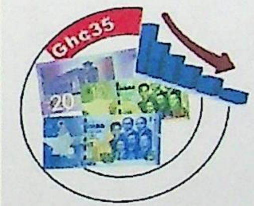
A5. Using the choice set provided below, please tick the hypothetical drought index insurance policy option you would prefer or if you do not prefer any.

CHOICE SET 5

	Premium	Basis risk	Claims payout	Interlinking credit with insurance	"No Claim Discount" payment	Subsidy	I would choose
Drought Index Insurance Policy Option 1	 GhȻ40	 Rainfall data from the GMet weather station	 Bank payment	 Credit interlinked with insurance	 Reduction of next seasons premium	 Subsidy on drought index insurance policy premium	o
Drought Index Insurance Policy Option 2	 GhȻ35	 Rainfall data from a satellite	 Non-bank payment	 Credit not interlinked with insurance	 Payout at the end of the next season	 Subsidy on agricultural inputs	o
			None of the policy option				o

A6. Using the choice set provided below, please tick the hypothetical drought index insurance policy option you would prefer or if you do not prefer any.

CHOICE SET 6

	Premium	Basis risk	Claims payout	Interlinking credit with insurance	"No Claim Discount" payment	Subsidy	I would choose
Drought Index Insurance Policy Option 1	 GhȻ40	 Rainfall data from a satellite	 Bank payment	 Credit not interlinked with insurance	 Reduction of next seasons premium	 Subsidy on agricultural inputs	O
Drought Index Insurance Policy Option 2	 GhȻ35	 Rainfall data from the GMet weather station	 Non-bank payment	 Credit interlinked with insurance	 Payout at the end of the next season	 Subsidy on drought index insurance policy premium	O
			None of the policy option				O

SECTION B: LAND HOLDINGS

B1. How many acre(s) do you have available for farming? __________Acre (s)

B2. How many acre(s) do you currently cultivate? _______Acre(s)

B3. What crops do you cultivate? ________________________________

B4. Do you have a land title for any of your land on which you cultivate your crop(s)? No = 0 Yes = 1

B5. How did you acquire the land on which you cultivate your insured crops?

a. Outright purchase **(Continue to question B6)**

b. Rented **(Continue to question B7)**

c. Leased **(Continue to question B7)**

d. Gift **(Continue to question B6)**

e. Inheritance **(Continue to question B6)**

f. Share cropping **(Continue to question B8)**

B6. Do you have a land title for any of the land on which you cultivated your insured farm(s)? No = 0 Yes = 1 **(Continue to question C1)**

B7. How much are you paying annually per acre? _________cedis/acre/year?

B8. Which type of share cropping system do you currently practice with your insured farm? ________________________________

B9. If you are not paying for the usage of the land on which you cultivate your insured crops, what kind of arrangement do you have with the land owner? ________________________________

SECTION C: RISK AND DROUGHT INDEX INSURANCE

C1. Have you received any training on financial literacy?

No = 0 Yes = 1

C2. Do you have access to credit?

No = 0 **(Skip the next question)** Yes = 1

C3. If yes, list your sources of credit **(Tick all that apply)**?

a. Cooperative societies b. Money lenders c. "Susu" (ROSCAS)

d. Friends/relatives. e. Farmer organization. f. Religious group

g. Microfinance scheme. h. Commercial banks i. Other__________

C4. Have you received any training on drought index insurance?

No = 0 **(Skip the next question)** Yes = 1

C5. If yes, which organization(s) conducted the training? **(Tick all that apply)**?

a. Cooperative Societies b. Farmer Based Organization

c. Religious group. d. Microfinance scheme. e. Banks

g. Other______________

C6. Do you have knowledge about drought-index insurance?

No = 0 **(Skip the next question)** Yes = 1

C7. If Yes, on a scale of **1 to 10**, where 1 indicates that you do not have any knowledge about drought index insurance and 10 indicates that you have a lot of knowledge about drought index insurance, how much knowledge do you have about drought index insurance? ___________

C8. Have you experienced any loss of crop due to drought in the past 10 years?

No = 0 **(Skip the next question)** Yes = 1

C9. In the past 10 years, how many times have you experienced crop failure due to drought?____ Times

C10. What effect does drought have on your household **(Tick all that apply)**?

a. Inability to feed the household. b. Scarcity of water

c. Inability to keep children in school. d. Loss of livestock

e. Fall in food production. f. Outmigration of labour

g. No effect on household **(Answer the next question)**

h. Other______________________________

C11. If the drought did not have any effect on your household, is it because you did any of the following **(Tick all that apply)**?

a. Use drought tolerant seeds. b. Practice conservation agriculture

c. Takings of loans to support household

d. Use of savings to support household e. Gifts f. Donations

g. Safety net h. Others ____________

C12. In the event of drought, how do you cope with its effect **(Tick all that apply)**?

a. Buy additional food b. Food rationing c. Reduce consumption

d. Sell a livestock to purchase food e. Sell assets to purchase food

f. Get income by working off-farm g. Did not do anything

h. Other___________________

C13. How willing are you to take risks **(Tick only one)**?

a. More prepared to take risks. b. Prepared to take risks

c. Indifferent to taking risks d. Not prepared to take risks

e. Not at all prepared to take risks

C14. Have you ever subscribed to a drought index insurance policy to cover your crops? No = 0 Yes = 1

C15. If No to Q35, why have you not subscribed to the drought index insurance policy **(Tick all that apply)**?

a. Have no knowledge on how policy works b. Lack of funds to subscribe

c. Policy not rewarding d. Do not like the policy

e. Other________

C16. Did you choose the crop you wanted drought index insurance policy to cover? No = 0 Yes = 1

C17. Which crop did you purchase drought index insurance policy to cover?

a. Rice b. Soybean c. Maize d. Millet e. Other ……………

C18. How many acre(s) of land did you cultivate in the 2016 farming season?

______Year(s) **(Answer the next question)**

C19. Did you insure your farm during the 2016 season?

No = 0 **(Skip the next question)** Yes = 1

C20. How many acres of farm were covered by drought index insurance policy in the 2016 farming season? _________Acre(s)

C21. For the 2016 season, how much did you pay per acre for subscribing to the drought index insurance policy? Gh¢ ______________ per acre.

C22. Have you ever received an insurance payout from the insurance company?

No = 0 **(Skip the next question)** Yes = 1

C23. If yes, was the payout/indemnity paid promptly?

No = 0 Yes = 1

C24. Have you ever received assistance when you experienced some natural or man-made disaster (eg. Flood, drought, bush fires, incidence of pest and disease etc.)? No = 0 **(Skip the next question)** Yes = 1

C25. If yes, in what form did the assistance take? **(Tick all that apply).**

a. Food items b. Clothing c. Beddings d. Temporal shelter e. Roofing sheet

C26. Which institution or organization provided the assistance when you experienced the disaster?

a. Government (NADMO) b. NGOs c. Family and friends

d. Cooperative society e. Religious organization f. Other________________

C27. How important were each of these sources of information on your household's decision to subscribe to Drought Index Insurance? **(Circle one per row. Prompt for other sources of information)**

	VLI	LI	MLI	HI	VHI
Printed material (Posters, brochures, etc.)	5	4	3	2	1
Radio programs	5	4	3	2	1
NGO's	5	4	3	2	1
Extension agent	5	4	3	2	1
Neighbouring farmers	5	4	3	2	1
Family members/friends	5	4	3	2	1
Seminars/workshops	5	4	3	2	1
Farmers organization/cooperative	5	4	3	2	1
Other (Specify):					

VLI = Very low importance

LI= Low importance

MLI Moderately low importance

HI= High importance

VHI= Very high importance

C28. How many years have you been buying drought index insurance policy?

_______Year(s)

SECTION D: INCOME AND OFF-FARM WORK ACTIVITIES

D1. Do you engage in off-farm work?

No = 0 **(Skip the next question)** Yes = 1

D2. In an ordinary day, how many hours do you work in a day **(both off-farm work and on-farm work)**? _______Hour(s) **(Please answer the next question)**

D3. How many hours do you give or allocate to off-farm work in a day?
_______Hour(s)

D4. Mention the most beneficial off-farm activities you (household head) and others (household members) engaged in and the earnings obtained from these activities in the 2016 season.

Please indicate if it is household head or member	Age (yrs)	Sex M/F	Years of schooling (yrs)	Off-farm employment (Please put the appropriate code and specific activity)	How many hours did you work off-farm per day/week	How many months per year does the household member work on this activity	How many days/months does the household member work on this activity	How much does paid per day (Gh¢)

Keys or Codes: Off-farm employment activities

1 = working for wages in mine/shop/factory/construction work, etc. i.e. non-agricultural activities

2 = working on other people's farms for wages i.e. non - family agricultural activities wage employment (agriculture)

3 = operating a shop, food selling etc.) non - agricultural family enterprise

4 = regular salaried employment e.g. teaching, nursing etc.

5 = burning charcoal/collecting firewood for sale

6 = making smock

7 = (tailoring, barbering, hair dressing) for money

8 = carpentry, masonry, tailoring, barbering, hair dressing) etc.

9 = selling goods or services (trading)

10 = petty trading

11 = other non-agriculture activities specify_______________

D5. Why does your household participate in off-farm activities?

____

____

____

D6. What are the earnings received from the off-farm activities used for?

____

____

____

D7. Please indicate if you (household head) or others (household members) have received remittances in a form of goods or money in the 2016 season.

Names of household head or household member	Sources remittances	Have you (household head) or others (household members) received remittances from any of these sources in the 2016 season No/Yes	Please indicate the total value of remittance received in cash and kind received in the last 2016 season (Gh¢)
		Cash	Kind
	Livelihood Empowerment Against Poverty (LEAP)		
	Charity organizations/NGOs		
	Family or friends who live outside the household		
	Transfers and remittances from other households		
	Rent from property or other Assets		
	Other (Specify):		
	Other (Specify):		
	Other (Specify):		

D8. Please we will like to find out your yield for all the crops you cultivated 2016 season? **(Please fill for both insured and non-insured crops)**

Crop	Quantity	Unit= kg/basket/crates etc.	Unit price (Gh¢)
Maize			
Rice			
Soybean			
Yam			
Millet			
Sorghum			
Tomato			
Pepper			
Others (specify)			
Others (specify)			

D9. Do you keep animals? No = 0 **(Skip the next question)** Yes = 1

D10. Please we will like to find out the sale of the animals in 2016 season?

Animals	Quantity of animals owned	Total number of animals sold	Unit price (Gh¢)
Cattle			
Goat			
Sheep			
Chicken			
Guinea fowl			
Duck			
Others (specify)			

D11. Please indicate the amount of money received as remittance for the 2016 season? Gh¢_______________

D12. Do you have trust for the insurance company offering the drought index insurance product? No = 0 Yes = 1

D13. What is the distance from your farm to the weather station? ________ km

SECTION E: CROP BUDGET

E1. What crop budget of your **insured crops** for the 2016 season?

Name of insured crop	Cost	Quantity (A)	Units=kg/ litre/bag	Unit Price (Gh¢)	Total=(A*B) Gh¢
	Seed				
	Fertilizer application:				
	NPK (1st application)				
	Urea (2nd application)				
	Herbicide application:				
	1st application				
	2nd application				
	Insecticide application:				
	1st application				
	2nd application				
	Other (Specify):				

SECTION F: CONSTRAINTS TO THE SUBSCRIPTION OF DROUGHT INDEX INSURANCE POLICY

F1. Please tick appropriately, your level of agreement with the following statements below.

Statements	VLA	LA	MA	HA	VHA
Inaccessibility of credit is a constraint to the subscription of drought index insurance policy.					
A high premium rate is a constraint to the subscription of drought index insurance policy.					
Basis risk is a constraint to the subscription of drought index insurance policy.					
Inadequate education on the insurance product is a constraint to the subscription of drought index insurance policy.					
Lack of trust is a constraint to the subscription of drought index insurance policy.					
Liquidity constraint is a constraint to the subscription of drought index insurance policy.					

Codes or keys: Level of agreement

VLA: Very low agreement

LA: Low agreement

MA: Moderate agreement

HA: High agreement

VHA: Very high agreement

SECTION G: DEMOGRAPHIC CHARACTERISTICS OF CEREAL FARMERS/HOUSEHOLD

G1. Gender of respondent? Female = 0 Male = 1

G2. How old are you?__________ Year(s)

G3. Relationship status of respondent? a. Single b. Married c. Co-habitation d. Divorced e. Widowed

G4. How many years did you spend in formal education?________Year(s)

G5. What was the highest level of formal education you attained?

a. No formal education b. Some primary school education

c. Completed primary school education d. Some JHS education

e. Completed JHS education f. Some SHS education

g. Completed SHS education h. Some Tertiary/University education

i. Graduated from Tertiary school or University

G6. How many people live in your household? ________

G7. How many adult males (18 yrs and above) do you have in the household? ___

G8. How many adult females (18 yrs and above) do you have in the household?

______

G9. How many male children (18yrs and below) do you have in the household?

______

G10. How many female children (18yrs and below) do you have in the household?

______

G11. How many years have you been farming? ________ Year(s)

G12. Are you a member of a farmer group or agricultural cooperative?

No = 0 **(Skip the next question)** Yes = 1

G13. If yes mention the name? ______________________

THANK YOU