UNIVERSITY OF GHANA

COLLEGE OF HUMANITIES

MAIZE FARMERS' WILLINGNESS TO PAY FOR WEATHER INDEX INSURANCE IN NSAWAM ADOAGYIRI MUNICIPALITY

BY

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INSTITUTE OF STATISTICAL, SOCIAL AND ECONOMIC RESEARCH (ISSER)

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THIS DISSERTATION IS SUBMITTED TO THE UNIVERSITY OF GHANA, LEGON IN PARTIAL FULFILLMENT OF THE REQUIREMENT FOR THE AWARD OF MA DEVELOPMENT STUDIES DEGREE

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DECLARATION

I, Elliott Alvin Bartrop-Sackey, hereby declare that except for the references to other peoples' work which have been duly acknowledged, this dissertation titled "Maize Farmers' Willingness To Pay For Weather Index Insurance In Nsawam Adoagyiri Municipality" is the result of my work under the supervision of Dr Fred M. Dzanku of the Institute of Statistical, Social and Economic Research (ISSER), and as such, this dissertation has neither been submitted in full nor part anywhere else for the award of any degree.

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DATE: 30th October 2020

ELLIOTT ALVIN BARTROP-SACKEY

(STUDENT)

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DATE: 30th October 2020

DR FRED M. DZANKU

(SUPERVISOR)

DEDICATION

I dedicate this work to my beloved Grandmother, Magdalene Bristow, for her unfailing love.

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The utmost appreciation goes to God for taking me through this scholar's task gracefully.

My sincere gratitude goes to my supervisor, Dr Fred M. Dzanku, for his unending guidance, resourcefulness and academic professionalism to ensure that this study met every highest academic standard.

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ABSTRACT

Agriculture in Ghana is dominantly dependent on rainfall and hence putting farmers at a high risk of crop failure due to the unpredictability of weather conditions. This is a chronic problem for farmers as annual crop failure puts farmers at the risk of poverty. The objectives of this study were to determine the level of awareness of weather index insurance among farmers; to estimate the average amount these farmers are willing to pay as premium for weather index insurance; and to examine the factors that influence their willingness to pay for weather index insurance. The study is based on a survey of 100 maize farmers sampled from ten communities located in one of Ghana's local government areas—Nsawam Adoagyiri Municipality. Bivariate descriptive analytical tools, as well as multivariate regressions models, were employed for inference. Specifically, for the regression models, Ordinary Least Squares (OLS) and Tobit regressions were used. The results showed that only 15% of the maize farmers were aware of weather index insurance, but 93% of the sampled maize farmers were willing to pay for the facility. Maize farmers were willing to pay a mean amount of about GHC229 per acre annually. The results further show that being a male, the level of on-farm income and previous disaster experience were positively correlated with willingness to pay for weather index insurance. Also, I found that farm size and having a secondary occupation are negatively correlated with the willingness to pay for weather index insurance. Given the low levels of awareness of weather index insurance but a positive attitude towards the facility as shown through the willingness to pay for the facility, the study recommends that more effort be devoted by the Ministry of Food and Agriculture at the district level towards educating farmers. The Ministry could also link insurers to the farmers to help mitigate the risk of crop failure.

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LIST OF ABBREVIATIONS

AYII	Area Yield Index Insurance
DII	Drought Index Insurance
FAO	Food and Agriculture Organisation
GAIP	Ghana Agricultural Insurance Pool/Programme
GDP	Gross Domestic Product
GIZ	German Society for International Cooperation
GSS	Ghana Statistical Service
IFAD	International Fund for Agricultural Development
IIPACC	Innovative Insurance Products for the Adaptation to Climate Change
IPA	Innovation for Poverty Action
IPCC	Intergovernmental Panel on Climate Change
MOFA	Ministry of Food and Agriculture
NAMA	Nsawam Adoagyiri Municipal Assembly
NGO	Non-Governmental Organisation
NIC	National Insurance Commission
OLS	Ordinary Least Squares
SRID	Statistics, Research and Information Directorate
WII	Weather Index Insurance

CHAPTER ONE

INTRODUCTION

1.1 Background

In Ghana, agriculture acts as an essential contributor to the economy, as well as aiding in poverty mitigation (MoFA, 2018). It is estimated that 38.3% of the Ghanaian total workforce in both informal and formal sectors is provided by the agricultural sector (GSS, 2019). As of 2019, Ghana's agricultural sector represented an 18.5% share of Gross Domestic Product (GDP), a decline from 19.7% in the previous year (GSS, 2020). An estimated 90% of farm sizes in Ghana are less than 2 hectares. The main cash crops cultivated are cashew, cocoa, pineapple, citrus, mango, tomato, oil palm, cassava, vegetables and banana (MoFA, 2018).

The total land area under irrigation is estimated to be about 221,000 hectares, which is 1.6% of the total 14 million hectares of agricultural land area in Ghana (MoFA, 2018). Due to heavy reliance on rainfall, agriculture in Ghana is deemed vulnerable to climate change (Yaro, 2010), as such, farmers in Ghana over the years, especially 1983, 1997, 2002, 2007 and 2009 were faced with a relevant number of harsh weather occurrences (Bekoe and Logah, 2016). Ghana continues to experience an increase in mean annual temperature of 1^{o}C (degree Celsius) each decade since 1960 and a 2.4% decrease in monthly rainfall over the same period (De Pinto *et al.*, 2012). The effects of climate change on agriculture include water and heat stress, the prevalence of pests and diseases, the loss of vegetative lands as a result of degradation of the ecosystem, resulting in yield reductions and post-harvest losses (Vermeulen *et al.*, 2010). It is estimated that yields of maize will decline by about 25% in each region by 2050 as a result of climate change impact (De Pinto *et al.*, 2012).

In this study, risk is defined as any factor that has a probability of causing potential loss to the farmer. De Pinto *et al.* (2012) further suggest that one climate change adaptation option for farmers is to employ insurance mechanisms that can be enforced to reduce the risk faced by farmers, and also to increase the total economic efficiency of production. A study by Stutley (2010) into the feasibility of crop insurance indicates that a range of insurance products can assist in reducing the bad effects of decision making within an environment filled with uncertainties and as such, will benefit Ghanaian farmers. Other authors like Stanturf *et al.* (2011) and Vermeulen *et al.* (2010) all agree to the use of weather and climate information services and crop insurance to aid in dealing with risk and uncertainty involved in climate change.

Agricultural insurance has been seen as one of the ways to transfer the risk associated with climate when it cannot be mitigated. As a result, the Ghana Agricultural Insurance Pool (GAIP) was established in 2011 with the introduction of their first product, weather index-based insurance, which is specifically known as the drought index-insurance (DII) (Adiku *et al.*, 2017). The Area Yield Index Insurance (AYII) was the second product launched which covered farmlands dependent on the approximations of a district's average yield (OppongMensah *et al.*, 2017). These two products represent the index-based products provided by the Ghana Agricultural Insurance Pool. GAIP also provides other agricultural insurance products based on traditional indemnity crop insurance and these are the Single Peril, Multi-Peril Crop Insurance (MPCI), and Aggregate Loss of Investment (OppongMensah *et al.*, 2017). Currently, the Ghana Agriculture Insurance Pool has four (4) main insurance products which are: Drought Index Insurance (DII), Area Yield Insurance (AYI), Multi-Peril Crop Insurance (MPCI) and Poultry Insurance (PI) (GAIP, 2012).

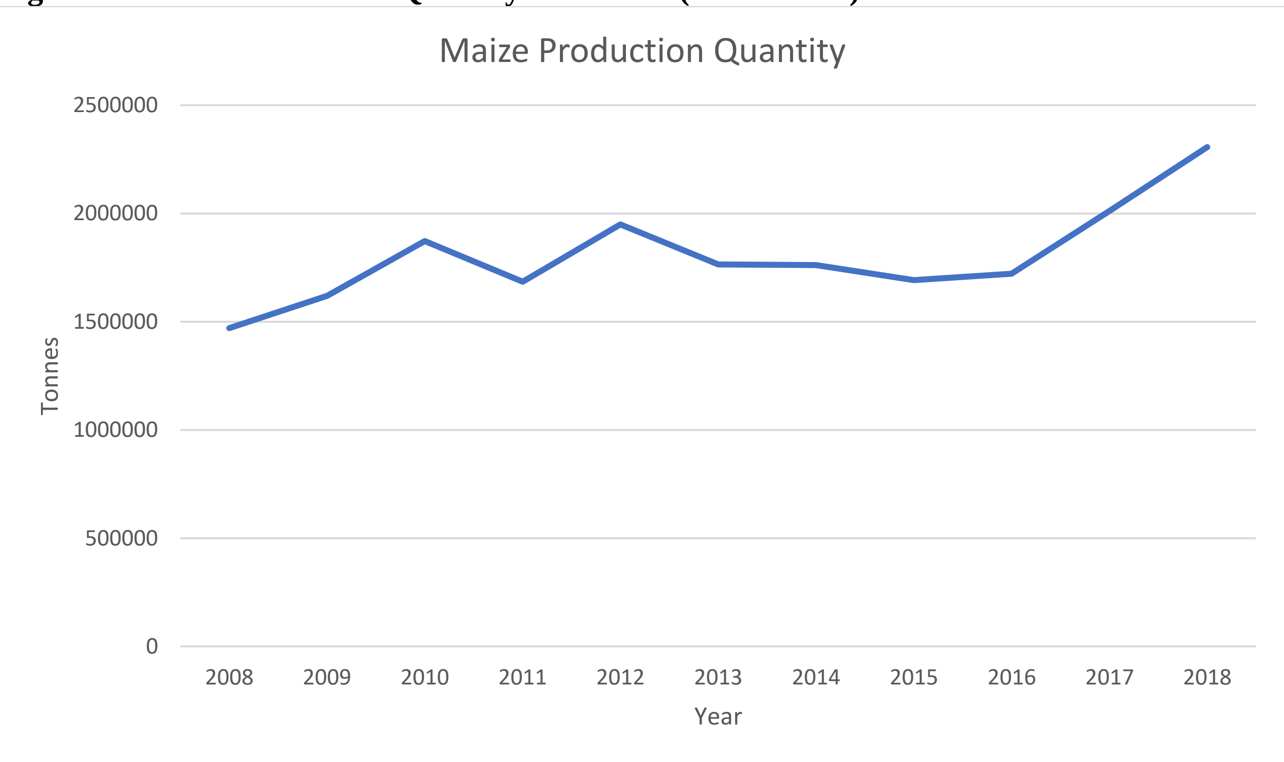
Agricultural production in Ghana consists mainly of an extensive number of small-scale farmers who cultivate a wide variety of rainfed crops, and of which maize is the dominant cereal food crop (MoFA, 2020). Maize is a very significant food crop and it forms more than

50% of Ghana's total cereal production (Ragasa *et al.*, 2014). In 2018, Ghana produced 2,306,384 tonnes of maize, but an examination of the time series of maize production from the Food and Agriculture Organisation (FAO) indicates that maize output experiences fluctuations (FAOSTAT, 2020).

1.2 Problem Statement

Figure 1.1 illustrates the production quantity for maize in Ghana. It can be observed that from 2008 to 2015, maize production in Ghana experienced some fluctuations. Agricultural activities in developing nations are most prone to the effects of weather extremes such as temperature extremes and rainfall extremes, and as such, many smallholder farmers at the household level heavily experience the impact of weather risks (Aidoo *et al.*, 2014). The farmer has no control over the weather but the weather can have an immediate consequence on the returns from farming (Baquet *et al.*, 1997).

Figure 1.1 Maize Production Quantity for Ghana (2008 – 2018)



Source: FAOSTAT, 2020

Farmers face the risk of weather conditions affecting their farming activities (World Bank, 2005). As a result, the heavy reliance on rainfall in farming is risky (Kahan, 2008). Bad weather conditions are one of the main sources of production risks as it affects farming activities and the supply chain as a whole, especially in countries highly dependent on rainfall as a source of agricultural water supply (Re, 2007).

The World Bank (2005) estimates that some of these production risks will escalate in the future as a result of the effects of climate change. Unfortunately, weather risks such as drought can affect a whole area instantly (Aidoo *et al.*, 2014), which can lead to crop failure.

Africa trails behind when it comes to its readiness towards climate change-related disaster management (BalmaIssaka *et al.*, 2015). Due to the escalating incidence of drought and irregular rainfall distribution, there are food security concerns (Vermeulen *et al.*, 2010). Due to the effects of climate change, the town of Nsawam in the Eastern region of Ghana has been experiencing decreasing rainfall patterns with increasing temperature (Williams *et al.*, 2017). This increasing temperature and its impacts on biodiversity and ecosystems have been reported as evidence of climate change in the Nsawam Adoagyiri Municipal's Medium-Term Development Plan (NAMA, 2018).

The increasing climate change risks in Ghana has brought up the need to consider alternative courses of action against famine and food insecurity, including the introduction of the weather-based crop index insurance to mitigate the risks farmers face (BalmaIssaka *et al.*, 2015).

Weather Index Insurance is a form of agricultural insurance package that covers specified crops against a threat such as low rainfall at a specific location. Weather index insurance has an advantage that in the occurrence of yield misfortune emanating from events outside the farmer's control such as drought, the insurance will cover the farmer against absolute income losses (CDS, 2010). The purpose of this study is to assess the willingness of maize farmers to pay for weather index insurance and the factors influencing a farmer's willingness to pay for weather index insurance.

1.3 Research Questions

Awareness is the first step in the process of adoption. Therefore, for a maize farmer to take up weather index insurance, she or he must first be aware of the facility. From the perspective of insurers and policymakers, understanding whether farmers are willing to pay for weather index insurance or not, and how much they are willing to pay is important for designing insurance products and for formulating risk mitigation policies and practices for farmers. How much, if any, farmers are willing to pay for weather index insurance will depend on several factors, and knowing which factors influence their decisions and which factors do not is important for both insurers and policymakers for the purpose of product and policy design. With the above in mind, the study seeks to answer the following questions:

1. What is the level of awareness of weather index insurance among maize farmers in the study area?
2. How much are maize farmers willing to pay as premium for weather index insurance?
3. What factors influence maize farmers' willingness to pay for weather index insurance?

1.4 Research Objectives

The main objective of this study was to assess maize farmers' willingness to pay for weather index insurance in Nsawam Adoagyiri Municipality. The specific objectives are:

1. To determine the level of awareness of weather index insurance among maize farmers.
2. To estimate the average amount farmers are willing to pay as premium for weather index insurance.

3. To examine the factors that influence willingness to pay for weather index insurance.

1.5 Justification of The Study

The negative impact of climate change on maize is expected to be high in the northern and central parts of Ghana (Murken and Gornott, 2019), hence maize yields are estimated to decline by 9% by 2080 as compared to the year 2000 (Rohrig and Lange, 2019). On this basis, this study seeks to assess the willingness of maize farmers to pay for weather index insurance, thus providing research findings that can be used in formulating risk mitigation policies and practices for maize farmers.

In 2011, weather index insurance was rolled out in the Northern regions of Ghana, and gradually introduced in the southern parts. It is relevant to assess the level of awareness of weather index insurance in the Nsawam Adoagyiri Municipality. This is to ascertain if enough effort has been made in promoting the insurance in the municipality.

Some studies have been conducted concerning the premium farmers are willing to pay for weather index insurance, but this study is of relevance due to the study area being considered, hence, this study will contribute to the body of knowledge of research on the topic.

It is expected that this study will inform stakeholders involved in the agricultural insurance sector as to the relevant determinants that will influence willingness to pay for weather index insurance among farmers in the Nsawam Adoagyiri Municipality. As such, this will inform the Ghana Agricultural Insurance Pool (GAIP) about the necessary determinants to consider when promoting their insurance product to maize farmers within the Municipality.

1.6 Organisation of the Study

Chapter two discusses the relevant literature. Chapter three discusses the methodology which includes the population and sampling methods, data collection, conceptual framework, empirical specification, and method of data analysis. Chapter four presents the results and discussion of the study, which incorporates socioeconomic characteristics of respondents, the awareness level of weather index insurance, the average amount farmers are willing to pay as premium, and the factors that influence willingness to pay for weather index insurance. The final chapter summarises the main findings of the study, draws conclusions and provides recommendations.

CHAPTER TWO

LITERATURE REVIEW

2.1 Concept of Agricultural Insurance

Insurance can be termed as a contract signed between two bodies where one of the bodies is called the insurer, who offers an exchange referred to as premium to be paid to the other body based on a fixed amount in the event of an unforeseen occurrence (Adams, 1995). Nimoh *et al.* (2011) further state that insurance provides an avenue for individuals to substitute risk with an established cost. Insurance is a medium to mitigate the financial risk of prevailing occurrences, for instance, death, medical costs, motor accidents, and weather hazards (Quagrainie, 2006). In Ghana, almost all the insurance companies offer a range of insurance schemes from auto insurance to that of life and health insurance, except for crop insurance (Aidoo *et al.*, 2014). Based on these definitions of insurance, agricultural insurance involves farmers paying a fixed amount (premium) to an insurance company that accepts to cover the farmer in the case of an unforeseen event such as yield loss and other damages agreed upon between the farmer and the insurance company. The World Bank (2007) defines agricultural insurance as insurance that applies to agricultural enterprises.

Insurance does not reduce the uncertainty of the farmer based upon whether the event would happen, neither does it change the likelihood of occurrence, but rather mitigates the likelihood of financial loss related to the event (Danso-Abbeam *et al.*, 2014). Agricultural insurance is widely employed in Europe, the United States of America and other continents but quite unknown in Africa (Goodwin, 2015). Though quite unpopular, through the aid of governments, Non-Governmental Organisations (NGOs) and commercial programmes, agricultural insurance has already reached close to 1,000,000 farmers in Africa (Greatrex *et al.*, 2015). There are two main broad categories of agricultural insurance, Index-Based Insurance products and Traditional Indemnity Insurance products. Both products have a role to play in agricultural risk management (Adiku *et al.*, 2017).

2.2 Index-Based Insurance

"The index is an easy-to-measure variable (e.g. temperature, wind speed, rainfall, sunshine, humidity, measured yield) that highly correlates with the loss or success of the particular crop being insured" (OppongMensah *et al*., 2017, p. 229). Skees et al. (2005) indicate that this type of insurance provides a possibly subsidised contract where farmers annually pay a premium and receive a payment that augments their income in the event of detrimental price and weather conditions. Smallholder farmers can use index insurance as a better management tool against climatic risk, as such, providing the agricultural sector with growth and investment (Greatrex *et al.*, 2015). The World Bank (2007) states that index insurance makes compensations not established on an evaluation of the policyholder's loss, but rather on measures of an index (such as rainfall) that is believed to represent the actual losses. It is believed that index insurance can give a major welfare gain to farmers as it can offer the role of alleviating credit constraints (Clarke, 2011). As of 2015, there were over ten million farmers worldwide insured by an index insurance package (Greatrex *et al.*, 2015).

The index insurance was designed to be applied in homogenous cases where there is a prevailing and measurable peril such as low rainfall or flooding (Adiku *et al.*, 2017). As such, should the index get to an agreed predetermined threshold, a pay-out is triggered. In the case of index insurance where the protection is against a weather variable of high realisation like excess rainfall, the limit is pegged above the threshold, as such, the indemnity increases as the realised value of the index nears the limit, but in the case of a weather variable of low realisation like drought, the limit is pegged at lower than the threshold (Barnett and Mahul, 2007). It is hypothesised that parties involved in this agreement must ensure that farm yield losses and the index are undeniably connected (Hess *et al.*, 2005).

The index-based insurance draws up agreements against a specified index that rely on agreed variables recorded at specific areas, rather than individualised agreements that compose against an assessed misfortune at the individual farm level (Molini *et al.*, 2010). Index-based Insurance depends on historical and up to date weather data for data analysis during product design and pricing (Okine, 2014). Each judgment depends on the index which is estimated by an individual organisation as a significant part of its exercises (Nunoo and Acheampong, 2014).

The index-based insurance has many merits such as a relatively less complicated insurance contract which results in a sales process that is simple (Barnett and Mahul, 2007). It mitigates moral hazard as a result of compensation independent or not reliant on single farm performance, as such, the farmer is motivated to get the best yield (Adiku *et al.*, 2017). Miranda and Farrin (2012) add that moral hazard is low since neither the insurer nor the insured can change the index from a third-party activity to suit their interest. It is also low cost as a result of agreements that are standardised and not individualised (Molini *et al.*, 2010). OppongMensah *et al*. (2017) also agrees with this advantage and further explains that premium rates for index insurance products are less expensive as a result of lower operational cost due to the omission of on-farm field loss assessment costs, hence, permitting it to be expanded to small-scale farmers (Adiku *et al.*, 2017).

Based on evidence collected from developing countries, there is the issue of farmers at the initial stages having difficulties comprehending index insurance (Dercon *et al.*, 2008). There is, in any case, the inconvenience of basis risk that happens in the case of a claim being activated even if the farm progresses admirably or the farm encounters misfortune that has not been accounted for by the index (Doherty and Richter, 2002). As such, pay-outs can occur even if there has been no misfortune, yet no pay-outs as a result of the index not accounting for it (Hellmuth et al., 2009). Hence, the achievement of index insurance can be adversely affected (Skees, 2008). In a study conducted by Patt *et al.* (2009), they found that the cost and timing of the premium were the main relevant factors to consider to make index insurance economically attractive to a farmer. There are two main index-based insurance packages, namely, weather index insurance and area yield index insurance.

2.2.1 Weather Index Insurance (WII)

The principles of weather index insurance were started by Harold Halcrow in 1948 and later advanced by Vinayak Dandekar in 1977. In 1999, Jerry Skees, Peter Hazell and Mario Miranda suggested these principles for developing countries and afterwards experimented with them in Morocco. Later on, Olivier Mahul offered a more official structure for weather index insurance in agriculture. With the use of data from historical temperature and rainfall, weather index insurance was utilised by Calum Turvey to discuss specific-event risks estimated at the local level and how rainfall and heat insurance could be priced in the application (Tadesse *et al.*, 2015). According to Mahul (2001, p. 594), “contrary to the standard crop insurance contracts, indemnity payments of weather insurance are based on the intensity of the weather index rather than on the effect on yield.” Weather index insurance mainly centres around protection against a solely named hazard like low rainfall at a predetermined location (Adiku *et al.,* 2017). Weather index is, for the most part, employed to cover farms utilising rainfall estimates derived from a weather station as the standard for deciding if a farm insured within a specified range around a specified weather station has encountered dry spell (OppongMensah *et al*., 2017). The index is gauged for individual crops and connected to several important stages of crop growth, as such, a farmer may get compensation in the occurrence of dry spells during germination, or poor rainfall during blooming (Adiku *et al.*, 2017).

Mexico and India are recorded to have the most advanced weather index insurance programmes among middle- and low-income nations, with the main focus on drought index insurance (Barnett and Mahul, 2007). In Ghana, weather index insurance focuses mainly on maize, soya, rice, sorghum and millet (OppongMensah *et al.*, 2017). Some authors indicate that one challenge facing weather index insurance is how to make it operational and appealing to policyholders and insurers, as such, the authors recommend "appropriate compensation of the policyholders in the event of loss, and affordability to the bulk of farm households in the risky environments" (Tadesse *et al.* 2015, p. 6).

The merit of weather index insurance is the activation of a claim being offered in the course of the season, for instance, in situations of an occurrence of a premature dry spell season, replanting is guaranteed (Adiku *et al.*, 2017). Another merit is that, in situations of the farmers experiencing poor rainy seasons, they still have the potential of paying back loans acquired from banks, which in turn results in lesser default risk faced by banks, hence leading to increased access to loans and creating the atmosphere for more farmers to be interested in embracing this insurance scheme (Gallenstein, 2017).

As discussed earlier, the demerit of using index-based insurance results in basis risk, which is encountered in weather index insurance as well. Clarke (2011) explains that basis risk is a key factor in the low demand by poor farmers for weather index insurance. Karthikeyan (2005) indicates the basis risk as being the contrast between the real risk encountered by farmers and the risk evaluated by the insurance scheme. Barnett and Mahul (2007) suggest that basis risk can be mitigated by providing weather index insurance to regions where weather variables like drought are the major cause of loss. Rosenzweig and Udry (2014) raise a concern about the issue of a missing market for forecast insurance even in the case of an ideal weather index insurance having been designed without basis risk.

It is mostly assumed that a demerit of the design of weather index insurance is its dependence on a sole weather station which represents a 20-25km radius of a location or region (Gommes and Gobel, 2013). Tadesse *et al.* (2015) further add that farmers under this radius are supposed to have similar farming systems and topography. In India, other problems of weather index insurance that were experienced included the absence of a verified and unbiased determinant of recent weather estimations, and the absence of dependable historical weather data for a given weather station in many parts of India. (Karthikeyan, 2005).

2.2.2 Area Yield Index Insurance (AYII)

The mean yield of a wide geographical location is utilised under the area yield index insurance as a limit to trigger compensation, allowing protection against multiple risks (Adiku *et al.*, 2017). "Area yield index insurance is a product which is most suited to those crop and hazard combinations where a peril, or series of more complex perils, simultaneously affects a crop in a particular region" (World Bank, 2007, p. 68). Turvey and Mclaurin (2012) indicate that this index is designed based on historical average yields and vegetation index for a specified area or region. Area yield index insurance depends on selected crop cuttings over every affected area, as such, it is mostly achievable with a mature yield reporting framework set up (Adiku *et al.*, 2017). Compensation is paid if the realised yield for the area is less than the insured yield despite the actual yield on a farmer's farm, as such, it requires historical area yield data for accurate estimation (World Bank, 2007). Area yield insurance can be compared to multi-peril insurance such that it insures all factors which may result in low yields, as such, instead of compensation being paid for a particular customer, it is paid as a result of the average yield over the region of consideration (Adiku *et al.*, 2017).

The major constraints linked to area yield insurance are that, there is insufficient data on area yield for all crops and locations, risks are established on geographical locations, the discrepancy of past data on an area yield, inadequate time-series data for a specified location concerning its area yield, and implementation challenges (Karthikeyan, 2005).

2.3 Traditional Indemnity Insurance

According to the World Bank (2007, p. 75), indemnity can be defined as "the amount payable by the insurer to the insured, either in the form of cash, repair, replacement, or reinstatement in the event of an insured loss." The traditional indemnity insurance offers claims factored on estimated damages, either for a single risk or for multiple risks that might affect a farm (Adiku *et al.*, 2017). Stutley (2010) indicates that misfortune or loss to the insured crops is estimated on the field immediately after an insurable peril has resulted in a loss. This form of insurance is mostly available to commercial farmers with large farm hectarage, years of production and sales data, and has been noted as the first crop insurance product provided in many countries (World Bank, 2007). In Ghana, it is provided to farmers who cultivate at least fifty (50) acres and it also insures both crops and poultry (Adiku *et al.*, 2017).

The traditional indemnity insurance is not suitable for small-scale farmers because of the number of farms that would need to be visited, as such, this insurance is dependent on the skills and availability of skilled loss adjusters (Adiku *et al.*, 2017). Farmers under this insurance are covered for the single hazard, the multi-hazard and aggregate loss of investment in situations where the farmer can offer a considerable amount of time series data on production and sales (Nunoo and Acheampong, 2014). "The basis for the indemnity is the loss incurred which is calculated as the amount of yield shortfall below the insured yield multiplied by the agreed value per unit of yield" (Adiku *et al.*, 2017, p. 39). Due to field evaluation expenses, this type of insurance makes it hard to provide them to smallholder farmers at an affordable premium rate (Nunoo and Acheampong, 2014).

Though the traditional indemnity insurance offers a higher final cost due to field evaluation expenses, it has an advantage over the index insurance such that it calculates the real farm losses which result in the farmer being compensated for the crop loss (Nunoo and Acheampong, 2014). Unfortunately, Miranda and Farrin (2012) indicate that this form of insurance likewise, opens up the issue of moral hazards, whereby farmers deliberately induce the elements which can stimulate crop failure and result in filing for insurance claims to the insurance companies. It is also exposed to a form of basis risk as a result of the difficulty to identify the difference between a loss from an exogenous factor and poor farm management (Adiku *et al.*, 2017). The premium rate for the traditional indemnity insurance is expensive as compared to the index insurance due to the cost incurred in field evaluation, resulting in a higher premium (OppongMensah *et al*., 2017).

2.4 Agricultural Insurance in Ghana

Agricultural insurance in Ghana was officially rolled out in 2011 to serve as a safety net for farmers who suffered from climatic perils (OppongMensah *et al*., 2017). In 2009, a few farmers purchased an agricultural insurance product called "Takayuya" which was developed by the Innovation for Poverty Action (IPA), in the Northern region of Ghana (IPA, 2010). By late 2009, the Innovative Insurance Products for the Adaptation to Climate Change programme (IIPACC) through collaboration between the German Society for International Cooperation (GIZ) and the National Insurance Commission (NIC), was launched to aid achieve sustainable crop and livestock insurance through private and public sectors in Ghana (Adiku *et al.*, 2017).

Together with IIPACC, the directive of the Ghana Agricultural Insurance Pool (GAIP), offered to farmers an agricultural insurance scheme that was advanced and met the demand to secure farmers of harsh weather conditions leading to crop damage (OppongMensah *et al*., 2017). In May 2011, the maiden weather index insurance was launched in the three Northern Regions of

Ghana and was approved on an experimental trial for maize (Zeney, 2011). Hence more than three thousand farmers in these three regions benefitted from three financial institutions and one research-based NGO as policyholders (Nunoo and Acheampong, 2014).

In 2012, weather index programme was expanded to the Ashanti, Brong Ahafo and Eastern Region to offer protection for soya and sorghum (Nunoo and Acheampong, 2014). In 2013, the multi-peril insurance was rolled out and later that year, GAIP became wholly supported and managed by Ghanaian partners (Adiku *et al.*, 2017). In 2015, poultry insurance was offered to commercial farmers by the Ghana Agricultural Insurance Pool (GAIP) and by 2016, offered insurance to over five thousand (5,000) farmers in a year (Adiku *et al.*, 2017). In 2016, through the Ghana Agricultural Sector Investment Programme, the Government of Ghana declared its continued assistance for crop insurance (Futokpor, 2016).

According to the National Insurance Commission (NIC) of Ghana in their 2015 published report "Landscape of microinsurance in Ghana", they stated that there were very minimal agricultural insurance products offered which served 490, 436, and 2,115 farmers in the years 2012, 2013, and 2014, respectively. They further indicated that agriculture cover (drought index) stands as the least type of insurance cover for the microinsurance sector in Ghana. In Ghana, the complex nature and inconvenient price structure of agricultural insurance products have been a problem for the microinsurance sector (NIC, 2015).

According to Karlan *et al.* (2014), farmers in Ghana benefit from increased average total farm revenue (net of insurance premiums and indemnity payments) from being covered under an insurance product. According to GIZ (2019), the premium rate for weather index insurance is 5% of the total production cost, that of the area yield index insurance is 6%, multi-peril crop insurance is 3-6% and poultry insurance is 3-5%.

Kwadzo *et al.* (2013) in their study found that the mean premium farmers in the Kintampo North Municipality of Ghana were willing to pay for a hypothetical farm income loss of GHC1000 was GHC24.43, while the minimum and maximum premia were GHC5.00 and GHC80.00 respectively. Danso-Abbeam *et al.* (2014) analysed the willingness to pay for cocoa price insurance and arrived at a conclusion that cocoa farmers in the Bibiani-Anhiawso-Bekwai district of Ghana were willing to pay between 9.3% and 10.5% of the option value they plan to receive as premium.

In Okoffo *et al.* (2016) research, cocoa farmers were willing to pay a mean premium of GHC49.32, a minimum and maximum premium of GHC32.10 and GHC128.40 respectively as crop insurance per production cost per acre. Aidoo *et al.* (2014) found that maize farmers in Sunyani municipality were willing to pay a premium minimum of GHC20.74, maximum of GHC31.26 and a mean of GHC24.12 per acre.

2.5 Challenges of Agricultural Insurance in Ghana

One main challenge of agricultural insurance in Ghana is the low level of awareness among farmers together with a negative perception of insurance (OppongMensah *et al*., 2017). According to Nimoh *et al.* (2011), a farmer’s perception about insurance policies results from the recurrent events of natural disasters, and Aidoo *et al.* (2014) confirm this when they attribute low-risk perception to be the cause of low participation among farmers in crop insurance. World Bank (2007) further states that rural farmers do not entirely comprehend agricultural insurance and as such, it is relevant that the various crop insurance products available on the market are easily comprehendible by farmers based on the merits and demerits of these products.

Another issue faced is the poor sale performance for weather index insurance product. According to OppongMensah *et al*. (2017), the poor sales and marketing performance of weather index insurance was a result of differences in the establishment nature of the GIZ, which is a non-profit making organisation, and that of the Ghana Agricultural Insurance Pool, which runs to make a profit. Some other challenges faced by the agricultural insurance sector in Ghana include the unsatisfactory methods of developing and rolling-out insurance products, the inadequate access to consistent and reliable data, and the delayed responses from state institutions" (Nunoo and Acheampong, 2014, p. 242).

2.6 Empirical Literature on the Determinants of Willingness to Pay for Agricultural Insurance

This section reviews the literature on willingness to pay for agricultural insurance.

Farm Size

Many authors have considered farm size as an important factor when examining willingness to pay for agricultural insurance. In some studies, the farm size is observed to have a positive association with the willingness to pay, hence, an increase in the farm size would result in an increase in the willingness to pay for agricultural insurance (Kwadzo *et al.*, 2013; Okoffo *et al.*, 2016; Nimoh *et al.*, 2011). In other studies, the farm size negatively influenced the premium farmers were willing to pay, hence, an increase in the farm size resulted in a decline in the premium farmers were willing to pay for agricultural insurance (Aidoo *et al.*, 2014).

Household Size

The household or family size of a farmer has been factored in some studies concerning willingness to pay for agricultural insurance. Some of the literature reviewed observed that the household size of the farmer had no significant influence on willingness to pay (Danso-Abbeam *et al.*, 2014; Aidoo *et al.*, 2014), but some other studies found that household size had a positive correlation with the willingness to pay (Kwadzo *et al.*, 2013; Okoffo *et al.*, 2016. Hence, farmers with larger household sizes were more willing to pay for agricultural insurance because, larger household sizes meant higher dependency on farm returns, as such, the farmer did everything possible to avoid farm loss.

Land Ownership

Researchers who considered land ownership as a factor of willingness to pay categorised it into two, either the farmer had self-ownership to the land or otherwise. As such, they wanted to know if the possibility of owning land could influence willingness to pay for agricultural insurance. Some results indicate that if a farmer owns the land, there was a higher probability of the farmer being willing to pay for agricultural insurance (Danso-Abbeam *et al.*, 2014; Nimoh *et al.*, 2011). Other results indicate a negative association, hence, a farmer who owned land had a less probability of being willing to pay for agricultural insurance (Kwadzo *et al.*, 2013; Aidoo *et al.*, 2014). This negative association has been attributed to the fact that farmers who own land can diversify into other crops and rely on them as a safety net even in the case of disaster, as compared to a farmer in share tenancy who is limited by some terms of agreement (Aidoo *et al.*, 2014).

Sex

Researchers have considered the relationship between the sex of respondents and the willingness to pay. Some studies focused on females due to their risk-averse nature (Porth *et al.*, 2015), as a result, three studies reviewed considered males and their influence on willingness to pay for agricultural insurance, but none of these three studies found it to be significant (Danso-Abbeam *et al.*, 2014; Aidoo *et al.*, 2014; Okoffo *et al.*, 2016).

Age

Researchers have been interested in finding out if the age of a farmer could influence willingness to pay for agricultural insurance. Okoffo *et al.* (2016) found age to have a positive correlation with the willingness to pay for agricultural insurance, while other studies found age to have a negative correlation with the willingness to pay (Teshome and Bogale 2015; Aidoo *et al.*, 2014). Aidoo *et al.* (2014) explain this as a result of older farmers having more experience in farming than the younger farmers, hence, older farmers are more risk lovers.

Educational level

It is necessary to evaluate if the educational level of farmers influences the willingness to pay for agricultural insurance. There has been some evidence of educated farmers having a higher probability of being willing to pay for agricultural insurance (Danso-Abbeam *et al.*, 2014; Aidoo *et al.*, 2014; Okoffo *et al.*, 2016; BalmaIssaka *et al.*, 2015). Hence, a farmer with a higher number of schooling years is expected to be more willing to pay, while another study found the educational level of farmers to have a negative association with the willingness to pay (Kwadzo *et al.*, 2013), hence, a farmer who was more educated was expected to be less willing to pay. The study attributes this to the theory of educated farmers perceiving themselves as better managers of risk (Kwadzo *et al.*, 2013).

On-Farm Income

For a farmer to be able to pay for agricultural insurance, his or her income must be a factor to consider, hence some studies have sort to evaluate the relationship between on-farm income and the willingness to pay for agricultural insurance. In some studies, the income derived from farming was observed to be not significant to influence willingness to pay (Kwadzo *et al.*, 2013; Nimoh *et al.*, 2011), while other studies found on-farm income to have a positive association with willingness to pay (Teshome and Bogale 2015; Danso-Abbeam *et al.*, 2014; Aidoo *et al.*, 2014)

After reviewing all these studies, it can be noticed that farm characteristics such as farm size and others are evident in almost all the factors the various authors considered. This confirms Sharma (2016) finding that indicates that farm characteristics influence crop insurance returns. Interestingly, some of these factors varied from each study dependent on whether they influenced willingness to pay negatively or positively. In some cases, the same factor exhibited a positive influence on willingness to pay in one study, and negatively influenced willingness to pay in another study, thereby indicating that one factor may differ concerning the willingness to pay based on the location.

2.7 Gaps Identified in Literature

Reviewing the literature on the broad study of agricultural insurance in Ghana, I could appreciate the efforts made by many authors to assess willingness to pay for an agricultural insurance product. The common recommendation given by most of these authors is for more research to be conducted on the topic as agricultural insurance is still new and unpopular to many Ghanaian farmers, especially to those in the southern part of Ghana since the pilot version of the programme was initiated in the Northern parts of Ghana. Through my review of literature, most of the gaps identified were concerning the methodology used and the study area. Per my knowledge, the study area of Nsawam Adoagyiri municipal has not been covered concerning the topic. Also, other authors used various means of determining the premium farmers were willing to pay, but with this study, the open contingent valuation approach which would not allow for further probing and would record the exact premium response as given by the farmers was employed. This was to prevent any influence by the interviewer to alter the response of farmers concerning the premium they are willing to pay.

CHAPTER THREE

PROFILE OF STUDY AREA AND METHODOLOGY

This section is made up of three sub-sections. The first sub-section contains a profile of the study area; the second sub-section includes the conceptual framework; and the third includes the methods of data collection and analysis.

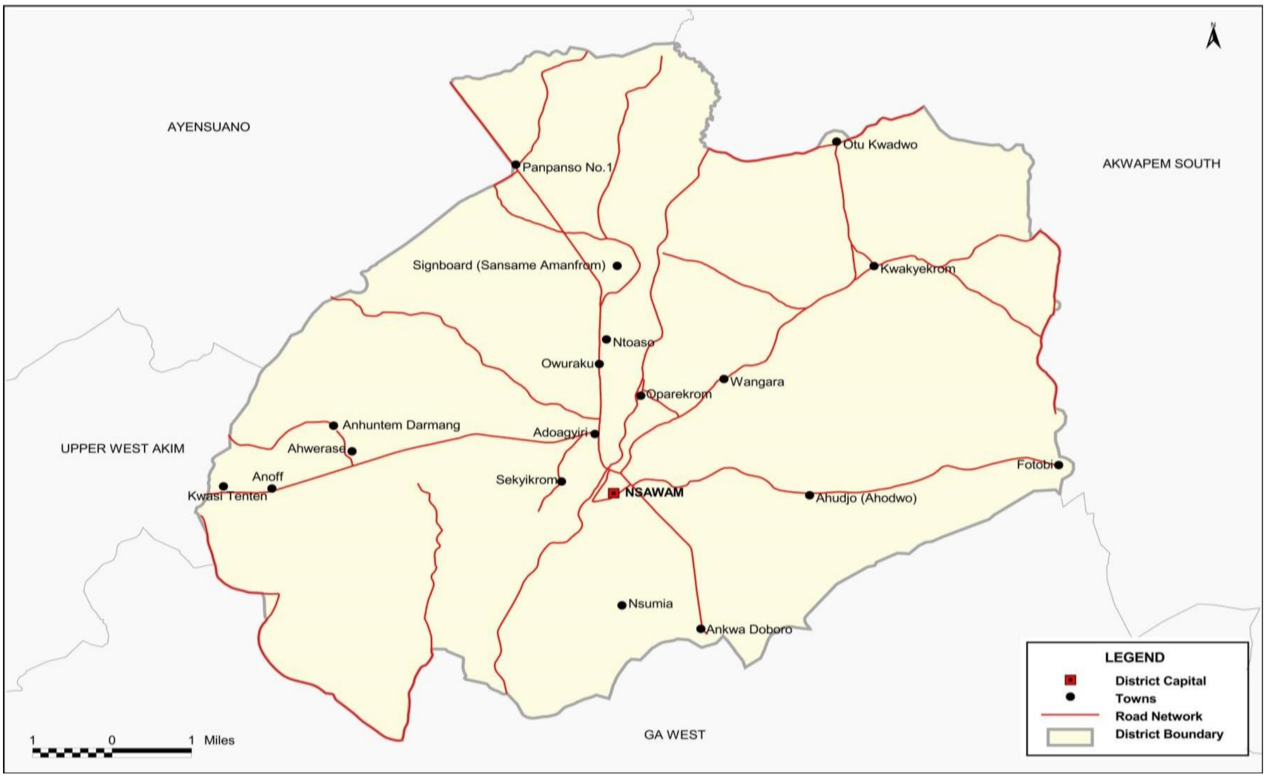
3.1 Geographical Description

The Nsawam Adoagyiri Municipal Assembly in the Eastern region of Ghana was formed from the then Akuapem South Municipal Assembly which was later split into two, by the Local Government Instrument, 2012 (L.I 2047).

3.1.1 Location

Nsawam Adoagyiri Municipality lies between longitude 0.07'W and 0.27'W and latitude 5.45'N and 5.58'N in the South-Eastern part of the Eastern Region. It can be located approximately 23km from the national capital, Accra, and covers a land area of about 175 square kilometres. The municipality shares borders to the South by the Ga West and Ga South Municipalities in the Greater Accra Region and to the North by Akwapim South District. It also shares boundaries in the North-West with Ayensuano District and the South West with the Upper West Akim District and has the town of Nsawam as its municipal capital. The Nsawam Adoagyiri has two (2) Zonal Councils, namely, the Nsawam Zonal Council and Adoagyiri Zonal Council (NAMA, 2018). Below is the map of the Nsawam Adoagyiri municipality.

Figure 3.1 Map of Nsawam Adoagyiri Municipality



Source: Ghana Statistical Service, 2014

3.1.2 Vegetation and Climate

The main ecological zones in the municipality are the Coastal Savanna Grassland and semi-deciduous forest. The forest cover is about 40% of the municipality, while the coastal savanna grassland covers 60% of the vegetation in the south and forms the transition zone between the coastal savanna and rain forest region. The Municipality lies within the wet semi-equatorial climatic zone which encounters a significant measure of rainfall. Annual rainfall is between 1250mm and 2000mm, attaining its maximum in the course of the two peak periods of May - June and September - October. As such, intensive farming activities are encouraged within these two periods. The relative humidity is about 50% in the dry season and 91% in the rainy season, while the temperature ranges from 24˚C and 30˚C (NAMA, 2018).

3.1.3 Soil Characteristics and Crops Cultivated

The principal soil in the moist semi-deciduous forest zone is forest ochrosols. However, the soil is modified by the location and relief pattern. The soil in the lowlands and valleys holds enough soil moisture and tend to be waterlogged near rivers. The soils are shallow, drier and often layered at higher altitudes and hillsides. There are five main types of soils in the municipality, namely, Adawso-Bawjiase-Ofin Compound Association, Ayensu-Chichiwere Association, the Fete and Nyanoa-Opimo Association, Yaya Pimpinsu-Befua Association and Dewasi Wayo Association. The main crops cultivated in the municipal include, pineapple, pawpaw, cassava, oil palm, okro, tomatoes, plantain, yam, onion, pepper, cabbage, garden eggs and maize being the most cultivated (NAMA, 2018).

3.2 Socio-Economic Description

3.2.1 Agriculture

Agriculture is the main economic activity in terms of employment and income generation in the municipality, accounting for about 37% of the working population (NAMA, 2018). The various types of farming systems in the municipality include crop production, livestock rearing and fish rearing. The predominant agricultural activity in the municipality is crop farming (94%), with about 80% of farmers practise mixed cropping, 9.3% practise mono-cropping and 2.7% practise mixed farming. The dominant crop cultivated by farmers practising mono-cropping is pineapple, pawpaw and orange fruit growers. The municipality accounts for about 60% of all pineapples and 30% of vegetables exported from the country (NAMA, 2018).

3.2.2 Population

With a population of 86,000, the Nsawam Adoagyiri Municipality comprises 43,267 (50.3%) females and 42,733 (49.7%) males (GSS, 2014). Urban population constitutes 50,864 (59.1%)

whilst rural is 35,136 (40.9%). The municipality is densely populated with a density of 491 persons per square kilometre. Population growth is estimated at 1.6% per annum, which is lower than that of the country at 2.7% but slightly higher than the regional population growth rate of 1.4% per annum. The workforce represents 57.4% of the total population of the municipality. The age dependency ratio for the municipality is 64.3% which is lower than the regional dependency ratio of 82% (NAMA, 2018).

3.2.3 Economic Activities

The economically active population (15-64 age group) form 66.5% of the population of the municipality. Agriculture employs 37% of the total labour force, followed by the commercial sector which employs 28% of the labour force. The sale of cloth, foodstuff, electrical gadgets and plasticware are some of the types of commercial activities undertaken in the municipality. The industrial and service sectors employ 20% and 15% respectively (NAMA, 2018).

3.3 Conceptual Framework

This study employs the Random Utility Theory, which is of the assumption that each individual is a rational decision-maker, maximising utility comparative to their choices (Cascetta, 2009). The random utility model assumes that researchers are unable to correctly observe a farmer's utility, hence, the unobservable characteristics are factored as the random error (Holmes *et al.*, 2017). The random utility model is expressed as:

$$V_{ik} = v_{ik}(Z_i,\ y_k - p_i) + \varepsilon_{ik} \qquad (1)$$

Where V_{ik}= the true but unobservable indirect utility associate with alternative *i*

Z_i = a vector of attributes associated with alternative *i*

y_k = income

p_i = the cost of alternative *i*

ε_{ik} = random error with zero mean

A farmer may decide to either purchase or not to purchase a specific innovation or technology, while not only factoring the means of maximising profit from that technology but on how to achieve the maximum level of utility (McConnell et al. 2009; Sadoulet et al. 1998). In this case, a farmer will be willing to pay for a technology if the marginal utility for purchase is bigger than that of non-purchase. Nchinda et al. (2010) further add that the utility the farmer obtains from purchasing any technology is not observable and is reliant on a series of observed extrinsic components. As such, Churchill (2006) explains that the expected utility from a farmer purchasing insurance will increase dependant on the net average cost to the farmer, the possibility and extent as to whether it protects him or her from losses and their level of risk unwillingness. For this study, this would assume that a farmer is a rational decision-maker and will be willing to pay for weather index insurance if considering that, he or she will attain the highest level of utility from purchasing weather index insurance as compared to not purchasing it.

3.4 Study Design

This research sort to evaluate the relationship between some identified factors by linking observations with mathematical expressions, thus the need for using the quantitative research method. This study used the quantitative research method of data collection involving the administration of structured survey questionnaires to farmers. Since the main population of interest is maize farmers, the survey questionnaires were administered to those involved in the cultivation of maize in the identified study area.

3.5 Study Population

The target population for this study included farmers in the Nsawam Adoagyiri Municipality. As discussed earlier in this chapter, there are many farming activities in the municipality including livestock farming, fish farming and crop farming, but for this study, it was narrowed to crop farmers and more specifically, maize farmers. This is because, from our literature review, it is evident that maize is the predominant crop covered under weather index insurance in Ghana and also worth noting that, maize is a major food crop cultivated in the municipality. As a result, this study was limited to only maize farmers in the municipality.

3.6 Sample Size and Sampling Method

From data provided by the Agriculture Department of the Nsawam Adoagyiri Municipal Assembly (NAMA), there are about 6,382 registered farmers cultivating maize in the municipality. Reaching all these maize farmers was difficult as some of them are located in very remote areas with poor road networks leading to them. Also, as a result of the limited timeframe, budgetary constraints and the active COVID-19 pandemic at the time of conducting this study, 100 maize farmers were sampled from the population purposively. As maize is a crop cultivated widely in the municipality, the researcher purposively sampled 10 communities from the municipality, as these were major maize cultivation areas. Table 3.1 shows the various communities that were sampled and the number of farmers surveyed in the corresponding communities. The number of farmers surveyed in one particular community was dependent on the availability and readiness of farmers to participate in the survey, hence, the basis for surveying more farmers from one community than another. For the desired sample to be achieved, this study utilised a non-probability sampling method known as snowball sampling. This means, upon arrival in the community, the researcher enquired of any known maize farmer. After the identified farmer was surveyed, the location of other maize farmers in the community was sought from a surveyed participant. This sampling method was iterated until all 100 maize farmers were surveyed.

Table 3.1 Sampled Community Distribution

Sampled Communities	**Farmers Surveyed**
Ahodwo	5
Akwane Doboro	19
Alafia	10
Asiawkrom	11
Fotobi	15
Mensaman	10
Okobeyeyie	6
Otu-Kwadwo	13
Pepraw	7
Yawdjan	4
Total	100

3.7 Data Collection Method

Primary data was collected by the use of a structured questionnaire consisting of both open and closed-ended questions. Data was collected based on some socio-economic characteristics, farmer and farm characteristics, and other relevant data needed for this study to answer the various research questions. Respondents' confidentiality was highly respected and ensured during the survey, as such, the identities of respondents like their names were not used in the collection and analysis.

3.8 Data Management and Analysis

Data entry and analysis were done with the use of the Stata statistical software. Descriptive statistics were used to present the findings. To achieve the first objective of determining the awareness level of farmers concerning weather index insurance, descriptive statistics were used.

The second objective on the amount farmers are willing to pay for weather index insurance was achieved through the use of the contingent valuation. There are various techniques of the contingent valuation, but for this study, the open approach was used where the farmer is directly asked outright, how much he or she was willing to pay without probing on the part of the interviewer. The premium was measured annually per acre as farmers earn income annually or per season. The findings were presented with the use of t-test, mean, minimum and maximum.

The final objective involving factors influencing willingness to pay for weather index insurance was achieved using OLS and Tobit regression models. This is because willingness to pay for index insurance, which is the dependant variable, can be continuous or censored. That is, if all farmers are willing to pay a nonzero amount for weather index insurance, then we will have a continuous dependent variable. On the other hand, it is possible that a significant proportion of farmers will not be willing to pay any amount for index insurance while others may be willing to pay a positive amount, in which case we have a dependent variable that is censored at zero. Where there is a substantial number of zeros, the Tobit model is the right estimator. The probit and logit regression models would be unsuitable because the dependent variable is continuous in nature and happens to be more skewed towards one side of the distribution, whereas, the probit and logit models deal with a normal distribution. Also, the small sample size of this study would make using a logit model unsuitable.

The OLS model is expressed as:

$$WII_i = \beta_i X_i + \mu_i \tag{2}$$

Where WII_i is the amount (in Ghanaian cedi) that farmers are willing to pay for weather index insurance, β_i is the coefficient to be estimated, X_i is a vector of explanatory variables or factors that could influence willingness to pay for weather index insurance and μ_i is the error term.

The Tobit model is expressed as:

$$WII^* = \beta_0 + X\beta + u,\ u|X \sim \text{Normal } (0, \sigma^2) \quad WII = \max (0, WII^*), \tag{3}$$

where WII^* is the latent or censored amount (in Ghanaian cedi) that farmers are willing to pay for weather index insurance, β_0 is the coefficient, X is a vector of explanatory variables or factors that could influence willingness to pay for weather index insurance and u is the error term.

The OLS and Tobit models are empirically specified as:

$$Y_i = \beta_0 + \beta_1(AGE) + \beta_2(SEX) + \beta_3(EDUC) + \beta_4(HSIZE) + \beta_5(ONFARM) + \beta_6(AWARE) + \beta_7(SEC) + \beta_8(MFARMSIZE) + \beta_9(PROD\_RISK) + \mu_i \tag{4}$$

Where

Y_i = premium maize farmer is willing to pay for weather index insurance (GH₵).

AGE = age of respondent in years.

SEX = sex (1 if male, 0 otherwise).

$EDUC$ = number of schooling years.

$HSIZE$ = number of household members.

ON_FARM = annual income from farming (GHC).

$AWARE$ = awareness of weather index insurance (1 if aware, 0 otherwise).

SEC = secondary occupation of the farmer (1 if engaged in other occupations, 0 otherwise).

$MFARMSIZE$ = size of maize farm (acres).

$PROD\_RISK$ = risk perception (1 if considers production risk important, 0 otherwise).

μ_i = error term.

β_0 is the constant term and $\beta_1,\ldots,\beta_9$ denote the coefficients of the explanatory variables.

Statement of Hypothesis

The study formulates the following null (H_0) and alternate (H_a) hypotheses based on equation (4) and the related literature:

1. H_0: No significant relationship between age and the dependent variable, versus

   H_a: A negative relationship between age and the dependent variable.

2. H_0: No significant relationship between being a male and the dependent variable, versus

   H_a: A negative relationship between being a male and the dependent variable.

3. H_0: No significant relationship between schooling years and the dependent variable, versus

   H_a: A positive relationship between schooling years and the dependent variable.

4. H_0: No significant relationship between household size and the dependent variable, versus

   H_a: A negative relationship between household size and the dependent variable.

5. H_0: No significant relationship between annual income from farming and the dependent variable, versus

   H_a: A positive relationship between annual income from farming and the dependent variable.

6. H_0: No significant relationship between awareness and the dependent variable, versus

   H_a: A positive relationship between awareness and the dependent variable.

7. H_0: No significant relationship between secondary occupation and the dependent variable, versus

   H_a: A negative relationship between secondary occupation and the dependent variable.

8. H_0: No significant relationship between maize farm size and the dependent variable, versus

   H_a: A positive relationship between maize farm size and the dependent variable.

9. H_0: No significant relationship between risk perception and the dependent variable, versus

   H_a: A positive relationship between risk perception and the dependent variable.

CHAPTER FOUR

RESULTS AND DISCUSSION

This chapter provides the results generated from the analysis of field data collected using the survey questionnaire. The results discussed in this chapter sought to answer all the research questions stated in the first chapter.

4.1 Socio-economic and Demographic Characteristics of the Respondents

A total of 100 male and female maize farmers were surveyed from 10 communities in the Nsawam Adoagyiri Municipality. However, the males dominated the sample with 74% out of the total number. Based on Lambrecht *et al.* (2018) study, gender-related inequalities in crop production are more prominent in forest and savanna agro-ecological zones as compared to the coastal zones, hence, the findings here are disaggregated by sex. Table 4.1 presents selected demographics and farm characteristics of the sampled respondents by sex of farmers.

The overall mean age of the respondents was 49 years, with females having a mean age of 50 years compared with 49 years for males. There was no statistically significant difference between their ages (*p*-value = 0.712). The mean household size of the respondents was 5, with no statistically significant difference between the sexes.

Concerning the number of years of schooling, 8 years was the average. Female respondents had 4 years of average schooling, as compared to males who attained an average of 9 years of schooling. This difference is statistically significant at the 1% level (*p*-value = 0.000).

The mean total farm size for the sampled respondents was 5 acres, with males having a mean of 6 acres and females recording a mean of 3 acres, this difference is statistically significant at the 1% level (*p*-value = 0.005). Concerning the total annual income of the respondents, there was no statistically significant difference between the two sexes, but focusing on only the income derived from farming, it is evident that males have a higher farm income compared with females, and the difference is statistically significant at the 1% level (*p*-value = 0.003). Table 4.1 also shows that though male farmers got more than two times the output that female farmers obtained, the difference is not statistically significant (p-value = 0.123), which could be due to the small sample size.

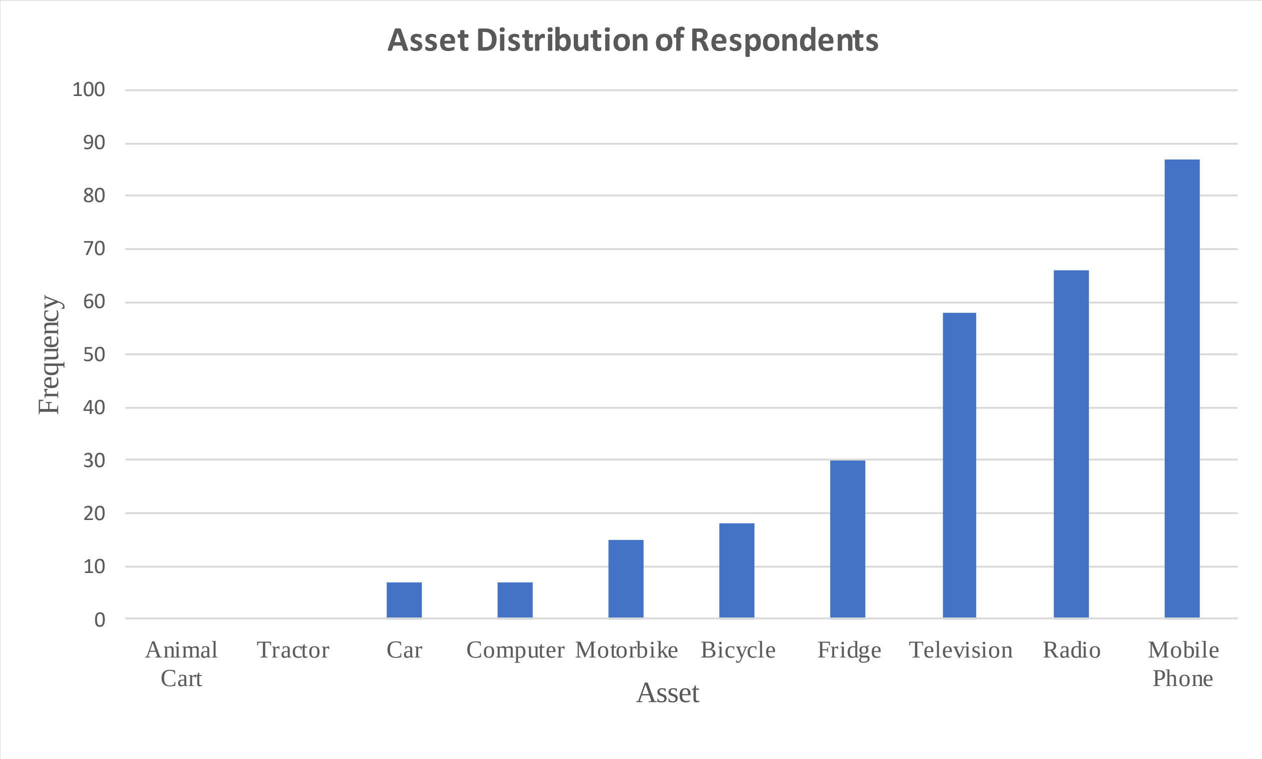
Table 4.1 Demographic and Farm Characteristics of Respondents

	Overall	**Male**	**Female**	***t*-stat**	***p*-value**
Age (years)	49.21	48.96	49.92	0.37	0.712
Household size	5.07	5.03	5.19	0.28	0.777
Years of schooling	8.07	9.49	4.04	5.93	0.000
Total farm size (Acres)	5.05	5.74	3.09	2.86	0.005
Total annual income	9817.50	10629.05	7507.69	1.51	0.134
Annual farm income	6199.50	7050.68	3776.92	3.04	0.003
Maize output (kg)	684.00	805.74	337.50	1.56	0.123

Source: Field Survey, 2020

Respondents were presented with a list of ten assets for them to indicate which of the assets they owned. These ten assets were selected based on the asset indicator used to measure the standard of living of a person under the Multidimensional Poverty Index. Out of the 100 respondents, 99 respondents willingly answered this aspect, except for one respondent who politely opted out to give details on the assets owned. Figure 4.1 illustrates the distribution of assets owned by the surveyed respondents. From the graph, it is evident that the mobile phone is the most commonly owned asset by the respondents (about 87% of the sample). Radio, television, fridge, bicycle, motorbike, car or truck and computer followed with 66, 58, 30, 18, 15, 7 and 7 respondents owning these assets respectively. The animal cart and tractor were not owned by any of the respondents.

Figure 4.1 Asset Distribution of Respondents



Source: Field Survey, 2020

Table 4.2 shows an asset index for respondents. The asset index was constructed using the principal component analysis to estimate asset weights, which are used as a representation of economic status (Filmer and Pritchett, 2001). The result from the asset index indicates that the difference in economic status among males and females was statistically significant at the 10% level.

Table 4.2 Asset Index for Respondents

	Overall	**Male**	**Female**	***t*-stat**	***p*-value**
Asset Index	0.34	0.36	0.28	1.68	0.096

Source: Field Survey, 2020

Knowing the occupational status of the respondents could help determine the importance of agriculture in their portfolio of activities, which could play a role in their attitude towards weather index insurance. For example, one would expect part-time farmers to be less worried about the risk of crop failure because they have other resources to fall upon in the event of crop failure. The results show that 73 out of the 100 respondents had farming as their main occupation. The others were involved in professional or technical, administrative or managerial, clerical, sales, service, and production and related work as their main occupation, but the majority (15 out of the 27 respondents) were involved in sales or trade as their main occupation. Of the 73 respondents who had farming as their main occupation, only 29 of them had a secondary occupation, mostly (12 out of the 29) in the services sector. This means that farming is critical for the majority of farmers in our sample.

4.2 Risk Nature of Respondents

The survey results show that all the respondents were practising mixed cropping, which involves cultivating more than one crop on the same piece of land. This is consistent with the report of the Medium-Term Development Plan of the Nsawam Adoagyiri Municipal Assembly, which indicates that about 80% of farmers in the municipality engage in mixed cropping (NAMA, 2018). Mixed cropping, which is essentially crop diversification, can be considered as an adaptation strategy against total crop failure. Maize farmers are prone to risk factors that affect them during production and marketing. There could also be institutional (decisions of state institution) factors that expose farmers to production and marketing risks. It was essential to understand which of these risk factors farmers considered as important.

Table 4.3 presents the risk which respondents indicated to be important concerning their agricultural activities. The results show that marketing risk (44% of the respondents) was considered the most critical, followed by production risk (39% of respondents), and then institutional risk factors (17% of respondents). This explains that the majority of farmers supposed marketing-related risk to have the highest probability of causing much loss to their agricultural activities. Disaggregating by sex, however, we find that female farmers considered production risk to be more important than marketing risks, while male farmers considered marketing risks to be more important. From the table, though there is no significant relationship between risk and sex, it seems, as the literature suggests, that females are more averse to production risks.

Table 4.3 Distribution of Risk Importance of Respondents

Risk	Female	Male	Total
Production Risk	11 (42%)	28 (38%)	39
Marketing Risk	8 (31%)	36 (49%)	44
Institutional Risk	7 (27%)	10 (14%)	17
Total	26	74	100

Pearson chi2(2) = 3.532 Pr = 0.171

Source: Field Survey, 2020

4.2.1 Farm Disasters

Narrowing down to the production-related risks that maize farmers faced, the study went further to seek the respondents' views on farm disasters they had encountered in the past. They were presented with the following: bad weather, low yields, bush fires and pest and disease attacks. From the survey, 99% of the respondents indicated that they experienced bad weather and also pest and disease attacks, while 5% had faced low yields and 9% had also encountered bush fires. From this, the respondents were made to choose which of these disasters they found to be the most prevalent. Pest and disease attacks and bad weather were the most frequent disasters encountered by 50% and 49% of the respondents, respectively; only one farmer indicated that bush fires were the most encountered. With bad weather being one of the most prevalent farm disasters, it is relevant for a mitigation measure such as weather index insurance to serve as a safety net for farmers during periods of dry spells.

4.2.2 Disaster Mitigation Practices

Based on the various disasters encountered by respondents, the study sought to know the various measures or practices that maize farmers in the Nsawam Adoagyiri Municipality were enforcing and Table 4.4 illustrates the distribution. I find that 47% of the maize farmers practised no disaster mitigation measures; 7% practised occasional irrigation to mitigate against bad weather. It is worth noting that crop farming in the municipality is heavily dependent on rainfall with very few farmers practising irrigation. I find that 44% of maize farmers applied pesticides to combat pest and disease attacks.

Table 4.4 Respondents' Distribution of Disaster Mitigation Measures

Mitigation Measure	Frequency	Percentage
None	47	47
Irrigation	7	7
Application of Pesticides	44	44
Application of Fertiliser	1	1
Creation of Fire Belts	1	1

Source: Field Survey, 2020

It is also worth noting here that, the Department of Agriculture in the municipality offers some free pesticides or at a subsidised cost to the farmers in the municipality to control pest and disease attacks. Only one farmer indicated that he used chemical fertiliser to mitigate against low yields. Similarly, only one farmer engaged in the creation of fire belts to prevent bush fires from destroying their crops.

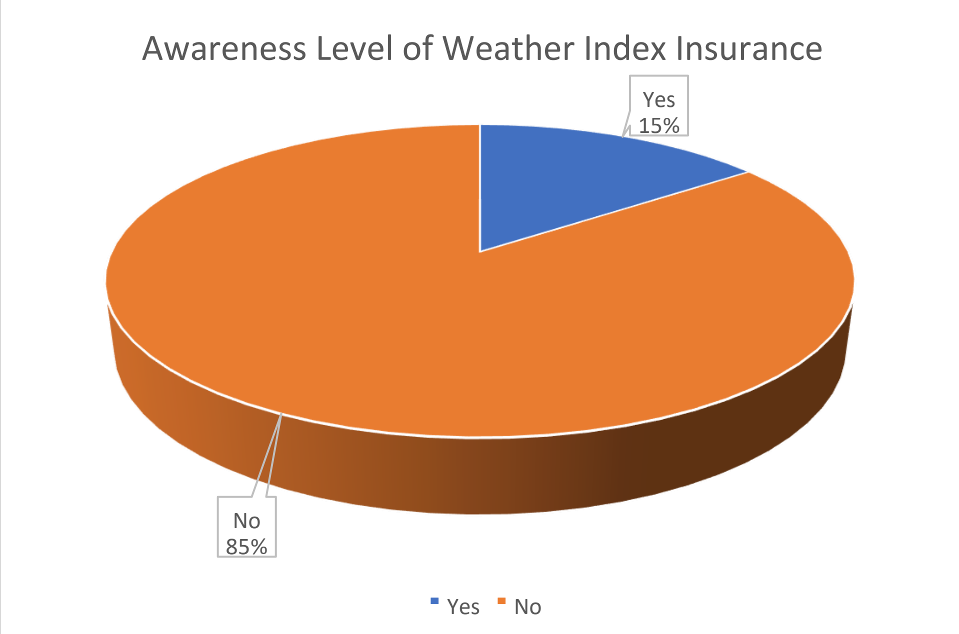
4.3 Awareness of Agricultural Insurance

The first objective of this study was to determine the awareness level of weather index insurance in the sample. First of all, the farmers were asked if they were aware of any form of insurance that covers farms against disasters, and if they responded in the affirmative, they were asked to list those they were aware of before proceeding to ask of their awareness of weather index insurance in particular. I find that only 29 out of the 100 respondents were aware of any insurance packages that cover farms against disasters. The insurance packages they indicated included, drought or weather index insurance, area yield index insurance, fire insurance, pest invasion insurance and transit damages insurance.

4.3.1 Awareness Level of Weather Index Insurance

The awareness level of weather index insurance is shown in figure 4.2. Out of the 100 respondents surveyed in the Nsawam Adoagyiri Municipality, 15 respondents comprising of 14 males and 1 female indicated that they were aware of weather index insurance. None of the 15 respondents was utilising weather index insurance. The majority of the 15 respondents had the media and farmer-based organisations as their source of awareness. Table 4.5 presents the distribution of their source of awareness of weather index insurance.

Figure 4.2 Awareness Level of Weather Index Insurance



Source: Field Survey, 2020

Table 4.5 Source of Awareness of Weather Index Insurance

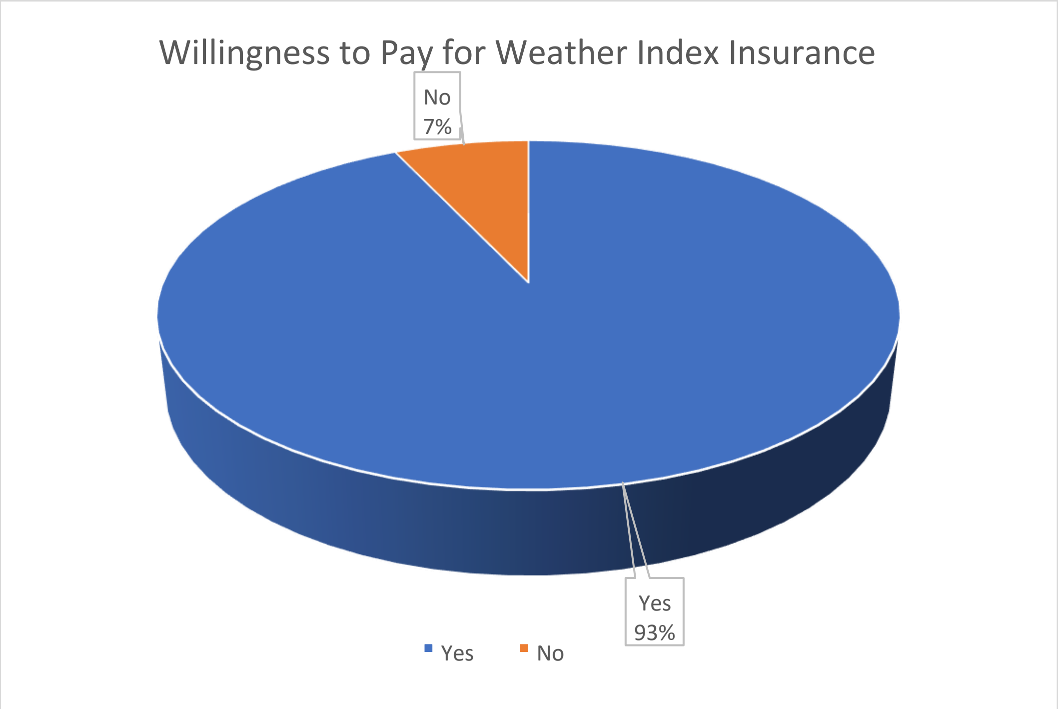
Source of Awareness	Frequency	Percentage
Insurance company	1	6.67
Farmer based organisation	5	33.33
Media	6	40.00
Colleague farmer who was only aware	2	13.33
Colleague farmer who uses the insurance	1	6.67

Source: Field Survey, 2020

4.4 Willingness to Pay for Weather Index Insurance

The second objective of this study was to estimate the average premium farmers were willing to pay as premium for weather index insurance. It was important to estimate respondents' willingness to pay for weather index insurance since it informs insurance companies during the design phase of an insurance product. Figure 4.3, shows that 93% of the respondents showed interest and were willing to pay for weather index insurance. The lack of trustworthiness of insurance companies was the reason behind 7% of respondents being unwilling to pay for weather index insurance.

Figure 4.3 Distribution for Willingness to Pay for Weather Index Insurance



Source: Field Survey, 2020

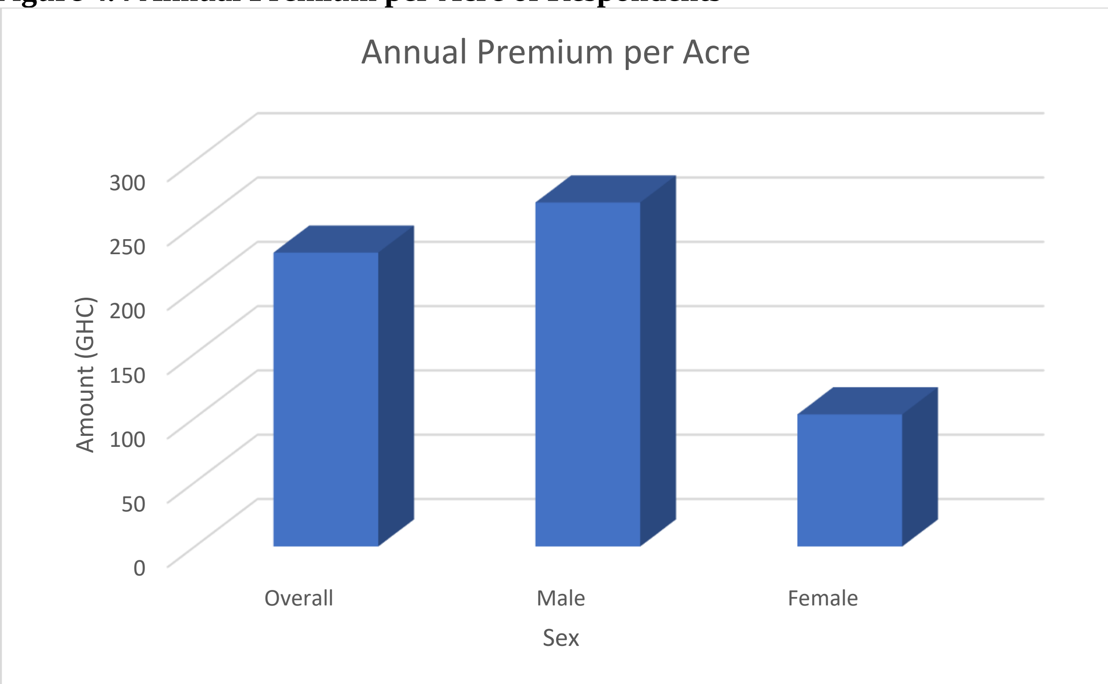
4.4.1 Amount Willing to Pay for Weather Index Insurance

The minimum amount maize farmers were willing to pay as a premium for weather index insurance annually in the sample is about GHC10 per acre and a maximum amount of GHC2000 per acre. Figure 4.4 shows that maize farmers in the sample were willing to pay a mean of GHC228.54 per acre annually as premium for weather index insurance. According to Munkaila (2015), maize farmers were estimated to pay GHC275.52 per acre annually. Per the results, it shows that farmers in the municipality are willing to pay GHC46.98 less than the original premium provided by the GAIP, even without adjusting for inflation. Perhaps increasing the level of awareness could increase how much farmers are willing to pay for the facility.

Disaggregating by sex of farmers, I find that males were willing to pay a mean of GHC267.52 per acre annually, while the females were willing to pay a mean of GHC102.73 per acre annually as premium. A *t*-test shows that the difference between the two groups is statistically significant at the 5% level (*p*-value = 0.022). Akter *et al.* (2016) suggest that female farmers do not fully comprehend the conditions of weather index insurance, and hence, the result of this study opens up the opportunity for further studies.

Respondents who were willing to pay for weather index insurance were offered the opportunity to choose their preferred payment plan and the results can be found in Table 4.6. The results show that quarterly and yearly plans were the most preferred by farmers in the sample, which could be expected given the seasonal nature of agricultural production. Disaggregating by sex of farmers in table 4.7, I find that most males preferred the quarterly payment plan while most females preferred either the monthly or yearly payment plans.

Figure 4.4 Annual Premium per Acre of Respondents



Source: Field Survey, 2020

Table 4.6 Payment Plan Distribution of Respondents

Payment Plan	Frequency	Percentage
Monthly	15	16.13
Quarterly	33	35.40
Half-yearly	15	16.13
Yearly	30	32.26

Source: Field Survey, 2020

Table 4.7 Payment Plan Distribution of Respondents Disaggregated by Sex

Payment Plan	Male	Female	Total
Monthly	8	7	15
Quarterly	28	5	33
Half-yearly	12	3	15
Yearly	23	7	30
Total	71	22	93

Source: Field Survey, 2020

4.5 Determinants of willingness to pay for weather index insurance

4.5.1 Summary Statistics of the Variables Examined in the Model

The summary statistics of the explanatory variables used in the model are presented in Table 4.8. It compares the means across terciles of the willingness to pay distribution. From the table, sex has a positive correlation with the willingness to pay and is statistically significant at the 5% level. The highest proportion of males are found in the highest tercile, indicating that males are willing to pay higher premiums for weather index insurance, on average. Awareness is positively correlated with the willingness to pay and is statistically significant at the 10% level. We see that a larger proportion of those aware can be found in the highest tercile, indicating that those aware of weather index insurance are willing to pay relatively higher premiums. The other variables were not statistically significant at conventional levels as presented in the table.

Table 4.8 Summary Statistics for Variables Included in the Model

		Willingness to Pay Terciles			
Independent Variable	**Overall Mean**	**Bottom Tercile (Mean = 57.1%)**	**Middle Tercile (Mean = 174.3%)**	**Highest Tercile (Mean = 556.9%)**	***p*-value of *F* or χ^2**
Age	49.2	49.1	48.2	50.4	0.801
Sex (1 = male)	74.0%	61.2%	84.6%	88.0%	0.016
Schooling years	8.1	7.2	8.3	9.5	0.146
Household size	5.1	5.2	5.0	4.8	0.738
On-farm income (GHC per year)	6199.5	5620.4	5967.3	7576.0	0.261
Awareness (1 = aware)	15.0%	12.2%	7.7%	28.0%	0.097
Secondary occupation	29.0%	32.7%	23.1%	28.0%	0.686
Maize farm size (acre)	2.2	2.2	2.3	2.1	0.945
Production risk	39.0%	36.7%	34.6%	48.0%	0.566

Source: Field survey, 2020

4.5.2 Empirical Results and Discussion

The Ordinary Least Squares (OLS) and Tobit regression models were used to estimate the factors influencing maize farmers' willingness to pay for weather index insurance. A heteroskedasticity test was conducted and confirmed the presence of heteroskedasticity in the OLS model, hence the standard errors were adjusted by computing heteroscedasticity consistent standard errors. The approach suggested by Davidson and MacKinnon (1993)[1] was used. The heteroscedasticity results can be found in appendix B. The results of the OLS

[1] Davidson and Mackinnon (1993) approach to adjusting for heteroscedasticity included the use of an alternative estimator that was believed to have superior properties in finite samples, hence the standard errors were adjusted by computing heteroscedasticity consistent standard errors.

regression model at level, log-level, log-log and level-log are presented in Table 4.9. The coefficients help us understand the nature and magnitude of the relationship between each explanatory variable and the willingness to pay for weather index insurance. As such, a negative coefficient tells us of a negative relationship with the willingness to pay for weather index insurance, while a positive coefficient indicates a positive relationship with the willingness to pay for weather index insurance.

The results of both models (Table 4.9 and Table 4.10) show that five variables (sex, farming income, secondary occupation, production risk and maize farm size) are statistically significant predictors of willingness to pay for weather index insurance. In both OLS and Tobit, the variable sex has a positive relationship with the dependent variable and is statistically significant at the 5% levels (*p*-value = 0.013) and 1% level (*p*-value = 0.005) respectively. This implies that in the OLS, male farmers are willing to pay about GHC143 more for weather index insurance than their female counterparts, while in the Tobit, male farmers are willing to pay about GHC138 more than females, holding all other variables constant. This is in contrast with the findings of Porth *et al.* (2015) that females were more willing to pay for weather index insurance because of the presumption that females are more risk-averse. In the case of Nsawam Adoagyiri Municipality, out of the 7 respondents who were unwilling to pay for weather index insurance, 4 of them were females who indicated their lack of trust in the insurance system.

Farm income in the OLS is positively correlated with the willingness to pay for weather insurance and is statistically significant at the 5% level (*p*-value = 0.019). Considering the Tobit, farm income is also positively correlated with willingness to pay for weather insurance and statistically significant at the 1% level (*p*-value = 0.000). Increasing farm income by GHC100 in both models is associated with an approximately GHC3 increase in the amount maize farmers are willing to pay for a weather index insurance, holding all other variables constant. The OLS log-log model suggests a farm income elasticity of about 0.52, meaning that increasing farm income by 1% is associated with about 0.5% increase in the amount a farmer is willing to pay for weather index insurance, on average. This is consistent with a study by Aidoo *et al.* (2014), where on-farm income significantly influenced maize farmers' willingness to pay for a crop insurance scheme.

In both models, there is a negative correlation between maize farmers in off-farm occupations and the willingness to pay. This is statistically significant at the 10% level (p-value = 0.079) for the OLS and at the 5% level (p-value = 0.026) for the Tobit. In the OLS, the premium farmers are willing to pay is estimated to be GHC92 lower for a farmer engaged in other occupations apart from farming, while in Tobit, the premium is estimated to be GHC93 lower for a farmer engaged in other occupations apart from farming, holding all other variables constant. This is consistent with Nimoh *et al.* (2011) study which also concluded that farmers who had off-farm occupations were less willing to accept farm insurance schemes.

Maize farm size has a negative relationship with the premium farmers are willing to pay for insurance and is statistically significant at the 5% level (p-value = 0.021). The Tobit results also indicate a negative relationship between maize farm size and the amount farmers are willing to pay, and this is statistically significant at the 1% (p-value = 0.000). In the OLS, the insurance premium farmers are willing to pay is estimated to decrease by GHC73 for an acre increase in maize farm size, while in the Tobit, the premium farmers are willing to pay is estimated to decrease by GHC58 for an acre increase in maize farm size, holding all other variables constant. The OLS log-log model suggests a maize farm size elasticity of about 0.56, meaning that increasing maize farm size by 1% is associated with about 0.6% decrease in the amount a farmer is willing to pay for weather index insurance, on average. This is an interesting finding as this corresponds to the characteristic of a weather index insurance package in Ghana to focus on smallholder maize farmers. Since the premium is paid based on per acre, farmers with larger farm sizes are most likely to pay a higher premium for their overall farm sizes as compared to farmers with smaller farm sizes. This negative relationship of maize farm size and willingness to pay is consistent with Aidoo *et al.* (2014) study.

Maize farmers who had experienced production failures are willing to pay higher premiums than those who did not face such events in the past; the difference in mean willingness to pay for insurance is statistically significant at the 10% level (p-value = 0.065) in the OLS model and at the 5% level in the Tobit model (p-value = 0.010). In the OLS model, the premium maize farmers are willing to pay is estimated to be GHC125 higher for a farmer who had experience in production failure, while the Tobit model estimates GHC98 higher, holding all other variables constant. The other independent variables in both models were not statistically significant at conventional levels (Table 4.9 and Table 4.10).

Table 4.9 Determinants of Willingness to Pay for WII (OLS Model)

VARIABLES	(1) Level	(2) Log-level	(3) Log-log	(4) Level-log
Age	3.079	-0.002		
	(2.727)	(0.016)		
Log Age			0.023	174.759
			(0.777)	(128.070)
Sex	142.966**	1.596***	1.476***	117.841**
	(56.434)	(0.494)	(0.479)	(55.378)
Schooling years	2.042	-0.023	-0.023	5.181
	(7.001)	(0.047)	(0.044)	(6.646)
Household size	7.610	0.021	-0.002	5.943
	(10.029)	(0.081)	(0.062)	(10.414)
On-farm income	3.753**	0.012**		
	(1.571)	(0.006)		
Log On-farm income			0.518**	140.824**
			(0.241)	(67.500)
Awareness	94.180	0.002	0.202	140.380
	(115.788)	(0.549)	(0.470)	(121.791)
Secondary occupation	-91.668*	-0.813*	-0.886*	-103.876*
	(51.525)	(0.475)	(0.450)	(55.272)
Maize farm size	-73.457**	-0.331**		
	(31.188)	(0.154)		
Log maize farm size			-0.563*	-129.910
			(0.296)	(79.050)
Production risk	124.456*	0.338	0.341	124.553
	(66.714)	(0.366)	(0.356)	(76.502)
Constant	-205.797	3.657***	1.938	-1,145.301
Observations	100	100	100	100
R-squared	0.313	0.258	0.218	0.261
F	1.853	2.844	3.092	1.813

Note: Standard errors in parentheses ***, **, and * represent statistical significance at the 1%, 5% and 10% levels, respectively.
Source: Field Survey, 2020

Table 4.10 Determinants of Willingness to Pay for WII (Tobit Model)

Variables	(1) Coefficient	(2) Average marginal effect
Age	2.536	1.878
	(2.409)	(1.784)
Sex	186.375**	138.063***
	(72.664)	(53.024)
Schooling years	1.462	1.083
	(7.465)	(5.531)
Household size	10.008	7.414
	(10.990)	(8.124)
On-farm income	3.785***	2.804***
	(1.014)	(0.740)
Awareness	81.726	60.541
	(77.100)	(57.061)
Secondary occupation	–125.560*	–93.012**
	(64.274)	(47.122)
Maize farm size	–78.719***	–58.314***
	(18.995)	(13.760)
Production risk	131.959**	97.752**
	(56.690)	(41.743)
Constant	–213.272	
	(149.633)	
Observations	100	
LR (9) χ^2	38.22	
p-value of χ^2	0.000	
Log-likelihood	–651.8	
Pseudo R2	0.0285	

Note: Standard errors in parentheses ***, **, and * represent statistical significance at the 1%, 5% and 10% levels, respectively.
Source: Field Survey, 2020

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATION

The main objective of this study was to assess the willingness of maize farmers to pay for weather index insurance in Nsawam Adoagyiri Municipality. A survey instrument was used to gather data from 100 maize farmers in the municipality. The study used descriptive statistics such as frequencies, mean, minimum, maximum, bar charts and pie charts to give a meaningful presentation of the data analysed. The two-sample t-test, chi-square, OLS and Tobit regression models were also included in the statistical analysis of the data. This chapter presents a summary of the findings of the study, conclusion and recommendations.

5.1 Summary of Key Findings

This study sought to achieve three objectives: to determine the level of awareness of weather index insurance among maize farmers; to estimate the average amount farmers are willing to pay as premium for weather index insurance; and to examine the factors that influence willingness to pay for weather index insurance.

Awareness Level of Weather Index Insurance

I first sort information about farmer's awareness of agricultural insurance before narrowing it down to awareness of weather index insurance in particular. The results show that 29% of the respondents were aware of agricultural insurance, ranging from products that covered against drought, fire, low yield, pest invasion and transit damages. However, only 15% of the respondents were aware of weather index insurance. The major source of awareness was the media and farmer-based organisations. Other sources of their awareness of weather index insurance included other farmers and an insurance company.

Amount Willing to Pay as Premium

Knowing if farmers are willing to pay for weather index insurance or not, and if willing, how much they are willing to pay is important for both policymakers and the insurance industry. I found that 93% of the respondents were willing to pay for weather index insurance. The mean premium was approximately GHC229 per acre annually. The minimum premium respondents were willing to pay annually was GHC9.93 per acre, while the maximum amount was about GHC2000 per acre. The majority of the respondents preferred a quarterly payment plan, which could be expected because of the seasonal nature of agricultural production. This suggests to insurance companies to consider a quarterly payment plan for farmers in the designing phase of insurance. The results further show that males were willing to pay a higher mean premium than females. Males were willing to pay an average annual premium of about GHC268 per acre, while females were willing to pay an annual mean premium of about GHC103 per acre, and this difference is statistically significant.

Factors Influencing Willingness to Pay

OLS and Tobit regression models were employed to determine which factors significantly influence a maize farmer's willingness to pay for weather index insurance in Nsawam Adoagyiri Municipality. The results for the OLS and Tobit regressions tell a similar story, and indicate that being male, on-farm income and previous crop failure experience are all positively associated with the premium maize farmers were willing to pay for weather index insurance. Conversely, farm size and having a secondary occupation are negatively correlated with the willingness to pay for weather index insurance.

5.2 Conclusion

Weather index insurance is a mitigation measure for bad weather faced by maize farmers in the Nsawam Adoagyiri Municipality. This study has shown that maize farmers in the municipality have a promising reception towards weather index insurance and are willing to pay for it to ensure that they have some form of safety net in times of crop failure as a result of dry spells of weather.

GAIP (personal communication, October 29, 2020) confirmed in an email that, maize farmers pay 5% of the total production cost as premium rate and this is consistent with GIZ (2019). Munkaila (2015) estimates the premium for maize farmers to be GHC22.96 per acre monthly. Hence in a year, a maize farmer will pay GHC275.52 per acre which is higher than what maize farmers in the study area are willing to pay (GHC228.54), even without adjusting for the time value of money. It is thus important for insurance companies to factor in relevant characteristics of farmers when designing and implementing weather index insurance in the municipality.

Although some literature suggests that females are more likely to be willing to pay for weather index insurance, this study found the opposite with males being willing to pay higher premiums for weather index insurance in the Nsawam Adoagyiri Municipality. This suggests insurance companies need to put in strategic measures to promote the concept and benefits of utilising weather index insurance, particularly to female farmers. Also, maize farmers with smaller farm sizes were more willing to pay than those with larger farm sizes. Farmers who had experienced production-related risks such as bad weather were expected to be more willing to pay for the insurance. Though there is a promising reception for the weather index insurance in the municipality, it is very important to put more effort into promoting its awareness in the municipality. This could raise the premium farmers will be willing to pay for the product.

5.3 Recommendations

It is necessary to increase the level of awareness of weather index insurance among maize farmers in the study area since most farmers were not aware of the product. From the results, it was shown that the majority of the farmers who were aware of the product heard about it from the media and farmer-based organisations, as such, the Ghana Agricultural Insurance Pool (GAIP) should put in more effort to utilise the farmer-based organisations or rely on agriculture extension officers to reach more of the farmers. Regular broadcasting for the need and benefits of being covered under weather index insurance should be encouraged, especially via radio stations since most of the farmers own a radio than television.

It is also important for weather index insurance to be designed to meet the preferred payment plan of the farmers, as such, the quarterly or yearly payment plan should be focused on since these were more preferred by the farmers as a result of their seasonal income-earning nature. Also, GAIP needs to consider the relatively low willingness to pay for weather index insurance when designing and implementing the facility in the municipality.

Lastly, from the results of this study, female farmers must be educated on the benefits of insurance, as this will promote trustworthiness for agricultural insurance. Further research can be conducted to identify reasons for female farmers ‘unwillingness to pay for weather index insurance. Farmers who have farming as their sole occupation should also be targeted as farmers with secondary occupations are less likely to be willing to pay for weather index insurance in the municipality.

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APPENDIX A: QUESTIONNAIRE

UNIVERSITY OF GHANA, LEGON
INSTITUTE OF STATISTICAL, SOCIAL AND ECONOMIC RESEARCH
MA IN DEVELOPMENT STUDIES DISSERTATION
QUESTIONNAIRE GUIDE FOR MAIZE FARMERS IN THE NSAWAM

ADOAGYIRI MUNICIPALITY

This questionnaire is designed to seek important primary data for the sole purpose of an academic study conducted on the topic "**MAIZE FARMERS' WILLINGNESS TO PAY FOR A WEATHER INDEX INSURANCE IN NSAWAM ADOAGYIRI MUNICIPALITY**." Your confidentiality is highly assured and your support and co-operation are very much appreciated.

Community……………………………………..

Date of administration ……………………........

A. Socio-demographic characteristics of respondents

1. Sex: 1. Male [ ] 2. Female [ ]

2. Please, what is your age (in years)? …………

3. What is your highest level of formal education attained? **(refer to code)** ……………

ITEM	CODE
None	0
Kindergarten	1
Primary	2
JSS/JHS	3
Middle	4
SSS/SHS	5
Secondary	6
Voc/Tech/Teacher/Agric	7
Nursing Training	8
Polytechnic	9
University(bachelors)	10
University (postgraduate)	11
Professional	12
Don't know	13

4. What is the highest grade completed at the educational level indicated in **Q3**? (**refer to code)**

………………..

ITEM	CODE		ITEM	CODE
None	00		S1	19

Pre-school	01		S2	20
P1	02		S3	21
P2	03		S4	22
P3	04		S5	23
P4	05		L6	24
P5	06		U6	25
P6	07		Year one	26
JSS1/JHS1	08		Year two	27
JSS2/JHS2	09		Year three	28
JSS3/JHS3	10		Year four	29
M1	11		Year five	30
M2	12		Year six and above	31
M3	13			
M4	14			
SSS1/SHS1	15			
SSS2/SHS2	16			
SSS3/SHS3	17			
SHS4	18			

5. Marital status: 1. Married [ ] 2. Single [ ] 3. Divorced [ ] 4. Widowed [ ]

6. How many people normally live and eat together in your household? ………………

7. Is farming your main occupation?

1. Yes [ ] 2. No [ ]

8. If No to **Q7**, kindly tick the main occupation:

1. Professional/Technical [ ] 2. Administrative/Managerial [ ] 3. Clerical. [ ] 4. Sales [ ]

5. Service [ ] 6. Production & related work [ ] 7. Workers NEC [ ] 8. Homemaker [ ]

9. Others (specify)……………………

9. If Yes to **Q7**, do you have any secondary occupation?

1. Yes [ ] 2. No [ ]

10. If Yes to **Q9**, kindly indicate tick the appropriate:

1. Professional/Technical [ ] 2. Administrative/Managerial [ ] 3. Clerical. [ ] 4. Sales [ ]

5. Service [ ] 6. Production & related work [ ] 7. Workers NEC [ ] 8. Homemaker [ ]

9. Others (specify)……………………

11. How long have you been into farming? ……………………………..

12. How long have you been into maize farming? ………………………………………….

13. What is your annual income from farming? ……………………………………………

14. What is your annual income from other activities? ……………………………………..

15. Please tick if you own any of these assets:

ASSETS	**YES**	**NO**
Television		
Radio		
Fridge		
Bicycle		
Mobile phone		
Motorbike		
Animal cart		
Car or Truck		
Computer		
Tractor		

B. Farm Characteristics

16. What is your main reason for farming?

1. For food [ ] 2. For income [ ] 3. Both food and income [ ]

17. If you ticked for "both food and income" in **Q16**, which is more important to you?

1. Food [ ] 2. Income [ ]

18. What type of land tenure system are you practising?

1. Family Ownership [ ] 2. Self-Ownership [ ] 3. Share Tenancy [ ] 4. Hiring [ ]

19. What is the size of your total cultivated area? ……………………………………..

20. What is the size of your maize farm (in acres)? …………………………………….

21. How many 50kg bags of maize do you produce per season? …………………………….

22. Apart from maize, do you cultivate any other crops?

1. Yes [ ] 2. No [ ]

23. If Yes to **Q22**, kindly tick the crops that apply:

1. Pineapple [ ] 2. Pawpaw [ ] 3. Cassava [ ] 4. Yam [ ] 5. Plantain [ ]

6. Cocoyam [ ] 7. Vegetables [ ] 8. Others (specify)……………………………………….

24. Please indicate the following risks that affect your agricultural activities **(tick as many)**:

1. Production related risk [ ] 2. Marketing related risk [ ] 3. Institutional related risk [ ]

25. Which of the above in **Q24** do you consider to be the riskiest or most risk adverse?

1. Production related risk [ ] 2. Marketing related risk [ ] 3. Institutional related risk [ ]

26. Kindly tick the following farm disasters you have experienced **(tick as many)**:

1. Bad weather [ ] 2. Low yields [ ] 3. Bush fires [ ] 4. Pest and disease attack [ ]

27. Which of these disasters is the most prevalent?

1. Bad weather [ ] 2. Low yields [ ] 3. Bush fires [ ] 4. Pest and disease attack [ ]

28. What practices do you enforce to reduce the impact of disasters on your maize farm?

…………………………………………………………………………………………………

…………………………………………………………………………………………………

29. Are you aware of any insurance product to cover your farm against disasters?

1. Yes [ ] 2. No [ ]

30. If Yes to **Q29**, kindly indicate the insurance products you are aware of

…………………………………………………………………………………………………

…………………………………………………………………………………………………

C. Weather/Drought Index Insurance

The Weather/Drought Index Insurance is a form of agricultural insurance package that covers specified crops against a threat such as low rainfall (drought) at a specific location.

31. Are you aware of the Weather/Drought Index Insurance product?

1. Yes [ ] 2. No [ ]

32. If Yes to **Q31**, kindly tick your source of awareness:

1. Insurance company [ ] 2. Farmer based organisation [ ] 3. NGOs [ ]

4. Media [ ] 5. Colleague farmer who was only aware [ ] 6. Colleague farmer who uses the insurance product [ ] 7. Others (specify)………………………………….

33. If Yes to **Q31**, are you covered under the Weather/Drought Index Insurance?

1. Yes [ ] 2. No [ ]

34. Are you willing to pay for a Weather/Drought Index Insurance for your maize farm?

1. Yes [ ] 2. No [ ]

35. If Yes to **Q34**, how much are you willing to pay as premium per acre? ……………………..

36. If Yes to **Q34**, tick your preferred payment plan:

1. Monthly [ ] 2. Quarterly [ ] 3. Half-yearly [ ] 4. Yearly [ ]

37. If Yes to **Q34**, is there anything that can negatively affect your willingness to pay for the weather/drought index insurance?

1. Yes [ ] 2. No [ ]

38. If Yes to **Q37**, what will it be?

………………………………………………………………………………………………

………………………………………………………………………………………………

39. If Yes to **Q34**, in this question you are presented with three (3) options and expected to **choose only one option** based on the attributes of your willingness to pay for a weather/drought index insurance. You also have the option of choosing none of these options provided. After reading through, please indicate which of these options you would prefer?

Attributes	**Option A**	**Option B**	**Option C**
Payment Plan	Monthly	Yearly	Monthly
Weather updates	No text messages on the weather forecast	Daily text messages on the weather forecast	Weekly text messages on the weather forecast
Monitory Farm visits	No farm visit	Monthly visit	Monthly visit
Contracted party	Individual farmer	Large group (100 farmers)	Small group (5 farmers)

Which option do you prefer?

1. Option A [ ]
2. Option B [ ]
3. Option C [ ]
4. None of the options above [ ]

APPENDIX B: REGRESSION RESULTS

DETERMINANTS OF WILLINGNESS TO PAY FOR A WEATHER INDEX INSURANCE (OLS MODEL)

Non-Adjusted Heteroskedasticity

Variables	(1) Level	(2) Log-level	(3) Log-log	(4) Level-log
Age	3.079	–0.002		
	(2.402)	(0.014)		
Log Age			0.023	174.759
			(0.656)	(116.174)
Sex	142.966**	1.596***	1.476***	117.841
	(71.281)	(0.407)	(0.429)	(75.888)
Schooling years	2.042	–0.023	–0.023	5.181
	(7.453)	(0.043)	(0.042)	(7.438)
Household size	7.610	0.021	–0.002	5.943
	(10.965)	(0.063)	(0.066)	(11.600)
On-farm income	3.753***	0.012**		
	(1.016)	(0.006)		
Log On-farm income			0.518*	140.824***
			(0.277)	(49.009)
Awareness	94.180	0.002	0.202	140.380*
	(77.126)	(0.440)	(0.440)	(77.840)
Secondary occupation	–91.668	–0.813**	–0.886**	–103.876
	(62.628)	(0.357)	(0.365)	(64.545)
Maize farm size	–73.457***	–0.331***		
	(18.916)	(0.108)		
Log maize farm size			–0.563**	–129.910**
			(0.281)	(49.663)
Production risk	124.456**	0.338	0.341	124.553**
	(56.073)	(0.320)	(0.333)	(58.938)
Constant	–205.797	3.657***	1.938	–1,145.301**
	(148.858)	(0.849)	(2.741)	(485.019)
Observations	100	100	100	100
R–squared	0.313	0.258	0.218	0.261
F	4.546	3.484	2.783	3.534
Heteroskedasticity test[a]	23.35	3.28	2.63	21.57
χ^2 stat (p-value)	(0.000)	(0.070)	(0.105)	(0.000)

Note: Standard errors in parentheses ***, **, and * represent statistical significance at the 1%, 5% and 10% levels, respectively.

a. Breusch-Pagan / Cook-Weisberg test for heteroskedasticity