



DETERMINANTS OF WEATHER INDEX-BASED INSURANCE ADOPTION AMONG GHANAIAN FARMERS: INSIGHTS FOR CLIMATE RISK MITIGATION AND SUSTAINABLE AGRICULTURE

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Article DOI: <https://doi.org/10.36713/epra19711>

DOI No: 10.36713/epra19711

ABSTRACT

In Sub-Saharan Africa, agricultural insurance products have been piloted to address the connected climatic risks that farmers confront. However, these products, in general, face low rates of adoption in Ghana. Specific determinants and opportunities of weather index-based insurance are evident in the existing literature. However, empirical studies on the effect of the variables in question seem to be lacking. The purpose of this study was to determine whether farmers in Ghana are willing to demand weather index-based insurance and what factors influence crop insurance participation and purchase. The factors under consideration included farmers' trust in financial institutions, farmers' perception of risk, and farmers' perceptions of policy interventions. This study utilized the theory of planned behavior (TPB) to explain the factors that influenced crop farmers' demand for weather index insurance. Based on the objectives of the research, the study adopted the quantitative research approach. In Ghana's Northern and Southern Savanna regions, a purposive sample technique was used to survey two hundred and three (203) farmers. The variables that affected the likelihood of farmers requesting weather index insurance were identified using Ordered Probit econometric models.

The empirical results from the crop farmers show that farmers' trust in financial institutions, farmers' perceived risk, and farmers' perception of public policy were significant predictors of weather index insurance demand.

The study found that farmers' trust in financial institutions and perceptions of public policy positively affected the probability of demanding weather index-based insurance. On the contrary, farmers' perceived risk negatively affected farmers' likelihood of demanding weather index insurance. The ordered probit regression analysis showed a significant difference between agroecological zone (p -value = 0.020, z = -2.31), maize crop (p -value = 0.022, z = -2.13), farming experience (p -value = 0.038, z = 1.92) and educational background (p -value = 0.042, z = 1.83) in farmer's willingness to demand weather index insurance.

The study finds that farmers with a high level of perceived risk are less likely to demand for weather index-based insurance. Also, farmers with a high level of trust are more likely to demand for weather index-based insurance. Finally, farmers who view policy interventions to be effective are more likely to demand extra weather index-based insurance.

The findings provide useful insight for government agencies and policymakers to review existing policies and introduce new ones that would encourage the participation of weather index insurance. Also, insurers can take a clue from the findings to draw up effective programs and workshops that would train farmers on better risk management strategies through the adoption of weather index insurance products. The study recommends the government improve the infrastructure and the quality of weather data. The study also suggests future studies to focus on farmers' saving and access to credit facilities on adopting weather index-based insurance.

KEYWORDS: *Weather Index-Based Insurance, Climate Risk Mitigation, Sustainable Agriculture, Farmer Perceptions, Trust in Financial Institutions*



CHAPTER ONE: INTRODUCTORY CHAPTER

1.1 Introduction

This chapter gives a general overview of the research. The chapter begins with a background to the study, followed by the research objectives, research questions, significance of the research, and the structure of the entire research.

1.2 Background of the Study

In most developing countries, income generated from agricultural products represents a major percentage of the country's Gross Domestic Product (GDP) (Akinwale, Adekunle, & Obagunwa, 2018). Agriculture, on the other hand, being one of the most important sectors of the economy, faces a variety of hazards in the production of commodities for the public. Random changes in weather, such as droughts and floods, are one of the primary risks that farmers confront. According to Singh and Agrawal (2020), increasing weather risk adds to agricultural product shortages, putting many people's livelihoods in danger. In response, governments and other stakeholders provide farmers affected by floods or droughts with emergency assistance to relieve them from the related negative effects. However, the disaster funds set to support the farmers in times of undesirable weather conditions may not be sustainable (Mare, Bahta, & Van Niekerk, 2018). Farmers have responded by attempting to use risk management techniques to limit the negative impact of weather conditions on farm products, rather than disaster relief, which is seen as an "ex-post" strategy (Javadinejad, Dara, & Jafary, 2020).

Over the past years, traditional risk management approaches such as diversification and supplementary irrigation fail to fully address farmers' production risks (Fuchs & Wolff, 2011). Besides, the problem of information asymmetry continues to prevail in traditional crop insurance (Gunnsteinsson, 2020). The limitations of traditional insurance instruments and practices have led to the birth of modern insurance schemes easily accessible to low-income and small-scale farmers. The introduction of index-based crop insurance addresses the challenges of traditional insurance instruments and provides specific opportunities for farmers to transfer climate risk when mitigation is impossible (Adiku, Debrah-Afanyede, Greatrex, Zougmore, & MacCarthy, 2017). According to Pietola, Myyrä, and Jauhiainen (2011), the existence of weather index-based insurance distributes fair information of future index values among the insured farmers and the insurers.

W. IFAD (2011) describes weather index-based agricultural insurance as a contingent claim contract in which a lump sum payment is made depending on the occurrence of a certain weather parameter that is strongly related to outputs, expenditure, or revenue. Also, weather index-based insurance is used in agriculture to control climate and weather risk, and it has proven as a viable substitute for traditional risk management methods (Osumba & Kaudia, 2015). For instance, weather index insurance occurs when an insurance holder (farmer) is paid an amount of money by an insurance firm on the condition that an agreed measured weather index is above or below a pre-determined threshold. Weather index insurance helps farmers to overcome credit constraints and potentially increase farm productivity (Adiku et al., 2017). The use of weather index insurance has increased farmers' understanding and appreciation of insurance packages to reduce losses in drought and adverse rainfalls. In Africa, certain countries like Kenya, Tanzania, and Rwanda have enrolled a larger number of poor smallholder farmers in the weather index insurance market (Ali, Egbendewe, Abdoulaye, & Sarpong, 2020). Studies on the contemporary use of weather index insurance continue to emerge in developing countries (Shirsath, Vyas, Aggarwal, & Rao, 2019).

1.3 Problem Statement

This study looks at one of the major production risks that appear to be common among vulnerable and disadvantaged agricultural producers: weather risk (Barnett & Mahul, 2007). The existence of weather index-based insurance provides specific opportunities for farmers to transfer climate risk when mitigation is impossible (Adiku et al., 2017). According to Marr, Winkel, van Asseldonk, Lensink, and Bulte (2016), farmers' output risk may impact demand for weather index-based insurance. Insurance participation rises when risk aversion rises, according to the rational demand hypothesis (Clarke, 2011). This means that the more risk-averse producers are, the higher the price they are ready to pay to mitigate risk. The ambiguous empirical link between risk aversion and the purchase of index-based insurance, on the other hand, requires additional research (Marr et al., 2016). Furthermore, the demand for index-based insurance is predicted to be low with a larger variety of risk mitigation strategies. According to Carter, De Janvry, Sadoulet, and Sarris (2014), farmers that bought rainfall index insurance boosted their agricultural investment by 13%. Also, Giné, Menand, Townsend, and Vickery (2010) argue that farmers might take index-based insurance provided current risk-sharing methods are insufficient. Farmers would also employ index-based insurance as a supplement to existing risk reduction measures in other situations (Barnett & Mahul, 2007). However, there has not been enough research on the impact of risk mitigation techniques on demand for weather index-based insurance (Singh & Agrawal, 2019). As a



result, the research focuses on the impact of farmers' risk aversion and risk mitigation techniques on weather index-based insurance demand.

Most of the research look at how farmers react to the demand for weather index-based insurance (Adjabui, Tozer, & Gray, 2019; Marr et al., 2016; Singh & Agrawal, 2020). Weather index-based insurance may appeal to and be demanded by farmers who have a greater grasp of how insurance works. Again, confidence in the financial organization offering insurance is a determinant in index-based insurance demand (Karlán, Osei, Osei-Akoto, & Udry, 2014). There is currently inadequate empirical data concerning farmers' trust in issuers of weather index-based insurance products (Marr et al., 2016)

In addition, Mcleman and Smit (2006) argue that policy interventions such as subsidies may be an incentive for farmers to embrace insurance packages and increase the ability of subscribers to cope with a high level of risk exposure. Yet, there has been little discussion of farmers' perspectives on the impact of governmental interventions on requests for weather index-based insurance (Mahul & Stutley, 2010). The present study looks at how farmers' views of policy interventions affect their decision to buy weather index-based insurance.

Researchers assert that the use of weather index-based insurance is considered to be an effective tool for farmers in developing countries (Cole, Bastian, Vyas, Wendel, & Stein, 2012). However, there is low patronage of the weather index insurance in most countries especially in Sub-Saharan Africa. Also, weather index-based insurance program is quite novel to the farmers in developing countries. Hence, further studies need to be undertaken to investigate the determinants of demand for index-based insurance in the Ghanaian context.

1.4 Research Purpose

The goal of this research is to examine the elements that impact crop producers' desire for weather index-based agricultural insurance in Ghana.

1.5 Research Questions

In line with the research purpose, this study answers the following research questions.

1. What is the impact of farmers' risk aversion and risk mitigation methods on crop insurance demand depending on weather indexes?
2. Does a farmer's faith in the financial organizations that provide insurance affect their decision to purchase weather index-based crop insurance?
3. What role do farmers' perceptions of policy interventions have in their decision to use index-based agricultural insurance?

1.6 Significance of the Study

The findings from this study will provide useful insights and make several contributions to academia, practice, and policy.

Academia has seen a rising interest in the study of weather index-based agricultural insurance. This interest has been generated because of the practical application and ability to enhance the understanding of how weather index insurance could be used as a robust strategy in farming systems. This research adds to the current body of knowledge by looking at the elements that may impact the demand for weather index insurance in developing countries.

The findings of this research will also give useful information to the government and other agricultural stakeholders. For instance, the current study explores the relationship between farmers' trust in insurance providers and demand for weather index insurance. The findings may inform insurance providers and the government on the behavior of farmers towards the selection of insurance packages. The results may give insight to governments, investors, and financial providers to finance agriculture in developing countries.

Again, the research findings will impact institutions in developing successful programmes and seminars to promote and teach farmers in improved risk management methods, which are critical to the uptake of weather-index-based insurance products.

Moreover, the current study can provide a new perspective for policymakers to review existing policies and introduce new ones to encourage the participation of weather index insurance programs. Policy interventions play a key role in



the successful implementation of weather index insurance projects. Therefore, the perceptions of farmers on policy interventions will give policymakers a better understanding and feedback of the existing policies towards agricultural insurance.

1.7 The Organization of the Study

The study is structured into five sections. The first chapter gives a synopsis of the study. It gives a brief background to the concept of weather index insurance and highlights the gap related to the research area. It is followed by the problem statement, objectives of the study, research questions and the significance of the study.

Chapter two reviews the literature on the determinants of weather index insurance adoption. The chapter discusses demographics, trust, risk strategies and policy interventions as factors influencing demand for weather index insurance. The theory appropriate for the study and the conceptual framework is also discussed in this chapter.

The third chapter discusses in detail the research methodology employed. These include the research design, target population, sampling method, instruments for data collection and the data analysis techniques.

Chapter four focuses on the data analysis; it also discusses and contextualizes the results with prior research. Finally, chapter five summarizes the findings and concludes the study. It also gives recommendations and suggestions for future research.

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

This chapter presents existing studies on weather index-based insurance and discusses the theoretical framework underpinning the research work. The chapter confers in detail the following themes: climate and weather risk assessment, the concept of weather index-based insurance, principles of weather index-based insurance, the market size of weather index-based insurance, weather index-based insurance in Ghana, opportunities of weather index-based insurance, advantages of weather index-based insurance, challenges of weather index-based insurance, weather index-based insurance application and benefits to micro, meso and macro levels of market size, theoretical review as well as conceptual framework and hypotheses development.

2.2 Climate and Weather Risk Assessment for Farm Planning

In agriculture, the threat of bad weather is all-pervasive (Ivana, Kristina, & Tomislav, 2016). The term "weather" refers to the day-to-day changes in the atmosphere. This covers, among other things, precipitation, temperature, humidity, and cloud cover (Coumou & Rahmstorf, 2012).

Diverse timeframes and major agricultural decisions are critical, especially when understanding how distinct climate and weather systems influence different farming decisions. Dayamba et al. (2018) argue that farmers must evaluate climate-related risks and seek extra information, such as technical and market data, as part of their agricultural strategy.

For example, according to an Australian agricultural survey, the decision system extends across the value chain in farm output, influenced by weather and climatic variability (Stone & Meinke, 2005). Interactions between the climate system's different components—the atmosphere, seas, biosphere, ice layer, land surface, and human action—can result in weather and climatic variability (Kurukulasuriya & Rosenthal, 2013). According to the United Nations Framework Convention on Climate Change (UNFCCC), climate change may be attributed to both human activities and natural factors. Human activities change the composition of the global atmosphere, either directly or indirectly. Extreme events and regional climatic anomalies are two types of climate disasters. Drought and excessive rainfall are two severe occurrences that impact agricultural productivity especially in Africa. Drought causes plants to die and soils to become exposed. Droughts of different lengths have already afflicted Ghana. 1970, 1975, 1977, and 1983/84 are the most recent occurrences. Droughts were widespread, resulting in lower export earnings and a high cost of hunger in the country.

2.2.1 Drought

Drought conceptual definitions provide a broad notion or concept of drought. Glossary of Meteorology (1959) defines drought as "a period of abnormally dry weather sufficiently prolonged for the lack of water to cause a serious hydrologic imbalance in the affected area" (Huschke, 1959). In the context of agricultural, Blain (2012) added to the definition and explained drought to be a protracted period of deficient precipitation resulting in extensive damage to crops and a consequential loss of yield. Drought is caused by a lack of water for basic needs, such as plant development



in agriculture. Drought differs from other natural disasters in that its consequences frequently take time to manifest and might last for years after the event has ended (Wilhite, 2000). Antwi-Agyei, Fraser, Dougill, Stringer, and Simelton (2012) view drought as an integral part of a natural climatic cycle even though extreme droughts can have disastrous consequences. Drought can limit both the quantity and quality of water available to productive fields, resulting in substantial direct and indirect economic implications for the agricultural industry. The severity of agricultural drought is determined by how a lack of rainfall and soil moisture affects plant development and, eventually, the health and welfare of rural populations. In 2012, for example, severe drought affected 80 percent of agricultural land in the United States, resulting in disaster declarations in more than two-thirds of the country's counties (Luther et al., 2017). Wheat, corn, and soybean were among the field crops that suffered losses.

Also, according to the findings of a study that used rainfall, yield, and socioeconomic data to map the vulnerability of crop production to Drought in Ghana, crop production to Drought in Ghana has discernible geographic and socioeconomic patterns, with the Northern, Upper West, and Upper East regions being the most vulnerable (Antwi-Agyei et al., 2012).

Droughts are generally creeping, slowly developing catastrophes that can be watched over time as they grow. Although some drought occurrences (such as flash drought) can emerge very rapidly, droughts are typically creeping, slowly emerging disasters that can be tracked over time as they develop (Schwartz, 2018). The monitoring indicators include changes in precipitation, temperature, and surface and groundwater supplies. Drought has a wide range of effects that are dependent on the socioeconomic context of the afflicted population. When choosing drought indicators for a specific drought monitoring and early warning system, it's critical first to identify the sorts of effects to which an area is prone. Early warning systems for Drought keep track of, assess, and exchange water supply, climate, and hydrology (Delfiyan, Yazdanpanah, Forouzani, & Yaghoubi, 2021). Considerations should ideally include both monitoring and forecasting components, to give information before and during drought onset, prompting measures that might mitigate possible impacts.

2.2.2 Flood

Flooding has become a global problem as a result of shifting climate patterns. The Commission for Environmental Cooperation (CEC), 2006 defines flood as “the covering of normally dry land by water that has escaped or been released from the normal confines of any lake or river, creek or other natural watercourses whether or not altered or modified or from any reservoir, canal or dam” (Barredo, 2007). Floods result from extreme meteorological phenomena such as prolonged rainfall and snowmelt (Ma, Chen, Zhang, Zheng, & Liu, 2007).

According to Ndamani and Watanabe (2015), excessive rainfall variability has a variety of effects on food crop productivity, including delayed planting and harvesting, limited root growth, and severe decreases in soil fertility. In Ghana, the Ministry of Environment, Science, Technology, and Innovation / Environmental Protection Agency (MESTI/EPA) discloses that the rate of change in observed rainfall in 2015 was found to be varied in a recent examination of the 20-year rainfall data from the 22 synoptic weather stations for the six agro-ecological zones. The rate of change in Ghana varies between 333 percent in the south (rainforest and coastal agro-ecological zones), 112 percent in the center (deciduous and transition zone), and 431 percent in the north (Guinea and Sudan savannah zones). The change in decadal rainfall was negative in the center, at -2.8 percent, but positive in the southern (13 percent) and northern parts (3.3 percent). Temperature and rainfall variations are more pronounced in the north than in the south. According to Group (2016), rainfall in the country is expected to drop by 2.9 percent in the near future, based on historical rainfall trends (1980-2010). This will be followed by a 1.1 percent increase in the mid-future (2060) and a 1.7 percent reduction in the far future (2080).

As a result, farmers are being pushed to improve their flexibility and management skills (Smit & Wandel, 2006). Farmers may be able to salvage their harvests with the aid of an early warning system. Occasionally, flash floods occur during harvesting. Farmers will have more time to harvest their crops if they receive the notice early. The improvement of emergency management systems is another area that may assist farmers in increasing their resilience. It is hugely beneficial to them in managing their agricultural goods during a crisis (Group, 2016).

One innovation is to provide farmers crop insurance based on weather indexes. This would offer a safety net for farmers in crop failure due to extreme weather conditions such as droughts or floods (Shirsath et al., 2019).



2.3 The Concept of Weather Index-based Insurance

Agricultural index-based insurance is termed an intangible commodity whose quality is often not directly ascertained by the consumer (Carter et al., 2014). Weather index-based insurance is a new type of index-based insurance that protects policyholders from weather-related disasters as it makes use of proxies like rainfall, temperature, wind speed, and relative evapotranspiration (Clement, Botzen, Brouwer, & Aerts, 2018). Insurance operates best where it forms part of an integrated approach to risk management, where constraints such as lack of access to finance, improved seed, inputs, and markets (Le Quesne et al., 2017). Johnson, Wandera, Jensen, and Banerjee (2019) describes index-based insurance as a "credence good", implying a good whose quality can at best be partially inferred after purchase; thus, quality is not ascertained before purchase.

V. H. Smith and Watts (2019) discoursed that the index-based aids in determining whether farmers have sustained losses as a result of the insured peril and, as a result, are entitled to compensation. The key aspect of weather index-based insurance is that the insurance contract is triggered by an objective parameter (such as rainfall or temperature measurements) at a specific weather station over a specified period. This indicator is designed to correlate as closely as feasible with the policyholder's crop losses. The contract's specifications are adjusted to correspond as closely as possible to the loss of any particular crop type sustained by the policyholder (D. S. IFAD, 2010).

All policyholders in a defined area receive compensation based on the same contract and measurement at the same station, obviating the requirement for in-field inspection.

Weather index-based insurance policies specify a threshold and a limit that determine the range of values over which indemnity payments will be made (J. R. Skees, 2008). For example, when a given measured weather index-based (precipitation) is above (flood) or below (Drought) a pre-defined threshold, financial institutions pay indemnity payments to farmers (Mahato & Saha, 2019). This payment is often equivalent to the percentage of rainfall index-based shortage multiplied by the selected coverage level. Again, insurance payment may be based on an average outcome measured over a small area, such as crop yield or livestock mortality, possibly observed through remote sensing techniques (De Leeuw et al., 2014). Index-based insurance, therefore, can be contacted at the individual, institutional, national, or regional level (Weber, Fecke, Moeller, & Musshoff, 2015).

2.4 Principles of Weather Index-Based-Based Insurance

Traditional crop or livestock insurance is based on a direct measurement of the farmer's loss or damage. Field loss assessment is usually prohibitively expensive or impossible, especially in areas with a significant number of small-scale farmers or where insurance markets are underdeveloped (Hazell et al., 2010). Similarly, Dick, Stoppa, Anderson, Coleman, and Rispoli (2011) confirm the cost nature of field loss assessments, especially amongst small-scale farmers in developing countries. The fundamentals of weather index-based insurance ensure that it is best suited to weather dangers that are well-correlated over a large area and where weather and agricultural produce are closely related.

A single crop, a defined rainy season, and no irrigation are typical of the strongest associations (List, Laszlo, & Coomes, 2020). Presently, most WII activities have concentrated on the threat of a rainfall shortfall (Drought). Likewise, the focus of WII is limited to agricultural output that has been affected by several or extensive causes of loss (Hazell et al., 2010).

Various components constitute the implementation of weather index-based-based insurance (Hazell et al., 2010). First of all, WII requires the naming of the reference station, which is a specific meteorological station. Also, a trigger weather measurement needs to be set (cumulative millimeters of rainfall), at which the contract starts to payout. Besides, a lump sum or an incremental payment is decided (D. S. IFAD, 2010). For example, a dollar amount per mm of rainfall above or below the trigger. Afterward, the limit of the measured parameter is set (cumulative rainfall) to control the maximum payment made to beneficiaries. The contract specifies the insurance duration and corresponds to the crop growth cycle; it is separated into phases (usually three), each with its trigger, increment, and limit (Carter et al., 2014).

2.5 Market Size of Weather Index-Based Insurance

The weather index-based insurance has a variable market size divided into three levels: micro, meso and macro (List et al., 2020). The segmentation influences the amount of intervention to manage the different sizes of the market and ensure the successful implementation of WII.



According to Mushai (2008), at the micro-level, insurance policyholders are farmers, households or small business owners buying insurance to protect themselves from potential weather-induced losses. Also, farmers' micro-level policies may be distributed by third parties, including financial service providers, farmers' associations, input suppliers, processors, or non-governmental organizations. The use of the intermediaries would expand the market reach to the target group and protect the social and commercial interests of the identified intermediaries.

For instance, Song, Yang, and Tao (2020) unveil that insurance services can help food security projects (FSPs), input suppliers, and other intermediaries minimize the risk of farmers defaulting. This may potentially unlock development opportunities for poor smallholders to obtain credit access or better inputs for farming (Castillo, Boucher, & Carter, 2016). Furthermore, during difficult times, the payout of WII provides some financial assistance to allow the farmer to resume production.

Companies may operate as policyholders at the meso level and FSPs Processors, Input suppliers Farmers' associations, and non-governmental organizations (NGOs). At this level, a policy provided to the organization can establish WII, but with payment criteria that could benefit farmers either directly or indirectly - for example, by reducing mass loan defaults in a microfinance institution (MFI) (J. R. Skees & Barnett, 2006). To cover their own risk, meso-level institutions purchase WII policy (for example, the portfolio of group insurance). They may establish payout criteria to help farmers directly or indirectly. WII provides access to a new customer base while also managing bulk defaults induced by weather events. Meso-level actors can create new supply chain linkages (examples include contract farming, credit packages, and inputs) to assist control risk and provide market opportunities.

Finally, index-based insurance can be marketed at the macro level to help governments and relief organizations with development and disaster assistance (Barnett & Mahul, 2007). It is also noteworthy to understand how any new WII initiative could be combined with the current policy on risk management and how these policies could impact WII incentives. Thus, following disasters, the government receives early cash, allowing the relief agency to continue operations (Chantararat, Mude, & Barrett, 2009).

2.6 Weather Index-based Insurance in Ghana

Ankrah, Kwapong, Eghan, Adarkwah, and Boateng-Gyambiby's (2021) findings predict rising population growth in Ghana, which calls for increased agricultural production. Similarly, most studies reveal that most rural inhabitants have their income sources tied to the success of agricultural production, which is undoubtedly highly susceptible to extreme weather conditions even if they are not directly involved in agricultural production (Carter et al., 2014; Marr et al., 2016). The study of Adzawla, Azumah, Anani, and Donkoh (2020) discloses that Ghana is very vulnerable to climate change. Besides, weather indices are based on rainfall, hail, wind and temperature, which are climatic data collected at meteorological stations (Zhang et al., 2011). According to the Innovative Insurance Products for the Adaptation to Climate Change (IIPACC) 2014, the average daily temperature is anticipated to rise three degrees Celsius, with rainfall falling between 9% and 27% depending on the region.

Governments in many countries, including Ghana, have stepped in with a range of interventions for farmers to help mitigate risk (Cooper et al., 2008; Hess, Richter, & Stoppa, 2002). These interventions include price stabilization, drought relief, and subsidized crop yield insurance, amongst others. The government's investments in agriculture have been channeled to most programs, especially the multiple-peril crop insurance, yet there is little evidence that these interventions positively affected agricultural production (Hess et al., 2002). However, In 2009, in collaboration with the Ghana Insurance Association, the German Development Corporation launched an "innovative demand-oriented and an economically sustainable agricultural insurance package to protect farmers, agro-processors, rural and financial institutions and input dealers among others" (Ghana Insurers Association, 2015). The insurance scheme's goal was to protect chain actors against the effects of inclement weather that resulted in crop failure. Rainfall reports are supplied directly to clients daily by the Ghana Meteorological Agency or a satellite provider every ten days (Ghann, 2020).

Currently, the weather index-based insurance applies to farmers within the five regions of the north and some parts of the southern belt (Ankrah et al., 2021). This confirms findings from Karlan et al. (2014) that the limiting factor to investment for maize farmers in Ghana is lack of access to insurance and not necessarily access to liquidity.

Since 2011, the Ghana Agricultural Insurance Pool (GAIP) has provided agricultural insurance to Ghana. GAIP created the country's first agricultural insurance products and currently serves as a risk management tool for the negative effects of climate change and other agrarian risks (Ankrah et al., 2021). A pool of 17 Ghanaian insurance



companies and 12 Ghanaian reinsurance businesses supplies the coverage (Mensah, Fialor, & Yeboah, 2017; Nunoo & Acheampong, 2014). Karlan et al. (2014) confirm that farmers who purchase rainfall index-based insurance increased their agricultural investment by 13%, leading to an increase in total income.

2.7 Opportunities of Weather Index-based Insurance

Jouanjean (2013) believes that the primary source of income for most businesses and families in developing countries is agri-business and agriculture. Nonetheless, agriculture and agri-businesses are intrinsically dependent on the vagaries of weather, such as the variation in rainfall. According to Dercon (2002), farmers in developing countries have constantly been exposed to weather risks and have made efforts to developed ways of reducing, mitigating or coping with these risks. These risks may take the form of excessive rainfall, which mostly leads to production risk and affects the farmers' ability to pay land rents, repay debt, and cater to essential living costs for their families (Hess et al., 2002). This has led to the demand for weather index-based insurance to help farmers to deal with weather risk.

Also, Arshad, Zaidi, and Mahmood (2015) study indicates that the joint family system in rural areas to a large extent positively influences the decision on purchasing insurance contracts. Moreover, due to credit access and other risk mitigation strategies amongst households, demand for insurance is high (Chantarat et al., 2009).

While health problems are often named the greatest risk facing many rural households, uninsured weather risks also contribute both directly and indirectly to chronic poverty (Barrett et al., 2007), hence the need for weather index-based insurance. To enhance the increase in demand for weather index-based insurance, governments must establish a suitable regulatory and legal framework. According to Ntukamazina et al. (2017), the courts in many lower-income countries poorly understand the concept of insurance, and this leads to insurance providers paying indemnities for losses that were not covered under the contract provisions. Contrariwise, insurance providers often refuse to pay claims to poor policyholders because they know that they cannot afford to have an attorney represent them in court (Randall, 2007). Hence, there is the need for a legal framework that addresses both proper regulations of insurance sales and contract enforcement (Ntukamazina et al., 2017). According to Cole et al. (2013), this is because testimonials of the insurance product, especially with payout confirmations from a trusted third party, increased uptake of policy by 40% compared to farmers who heard of no endorsement.

2.8 Advantages of Weather Index-Based-Based Insurance

2.8.1 Minimization of Adverse Selection

Adverse selection occurs when potential insured parties have concealed relevant information from the insurer on their exposure to risk that will influence premium payment (Odening & Shen, 2014). Adverse selection could lead the insurer to misjudge the insured's risk. Under conventional insurance, risk and premium are computed based on the average producer, where farmers with high risk are expected to pay more premium.

However, weather index-based insurance has the same insurance payment conditions for all insured farmers in a designated zone irrespective of their unique risk exposure (Castillo et al., 2016). As a result, both insurers and customers gain from less adverse selection. Again, issues of adverse selection are sorted as verification at the farm level is not needed, absence of long delays and high cost of claims verification, achievement of (Carter et al., 2014). Cole et al. (2012) attest that wherever available, index-based insurance is affordable and works for the intended purposes of achieving more effective shock coping, and that makes index-based insurance a less costly risk management approach.

2.8.2 Reduction of Moral Hazard

Moral hazard refers to people's actions to influence the outcome of claims by concealing acts that raise their risk exposure due to acquiring insurance (Hazell et al., 2010). These hidden activities may expose the insurer to higher levels of risk than initially anticipated when premium rates were set. With weather index-based insurance, the compensation is determined by an objective index-based that farmers and insurers have no control over (J. R. Skees, 2008). Hence the issue of moral hazard is escaped because farm-level verification is not needed (Carter et al., 2014).

2.8.3 Transparency

Index-based insurance contracts give policyholders information on how payouts are determined, which builds trust between the insurer and the policyholder (Adiku et al., 2017). During the payment session, the contractual agreement spells out all of the pertinent facts and accountability. In the long term, information is successfully transmitted, resulting in better decision-making when purchasing an insurance plan.



2.8.4 Low operational and transaction costs

Weather index-based insurance is standardized insurance that only requires little individual underwriting (Shirsath et al., 2019). In this instance, an insurer does not need to undertake individual farm pre-inspections or assess individual producer in-field area losses. This lowers the administrative cost of index-based insurance, which reduces the transaction cost (Carter et al., 2014). Also, compared to conventional insurance, index-based insurance is relatively affordable to the poor in developing countries as it exhibits lower transaction costs (Miranda & Farrin, 2012). Similarly, N. Jensen and Barrett (2017) emphasized that insurance leads to an increase in investment due to the reduction in precautionary savings. Additionally, N. D. Jensen, Barrett, and Mude (2016), in their study, revealed that households with insurance channeled investments to livestock health services and experienced an increase in milk production and overall income. Likewise, households with insurance are found to be less dependent on food aid and other forms of assistance, showing their ability to better cope with shocks (Carter et al., 2014) Hence, weather index-based insurance can be widely marketed and claims paid at a lesser price.

2.8.5 Timeliness of payouts

Weather index-based insurance is a type of insurance that measures weather station data without making any field loss adjustments (Shirsath et al., 2019). With the use of weather stations and satellite index-based, the payout period is shortened. This method allows for quick and efficient payouts to beneficiaries. Cai et al., (2014) findings suggest that experimenting with payouts establishes trust in oneself or by witnessing payouts to members of your social network. Payouts were the main instrument in building trust. Trust can then be increased by subsidies to boost demand and the observation of payouts and recommendation by others (Karlan et al., 2014) or by increasing the frequency of payouts by ensuring losses cheaply in addition to larger low-frequency losses (Carter, de Janvry, Sadoulet, & Sarris, 2017)

2.9 Challenges of Weather Index-based Insurance

Most studies reveal that insurance products are not extensively available in many lower-income countries (Barnett & Mahul, 2007; Marr et al., 2016; J. R. Skees & Barnett, 2006). Even if potential policyholders are conversant with other types of insurance products, many will almost certainly not be familiar with weather index-based insurance (Ntukamazina et al., 2017). Hence, Sarker (2013) highlighted that even though the basic concept of weather index-based insurance is simple, effective implementation is not that simple.

J. R. Skees (2008) and (Clarke, 2011) amongst many studies, identify that basis risk is the key determinant of low demand for weather index-based insurance, knowing that high basis risk eventually causes severe damage to livelihoods. This is further emphasized in a study by Carter et al. (2014), where their findings revealed that the existence of basis risk is the main challenge of index-based insurance. Basis risk occurs from the incongruity between measured risks at the meteorological station level and the occurrence of weather shocks at the location of the insured's farm (N. D. Jensen et al., 2016). Thus, it may rain more than the level for drought insurance at the meteorological station, whereas the farmer suffers from Drought on his farmland. In this case, there would be no payout for indemnities to the farmer to cover for his losses when in fact, the farmer had incurred the cost of the insurance and also had his crop devastated by Drought. On the contrary, there could be no rainfall at the meteorological station, but average rain on the farmland. In this case, the farmer enjoys the double benefits of a good harvest and an indemnity payment causing losses to the insurance company (Carter et al., 2014). However, Hess et al. (2002) opined that basis risk could be reduced by proposing weather index-based insurance only in areas where a particular, highly covariate weather variable like Drought or extreme temperatures is the prevailing cause of loss.

Therefore, for individuals, households, and organizations to make an informed decision to purchase a weather index-based insurance, it is essential to understand the basis risk inherent with weather index-based insurance (Tadesse, Shiferaw, & Erenstein, 2015). Similarly, V. Smith and Watts (2009) advocates the need for policyholders to understand that they may experience a loss but not receive an indemnity.

In the light of this, Miranda and Farrin (2012) propose the need for significant educational effort to ensure the successful introduction of weather index-based insurance. Although insurance suppliers provide some information as part of their sales efforts, Ntukamazina et al. (2017) encourage potential policyholders to seek additional information from other objective sources. For instance, potential policyholders should be aware that the financial requirements associated with signing up for index-based insurance are relatively higher than that of traditional insurance (Barnett & Mahul, 2007). This is because index-based insurance is highly exposed to spatially covariate losses.



Also, studies have revealed that the probability that crop farmers could reduce their efforts to control production risks is often high, leading to higher losses on the insurance company's side (Carter et al., 2014). Cole et al. (2013) further revealed that insured farmers tend to invest more in risky crops and economies of scale but do not use more inputs. Likewise, Karlan et al. (2014) establish that insurance leads to farmers shifting towards a more risky portfolio of crops, although the higher harvest worth does not necessarily offset the extra expenditures. Instead, they have led to excessive risk-taking of farmers and a growing dependency on public disaster relief (Haile, 2005). McIntosh, Sarris, and Papadopoulos (2013) further opined that index-based insurance plays a palliative rather than transformative role; thus, index-based insurance leads to the protection of those who already have higher levels of investment and does not necessarily increase investments.

Again, index-based insurance creates unique regulatory challenges because the indemnities are not based on the actual loss incurred (Gattineni, 2021). Despite the highly developed nature of legal and regulatory systems in some countries, the concern of regulatory standards for traditional insurance products remains unsuitable for index-based insurance products (Miranda & Farrin, 2012).

Therefore J. Skees et al. (2006) suggests that for weather index-based insurance to be effective, both the policyholder and the insurance company must have confidence that the index-based measurement is accurate and the data retrieved are secure from tampering. The underlying index-based should be assessed by a reputable government or commercial source of publicly available meteorological data to generate this confidence. Weather data are unlikely to be gathered, cleaned, stored, and made publicly available by private-sector enterprises due to its good public nature and financial commitment. As a result, these statistics are generally provided by government meteorological bureaus. On the other hand, many low-income nations struggle to sufficiently pay meteorological agencies or maintain a network of weather stations. Some donor organizations have contributed financing for enhanced meteorological services in low-income countries to make weather index-based insurance more accessible. It's important to have access to reliable historical weather data (Ntukamazina et al., 2017). Insurance firms must raise rates, engage in monitoring methods, and require marketable collateral as a requirement for borrowing to address such adverse selection and moral hazard issues, all of which raise premiums and lower demand for insurance (Hess et al., 2002). Data issues and credit risk concerns are two major roadblocks.

In recent years, development organizations and scholars have looked into how weather index-based insurance may be used as a risk management tool for farmers, particularly in rural regions.

Nonetheless, insurance markets in the rural areas of low-income nations are undeveloped or non-existent, owing to asymmetric information, weak contract enforcement, high transaction costs, and significant exposure to spatially covariate risks, among other factors (J. R. Skees, 2008). Crop growers are affected by these issues when they try to insure their agricultural output.

More growth and reduced poverty may be the result. Uptake is still a work in progress, with successes and disappointments, but the outcomes so far have been dismal. The rare instances where introduced index-based insurance were either free or substantially subsidized or offered insurance in conjunction with other advantages such as subsidized credit and extensive technical assistance (Carter et al., 2014). Table 2.1 shows the application of WII and business models of the three levels of market size.

Table 2.1 WEATHER INDEX-BASED INSURANCE APPLICATION AND BENEFITS TO MICRO, MESO AND MACRO LEVELS OF MARKET SIZE

Policyholder	Sales or distribution model	Potential benefit(s) of WII
Micro		
Farmers Households Small businesses	Farmers acquire insurance as part or sometimes as a stand-alone productive bundle (such as credit and other financial services, technology and agriculture information). Note: FSPs, farmers' groups, processors, input suppliers or NGOs can potentially operate as a micro-product distribution channel for farmers.	The payout of WII can: During difficult times, provide financial assistance. Allow the farmer to avoid going into default and resume production. Augment other sources of household income that may be unstable.



		Encourage the purchase of higher-quality inputs.
Meso		
FSPs Processors Input suppliers Farmers' associations NGOs	To cover their own risk, meso-level institutions purchase WII policy (for example, the portfolio of group insurance). They may establish payout criteria to help farmers directly or indirectly.	WII provides access to a new customer base while also managing bulk defaults induced by weather events. Meso-level actors can create new supply chain linkages (examples include contract farming, credit packages, and inputs) to assist control risk and provide market opportunities.
Macro		
Government or International Relief Agencies	The government or relief agency is reinsured	Following disasters, the government receives early cash, allowing the relief agency to continue operations.

2.10 Theoretical Review: Theory of Planned Behaviour

The theory of planned behavior (TPB) is an extension of the theory of reason action (TRA) (Ajzen, 1991), which claims that people's intentions and perceived control influence how they act. According to both models, individuals make rational, reasoned judgments to engage in specific behaviors by evaluating the information available to them. The theory postulates three underlying concepts: attitude, subjective norms, and perceived behavioral control (Chatzisarantis & Biddle, 1998). Attitude is concerned with one's ideas about the likely consequences of one's actions. Subjective norms take into account other people's normative expectations. At the same time, perceived behavioral control relates to how easy or difficult it is to do a specific activity, as well as one's confidence in one's capacity to do so. The framework shows that if an individual's attitude, subjective norms about behaviour, and perceived behaviour control are positive, the individual's intention to execute the behaviour is likely to be high. This means that an individual will participate in an action based on their apparent interest and capabilities in performing that action. The theory of planned behavior helps to predict and explain farmers' demand on weather index-based insurance. The attitude of farmers relating to weather-index-based insurance may influence their demand for the product. In this case, the study examines the perceived risk behavior of the farmers on demand for weather index-based insurance. Besides, TBP theorizes that individuals' perception of social pressure from referent groups influences their behavior. Specific to the study, farmers' trust in financial institutions may be classified as a subjective norm that may affect their demand for weather index-based insurance. Lastly, farmers' perception of policy interventions may be perceived as behavioral control under the TBP framework. Policy interventions may impede or facilitate the regulation of weather-index-based insurance in Ghana. As a result, farmers' perception of policies is a critical determinant of farmers' participation in weather index-based insurance.

2.11 Conceptual framework and hypotheses development

The conceptual framework for this study is grounded on the theory of Planned Behaviour. The framework of the study is illustrated below in Figure 2.1, and it illustrates the primary relationships proposed in this study. The conceptual framework shows the relationship between farmers' risk aversion, trust in financial institutions and perceptions of policy interventions on demand for weather index-based insurance.

Based on the conceptual framework and the theoretical implication, the study hypothesizes that

- H₁: Farmers' perception of risk is positively related to the likelihood of demand for weather index-based insurance.
- H₂: Farmers' trust in financial institutions is expected to positively affect the likelihood of demanding weather-index-based insurance.
- H₃: Farmers' perception of policy interventions has a positive effect on the likelihood of demanding weather-index-based insurance

CHAPTER THREE: RESEARCH METHODOLOGY

3.1 Introduction

The chapter explains the research approach and design used to achieve the research objectives. It also highlights the study population, sampling techniques, study area, sources of data, data collection techniques, and the data analysis procedures.

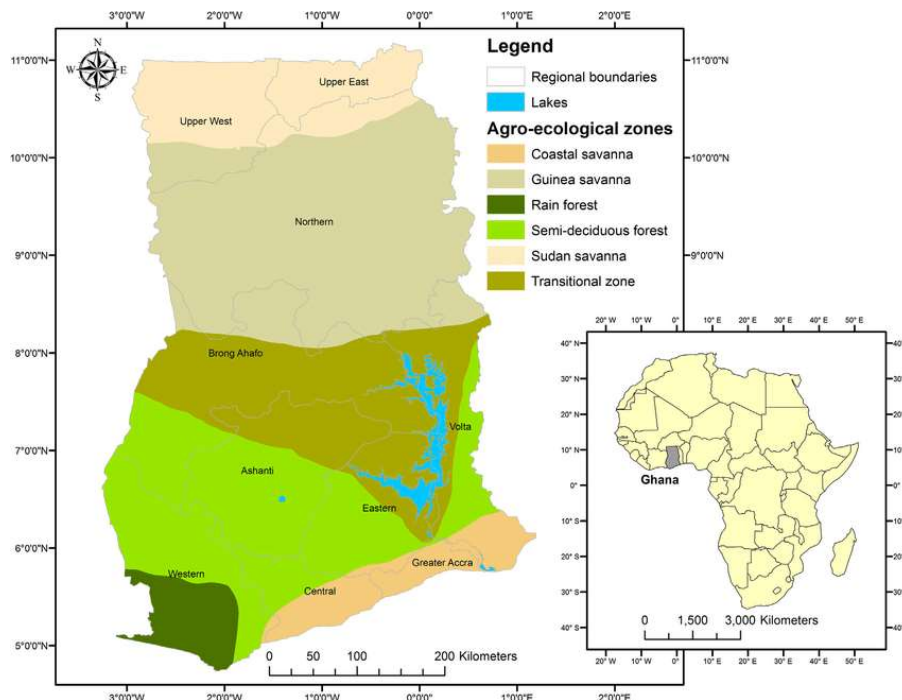
3.2 Study Area

The data were collected from two regions namely the Northern region and the Greater Accra region. These two regions represent the Guinea Savanna and the Coastal Savanna. The Northern region is in the upper part of the country covering an area of 70,384 square kilometers. The region is bounded by the North-East region, Savannah region, Oti region and Eastern Ghana. The economy of the Northern region is dominated by farming activities. The main food crops produced in the Northern Region are maize, sorghum, millet, groundnuts, and rice. Agricultural activities in Ghana are rain-fed, and drought is the leading source of livelihood losses, especially in the northern savannah zones (Choudhury et al., 2015). The average annual rainfall ranges between 750 to 1050 mm. The Northern region is much drier than the southern areas of Ghana. In terms of size, the Greater Accra region is the smallest, with a total land area of 4,450 km². It is situated in the heart of Ghana's coastal belt, sharing borders with the Eastern region to the north, the Volta region to the east, and the Central region to the west. The Gulf of Guinea is located to the south of the area. Thick overcast weather and high-intensity storms are common in the coastal savanna when it comes to rainfall. On the seashore, yearly rainfall ranges from 800mm to 1270mm. Farmers within the southern parts of Ghana are exposed to floods and windstorms which affect crop production. The main agricultural activities include the production of maize, cassava, tomatoes, and others.

The two regions were purposively selected because of their previous history identified as vulnerable to climate change and high temperatures (Abugri, Amikuzuno, & Daadi, 2017; Adiku et al., 2017). Besides, the contribution of agriculture to the region in selection and the crops prone to such climate risk are largely grown there. The main crops for the study are maize, millet, sorghum, and groundnut as such crops are most likely to suffer from drought and heavy rainfall events. The selected study site faces extreme climatic events such as floods and droughts

Based on the agroecological zones of the country, the Northern sector faces a lot of droughts whilst the Southern sector is susceptible to floods. This justifies the need to examine the behaviour of farmers concerning climate risk and weather index-based insurance at extreme climatic events.

Figure 3.1: Agroecological Zones of Ghana





Research Approach and Design

Based on the objectives of the research, the study adopts the quantitative research approach. This particular research approach relates to scientific research which allows one to measure different variables and establish a relationship between the different variables as indicated by (Taylor, 2005). This study aims to find the relationship between farmers' risk aversion, trust in financial institutions and perceptions of policy interventions on the demand for weather index-based insurance in Ghana. The testing of the hypotheses to either confirm or reject the propositions of the theory makes the quantitative approach most suitable for the study.

A survey of farmers in Guinea and Coastal Savanna was developed and undertaken to determine the nature of demand for weather index-based insurance. A survey allows the researcher to get access to a large amount of data from the population.

3.3 Research Instrument and Measurement Scale

There are five sections to the research instrument. Farmers' socio-demographic and agricultural characteristics were determined in Section A. Section B collected information on farmer's trust in financial institutions. Section C and D focused on farmers' perceptions of risk and policy interventions, respectively. The last section covers the demand for weather index-based insurance.

The demographic section of the questionnaire is made up of questions relating to age, gender, the educational level of the farmer, type of crop, marital status, and years of farming experience. In this study, the dependent variable is the demand for weather index-based insurance which shows farmer's interest to purchase the insurance product. It is measured using a Likert scale which ranges from very low (1) to very high (5). Also, the Trust Index by Ennew and Sekhon (2007) was adapted to measure farmers' trust in financial institutions. The scale contains thirteen items in which farmers are asked to respond to the statements on trust using a 5-point Likert scale (1= strongly disagree to 5= strongly agree). A sample item reads: 'I trust my financial institution to have my best interest at heart.' Risk perception is another independent variable that looks at farmers' general attitudes towards risk-taking. The study uses six (6) items to measure risk perceptions. One of the indicators includes 'I am usually very careful when it comes to financial decisions regarding my farms, like loans and investments. Farmers indicated their agreement on a scale from 1 (strongly disagree) to 5 (strongly agree). The last independent variable looks at farmers' perception of policy interventions adapted from Padachi, Urdhin, and Ramen (2016). It contains five statements that use a 5-point response format ranging from 'Strongly Disagree' to 'Strongly Agree'.

3.4 Sample and Sampling Technique

Due to the constraints of obtaining data from all farmers working in Ghana, the study concentrates on a suitable sample size using an appropriate sampling technique. Specific to this study, a purposive sampling technique was adopted. Purposeful sampling is a subjective research strategy for finding and selecting information-rich circumstances to maximize the use of limited resources. This sampling technique was used to choose and approach eligible participants for the survey. The objective is to select regions that mostly face flood and drought cases. This technique is convenient for the study as it allows every farmer contacted to recommend another farmer for data collection (Etikan, Musa, & Alkassim, 2016). The sample size used for the study constitutes two hundred and three (203) cereal farmers working within the Northern and Southern Savannah region in Ghana.

3.5 Model Specification

The study uses an ordered Probit regression estimator since the dependent variable is on a Likert scale and ordered categorically. The dependent variable measures the amount of weather index-based insurance that farmers in Ghana are willing to demand. The dependent variable scale order is from D_{VL} = not demanding any weather index-based insurance, D_L = rarely demand, D_M = occasionally demand, D_H = Often demand. The maximum likelihood estimation approach is used to estimate the model.



$$Y_i = \begin{cases} 1 & \text{if } WII_i < D_{VL} \\ 2 & \text{if } D_{VL} \leq WII_i < D_L \\ 3 & \text{if } D_L \leq WII_i < D_M \\ 4 & \text{if } D_M \leq WII_i < D_H \\ 5 & \text{if } WII_i \geq D_H \end{cases} \quad (1)$$

Where Y_i is the demand function for each respondent, WII_i is respondents i 's WII_i . The WII_i demand function is therefore:

$$WII_i = \alpha + \beta_1 TF + \beta_2 PR + \beta_3 PP + \varepsilon_i \text{ for } i = 1, \dots, n, \quad (2)$$

CHAPTER FOUR: ANALYSIS AND DISCUSSION OF FINDINGS

4.1 Introduction

This chapter presents the empirical results and discusses the findings in the context of the extant literature. The first section shows the descriptive statistics of the demographic characteristics of the respondents and the constructs in the study. Also, the results relating to the hypotheses testing of the ordered Probit model are presented. The chapter ends with discussions of the findings regarding existing studies.

4.2 Demographic Characteristics of Participants

Table 4.1 displays the frequency and percentages of the demographic statistics of the respondents. The demographic characteristics include respondents' gender, age, marital status, educational background, farming experience, and crop farming type. 66.5% of the respondents are male. The average age of responders is 30 (min 19, max 70). A large portion of the respondents (66%) engage in maize farming, followed by millet (39%). Additionally, 44.3% of the respondents had no education, with the remaining respondents having an educational background as Junior High School (6.9%) Senior High School (18%), tertiary (29%), postgraduate (15%) and others (37%). In terms of farming experience, the results indicate that 61.6% of the respondents have more than five (5) years of experience in crop farming.

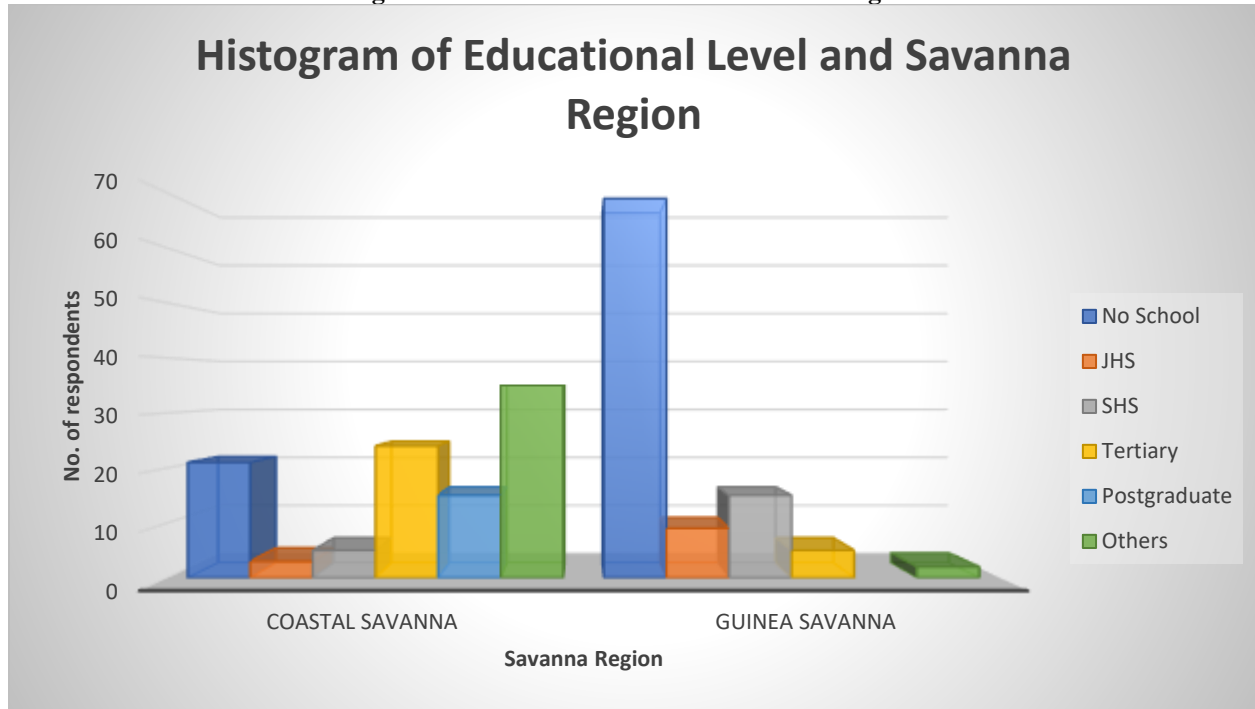
Table 4.1 Descriptive Statistics of Respondents

Demographics		Frequency (203)	Percent (%)
Gender	Male	135	66.5
	Female	68	33.5
Age	16-25	14	6.9
	26-35	27	13.3
	36-45	43	21.2
	46-55	76	37.4
	Above 55	43	21.2
Type of Crop	Maize	161	66
	Sorghum	24	9.8
	Millet	39	16
	Cowpea	20	8.2
Marital Status	Single	41	20.2
	Married	145	71.4
	Divorced	9	4.4
	Widowed	8	4
Educational Background	No school	90	44.3
	JSS	14	6.9
	SHS	18	8.9
	Tertiary	29	14.3
	Postgraduate	15	7.4
	Others	37	18.2



Farming Experience	< 3 years	10	4.9
	3-5 years	68	33.5
	6-10 years	81	39.9
	> 10 years	44	21.7

Figure 4.1 Educational Level and Savanna Region



The diagram above shows the educational level of the respective regional savanna. The diagram indicates Junior High School (JHS) to be the lowest educational background among the farmers within the Coastal Savanna. Most respondents from the coastal savanna indicated other educational levels which include O’level and Middle School Leaving Certificate (MSLC).

With the Guinea Savanna sector, farmers without education reported the highest among the educational levels. This may affect their knowledge of weather index-based insurance.

Figure 4.2 Farmers’ Years of Experience and Savanna Region

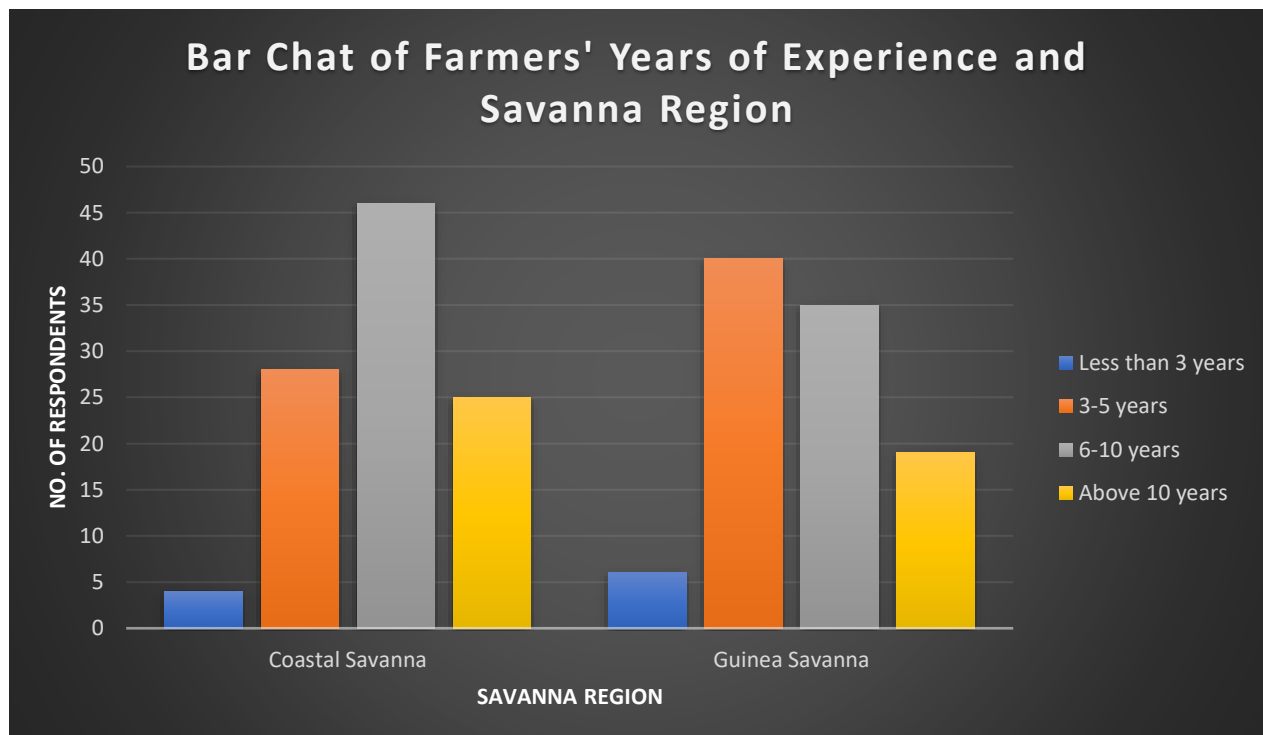
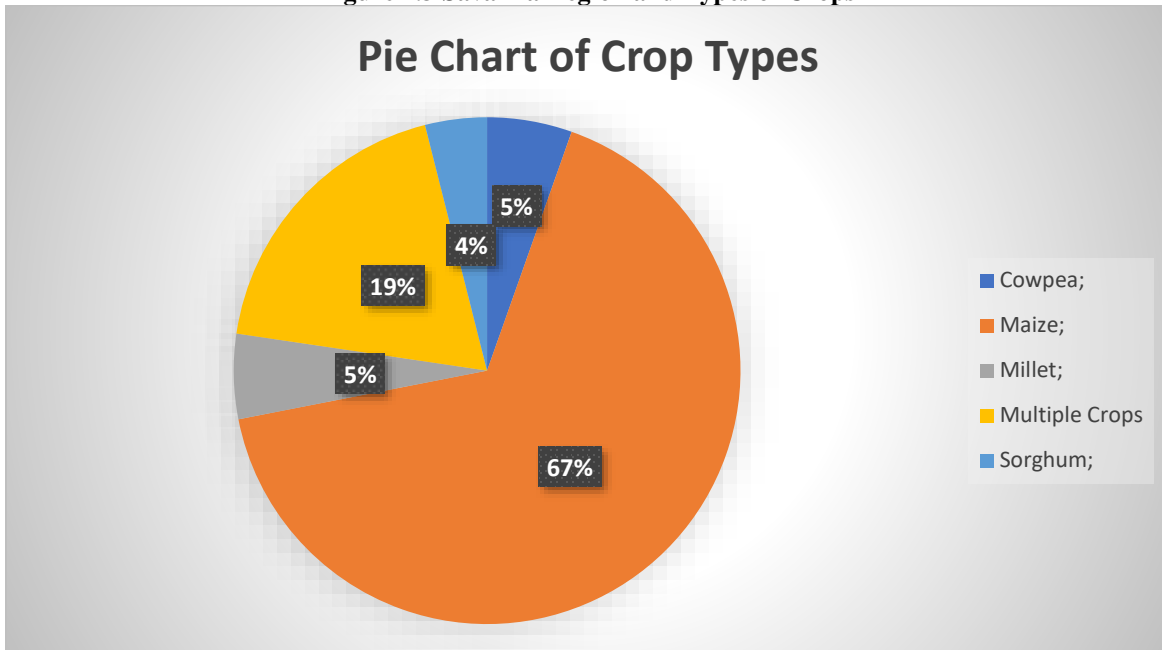


Figure 4.3 Savanna Region and Types of Crops



The pie chart gives further details on the demographics of farmers relating to the type of crops that is grown. As shown in the graph, maize is the dominant crop (67%) engaged by farmers in both Guinea Savanna and Coastal Savanna. Besides, 19% of the farmers engage in multiple crops. This suggests that farmers combine various crops such as maize and cowpea or millet and maize in their farming activities to reduce the level of risk. The result indicates sorghum to be the least crop (4%) engaged by the farmers within the two regions.

4.3 Descriptive Statistics of Study Constructs

Table 4.2 reports on the descriptive statistics of the study constructs. The constructs were measured on a scale of 1 to 5, where 1 is strongly disagree, 2 is disagree, 3 is neither agree nor disagree, 4 is agree and 5 is strongly agree. Respondents report having a moderate to a high level of trust in the financial institutions as the average mean score of trust is 3.15. The mean values obtained from risk perception indicate that Ghana farmers have a higher risk perception (4.09) when farming. Concerning public policy interventions on farming activities, the farmers surveyed perceived the introduction of policies to be favorable and encourage farming production. Lastly, analysis from the respondents reveals a high level of demand for weather index-based insurance.

Table 4.2 Descriptive Statistics of Study Constructs

Trust in Financial Institutions				
INDICATORS	Mean	Min	Max	SD
I trust my bank and insurer to do what it says it will do	3.27	1	5	0.76
I trust my bank and insurer to have my best interest at heart	3.40	1	5	0.86
My bank and insurer are not reliable	2.33	1	5	0.89
My bank and insurer are dishonest with me	2.35	1	5	0.93
My bank and insurer are concerned about my best interests	3.68	1	5	0.85
Overall, I feel I can trust my bank and insurer	3.67	1	5	0.85
My bank and insurer do not pay much attention to addressing my needs	2.72	1	5	0.76
My bank and insurer have a reputation for being reliable	3.58	1	5	0.88
My bank and insurer have a reputation for being honest	3.74	1	5	0.88
My bank and insurer have a reputation for being dependable	3.62	1	5	0.91
My bank and insurer are known for their poor customer service	2.62	1	5	1.03
My bank and insurer have a reputation for having its customers interests at heart	3.60	1	5	0.89
Overall, I feel my bank and insurer are not trustworthy	2.32	1	5	1.06
Trust in Financial Institutions	3.15	1	5	0.23



Perception of Policy Interventions

INDICATORS	Mean	Min	Max	SD
Policies on investments in organic material to fertilize the soil and preserve the natural vegetation motivate me to continue with farming and produce more	3.53	1	5	0.77
Policies on training programs for farmers and free access to information on whether climate may enhance my ability to deal with production risk	3.81	3	5	0.83
Policies to engage farmers participation is a critical component to successfully implement weather index-based insurance	3.31	2	5	0.53
Policies on improved access to resources like roads and linking farmers with the main market and agricultural fields will motivate me to produce more	3.87	2	5	0.88
Policies that will encourage NGOs to support farming could enhance my adaptive capacity to respond to floods and droughts	3.67	2	5	0.87
Policies on subsidized insurance may encourage me to demand weather index-based insurance	3.80	3	5	0.87
Perception of Policy Interventions	3.67	1	5	0.64
Demand for weather index-based insurance	3.07	1	5	1.73

Risk Perception

INDICATORS	Mean	Min	Max	SD
I do not like to take risky decisions concerning my farm	4.07	1	5	0.76
I am usually very careful when it comes to financial decisions regarding my farms, like loans and investments	4.30	2	5	0.57
I am not afraid to borrow money in order to make investments that can enhance profitability	2.00	1	5	0.77
There is a possibility that I may incur loss of production due to weather conditions	4.30	1	5	0.69
There is a possibility that unexpected changes in regulation may negatively have an impact on the farm	4.13	2	5	0.62
There is a possibility that insurance providers may cancel or reduce the share of the received subsidies or package	3.73	1	5	0.86
Risk Perception	4.09	1	5	0.45

4.4 Farmers' knowledge of Weather Index-Based Insurance

All respondents surveyed were asked about the WII scheme. Concerning Table 4.3, more than half of the respondents (64%) expressed knowledge of the risk covered by the WII. However, 50% of the respondents that knew the risk cover did not know more about the insurance contract and its phases. Also, 163 out of 203 respondents knew the institution responsible for collecting rainfall data on WII. Furthermore, a little more than half of the respondents (52%) did not know the insurance scheme's payback and premium packages.

The weighted average response from the questions showed that 50% of the respondents knew about weather index-based insurance whilst 30% knew nothing about it. Again, 20% of respondents displayed a lack of understanding of weather index-based insurance. These findings suggest that farmers' lack of uptake for weather index insurance may be attributed to the level of understanding of how index-based insurance works.



Table 4.3 Knowledge of Weather Index-Based Insurance by Participants

No.	Questions	Percentage (%) of correct answers	Percentage (%) of I do not know the answers	Percentage (%) of wrong answers
1	The WII covers farmers for what production risk on the farm?	64	4	32
2	How many phases does the WII contract have?	38	49	13
3	Who is responsible for collecting rainfall data for this type of insurance?	80	18	2
4	A farmer will receive an insurance payout even if he/she is the only one to have experienced drought or flood in the area	43	53	3
5	What crops are covered by this type of insurance?	63	3	34
6	At the end of the farming season, farmers are paid back all or part of their premium when there is no drought or flood	9	52	39
7	Overall Knowledge on Weather Index Insurance	50	30	20

4.5 Empirical Results

Table 4.4 summarizes the estimated outcome of farmer's demand for WII using a probit regression model. The results show the hypotheses testing of the effect of the independent variables on demand for weather index-based insurance. From the table, the coefficients on gender (p-value = 0.671, z = 0.42) and age (p-value = 0.254, z = 1.14) are not statistically significant; we cannot attribute any variation on farmers' willingness to demand weather index-based insurance to those variables. In contrast, the coefficient on the agro-ecological zone was significantly different from zero (p-value = 0.020, z = -2.31). Also, the results indicate maize crop (p-value = 0.022, z = -2.13), educational background (p-value = 0.042, z = 1.83) and year of experience (p-value = 0.038, z = 1.92) to be significant. The likelihood ratio chi-square of 55.31 with a p-value of 0.000 indicates that this model as a whole is statistically significant; that is, it fits significantly better than a model with no predictors.

There are many variables from the study that measure the concepts of trust in financial institutions, perceived risk, and farmer's perception of policy interventions. To effectively analyze the concepts on the demand for weather index insurance, a composite score with the use of summated scales was developed. The combination of several individual variables into a single composite measure increases the reliability of the measurement. An average score of trust in financial institutions, perceived risk and farmer's perception of policy interventions was integrated into the estimation of the relationship between the concepts and weather index insurance.

The results suggest that trust in financial institutions, perceived risk and perceptions of policy interventions are statistically significant. The probit regression coefficient changes the z-score or probit index for one unit change in the predictor. The findings suggest that all other things being equal, farmers with higher trust are likely to demand weather index-based insurance. Also, farmers with high perceived risk may not demand the insurance scheme. Lastly, farmers who perceive policy interventions to be good are more likely to demand weather index-based insurance.

Table 4.4 Estimates of the Ordered Probit Regression Model

Demand	Estimate	SE	Z value	Pr > z
Gender	-0.0763	0.1798	-0.42	0.671
Age	0.0038	0.0034	1.14	0.254
Savanna Region	-0.0894**	0.4632	-2.31	0.020
<i>Crop Types</i>				
Maize	-0.0669**	0.0589	-2.13	0.022
Cowpea	0.0217 0.2557	0.2264	1.29	0.196
Millet	-0.0392	0.2304	1.11	0.267
Sorghum		0.2712	-0.14	0.885
Edu	0.0771**	0.0543	1.83	0.042
Farming Experience	0.0350**	0.1107	1.92	0.038
Trust	0.7754**	0.4822	2.48	0.036
Perceived Risk	-0.6596***	0.2484	-2.76	0.006
Policy Interventions	0.9248***	0.3194	5.33	0.000
/cut1	2.6891	1.0993		



/cut2	2.8913	1.1035
/cut3	3.3191	1.1097
/cut4	3.5645	1.1100
Number		
of observations	203	
LR chi2 (10)	55.31	
Prob> chi2	0.000	
Pseudo R2	0.0977	
Log-Likelihood	-255.53444	

Notes: Except where noted, the number of responses in each category was 203, **p<0.05, ***p<0.01

Table 4.5 Marginal Effects of Ordered Probit Model

	dy/dx	Delta-method Std. Err	z	p> z
Trust				
1	-.2481206	.1381231	-1.80	0.072
2	-.0114402	.0078383	-1.46	0.144
3	.0003171	.0069791	0.05	0.964
4	.0148318	.0097001	1.53	0.126
5	.244412	.1354301	1.80	0.071
Perceived Risk				
1	.2110708	.0738094	2.86	0.004
2	.0097319	.0051587	1.89	0.059
3	-.0002697	.0059295	-0.05	0.964
4	-.0126171	.0060455	-2.09	0.037
5	-.2079159	.0724294	-2.87	0.004
Policy Interventions				
1	-.2959381	.0480879	-6.15	0.000
2	-.0136449	.0056839	-2.40	0.016
3	.0003782	.0083156	0.05	0.964
4	.0176902	.0062596	2.83	0.005
5	.2915147	.0461177	6.32	0.000

The marginal probability effects show the partial effects of trust, perceived risk, and public policy on the probability that the farmers demand weather index-based insurance is 1 in the probit model. It is important to note that the constructs for trust in financial institutions, perceived risk and policy interventions were measured on the scale of 1 to 5, where 1 is strongly disagree, 2 is disagree, 3 is neither agree nor disagree, 4 is agree and 5 is strongly agree. Due to that, the results show the marginal effects on each scale to help understand the change in probability when opinion moves from one level to another.

Table 4.5 shows the marginal effects of the various independent measures to demand weather index-based insurance. The findings reveal that two types of trust responses (strongly disagree and strongly agree) significantly predict the likelihood of weather index insurance demand. In terms of risk perception, four replies (strongly disagree, disagree, agree, and highly agree) effectively predict the likelihood of weather index insurance demand. The remaining group of responses on policy interventions, except for neither agree nor disapprove, strongly predicts the probability of demand for weather index insurance.

4.6 Perceived Risk and Demand for Weather Index-Based Insurance

As shown in Table 4.4, the results show a negative sign (-0.660) and statistical significance (p-value = 0.006) between farmers' risk perception and demand for weather index-based insurance. Although the relationship between perceived risk and demand for weather index-based insurance is significant, the result shows a negative relationship different from the statement in the related hypothesis. This makes the finding surprising as it denotes a negative impact on a willingness by farmers to purchase weather index-based insurance. The results contradict Meuwissen, de Mey, and van Asseldonk (2018) findings and Bao, Zhang, Deng, and Xu (2021), who assert that farmers with high perceived



risk are more likely to demand insurance packages. The present finding from the study can be attributed to the fact that farmers may perceive a higher premium due to higher risk, which would increase the expense of farming. In terms of risk perception, farmers who believe that expected risks are high are less likely to demand weather index-based insurance. This is because such farmers may result in mitigation procedures more than transferring the risk to insurance companies. According to some researchers, farmers with a higher level of risk are more likely to accept higher risk options and undervalue the relevance of risk management tools such as weather index-based insurance (Carrer, Silveira, & Souza Filho, 2019; Iqbal, Ping, Abid, Kazmi, & Rizwan, 2016; Ullah, Jourdain, Shivakoti, & Dhakal, 2015). Also, farmers' failure to understand how climate change may place them at greater risk may result in a negative causal relationship. These plausible explanations in the literature justify that risk perception is negatively related to the demand for weather index-based insurance.

4.7 Farmers' Trust in Financial Institutions and Demand for Weather Index-Based Insurance

Farmers' trust in financial institutions has a role in their agricultural insurance decision-making. The study's first hypothesis was to investigate whether farmers' trust in financial institutions is expected to affect the likelihood of demanding weather index-based insurance. Based on the results, the trust variable was related to farmers' willingness to demand weather index-based insurance as the results show a positive coefficient sign (0.775). The present finding implies that farmers with a high level of trust toward a financial institution are more likely to demand weather index-based insurance. This result reflects the findings of Stroe and Iliescu (2013) and Lin et al. (2015) that consumer attitudes such as trust influence crop insurance purchase decisions. Besides, the results confirm the arguments made by other studies that the loyalty of consumers is gained by winning their trust (Bao et al., 2021; Fischer & Wollni, 2018)

4.8 Policy Interventions and Demand for Weather Index-Based Insurance

Policy interventions play a critical role in the development of agricultural insurance. As part of the study, farmers took responses on selected policy interventions and how they would influence the demand for weather index-based insurance. The research findings show that perceptions of policy interventions have a significant positive relationship with demand for weather index-based insurance (coefficient = 0.925, p-value = 0.000). The relationship demonstrates that farmers with a strong perception of the effectiveness of policy interventions are more likely to demand weather index-based insurance. Further analysis suggests that policy interventions such as government grants, investment in agricultural products, and infrastructure establishment may increase the farmer's likelihood to demand insurance schemes. The result is in line with James, Ngarmasak, and Rolle (2010) and Asrat and Simane (2018) findings. Besides, Muatha (2014) confirms that farmers' participation and educational programs increase their preference for innovative agricultural products.

CHAPTER FIVE: SUMMARY, RECOMMENDATIONS AND CONCLUSION

5.1 Introduction

The chapter ends the research study with a summary of all the key issues discussed in the previous chapters. This chapter highlights the major findings and concludes the study results. It further discusses the relevant contributions and recommendations for policy and practice. The limitations and directions for future studies then bring the chapter to a close.

5.2 Research Summary

This dissertation examined the factors influencing the demand for weather index-based agricultural insurance by crop farmers in Ghana. The use of weather index-based insurance as a successful instrument for farmers in the era of climate change in underdeveloped nations is supported by past studies. In line with the arguments, the study derived its motivation from the insufficient empirical studies to investigate the determinants of demand for weather index-based insurance in the Ghanaian context. The study finds it important to focus on weather index-based insurance due to the impact of climate change on agricultural production. The theoretical underpinning of the research was the theory of Planned Behavior. The research adopted the quantitative method approach, specifically the survey design, to collect the required data. Two hundred and three (203) responses from two regions (Northern Region and Greater Accra Region) were collected for the analysis. The Ordered Probit regression model was employed to analyze the data collected.

The finding of farmers' risk aversion and risk mitigation strategies on demand for weather index-based insurance relate to the first objective of the study. The result contradicts the hypothesis stipulated in the research study. The hypothesis stated a positive relationship between risk perception and demand for weather index-based insurance.



However, the result proved otherwise. The study finds that farmers with a high level of perceived risk are less likely to demand weather index-based insurance. This illustrates that farmers prefer to manage their risk rather than transferring it to outside parties such as insurance companies. Also, the second objective of the study which relates to the relationship between farmers' trust in financial institutions and demand for weather index-based insurance was examined. The result indicates a significant positive influence of trust in financial institutions on the demand for weather index-based insurance. This means that farmers with a high level of trust are more likely to demand weather index-based insurance. As a result, financial institutions must make an effort to retain or strengthen the trust that farmers have in them. The last objective of the study investigated the perceptions of public policy on the demand for weather index-based insurance. The study finds that farmers' perception of public policy has a positive and significant relationship with the demand for weather index-based insurance. The underlying factors of policy interventions include roads and infrastructure, support from NGOs, subsidies on agricultural produce, and easy access to credit facilities. This suggests that farmers who view policy interventions to be effective are more likely to demand extra weather index-based insurance.

5.3 Recommendations of the Study

Taking into account the findings, the following recommendations are made for policy and practice.

First, the government and financial service providers should increase the awareness of weather index-based insurance products to farmers. In addition to selling insurance products, private organizations should teach farmers and intermediaries about the proper role of weather index-based insurance. Besides, government and donor support can help ensure that information is delivered balanced and that appropriate funds are allocated to a greater educational effort for the insurance products. This would go a long way toward stimulating farmer demand.

Further, the studies recommend the government improve the infrastructure and the quality of weather data. Efforts should be taken to guarantee that the territory is covered methodically, with weather stations located close enough to the insured parties.

Again, data must be collected, maintained, archived, and made available timely with insured events. In addition to developing index insurance products, weather infrastructure investment can have benefits - including developing other meteorological risk managing instruments for agriculture, food security, early warning systems and expansion services.

The government and financial institutions should develop a real-value proposition for the insured and include insurance in a larger package of services for farmers. According to the findings, weather index-based insurance must provide farmers with more value than just financial protection. As a stand-alone product, poor farmers who face different risks and productivity limits, as well as weather concerns, can regard weather index insurance as extra costs and have low demand among poor smallholder farmers. As a result, policymakers should tie weather index-based insurance to an existing development program to entice farmers to participate.

5.4 Contributions of the Study

The findings of this research contribute to academia, practice, and policy. Regarding the contribution to academia, the findings of this study add knowledge to the existing literature on the determinants of the demand for weather index-based insurance in developing countries. Prior studies have incited discussions on the practical application of weather index-based insurance. In response, the dissertation explored the level of understanding by Ghanaian crop farmers on weather index-based insurance and examined some factors that may influence the demand for weather index-based insurance. Further, the results of the study provide relevant information for the government and other stakeholders in the agricultural sector. The findings inform insurance providers and the government on the behavior of farmers towards the selection of insurance packages. This information would give clues for governments, investors, and financial providers to finance agriculture in developing countries.

Additionally, the research findings would influence institutions in drawing up effective programs and workshops that would encourage and train farmers on better risk management strategies that are crucial to the adoption of weather index-based insurance products.

Again, the dissertation gives a new perspective for policymakers to review existing policies and introduce new ones to encourage the participation of weather index-based insurance programs. To ensure the success of policy implementation, local farmers should be involved in the design process throughout the planning stage, using a top-



down and bottom-up approach. This would help policymakers to gain a better understanding and feedback of the existing policies towards agricultural insurance. At the same time, local farmers would gradually appreciate the need for weather index-based insurance and stimulate the demand for the insurance scheme.

Finally, Improved basis risk solutions are needed because basis risk is a difficulty for weather index-based insurance and would affect weather index-based insurance purchases by farmers in Ghana. This might involve the addition of more weather stations, the use of averages of data from nearby weather stations, the development of more appropriate weather indexes, and hybrid weather models.

5.5 Limitations and Directions for Future Studies

Despite the contributions made by this study, the researcher acknowledges certain limitations. First, the study uses a cross-sectional design which limits the extent to which cause-effect relations can be inferred from the findings. Further studies can employ different methods such as longitudinal designs and experimental studies better to understand the determinants of demand for weather index-based insurance. Again, the survey was mainly carried out in Northern Region and Greater Accra Region. Further studies can extend the research to other agroecological zones in Ghana and other developing countries.

The dissertation did not include other factors that may explain the demand for weather index-based insurance. It is worth noting that the implementation of weather index-based insurance has broader ramifications for agricultural sector growth. Hence, further studies should explore other factors that may influence the demand for weather index-based insurance. Suggestions include the effect of farmers' saving and access to credit facilities on adopting weather index-based insurance. Again, the dissertation proposes research of the effect of regional development features on the adoption of weather index-based insurance and an examination of the drivers of insurance use based on the proportion of production insured.

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