Farmers' willingness to participate and pay for, and agricultural extension officers' disposition to communicate weather index-based insurance scheme in Ghana: The case of the Upper East Region

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ABSTRACT

Ghana's agriculture is rain-fed, and drought causes reductions in farm household food supply, and income especially in the Upper East Region. Due to the impact of drought on farm household livelihood, weather index-based insurance (WII) scheme for drought was introduced to cushion farmers from the impact of drought events in the region. Previous studies claimed that the demand for agricultural insurance including WII is affected by factors such as farmers' risk profiles and management strategies in place, socio-demographic, farm characteristic, institutional, and knowledge factors. Little is known about the impact of these factors on demand for the WII scheme in the region. This study attempts to assess farmers' willingness to participate and pay for the scheme, and agricultural extension officers' disposition to communicate information regarding the scheme to farmers in the Upper East Region of Ghana.

Through two surveys data on 200 farmers': risk profiles and management strategies; knowledge and attitude towards WII; and willingness to pay (WTP) for WII using a double-bounded contingent valuation technique, were collected. Data on 90 extension officers' knowledge and attitude towards WII and socio-demographic factors were also collected. Farmers' willingness to participate and WTP was analysed with a Heckman two-stage regression model. Agricultural extension officers' knowledge about the WII scheme in the region was analysed with a probit regression model.

The results revealed that the most frequent and important risk events were pest or diseases outbreak, drought and erratic rainfall. The most frequently used risk management strategies farm/crop diversification and use of improved crop varieties negatively impacted on the adoption of the WII. Few farmers were aware of WII, and of those who knew few understood the concept. Farmers had an indifferent attitude towards WII because they had little information. The WTP for WII was between 7.5% and 12.5% premium rates of maize production per acre (GH¢714). Being a landowning farmer, maize income, attitude score, drought index, and access to credit, positively influenced willingness to participate in WII; total crops income negatively influenced farmers. Farm/crop diversification, drought index, knowledge about the WII, and the bid price, negatively influenced farmers' WTP for the scheme; attitude scores positively influenced farmers' WTP. Most extension officers knew about WII, but few understood the concept of WII, hence were most likely not to communicate information regarding the scheme to farmers in the region effectively. In general, extension officers had an indifferent attitude towards WII. The number of insurance related training sessions attended by an extension officer positively influenced their knowledge about WII.

It was recommended that the insurance provider/s (GAIP) in collaboration with the Departments of Agriculture should organise regular district or regional sensitisation and or training programmes for farmers and extension officers to improve their knowledge about the scheme for adoption and dissemination of information about the scheme, respectively. The minimisation of basis risk, as well as improving the effectiveness of the scheme by the GAIP could contribute to a favourable attitude towards the scheme by farmers.

KEY WORDS: *Willingness to participate, willingness to pay, risks, risk management strategies, knowledge of weather index insurance, attitude towards weather index insurance*

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TABLE OF CONTENTS

List of Figures

List of Tables

CHAPTER ONE - INTRODUCTION

1.1 Background

Agriculture plays an essential role in the economy of most developing countries and has, since independence, played a crucial role in the economic growth and development of Ghana (Nalley, Dixon, & Popp, 2014). Agriculture contributed about 20.2% to GDP as at 2015 (Ghana Statistical Service, 2016b) and employed about 44.7% of the total employed population of Ghana (Ghana Statistical Service, 2014d). The importance of agriculture in Ghana cannot be overemphasised, as asserted by Boansi (2014), the agricultural sector's role includes, but is not limited to, the enhancement of food security, employment creation, foreign exchange generation, industrial raw material supply, contribution to poverty reduction, and the support of environmental sustainability.

The Upper East Region is one of the ten administrative regions of Ghana as well as one of the poorest regions in the country (Ghana Statistical Service, 2014d). The high poverty rate has been attributed to the low economic activities in the region (Ghana Statistical Service, 2013, p. 5). Agriculture is vital to the region because about 83.7% of households are dependent on it for their livelihoods (Ghana Statistical Service, 2013). As such households grow crops such as sorghum, millet, maize, rice, beans, soya beans and groundnuts (Ghana Statistical Service, 2013), even though maize is reported to be the main stable in sub-Saharan Africa (Prasanna, Joseph E. Huesing, Regina Eddy, & Virginia M. Peschke, 2018), and rear animals such as cattle, sheep, goats and poultry (fowls and guinea fowls), among others (Ghana Statistical Service, 2013).

Agriculture is not without risks (Hardaker, Lien, Anderson, & Huirne, 2015) and the risks associated with farming have been classified by Kahan (2013) and Hardaker et al. (2015) into five areas namely: production, marketing, financial, institutional, and human risks. Farmers face production risk because of the occurrence of droughts, floods, pest and disease outbreaks, or breakdown, or unavailability of equipment or spare parts, among others (Hardaker et al., 2015; Kahan, 2013). Market risks arise when input and output prices fluctuate due to demand and supply dynamics in the market (Kahan, 2013). Financial risks arise when there are uncertainties about, the willingness of financial service providers to continue to provide credit, interest rates, and farmers default rate (Kahan, 2013). Risks that affect the farm's production and invariably profitability, due to changes in government rules are referred to as institutional risks, and the risk to the farm profitability due to the circumstance of the people operating it

such as ill health is referred to as human risk (Hardaker et al., 2015). Of these risks, market, and production risks (weather variability) are the most important regarding their impact on the incomes of agricultural producers and agribusinesses (Bryla & Syroka, 2007; Wossen & Berger, 2015).

In the West African sub-region, a 1.0 to 1.5 ºC rise in temperature has been reported over the past 30 years with further projected warming in the future which will lead to shifts in rainfall patterns with more extreme events such as droughts and floods (Adiku, MacCarthy, Hathie, Diancoumba, Freduah, Amikuzuno, Traore, Traore, Koomson, & Agali, 2015). Ghana's agriculture is rain-fed, and drought causes the most cumulative losses on livelihoods particularly in the northern savannah zones (Choudhary, Christienson, D'Alessandro, & Josserand, 2015). Because of this, the three northern regions of Ghana the Upper East, Upper West, and Northern regions are the most prone to climate variability, particularly droughts and floods (Choudhary et al., 2015) and high temperatures (Assan, Caminade, & Obeng, 2009). Even in the southern parts of Ghana with a relatively better rainfall pattern, drought among other risks like bushfires, floods, windstorms, and crop pests and diseases have been reported to be the perils to which farmers are exposed (Ellis, 2017a; Kwadzo, Kuwornu, & Amadu, 2013). As a result, the crops that are most likely to suffer from drought events are sorghum, millet, maize, and groundnuts (Choudhary et al., 2015). The frequent occurrence of such production risks (weather related) causes significant income volatility, especially for low-income rural households engaged in rain-fed agriculture resulting in food insecurity, especially in the three northern regions (Choudhary et al., 2015).

To mitigate some of the production risks, farmers have adopted strategies that enabled them to be more productive in favourable climatic years, so that they could offset losses in unfavourable climatic years (Adiku, Debrah-Afanyede, Greatrex, Zougmore, & MacCarthy, 2017). They often do this through investments in new inputs and technologies which at times exacerbate their problems when they become exposed to the vagaries of the weather (Adiku et al., 2017). Farm households suffering the consequences of drought have often used coping strategies such as the sale of assets and the withdrawal of wards from school which in itself is not helpful to the household in the long run (Hoddinott, 2006; Janzen & Carter, 2013). In Ghana especially in some southern parts, Ellis (2017a) and Kwadzo et al. (2013) reported the use of crop diversification and improved crop varieties to mitigate weather-related and bush-fire risks to which farmers in the Eastern Region and Kintampo North Municipality are exposed. In

northern Ghana particularly the Upper East Region, Assan et al. (2009) reported the use of out-migration to find jobs as well as engaging in off-farm activities as some of the risks coping strategies used by most farm households. Smallholder farmers sometimes successfully manage low magnitude but frequently occurring risks through the use of less risky technologies, diversification of production, engaging in income-generating activities and devising both formal and informal risks sharing strategies. However, these often prove inadequate for less frequent but severe impact perils associated with the weather such as drought and floods (Bryla & Syroka, 2007). Notwithstanding this, farmers have been reported to employ the following strategies: diversification, hedging, the use of resistant crop varieties, contract farming, and crop insurance to reduce the risks associated with their farming activities (Aidoo, Mensah, Wie, & Awunyo-Vitor, 2014).

According to Adiku et al. (2017), agricultural insurance based on indemnity awards farmers compensation based on direct measurement of the damages on the farm. Agricultural insurance based on index-based products, bases compensation on some proxy damages on the farm and provide farmers with the opportunity to transfer climate risk when mitigation is not possible (Adiku et al., 2017). Karlan, Osei, Osei-Akoto, and Udry (2014) emphasised that with insurance, farmers can make relatively more substantial investments as well as take riskier production choices in agriculture. Greatrex, Hansen, Garvin, Diro, Le Guen, Blakeley, Rao, and Osgood (2015, p. 22) claim that, "*index insurance has unlocked opportunities for farmers to make more money, or to show some other clear and tangible benefit such as asset protection, increased access to services such as credit, or increased food security in bad years*". Besides these, index-based insurance eliminates moral hazards and adverse selection as well as minimises transaction costs unlike traditional indemnity insurance (Hess & Syroka, 2005; Tadesse, Shiferaw, & Erenstein, 2015). As a result, through the efforts of governments, Non-Governmental Organisations (NGOs) and other commercial programmes, agricultural insurance has reached about 1,000,000 farmers in Africa even though most of these programmes are not subsidised (Greatrex et al., 2015).

Through the German Development Corporation (GIZ) in collaboration with the Ghana Insurance Association an "*innovative demand-oriented and an economically sustainable agriculture insurance package to protect farmers, agro-processors, rural and financial institutions, and input dealers among others*" was introduced in 2009 (Ghana Insurers Association, 2015)**.** The insurance package is meant to cushion the chain actors from the impact of extreme weather conditions (drought or excessive rainfall) that results in crop failures

(Ghana Insurers Association, 2015). However, Mahul and Stutley (2010) report that despite the recent global growth in agricultural insurance from $8 billion in 2004 to $20 billion in 2007, its penetration is still lower than that of life insurance in most countries, irrespective of development levels. They attribute this to the fact that agricultural insurance takes a long time to be fully implemented. Previous research also suggests that the low penetration of agricultural insurance in developing countries is attributed to a lack of awareness of the programmes and an inadequate understanding of insurance including rainfall index insurance (Giesbert, Steiner, & Bendig, 2011; Giné, Townsend, & Vickery, 2008). An example of this is the World Bank, and World Food Programme supported weather insurance scheme for farmers to mitigate the effects of weather variability in Ethiopia (Tadesse et al., 2015). Because farmers and other stakeholders did not have a good understanding of the concept of the weather index insurance in the early stages of the scheme, they were not in support of the scheme, especially in years with good rainfall. Tadesse et al. (2015) found that farmers were often hesitant after a good harvest to pay for the insurance coverage in the following season. It has, therefore, been suggested that to determine the demand for crop insurance including weather index-based insurance (WII), it is essential to assess the frequency and impact of critical weather-related perils and the mitigation strategies being used by the affected farmers (Barnett & Mahul, 2007; McCord, 2011), and the willingness of farmers to participate and pay for such insurance products (Barnett & Mahul, 2007). Other studies have also emphasized that the demand for microinsurance products including WII depends on a combination of farmers' economic (price, wealth, and income), social (risk, trust, financial literacy), structural (informal risk sharing, risk exposure) and personal (age, gender) factors (Eling, Pradhan, & Schmit, 2014; Fiala, 2017). Besides these, institutional factors such as a farmer's access to extension services have been reported to influence the uptake of agricultural insurance (Ali, 2013; Amin, Abdullahi, Suryani, & Alias, 2014; Wairimu, Obare, & Odendo, 2016).

It has been suggested that extension workers could support and assist farmers to not only recognise and understand their problems for better farm management decision making (Kahan, 2013) but to also provide them with real-time advisory services (Choudhary et al., 2015). Adiku et al. (2017) also emphasised that farmers often trust extension officers because of the close working relationship with them. Because of that farmers may require their expert assistance in joining a new scheme such as for crop insurance. According to Barnett and Mahul (2007), insurance products may be absent in most rural areas of many lower-income countries, and even where it is used, potential clients may not be familiar with the operations of crop insurance

such as the WII even if they are acquainted with other insurance products. Weather index insurance is associated with basis risk, and this has been reported to be a significant hindrance for uptake (Greatrex et al., 2015). Basis risk is the low correlation or mismatch between actual losses suffered and the amount of the insurance pay-out received by individual clients (Bryla & Syroka, 2007; Collier, Skees, & Barnett, 2009; Jensen & Barrett, 2017). It is, therefore, essential for potential clients to understand that they may experience losses, but not receive a claim and vice versa. As a result, the success of WII depends on a client's understanding, to which government agencies such as extension organisations could play a role in providing relevant information and education to potential clients (Barnett & Mahul, 2007). However, research in Nigeria on extension officers' knowledge and attitude towards an agricultural insurance programme has found that few extension officers knew about, and had a favourable attitude towards the insurance programme (Ajayi, 2013). Other previous survey studies of county-level agricultural extension officers in the USA also indicate that few agricultural extension officers were knowledgeable or felt they were knowledgeable in agricultural insurance as a risk management tool to teach farmers about it (Buzby, Skees, & Benson, 1992; Martin, Vergara, Patrick, Coble, Knight, & Baquet, 2003). It has also been concluded that extension officers with a favourable attitude towards an innovation were more in a position to communicate it to farmers than other officers with an unfavourable attitude (Ajayi, 2013; Jayaratne, Gaskin, Lee, Reeves, & Hawkins, 2007). Most of Ghana's smallholder farmers depend on free extension advisory services for their farming activities including the choice of technology to adopt. Agricultural extension services thereby to some extent exert influence on smallholder farmers' decisions on adoption. The Ministry of Food and Agriculture is part of the steering committee of the Ghana Agricultural Insurance Programme, and by extension, the various regional and municipal/district Departments of Agriculture are to play a role in communicating the insurance product to farmers. As a result, extension officers' knowledge and attitude towards the WII are essential if farmers are to adopt this as a risk management tool to mitigate the impacts of weather variability in the Upper East Region and the country at large.

1.2 Problem statement

Agricultural plays a vital role in Ghana, particularly the Upper East Region. Despite this, it is one of the most affected by weather variability, floods and or drought. Out-migration, as well as, engaging in off-farm activities are reported to be some of the risk-coping strategies used by most farm households in the region to cope with drought. Due to the impact of drought on farm

household livelihood, the WII scheme for drought was introduced to cushion farmers and other value chain actors from the impact of drought events in the Upper East Region. The WII scheme has been claimed to enable farmers to take other productive options by reducing the risk of climate-based crop failures. Despite the importance of WII, it has been reported to have a lower penetration than other insurance policies. Its demand is also said to depend on the farmers': risk profiles and the risk management strategies in place; and willingness to participate and pay for the insurance scheme. Also, it is dependent on farmers' economic, social, structural, and personal factors. However, little is known about the impact of these factors on farmers' demand for the WII scheme in the case of the Upper East Region.

Most smallholder farmers often require the expert advice of extension officers to adopt an innovation such as for WII scheme. This is because they trust extension officers due to their close working relationship with them over time. Previous studies have concluded that a farmer's access to extension services positively influence their decision to participate and pay for agricultural insurance schemes. However, there is evidence that indicates that some extension officers in parts of Nigeria and the USA are less knowledgeable in agricultural insurance schemes to teach farmers. Also, the attitude of extension officers towards an innovation impact on their motivation to communicate the innovation to farmers. This makes extension officers' knowledge and attitude towards the WII scheme important. However, little is known about extension officers' knowledge and attitude towards the WII in the region.

1.3 Research aim

The aim of the research, therefore, is to assess farmers' willingness to participate and pay for a WII scheme and to determine agricultural extension officers' disposition to communicate information regarding the scheme to farmers in the Upper East Region. The information arising from this research would enable the Ghana Agricultural Insurance Pool[1] (GAIP*), the Departments of Agriculture at the regional, municipal and district levels, and policymakers to make changes to ensure the success of the programme in the region and the country at large.

[1] It is a pool of 17 Ghanaian Insurance companies and 2 Ghanaian Reinsurance companies with other stakeholders as steering committee members.

1.4 Research questions

1. What production and market risk are farmers in the Upper East Region exposed to and what management strategies do they have in place?
2. What knowledge and attitude do farmers have about the WII scheme?
3. Are farmers willing to participate and pay for this insurance type, and what determines these?
4. What knowledge and attitude do agricultural extension officers have about the WII scheme, and what determines the officers' knowledge of this insurance type?

1.5 Research objectives

1. To identify the major risks to which farmers are exposed, and the risk management strategies they use to manage these risks.
2. To assess the knowledge about and the attitude held by farmers towards the WII scheme in the region.
3. To determine farmers' willingness to participate and pay for the scheme, and the factors determining these in the region.
4. To assess the knowledge about and the attitude held by agricultural extension officers towards the WII scheme in the region.
5. To identify the determinants of the agricultural extension officers' knowledge about the scheme in the region.

1.6 Organisation of the thesis

This thesis is organised into seven chapters. Chapter one highlights the background of the study. Chapter two is an overview of Ghana and the Upper East Region. The literature review relevant to the study is in chapter three. Chapter four highlights the methodology and methods used for the study. The empirical results of the study are presented in chapter five. The discussion of the results is presented in chapter six. Chapter seven is the conclusion and recommendation section of the thesis.

CHAPTER TWO - OVERVIEW OF THE REPUBLIC OF GHANA

2.1 Geographic location

Ghana, located on the west coast of Africa has a total land area of about 238 540 km^2. Ghana's extension from north to south is about 670 km, whilst its extent from east to west is about 560 km. The country borders Côte d'Ivoire to the west, Togo to the east, to the north with Burkina Faso, and to the south with the Gulf of Guinea and the Atlantic Ocean. The country has ten administrative regions (Frenken, 2005).

Figure 2.1 Map of Ghana

Source: Ghana Quest (2016)

2.2 The population of Ghana

Ghana's projected population in 2016 was about 28,308,301 people up from 24,658,823 people in 2010. Regarding sex, the female population was projected at 14,421,567 in 2016 from 12,633,978 in 2010, and the male population was also projected at 13,886,734 from 12,024,845 in 2010 (Ghana Statistical Service, 2016a)**.** This shows an increase in total population of 14.80% and also an increase in both female and male population by 14.15% and 15.48%,

respectively. The majority of households in the country are headed by males (65.3%) with female-headed households constituting about 34.7% (Ghana Statistical Service, 2013).

2.3 Agro-ecological zones

Ghana has five main agro-ecological zones depending on the climate of the area. This distinctiveness is seen in the natural vegetation and which is also affected by the soils. These agro-ecological zones are the Rain Forest, Deciduous Forest, Transitional Zone, Coastal Savanna and the Northern Savanna (Guinea and Sudan Savanna**)** (MOFA, 2010)**.** Table 2.1 gives specific details of the various agro-ecological zones in the country concerning mean annual rainfall and days in each growing period.

Table 2.1 Rainfall distribution by agro-ecological zones

Agro-ecological Zone	**Mean annual Rain (mm)**	**Growing Period (Days)**	
		Major season	**Minor season**
Rainforest	2,200	150-160	100
Deciduous forest	1,500	150-160	90
Transitional	1,300	200-220	60
Coastal	800	100-110	50
Northern Savannah:			
Guinea Savannah	1,100	180-200	NA
Sudan Savannah	1,100	150-160	NA

Source: (Meteorological Services Department, Accra) in MOFA (2010)

2.4 Climate, vegetation, and soils

Ghana's climate varies from one location to the other. The north is mostly hot and dry compared to other areas in the country. It is warm and relatively dry towards the eastern coastal belts, whilst that of the south-west corner is hot and humid. The annual average temperatures can range from 26.1 ^{0}C to about 28.9 ^{0}C from the coastal belt to the extreme north, respectively. Maximum temperatures which are usually recorded in Navrongo in the Upper East Region,

however, can reach about 40 ^{0}C (MOFA, 2010). Table 2.2 gives a summary of average rainfall data across the ten regions of the country between the periods of 2001 to 2009 collated by the meteorological services of Ghana.

Table 2.2 Regional Rainfall Data in mm (2001-2009)

Region	2001	2002	2003	2004	2005	2006	2007	2008	2009	9-Year Average	30-Year Average	% Change 2009/30 Year Average
Western	1,235	1,720	1,467	1,248	1,355	1,350	1,678	1,518	1,385	1,440	1,558	(11.1)
Central	1,156	1,305	1,178	949	1,124	1,462	1,330	1,361	1,195	1,229	1,252	(4.6)
Greater Accra	773	899	908	484	693	689	863	914	805	781	788	2.2
Eastern	1,150	1,583	1,054	1,174	994	1,410	1,328	1,454	1,211	1,262	1,340	(9.6)
Volta	1,027	1,263	1,245	1,215	1,139	1,093	1,195	1,436	1,212	1,203	1,180	2.7
Ashanti	1,136	1,637	1,326	1,098	1,118	1,384	1,542	1,412	1,380	1,337	1,345	2.6
Brong Ahafo	1,170	1,311	1,325	1,362	1,244	1,310	1,312	1,366	1,148	1,283	1,244	(7.7)
Northern	880	1,100	1,420	1,178	1,123	1,014	999	1,223	1,292	1,137	1,155	11.9
Upper East	936	898	1,117	613	791	925	1,320	902	884	932	912	(3.1)
Upper West	968	1,059	1,189	607	897	982	1,089	1,171	1,086	1,005	1,022	6.3
Total	**10,431**	**12,775**	**12,229**	**9,928**	**10,478**	**11,619**	**12,656**	**12,757**	**11,598**	**11,608**	**11,796**	**(1.0)**

Source: (Ghana Meteorological Agency) in MOFA (2010)

Ghana's vegetation varies from the south where it rains the most to the extreme north where rainfall is erratic and less as can be observed from the rainfall data in the table above. As a result, there are different vegetative covers from the south through to the middle belt and to the extreme north. Table 2.3 shows the various vegetation of the country from north to south (MOFA, 2010).

Table 2.3 The vegetation across Ghana

Vegetation zone	**Area (000 sq. km)**	**Percentage**
Guinea Savanna Woodland	147.9	62.0%
Deciduous Forest		
- *Celtis-Triplochiton* Association	37.3	15.6%
- *Antiaris Chlorophora* Association	27.0	11.3%
Rain/Deciduous Forest Eco-zone	8.4	3.5%
Rain Forest	7.5	3.2%
Thicket and Grassland	4.5	1.9%
Sudan Savanna Woodland	1.9	0.8%
Swamp and Lagoonal Vegetation	1.3	0.6%
Others	2.7	1.1%
Total	**238.5**	**100.0%**

Source: (Ministry of Lands and Forestry, Accra) in MOFA (2010)

Surface horizons soils are mostly sandy loams and loams. Coarse sandy loams to clays soils which are usually slightly heavy make up the lower soil horizons. The bottom of valleys is where heavy textured soils are mostly found. Coarse materials, in the form of gravel and stone, affect the physical properties of soils (MOFA, 2010).

2.5 The agricultural sector and its contribution to GDP

2.5.1 Farming systems and land use

Ghana's agriculture is dominated by smallholders with about 90% of farm holdings being less than 2 hectares. Large farms and plantations are mainly for the production of rubber, oil palm, and coconut in the southern part, whilst rice, maize, and pineapple production are on a relatively lower scale (MOFA, 2010). The agricultural system is traditional which involves the use of hoes and cutlasses with little mechanisation. The northern part of Ghana is, however, noted for the use of bullocks for ploughing (MOFA, 2010). Agricultural in Ghana is mostly rain-fed therefore production varies with rainfall distribution and soil factors. Intercropping, the cultivation of more than one crop on a piece of land at the same time, is a conventional cropping

system with mono-cropping mostly associated with large-scale commercial farms (MOFA, 2010).

Ghana has a total land area of 23,853,800 hectares of which the total agricultural land area is about 13,628,179 hectares (57.1%). The agricultural land area under cultivation and irrigation as of 2009 was about 7,311,500 hectares, and 29,804 hectares, respectively. However, the total agricultural land area not under cultivation is about 6,136,679 hectares (46.4%) (MOFA, 2010).

2.5.2 The agriculture sub-sectors

Ghana's agriculture has five main sub-sectors, that is Crops (cereal and starchy crops), Livestock (cattle, sheep, goats, pigs, and poultry), Fisheries (marine, inland, and aquaculture), Forestry, and Cocoa (MOFA, 2010). The agricultural sector as at 2016 contributed 20.3% to Ghana's GDP the third largest contributor after the industry sector (25.3%) and services sector (54.4%) (Ghana Statistical Service, 2016b). The various agriculture sub-sectors' contributions to the agriculture GDP is shown in Figure 2.2. The Crops sub-sector contributed about 68.0% which is the highest of the agriculture sector GDP, followed by Forestry and Logging which contributed 11.3%, Cocoa 9.4% to agriculture GDP with livestock and fisheries trailing.

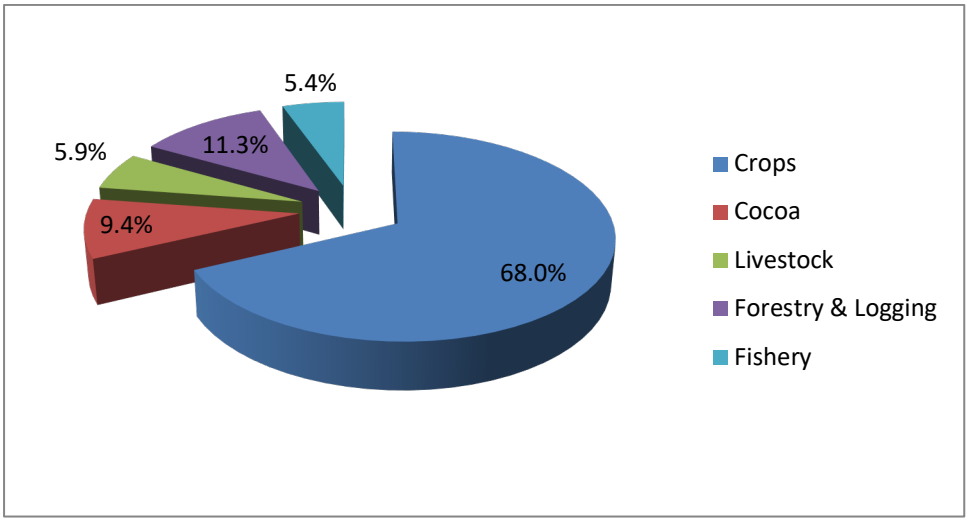

Figure 2.2 Agricultural sub-sectors contribution to GDP

Source: Adapted from (Ghana Statistical Service, 2016b)

2.5.2.1 The crop sub-sector

It is worthwhile to note that even though Cocoa is seen as a separate agricultural sub-sector, it is sometimes considered as part of the crop sub-sector. The three main food crop groups under the sector are the industrial crops (Cocoa, Oil Palm, Coconut, Coffee, Cotton, Kola, Rubber),

starchy and cereal staples (cassava, cocoyam, yam, maize, rice, millet, sorghum, plantain), and fruits and vegetables (pineapple, citrus, banana, cashew, pawpaw, mangoes, tomato, pepper, okra, eggplant, onion, Asian vegetables) (MOFA, 2010). Table 2.4 gives an overview of the production of selected food crops in Ghana.

Table 2.4 Production of selected food crops in Ghana (000MT)

Crop	**Year**				
	2005	**2006**	**2007**	**2008**	**2009**
Maize	1,171	1,189	1,220	1,470	1,620
Millet	185	165	118	194	246
Rice (Paddy)	237	250	185	302	391
Rice (milled)	142	150	111	181	235
Sorghum	305	315	155	331	351
Cassava	9,567	9,638	10,218	11,351	12,231
Cocoyam	1,660	1,660	1,690	1,688	1,504
Plantain	2,792	2,900	3,234	3,338	3,563
Yam	3,923	4,288	4,376	4,895	5,778
Total	**20,008**	**20,555**	**21,302**	**23,750**	**25,919**

Source: MOFA (2010)

2.6 Overview of the Upper East Region

2.6.1 Geographic location

Located in the north-eastern corner of the country and geographically, between longitude 0º and 10” West and latitudes 10º 30”N and 11º N is the Upper East Region of Ghana. The region borders Burkina Faso to the north and Togo to the east, the west by Sissala District in the Upper West Region and the south by West Mamprusi District in Northern Region. The capital is Bolgatanga, sometimes shortened to Bolga. Other big cities in the region include Bawku and Navrongo. The region is about 8,842 km^2 regarding area (Ghana Statistical Service, 2013).

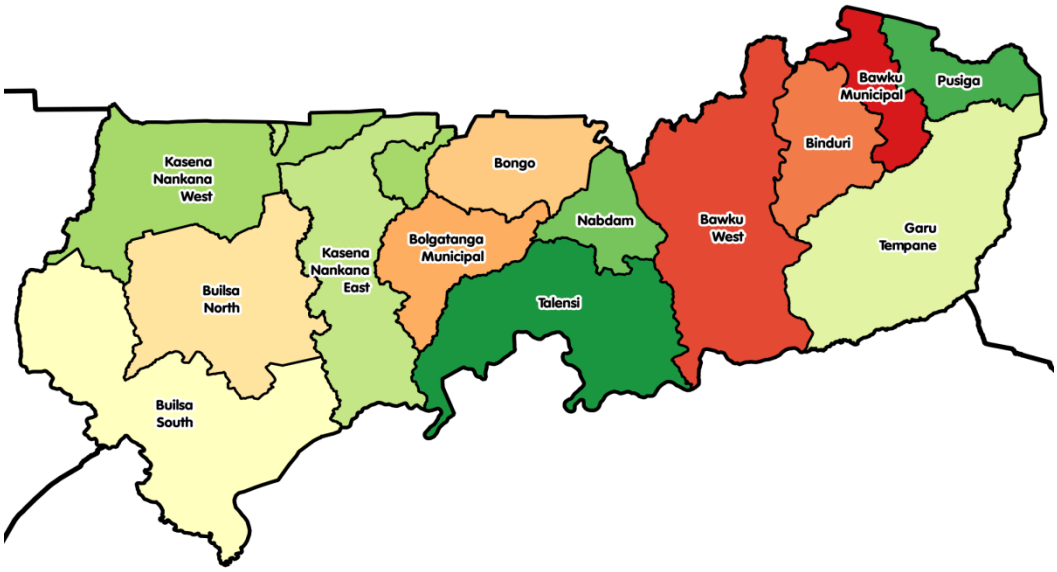

Figure 2.3 Map of the Upper East Region

Source: Wikipedia (2018)

2.6.2 Population

The projected population of the Upper East Region in 2016 was about 1,188,800 people from 1,046,545 people in 2010 an increase of about 13.60%. Concerning the population by sex, the female population was projected at 605,227 people in 2016 from 540,140 people in 2010, an increase of 12.05%, and the male population was projected at 583,573 people from 506,405 people in 2010, an increase of 15.24% (Ghana Statistical Service, 2016a). Agricultural households constitute 83.7% (148,660) of households in the Region. Agricultural household sizes differ depending on whether it is in the urban or rural area. Smaller agricultural households (1-3 people) are typical in urban areas whereas large household (7 or more people) are typical in the rural areas (Ghana Statistical Service, 2013). Concerning heads of households in the region in general, 77.8 % are headed by males. However, considering heads of agricultural households, 74.9 % are headed by males in the Region.

2.6.3 Climate (rainfall, temperature, and relative humidity)

The average rainfall in the region is about 921mm and ranges between 645mm and 1250mm. The region is associated with a unimodal rainfall distribution which results in a single growing period between April/May and September/October. There is a long dry season of about 6 to 7 months starting from October to April where the region experiences harmattan that is, dry winds with low humidity and temperatures (MOFA, n.d). In Navrongo, during the dry season

(Dec. to Feb.) annual average minimum temperatures can reach 15^{0}C, whilst the maximum can reach 45^{0}C from March to April. The relative Humidity ranges between 30% and 80% in the dry and wet seasons respectively. The dry harmattan winds with low humidity and low temperatures at night make the area suitable for the growing of horticultural crops like tomatoes, pepper, onions, watermelons, okra, and other leafy vegetables (MOFA, n.d).

2.6.4 Vegetation, soil, and drainage

The savannah woodland vegetation of the region is comprised mostly of short scattered drought-resistant trees and grasses that look scorched especially natural in the dry season. The area is almost semi-arid due to ecological interferences. (MOFA, n.d). The most common economic trees are the Shea nut, Dawadawa, Boabab, and Acacia (Ghana Statistical Service, 2013).

Soil formed from granite rocks make up most of the soil in the region. As such soils in the region are "*low in soil fertility, weak with low organic matter content, and predominantly coarse textured*" and erosion is a problem. Sandy loams to salty clay soils found in the valley areas, though are mostly fertile soils, are also difficult to plough and prone to floods. The White and Red Volta and Sissili Rivers serve as the main drainage in the region (Ghana Statistical Service, 2013).

2.6.5 Agriculture in the region

There are four types of agriculture in the Upper East Region that households are engaged in, that is crop farming, tree growing, livestock rearing, and fish farming households are engaged in. However, crop farming and livestock rearing are rather prominent in both urban and rural communities. Fewer people in the region undertake fish farming and tree growing because fish farming is entirely new and the initial capital investments are relatively high. Tree growing takes a long time for growers to reap the benefits hence is rarely undertaking (Ghana Statistical Service, 2013).

Concerning crop farming, the type of crops grown in the region depends on the climate, vegetation, soil, and drainage (Ghana Statistical Service, 2013). The crop types common in the area include the following as indicated by MOFA (2010):

- Cereals: Sorghum, Millet, Maize, and Rice
- Legumes: Groundnuts, Cowpea, Soybean and Bambarra beans

- Fibres: Kenaf, Cotton, and Kapok
- Roots & Tubers: Sweet Potato and Frafra Potato
- Vegetables: Okra, Pepper, and Leafy Vegetables
- Non-Traditional Export Crops: Sesame, Paprika, Cashew, Mangoes, Shea nuts.
- Irrigated Crops: Tomato, Onion, Water/Sweet Melon, Rice, Okra, Pepper, and Maize

As of 2010, the five most cultivated crops included millet, groundnut, rice, maize and beans which together accounted for 82.3 % of total farms in the Region. There are various cropping methods employed by agricultural households in the region such as mono, inter and mixed cropping. Cropping method depends on the type of crop grown (Ghana Statistical Service, 2013). The region has two main irrigation projects, the Vea Project in the Bolgatanga Municipality covering 850 hectares and the Tono Project in Navrongo covering 2,490 hectares, altogether providing a source of livelihood to about 6,000 small-scale farmers. Small dams and dugouts also provide water for both domestic and agricultural purposes (Ghana Statistical Service, 2013).

Livestock rearing which includes ruminants and non-ruminants and poultry comes second after crop farming in the region. Cattle, sheep, goats, and pigs, traditionally are the livestock kept by households in the region. Whilst chicken, turkey, guinea fowl, dove, duck, and ostriches are the birds that households rear (Ghana Statistical Service, 2013). The number of people rearing livestock and keeping birds is skewed towards the rural area and essentially a rural-based activity.

CHAPTER THREE - LITERATURE REVIEW

3.1 Introduction

This literature review consists of many sections. Section 3.2 takes a look at the definitions for key terms relevant to this research. Section 3.3 takes a look at risk in agriculture, the types and sources of risk in agriculture, agricultural risks in developing countries (some parts of Africa). Agricultural risk management strategies and agricultural risk management strategies of developing countries (Africa) are dealt with in section 3.4. Section 3.5 discusses types of agricultural insurance in general. Sections 3.6, 3.7, and 3.8 examine the literature on farmers' awareness, demand, and attitudes towards agricultural insurance, respectively. The factors influencing farmers' willingness to participate and pay for agricultural insurance are reviewed in section 3.9. Section 3.10 then examines agricultural extension officers' knowledge and attitude towards agricultural insurance as a risk management tool for farmers.

3.2 Definition of terms

3.2.1 Attitude

Even though the literature on attitudes is varied, their commonality is their evaluative nature of the subjects. According to Ajzen (2005, p. 3), "*an attitude is a disposition to respond favourably or unfavourably to an object, person, institution or event*". He further stated that the characteristic attribute of attitude is its "evaluative (pro-con, pleasant-unpleasant) nature". Attitude has also been defined as "*implicit responses that were sometimes unconscious and were oriented towards approaching or avoiding a given subject*" (Petty, Fazio, & Briñol, 2012, p. 1). For this research, the definition of attitude by Ajzen (2005), was adopted since it is quite straightforward and simple. As such, an attitude in this research would refer to the participant's disposition to respond favourably or unfavourably to the WII scheme in the Upper East Region.

3.3 Risks in agriculture

Hardaker et al. (2015, p. 5) distinguish between uncertainty and risk and thus define uncertainty as "*imperfect knowledge and risk as uncertain consequences, particularly, exposure to unfavourable consequences*". Kahan (2013) however, suggests that when the probability of an outcome is known in advance that is a risk, whilst when the probability of an outcome is not known a priori, it is called uncertainty. An illustration given by Hardaker et al. (2015) to further explain risk is the example of someone who is uncertain about the weather the next day

indicating an imperfect knowledge of the future. If the person goes ahead to plan a picnic for the next day, the associated risk is that it may rain. For this person to take the risk to go ahead with the picnic the next day, then, is to expose oneself to the consequences. According to Mahul and Stutley (2010), farmers face many risks which can jeopardise their farm productivity, income and consumption.

Risks are important because most people dislike it and most often it is a downside risk. Downside risks as explained by Hardaker et al. (2015) arises when a substantial deviation from the usual outcome (e.g. rainfall and or temperature) leads to a worse outcome, in the case of crops, low yields resulting from a deviation from the above factors. Regarding disliking it, when faced with risky incomes or wealth situations most people tend to be risk-averse that is, these people are willing to trade-off some gains to avoid the risk (Hardaker et al., 2015). Agricultural producer's level of risk aversion to some extent determines their risk management decisions which may include the adoption of agricultural insurance (Mahul & Stutley, 2010). Kahan (2013) classifies the attitudes of farmers towards risk under three categories, that is risk-averse (dislike risk), risk-takers (open to risk) and risk neutral (indifferent about risk). Risk aversion, therefore, is vital in the analysis of risky choices because, most farmers may not take a decision that predisposes them to significant unacceptable levels of loss even if there are long-term benefits (Hardaker et al., 2015).

3.3.1 Types and sources of risk in agriculture

Hardaker et al. (2015) and Kahan (2013) both have identified and classified risk in agriculture into five main categories. These are production and technical, price or market, institutional, human and financial risks.

Production and technical: these are risks associated with the uncertainties surrounding the nature of the weather and the poor performance of crops and livestock which may arise from pests and diseases or any other unpredictable factors such as the breakdown or unavailability of equipment or spare parts. Weather-related risk such as erratic rainfall, and drought or floods have severe repercussions for crop farmers in the Upper East Region as they can result in a reduction, or total loss, of crop yields on the farm. The same can be said of crop pest and diseases outbreaks on farms in the region as an outbreak can also reduce or destroy an entire farm's crop production.

Price or market: this is the uncertainty associated with input and output prices over a production period due to demand and supply dynamics, changes in consumer preferences and incomes. Input price fluctuations could negatively affect the scale of production a farmer may intend to cultivate in the Upper East Region as a sudden rise in input prices may lead to either a reduction in the scale of production or the use of less of the required inputs. Output price fluctuations could also expose farmers to post-harvest losses as they store their farm produce hoping for a better price shortly, and any reduction in output prices can reduce revenues. Input and output price uncertainties may altogether impact on a household's food security in the region.

Institutional: these are the risks associated with policy changes by governments and other formal or informal agencies such as banks, cooperatives, or extension services that provide services to support the farm business and may have significant consequences for farming. For example, policy changes on the disposal of animal manure, restricted pesticide use, or changes to income tax provisions among others. For farmers, in the region who are mostly smallholder farmers and depend mostly on public extension services, they are affected by the government's change of policy to make extension services private as this will impact negatively on their farm households and their livelihoods.

Human: the risk arising from workers or owners of the farm business. These could be the death of the farmer, a long-term ailment of the owner or one of the owners, carelessness of a worker in the use of equipment, can have the consequences of terminating the business. Migration or social or political unrest which causes possible shortages of farm labour is another source of human risk to the farm business. Risks such as long-term ailment, migration and social unrest have consequences for farmers in the Upper East Region because farming is mostly dependent on the use of manual farm tools which require the use of labour including family labour. The long-term ailment of productive family members means loss of family labour. Migration and social unrest lead to labour shortages as they are not available which altogether affect household farm production, productivity and subsequently food security in the region as a whole.

Financial: the risk associated with the use of credit such as sudden rise in interest rates on loan, the unavailability of credit to borrow when needed, the unexpected call-in of a loan, or the unwillingness of a lender to continue to provide credit, as well as, the fluctuations in the inflation rates which all have consequences for the farm enterprise. Most farmers in the region

would depend on external sources of finance such as friends and relatives, money lenders, rural, and commercial banks, especially after having paid their wards' school fees, to support their farm enterprises. Therefore, financial risks such as a rise in interest rates, unavailability of credit among others have consequences for farmers in the region, as they either do not get the required finance to fund their farming or they having to sell their farm produce or productive assets to pay back interest on loans. These altogether have implications for household food security in the long run.

Business: the combined effects of all other risks except for financial risk on the farm business has been termed by Hardaker et al. (2015) as the business risk and these impact on the performance of the business regarding net cash flow arising from the farm enterprise.

On the other hand, although Shadbolt and Martin (2005) agrees with the classification of risks broadly into business and financial risks, what constitutes a business risk to them is that of production and price risks and, therefore, argue that the classification does not cover other sources of risks. As a result, they treat other sources of risk such as human and institutional risks as separate risks and have introduced another dimension of risk known as scale risk. Scale risk is technology related and is associated with the risk of being too small relative to the economic size of farm unit increment.

Besides the general classification of risk into five main areas by Hardaker et al. (2015) and Kahan (2013), Mahul and Stutley (2010) also identify various types of risks that a farmer may face such as natural disasters, pest and diseases, prices, financial, operational, environmental, policy, health and property risks. Even though these classifications are not very different from the previous classifications of risk, Mahul and Stutley (2010) further classified the types of risks under two main categories, which are idiosyncratic and systemic risks. Idiosyncratic risks are those risks that affect farmers independently such as hail (natural disaster risk); illness, injury, and disability (health risk); and fire and theft (property risk). Systemic risks are those risks which affect many farmers at the same time such as drought (natural disaster risk); contagious animal disease (pest and diseases risk); input and output prices and exchange rates (prices risk); interest rates (financial risk); public subsidies and agricultural policy (policy risk); and earthquakes and flood (property risk).

Whereas, with idiosyncratic risks such as fire or injury, a farmer may be able to call on friends and relatives for cushioning especially in times of exposure, the same cannot be said for systemic risk. This is because systemic risks such as floods, droughts or pest and diseases affect

almost an entire community or area and the friends and relatives in the community the farmer may depend on, probably too could be suffering from the same peril. Some of these risks are unavoidable and coping strategies available may not be enough to prevent adverse effects on a farm household's livelihood. Farmers may have to transfer some of these risks, especially those associated with production, such as floods, or droughts to third parties so that in the event of an occurrence they can be compensated. Systemic risk, therefore, presents farmers with an opportunity to make use of risk transferring strategies such as insurance when community-level risk management and coping strategies prove to be inadequate to deal with systemic risk.

3.3.2 Agricultural risks in developing countries (some parts of Africa)

The literature on the risks that farmers in Ghana and some parts of Africa face is mostly that of production risk (Abebe & Bogale, 2014; Assan et al., 2009; Kouamé, 2010; Kwadzo et al., 2013). The purpose of the review in this section is to explore the range of risk to which farmers are exposed. Some of the risks that farmers have had to deal with include, but are not limited to, the following: bushfires (Ellis, 2017a; Kwadzo et al., 2013), droughts (Abebe & Bogale, 2014; Assan et al., 2009; Ellis, 2017a; Isaboke, Qiao, Nyarindo, & Ke, 2016; Kouamé, 2010; Kwadzo et al., 2013), floods and windstorms (Ellis, 2017a; Kwadzo et al., 2013), and crop pest and diseases (Abebe & Bogale, 2014; Ellis, 2017a; Isaboke et al., 2016; Kouamé, 2010; Kwadzo et al., 2013). Others include theft of farm produce, damage to crops by grazing livestock (Kwadzo et al., 2013), loss of soil fertility (Abebe & Bogale, 2014), access to inputs, and ill health/death of farmer (Kouamé, 2010). Of the production risks identified, weather-related risks (floods, droughts and windstorms) were reported to be the primary sources of risks and cause the most havoc to farmers' livelihood (Abebe & Bogale, 2014; Assan et al., 2009; Ellis, 2017a; Isaboke et al., 2016; Kwadzo et al., 2013) because these farmers were mostly reliant on rain-fed agriculture.

In the northern part of Ghana especially the Upper East Region, Assan et al. (2009) reports that rainfall and temperature variability which leads to drought is a significant production risk that has implication for agriculture in the area. Ellis (2017a) and Kwadzo et al. (2013) also reported weather-related risks (droughts, floods, windstorms) and bushfires to be significant risks, among others such as theft of farm produce, damage of crops by grazing livestock, and crop pests and disease, that farmers in the southern parts of Ghana (Eastern Region and Kintampo North Municipality) were exposed to. However, it was noted that bushfires and windstorms were more frequent than drought and floods even though they all impacted significantly on

farmers with their occurrence (Kwadzo et al., 2013). Elsewhere in Africa, in the Central Rift Valley of Ethiopia, it is also reported that drought is a significant source of risk followed by crop failure due to diseases and loss of soil fertility in that order (Abebe & Bogale, 2014). Côte d'Ivoire which shares a border with Ghana, cocoa farmers were reported to be exposed to risks such as droughts, crop pests and diseases, input access, output price fluctuation, and ill health of farmer. Isaboke et al. (2016) also reported drought, input cost, and crop pests and diseases, respectively, as the most important risk to smallholder farmers in the Embu County, Kenya. Output price fluctuations of cocoa, crop pests and diseases, and input access instability were the three most important risks to cocoa farmers in Côte d'Ivoire (Kouamé, 2010). The review has shown that the risks to which farmers are mostly exposed are main production risk as discussed in the previous section.

3.4 Agricultural risk management strategies

Mahul and Stutley (2010) defined risk management as "*actions taken including physical mechanisms (spraying against aphids, using hail netting, planting windbreaks) and financial mechanisms (hedging, insurance, and self-insurance) to prevent or reduce losses caused by undesirable events"*. Hardaker et al. (2015) however, also defines risk management as "*the systematic application of management policies, procedures and practices to the tasks of identifying, analysing, assessing, treating and monitoring risk*".

Strategies to reduce risk can be put into two categories such as risk management and risk coping (Mahul & Stutley, 2010) where the former deals with measures to address risk ex-ante, whilst the latter deals with measures to address risk ex-post. Mahul and Stutley (2010) go ahead to differentiate between technical and financial risk management strategies with the former associated with low-risk production, pest prevention, irrigation, livestock disease prevention, on-farm and off-farm diversification; and the latter associated with insurance, hedging, precautionary savings and contingent borrowing.

3.4.1 Agricultural risk management strategies in Developing Countries (Africa)

The literature on the risk management or coping strategies used by farmers in some parts of Africa to mitigate or cope with risk exposures is vast and mostly technical-based rather than financial measures (Abebe & Bogale, 2014; Aidoo et al., 2014; Apata, 2011; Assan et al., 2009; Berman, Quinn, & Paavola, 2015; Ellis, 2017a; Kwadzo et al., 2013; Obayelu, Adepoju, & Idowu, 2014). The purpose of the review in this section is to explore the range of risk

management strategies that are most used by farmers to manage various risk exposures. Most of the technical risk management or coping strategies employed by farmers include, but are not limited to, the following: out-migration (Assan et al., 2009), non-farm economic activities (Assan et al., 2009; Berman et al., 2015; Isaboke et al., 2016; Kwadzo et al., 2013; Obayelu et al., 2014), farm and/or crop diversification (Abebe & Bogale, 2014; Aidoo et al., 2014; Apata, 2011; Ellis, 2017a; Isaboke et al., 2016; Kouamé, 2010; Kwadzo et al., 2013; Obayelu et al., 2014), use of improved crop varieties (with respect to pests and drought) (Aidoo et al., 2014; Apata, 2011; Kwadzo et al., 2013; Obayelu et al., 2014), sale of productive assets, and intercropping (Abebe & Bogale, 2014; Kwadzo et al., 2013). Other strategies include variation in planting dates (Apata, 2011; Kwadzo et al., 2013; Obayelu et al., 2014), reliance on low risk inputs (Kwadzo et al., 2013; Obayelu et al., 2014), use of family labour, and share-cropping (Kwadzo et al., 2013), planting different fields, use of improved technology, and delay in sale of crops (Abebe & Bogale, 2014), water and soil conservation (Apata, 2011; Berman et al., 2015; Obayelu et al., 2014), irrigation and planting trees (Apata, 2011), and use of social support (Berman et al., 2015; Kouamé, 2010). With respect to the financial risks management and coping strategies used by farmers they include the following: borrowing from friends and relatives (Ellis, 2017a; Kwadzo et al., 2013), use of savings (Berman et al., 2015; Ellis, 2017a; Isaboke et al., 2016; Kouamé, 2010), use of marketing and production contracts (Ellis, 2017a), hedging and vertical integration (Aidoo et al., 2014) and use of weather index insurance (Isaboke et al., 2016).

In the Bongo District of the Upper East Region of Ghana, some farmers have had to cope with the occurrence of drought by either out-migrating or engaging in off-farm economic activities (Assan et al., 2009). Besides drought having implication for agriculture in the area, out-migration also causes shortages of labour. In southern Ghana where weather-related incidence and bushfires have been reported to be the main risks to farmers, the most frequently used options were crop diversification and improved crop varieties (Aidoo et al., 2014; Ellis, 2017a; Kwadzo et al., 2013) among others, such as borrowing from friends and relatives, using savings, use of low-risk inputs, and sale of productive assets.

Farm or crop diversification has been reported to be the most commonly used risk management strategy by farmers in other parts of Africa (Apata, 2011; Isaboke et al., 2016; Kouamé, 2010; Obayelu et al., 2014). In the Ekiti State and Southwest of Nigeria, to mitigate and cope with the risk associated with climate variability, farmers mostly used or combined a number of the technical-based risk management or coping strategies. These include crop diversification,

variation in planting dates, or soil and water conservation methods among others (Apata, 2011; Obayelu et al., 2014). In Côte d'Ivoire, cocoa farmers either use one or a combination of the following risk management strategies: crop diversification, precautionary savings or reliance on social networks to cope with cocoa output price fluctuations, crop pest or disease outbreaks, and input access risk (Kouamé, 2010). Farm households in western Uganda, depending on the risk exposed (floods or droughts), used different coping strategies (Berman et al., 2015). Agricultural practices (soil conservation), off-farm income generating activities and dependence on a social support are the commonly used coping strategies for floods. Off-farm income-generating activities, use of savings, and dependence on social support were the most commonly used strategies in times of drought. Isaboke et al. (2016) reported that off-farm activities, use of savings, and crop diversification, respectively, were the most important risk management strategies against drought and hunger, whilst weather index insurance was the seventh most crucial strategy out of ten strategies.

The above literature on risk management strategies used so far by farmers especially in Africa to manage and cope with risk can be said to be mostly technical-based. Little mention is made of the use of financial risk management strategies such as insurance as a major risk management strategy. The only exception is the use of precautionary savings or borrowing from friends and relatives. Farmers rarely use other financial risk management strategies such as marketing and production contracts, hedging, vertical integration, and WII. If this is anything to go by, then these other strategies already in place could crowd out crop insurance including weather index-based insurance for farmers in these areas. This concern has been pointed out by Guo (2016) in Nepal where it is reported that the risk management strategies being employed by farmers make it less likely for them to engage in any crop insurance program.

3.5 Agricultural crop insurance

Indemnity based and index-based crop insurance are the two main types of agricultural crop insurance (Bryla-Tressler, 2011). Indemnity based crop insurance is further divided into damage-based (Named Peril) and yield-based (Multiple Peril) crop insurances whilst index-based insurance is divided into area yield and weather index-based insurance. For this research, the interest is on index-based insurance mainly weather index-based insurance, notwithstanding this, indemnity-based insurance is briefly highlighted.

3.5.1 Indemnity- based crop insurance

With damage-based (Named Peril) indemnity crop insurance, the payment of a claim is based on a percentage of the damage measured on the policyholder's field soon after the damage occurs. It is expressed as a percentage and applied to the sum insured which may be based on the total cost of production or expected revenue (Bryla-Tressler, 2011; Mahul & Stutley, 2010). Yield-based insurance, on the other hand, depends on the establishment of a historical average yield of a farmer upon which the insured yield is a percentage (50-70%) of that yield. A farmer receives a claim when actual yields fall below the insured yield (Bryla-Tressler, 2011; Mahul & Stutley, 2010).

3.5.2 Index-based crop insurance

For area yield index insurance, the indemnity is not based on the actual yields of the client but the average yield of the region, district or area. The client insures the yield which is a fixed percentage of the average yield for the area. The client receives a payout when the average yield of the area for the particular year is less than the insured yield, irrespective of the client's actual farm yield for the year. Area yield index insurance requires reliable historical area yield data for the establishment of the standard average yield and the insured yield (Bryla-Tressler, 2011; Mahul & Stutley, 2010).

Weather Index Insurance (WII) is based on the collection of data on a particular weather parameter (rainfall and or temperature) that has been measured over a particular period at a particular weather station. The insurance can be designed to give protection to farmers in the event of excess or shortage of rainfall (flood and drought, respectively) that is detrimental to crop growth hence results in yield and or financial losses. Payment of a claim is triggered when rainfall amount measured which is the index, exceeds or is less than a predetermined threshold in the case of protection for floods and droughts, respectively. The indemnity is calculated based on a pre-agreed sum insured per unit of the index (Bryla-Tressler, 2011; Mahul & Stutley, 2010).

The advantages of Index Insurance including WII is its ability to reduce or eliminate the problem of moral hazard, and adverse selection associated with indemnity-based insurance. This is because the payment of the claim is based on an external parameter that is not affected by the policyholder or the insurer (Bryla & Syroka, 2007; Giné et al., 2008; Hess & Syroka, 2005; Tadesse et al., 2015). It also reduces the transaction cost involved because the index upon which indemnification is based on, that is rainfall amount, is an objectively verifiable and

measurable variable that can be obtained at a weather station. Also, it does not require the assessment of individual policyholder's farm hence reduces the time required to settle claims due (Bryla & Syroka, 2007; Hess & Syroka, 2005; Molini, Keyzer, van den Boom, & Zant, 2008; Tadesse et al., 2015).

The potential of Index insurance cannot be overemphasised. Karlan et al. (2014) emphasised that, with insurance, farmers can make relatively more substantial investments (production expansion) as well as take riskier production choices in agriculture. Index insurance has given farmers the opportunities to make more money, protect their assets, increased food security in bad years, and increased access to services such as credit (Bryla & Syroka, 2007; Greatrex et al., 2015) which enable them to make investments in high-yielding crop varieties, production technologies, or access high end markets (Bryla & Syroka, 2007).

Nonetheless, the problem smallholder farmers have with WII is the associated basis risk, which is made worse by the poor quality of data used for the index calibrations especially in low income countries (Barnett, Barrett, & Skees, 2008; Clarke, 2016; Cole, Giné, Tobacman, Topalova, Townsend, & Vickery, 2013; Hill, Hoddinott, & Kumar, 2013; Osgood, McLaurin, Carriquiry, Mishra, Fiondella, Hansen, Peterson, & Ward, 2007). Basis risk is the low correlation or mismatch between actual losses suffered and the amount of the insurance pay-out received by individual clients (Bryla & Syroka, 2007; Collier et al., 2009; Jensen & Barrett, 2017). As a result, a farmer may suffer losses without receiving payments or receive payment without incurring losses (Smith & Watts, 2009). Basis risk arises when there are spatial variations in the weather variables, mostly associated with micro-climates, differences in farm management practices, soil quality or crop varieties (Collier et al., 2009).

3.5.2.1 The operations of a WII contract

The WII scheme as explained by Muamba and Ulimwengu (2010), operates with two pre-set rainfall volume levels, that is, a threshold and a limit. The threshold is a trigger for insurance pay-out to the clients, and the limit is the minimum level of rainfall volume that entitles a policyholder to a maximum insurance pay-out as stipulated in the insurance contract. Therefore, as the recorded rainfall level falls below the threshold, the policyholder will begin to receive insurance pay-out in proportion to the volume dropped relative to the limit. At the limit, the policyholder would be entitled to receive a maximum payout. Muamba and

Ulimwengu (2010) illustrate the operations of an insurance contract for drought in the following example with these details:

- *Index variable: seasonal rainfall volume measured at a local weather station*
- *Threshold: 100 millimetres of rainfall*
- *Limit: 50 millimetres of rainfall*
- *Liability purchased by the policyholder: $50,000*
- *Payment rate: = (threshold − actual value)/(threshold − limit)*
  = (100 − actual value)/ (100 − 50)
- *Indemnity payment: The payment rate multiplied by the total liability:*
  = (100 − actual)/ (100 − 50) × $50,000

Referring to the Table 3.1 and Figure 3.1 (reading the graph from right to left), a rainfall volume of 110 mm will not trigger insurance pay-out to any policyholder since this is above the threshold. However, the moment the accumulated rainfall volume reaches the threshold the insurance pay-out to policyholders is triggered. The amount paid to policyholders, increases as the actual rainfall collected moves from the threshold to the limit, where the insurance pay-out no longer increases even with lower rainfall volumes.

Table 3.1 Indemnity payments for different rainfall level

Total Rainfall (mm)	Indemnity Payment Due
110	None. The threshold has not been reached.
80	(100 − 80)/(100 − 50) × 50,000 = $20,000
50	(100 − 50)/(100 − 50) × 50,000 = $50,000
40	$50,000. 50-millimeter limit has been exceeded.

Source: USAID, (2006) in Muamba and Ulimwengu (2010)

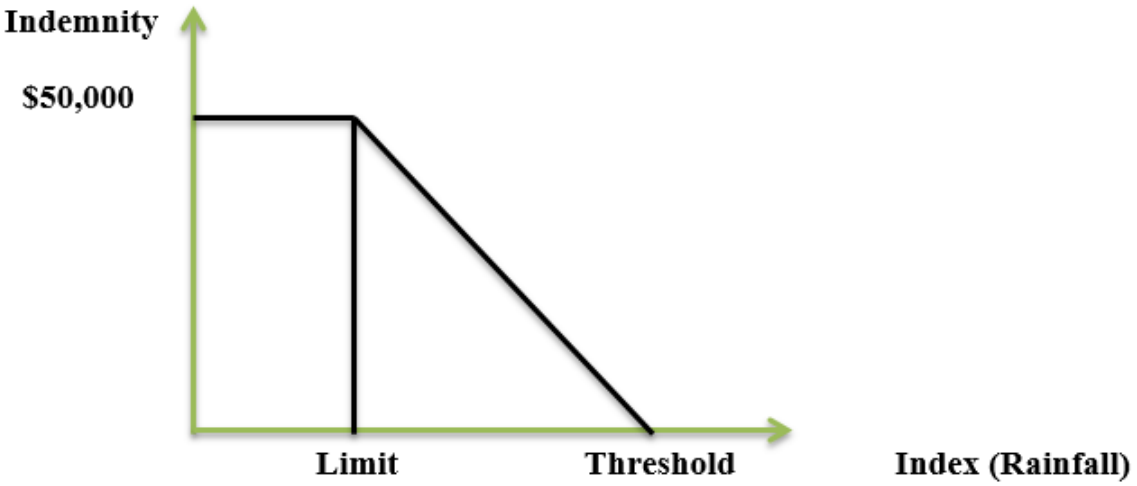

Figure 3.1 Indemnity schedule for a standard unit contract

Source: USAID, (2006) in Muamba and Ulimwengu (2010)

3.5.2.2 WII contract for drought in India and parts of Africa

A three-phase insurance contract for rainfall deficit designed by ICICI Lombard, with technical assistance from the World Bank was piloted for groundnut and castor farmers in Andhra Pradesh, India, based on the growing period of the crop with each growing phase having a trigger and a limit (Giné et al., 2008). This design has been piloted in Malawi, Kenya, and Tanzania as well as other parts of Africa (Bryla & Syroka, 2007). As explained by Giné et al. (2008), in the contract design for the rainfall deficit insurance, the season has three phases, that is sowing, podding/flowering, and harvesting. No payout is made as long as the accumulated rainfall stays above the threshold for each phase. However, a fixed payout is made for each millimetre drop in the accumulated rainfall below the threshold until the limit is reached. A higher fixed pay-out is made for accumulated rainfall below the limit in each phase. Thereby, the total payout for the insurance contract is the sum of the pay-out of the three phases.

3.5.2.3 WII contract design for drought in Ghana

In Ghana, the WII for drought follows from that of India and others in Africa (Malawi, Kenya and Tanzania) with slight variations. The contract which covers maize and soya bean crops has three phases: germination, crop growth, and flowering stages. For the first two phases of the insurance contract, each phase's insurance pay-out is triggered when there are more than 13 consecutive dry days with less than 2.5mm rainfall daily. The third phase's insurance pay-out is triggered when there is less than 125 mm of rainfall recorded at the nearest rainfall station (radius of 20km) during that phase. Insurance payout is 30%, 50% and 100% of production cost for the first, second and third phases, respectively.

3.6 Farmers' awareness of WII schemes

There is evidence to show that farmers' awareness level of agricultural insurance[2] including WII as a risk management tool vary (Akintunde, 2015; Falola, Ayinde, & Agboola, 2014; Jin, Wang, & Wang, 2016; Kumar, Barah, Ranganathan, Venkatram, Gurunathan, & Thirumoorthy, 2011; Nimoh, Baah, & Tham-Agyekum, 2011; Okoffo, Denkyirah, Adu, & Fosu-Mensah, 2016). The purpose of this review is to identify from previous research farmers' awareness of agricultural insurance in various countries across Africa and other developing countries as a risk management tool. In Ghana, where some level of research has been done on

[2] Unless explicitly specified, agricultural insurance includes the weather index-based insurance (WII)

crop insurance based on the WII, Ellis (2017b) found that about 51% of a sample of 208 cereal farmers in the Eastern Region were aware of crop insurance. On the contrary, Okoffo et al. (2016), and Nimoh et al. (2011) in the Dormaa District and Sekyere West Municipality of Ghana, respectively, all in the southern part of the country, reported that cocoa farmers were less aware of any crop insurance programme. In rural China, a relatively high percentage of farmers (70% of a sample of 200 farmers) were found to be aware of WII programme (Jin et al., 2016).

Concerning other forms of agricultural insurance including that of livestock insurance, research so far indicates that most farmers are aware of agricultural insurance as a risk management tool in some parts of Nigeria and India (Akintunde, 2015; Falola et al., 2014; Kumar et al., 2011). In South West and Ondo States of Nigeria, Akintunde (2015) and Falola et al. (2014) report a relatively high level of awareness of livestock insurance policies and agricultural insurance among poultry farmers (59.6% of a sample of 403 farmers) and cocoa farmers (77.5% of a sample 120 farmers), respectively. Similarly, Kumar et al. (2011) in Tamil Nadu, India found that 65.3% of a sample of 600 farmers were aware of government and other organisations risk mitigating activities for farmers, however, only about 50% of the target farmers were aware of crop insurance products. However, these researchers did not provide information about the level of knowledge these farmers in their various study knew about the insurance schemes.

A farmer's awareness of agricultural insurance does not imply a full understanding of insurance operations especially the WII. In seeking to ascertain how farmers understand crop insurance as a means to manage risk associated with climate variability, Patt, Suarez, and Hess (2010) reported that many farmers even after learning about index insurance through a simulation game or conventional educational learning session, still did not understand most of the basic concepts of the index insurance. As such, they were unable to make an informed decision to purchase the index insurance. Similarly, Giné et al. (2008) concluded that some households did not even understand the rainfall index insurance product and thus relied on other farmers' recommendations to make a purchase. Several other studies have also made mention of the critical role lack of understanding and trust in index insurance by smallholder farmers has played in reducing the effectiveness of this type of insurance (Churchill, 2006; Cohen & Sebstad, 2006; Dercon, Kirchberger, Gunning, & Platteau, 2009).

With regards to farmers' awareness of agricultural insurance the following were found to be their sources of information: the media, agricultural extension officers, insurance companies

(Ellis, 2017b; Jin et al., 2016; Nimoh et al., 2011; Okoffo et al., 2016), farmer-based organisations, friends and relatives, NGOs (Ellis, 2017b; Jin et al., 2016; Okoffo et al., 2016), and banks and financial institutions (Ellis, 2017b) . Kumar et al. (2011) emphasised that farmers with higher educational levels and who participate in farmer-based organisations were more likely to be aware of agricultural insurance programmes than other farmers.

3.7 Farmers' demand for, and willingness to participate in WII schemes

Even though, the available literature on the demand for WII indicates a low or moderate demand for insurance (Arshad, Amjath-Babu, Kächele, & Müller, 2016; Cole et al., 2013; Giné et al., 2008; Jin et al., 2016; Kumar et al., 2011), there is, however, a reported high level of willingness to adopt WII among farmers especially in some parts of Africa (Abebe & Bogale, 2014; Aidoo et al., 2014; Ellis, 2017b; Issaka, Wumbei, Buckner, & Nartey, 2016). The purpose of this review is to examine the demand for, and the willingness to participate in WII among farmers as a risk management tool for weather-related perils, and some of the reasons for the use or otherwise.

Jensen and Barrett (2017) after a review of the literature on the demand for index insurance by farmers concluded that despite the high supply of index insurance products especially, in developing countries, adoption, as well as the level of coverage is still low. In India, the adoption of rainfall index crop insurance among farmers has been reported to be low (Cole et al., 2013; Giné et al., 2008; Kumar et al., 2011). In Tamil Nadu, India, 31.3% in a sample of 600 crop farmers had adopted (Kumar et al., 2011), whilst 5-10% of household heads were reported to have purchased rainfall deficit insurance even though rainfall variability happens to be the most important risk farmers faced (Cole et al., 2013). Giné et al. (2008) stated that barriers such as cash constraints have made it impossible for rainfall index insurance to successfully reach the most vulnerable households who will most benefit from protection against drought. Similarly, in other agricultural insurance programmes such as livestock insurance in Nigeria, Ajieh (2010) and Akintunde (2015), also reported a low adoption of livestock insurance among poultry farmers.

The fundamental reasons for not adopting agricultural insurance as given by some farmers include, but are not limited to, the following: inadequate knowledge about the benefits of insurance, high premium rates (Ajieh, 2010; Jin et al., 2016), cash constraints (Jin et al., 2016), unsatisfactory terms and conditions of the insurance policies, non-payment of claims even with

losses, (Chizari, Yaghoubi, & Lindner, 2003; Jin et al., 2016), as well as some negative attitudinal issues towards insurance (Ajieh, 2010). Jensen and Barrett (2017) suggest that poverty and product relevance may be the cause of the low demand. This is because poor farmers usually lack the cash to purchase insurance, whilst some use other risk management strategies such as migration, diversification, or informal risk pooling, and may not see the value in index insurance. Fiala (2017) proclaimed that despite the importance of rainfall insurance as a tool to reduce low-income households' vulnerability, its low adoption rates could be explained by both demand and supply side. On the supply side, administrative and overhead costs of insurance providers are likely to make insurance premiums relatively higher, and because these tools are meant for vulnerable low-income households, demand will be affected (Fiala, 2017). On the demand side, various factors including social factors (risk aversion, trust and financial literacy), structural factors (informal risk-sharing instruments and individual risk exposure), economic factors (insurance premium, and household's wealth and income), and personal factors (age and gender) all together influence individual demand (Eling et al., 2014; Fiala, 2017).

Giné et al. (2008) and Jin et al. (2016) however, reported a relatively high adoption of WII in both India and China, respectively. In rural China, the reasons for the adoption of WII by some farmers included, but are not limited to the following: insurance subsidy from the government, high probability of climate risks occurring in the future, and affordable premiums (Jin et al., 2016). In Andhra Pradesh India, rainfall index insurance uptake was high among BASIX's (an insurance company) primary clients. The primary reasons for the purchase of rainfall index insurance included, but are not limited to risk reduction, to obtain money for harvest, the advice of progressive farmers, the patronage of insurance by trusted farmers, and the high expected pay-out or low insurance premium rates (Giné et al., 2008). In Turkey where Gulseven (2014) reported a relatively high adoption of crop insurance, it was primarily because agricultural (crop) insurance was a legal requirement to obtain credit. Other reasons, however, included protection against losses, patronage of insurance by friends and relatives, and the involvement of government through sponsorship or advertisement.

With respect to farmers' willingness to participate in agricultural (crop) insurance, research has found that a fairly high number of farmers are willing to participate in WII schemes (Abebe & Bogale, 2014; Aidoo et al., 2014; Ellis, 2017b; Issaka et al., 2016) and other crop insurance programmes (Falola et al., 2014; Ghazanfar, Wen, Abdullah, Ahmad, & Khan, 2015; Okoffo et al., 2016) in Ghana as well as across some parts in Africa, with a few exceptions. Separate

research in the southern part of Ghana which has a fairly good rainfall pattern reported that most cereal (maize) and cassava farmers were willing to participate in WII scheme for protection against drought (Aidoo et al., 2014; Ellis, 2017b). A similar study in the northern part of the country (in Nanumba District) where weather variability regarding rainfall is a major problem in general, also reported a high willingness to participate in WII scheme for drought by farmers (Issaka et al., 2016). This is an indication that crop farmers in the country, in general, are concerned about weather variability and its impacts on farming households. Elsewhere in Ethiopia similar studies to determine the factors that affect farmers' maximum willingness to pay for rainfall insurance also revealed that about 89% of a sample of 161 household heads were willing to participate and pay for rainfall-based insurance in Central Rift Valley of Ethiopia (Abebe & Bogale, 2014). In other crop insurance programmes in Nigeria and Ghana, similar studies also revealed that cocoa farmers were willing to participate in agricultural (crop) insurance mainly to guard against theft and other perils (Falola et al., 2014; Okoffo et al., 2016). Other reasons for farmers' willingness to participate in agricultural insurance were: protection of the farm against uncertainties, to have access to government assistance, and insurance as a buffer (Nimoh et al., 2011). Contrary to this, Christiaensen, Karfakis, and Sarris (2006) reported that less than 50% of households (47% in Kilimanjaro and 34% in Ruvuma) in Tanzania were interested in rainfall-based insurance. Because households in Kilimanjaro did not have the funds to pay for insurance at any premium rate, whilst in Ruvuma drought was infrequent and even when it occurred the harm was not significant. Other studies also reported the following reasons for which farmers were not interested in crop insurance schemes: not enough information about the scheme (Ellis, 2017b; Nimoh et al., 2011), insufficient funds to purchase insurance (Abebe & Bogale, 2014; Ellis, 2017b; Kouame & Komenan, 2012; Nimoh et al., 2011), high premium rates, probable delay in compensation (Ellis, 2017b) , and lack of trust for insurance (Abebe & Bogale, 2014; Kouame & Komenan, 2012).

Even though the literature indicates that a reasonably high percentage of farmers are willing to participate in agricultural (crop) insurance programmes, the actual adoption and paying for it may be influenced by certain factors. These factors include but are not limited to farmers' attitudes towards agricultural insurance which could result in a high or low adoption rate.

3.8 Farmers' attitudes towards WII schemes

There is a considerable amount of literature that suggests that farmers have both negative and positive attitudes towards some agricultural insurance schemes as a risk management tool. The purpose of the review in this section is to examine farmers' attitude towards WII schemes as a risk management tool for weather-related perils. Farmers' attitudes towards other schemes are also highlighted. Research has reported a positive attitude by farmers towards WII scheme in Nepal as a high proportion of farmers (87%) agreed that it was the best way to deal with climate variability impacts (Guo, 2016). In other agricultural insurance programmes in the Sekyere West Municipality, Ghana, Delta State, Nigeria and Isfahan Province, Iran, a positive attitude is reported by some farmers because of their recognition of the benefits associated with taking agricultural insurance (Ajieh, 2010; Chizari et al., 2003; Nimoh et al., 2011). Agricultural insurance's ability to protect farmers against uncertainties (Ajieh, 2010; Chizari et al., 2003; Nimoh et al., 2011) and farmers' access to government assistance through it (Nimoh et al., 2011) were the reasons some farmers had a positive attitude towards agricultural insurance. On the other hand, a certain level of negative attitude has been recounted by farmers towards WII schemes in Ghana, Bunda Tanzania, and Tamil Nadu, India and south India (Daninga & Qiao, 2014; Ellis, 2017b; Issaka et al., 2016; Kakumanu, Palanisami, Nagothu, Xenarios, Reddy, Ashok, & Tirupataiah, 2012; Kumar et al., 2011). Most of the negative attitudes towards WII stem from the following: insurance contracts are not beneficial to farmers and only suit insurers, lack of government protection for farmers from profit-seeking insurers (Daninga & Qiao, 2014), bureaucracies involved in accessing services (Daninga & Qiao, 2014; Kumar et al., 2011), and late payment of claims (Daninga & Qiao, 2014; Ellis, 2017b; Kakumanu et al., 2012). Others include non-payment of claims even after suffering losses (Daninga & Qiao, 2014; Issaka et al., 2016; Kakumanu et al., 2012), unfair loss assessment (Kumar et al., 2011), and high premium rates (Ellis, 2017b; Issaka et al., 2016).

In other agricultural insurance programmes especially for poultry and livestock in Delta State, Nigeria and Isfahan Province, Iran, respectively, it is reported that farmers who have purchased such insurance products have expressed certain concerns indicating a negative attitude towards insurance (Ajieh, 2010; Chizari et al., 2003). Late payment of compensation, fear of claims not being paid, high premium rates, long bureaucracies involved in insurance contracting (Ajieh, 2010), unsatisfactory loss assessment, and terms and conditions for insurance policies (Chizari et al., 2003) were some of the concerns raised by insurance clients indicating a negative attitude towards agricultural insurance.

It could be concluded from the review that, farmers' attitude towards agricultural insurance depends on the perceived benefits expected to be derived from agricultural insurance. These may include, but not limited to, insurance pay-out and access to some government's assistance, how well insurance mitigates the risk they face, the simplicity of insurance contract terms, the presence of transparent and easy to understand loss assessment methods, the affordability of insurance premiums, and the promptness of payment of claims among others.

3.9 Factors influencing farmers' willingness to participate and pay for WII schemes

There are a growing number of studies that provide evidence to suggest that farmers socio-demographic, farm characteristics, institutional and knowledge factors affect their willingness to participate and pay for agricultural insurance as a risk management tool (Adjei, Amagashie, Anim-Somuah, & Oppong, 2016; Akintunde, 2015; Boyd, Pai, Zhang, Holly Wang, & Wang, 2011; Ellis, 2017b; Falola et al., 2014; Ghazanfar et al., 2015; Kumar et al., 2011; Kwadzo et al., 2013; Nimoh et al., 2011). This review examines the factors that affect farmers' willingness to participate and pay for agricultural insurance as a risk management tool. It also examines how these factors affect farmers' willingness to participate and how much they are willing to pay for the insurance schemes. The main categories reviewed here are farmers' socio-demographic, farm characteristics, institutional, and knowledge factors.

3.9.1 Farmers' socio-demographic factors

The socio-demographic factors that have been found to influence farmers' willingness to participate and pay for agricultural (crop) insurance are, but are not limited to, the following: age of farmer, years of farming experience, farmer's educational level, farm income level and other income sources of a farmer among others. They are discussed in the following sub-sections.

Age of farmer: A farmer's age has been found to influence their willingness to participate and pay for agricultural insurance in Africa (Nigeria, Kenya, Ethiopia and Ghana), Pakistan, and India (Abebe & Bogale, 2014; Aidoo et al., 2014; Ali, 2013; Falola et al., 2014; Kakumanu et al., 2012; Okoffo et al., 2016; Wairimu et al., 2016). The age of a farmer was found to negatively affect farmers' willingness to participate and pay for agricultural insurance (Abebe & Bogale, 2014; Aidoo et al., 2014; Falola et al., 2014; Kakumanu et al., 2012; Wairimu et al., 2016). This was because older farmers were more hesitant about using innovations such as

agricultural insurance (Falola et al., 2014), and comparatively, they were generally illiterate with less understanding of insurance policies and products (Kakumanu et al., 2012) than younger farmers, hence less likely to participate and pay for agricultural insurance. Besides the aforementioned, older farmers may have gained enough experience and knowledge in farming, therefore, can (1) predict future weather occurrences (Abebe & Bogale, 2014), (2) accept risk (risk-loving) (Aidoo et al., 2014) or (3) devise a means to manage certain risks since they are aware of them (Wairimu et al., 2016) than younger farmers with less experience, hence are less likely to participate in agricultural insurance. On the contrary, the age of a farmer was found to have a positive influence on farmers' willingness to participate and pay for agricultural insurance in Soon Valley and Telagang, Pakistan and Dormaa District in the Brong Ahafo Region, Ghana (Ali, 2013; Okoffo et al., 2016).

Household size: Household size has been found by various studies to have an impact on a farm household's willingness to participate and pay for crop insurance in Ghana (Danso-Abbeam, Addai, & Ehiakpor, 2014; Kwadzo et al., 2013; Okoffo et al., 2016). Kwadzo et al. (2013) found a positive relationship between household size and willingness to participate, whilst Okoffo et al. (2016) found a positive relationship between household size and willingness to pay for agricultural insurance. Kwadzo et al. (2013) suggest that because the household depends on the farm for their livelihood an increase in the household size makes it even more important for the household to protect this livelihood against any unforeseen circumstances, hence are more likely to participate in agricultural (crop) insurance than smaller households. On the contrary, a negative relationship was found between household size and household willingness to participate (Danso-Abbeam et al., 2014; Okoffo et al., 2016) and pay for agricultural (crop) insurance Danso-Abbeam et al. (2014). However, these authors failed to provide any explanations for this negative influence of household size on participation and willingness to pay for insurance.

Marital status: Studies, especially in Ghana, also provides evidence that marital status influences a farmer's willingness to participate and pay for agricultural (crop) insurance (Danso-Abbeam et al., 2014; Ellis, 2017b; Okoffo et al., 2016). A positive relationship was found between married farmers and the willingness to participate (Danso-Abbeam et al., 2014; Ellis, 2017b; Okoffo et al., 2016) and pay for agricultural (crop) insurance (Danso-Abbeam et al., 2014). Married farmers were more likely to participate in the insurance to reduce the vulnerability of their families in times of a production risk than unmarried farmers who probably do not have to worry about a family of their own (Danso-Abbeam et al., 2014; Ellis,

2017b). On the contrary, Okoffo et al. (2016) found a negative relationship between willingness to pay for agricultural (crop) insurance and married farmers. This could be because as the premium increases the farmer has to choose between meeting the short-term needs of the family and the long-term benefits of paying for the insurance especially when financial constraints limit expenditure.

Years of farming experience: The years of farming experience of a farmer has also been found to influence farmers' willingness to participate in agricultural insurance in parts of Ghana, Nigeria, Kenya, Malaysia, and China (Akintunde, 2015; Amin et al., 2014; Danso-Abbeam et al., 2014; Jin et al., 2016; Wairimu et al., 2016). The number of years of farming experience was reported to positively influence farmers' willingness to participate in agricultural crop insurance (Amin et al., 2014; Danso-Abbeam et al., 2014; Jin et al., 2016). Because such farmers may have experienced losses with the occurrence of risk and would be willing to take measures to prevent future losses, hence are more likely to purchase insurance than farmers with less experience who do not even understand the risk and potential losses involved. In a related insurance product for poultry in Nigeria, Akintunde (2015) found years of farming experience having a similar influence on farmers' willingness to purchase insurance cover basically for the same reasons. On the other hand, years of farming experience was reported to negatively influence a farmer's willingness to participate in agricultural crop insurance for weather perils because such a farmer may have encountered these risks previously and probably devised ways of coping with the risks and associated consequences (Wairimu et al., 2016).

Land tenure system: Various studies have also suggested that the land tenure system that a farmer has impacts on their willingness to participate and pay for agricultural (crop) insurance in Pakistan and most parts of Ghana (Aidoo et al., 2014; Danso-Abbeam et al., 2014; Ghazanfar et al., 2015; Kwadzo et al., 2013; Nimoh et al., 2011). A positive relationship was found between land ownership and the willingness to participate (Danso-Abbeam et al., 2014; Nimoh et al., 2011) and pay for agricultural (crop) insurance (Aidoo et al., 2014; Danso-Abbeam et al., 2014) in Ghana. Nimoh et al. (2011) suggest that farmers like shared-croppers and land renters, who did not own lands did not have any incentive to participate in crop insurance. In terms of insurance payment, Aidoo et al. (2014) suggests that because landowners did not have to give part of their farm produce as land rents, they had enough resources to afford the insurance premiums hence were more willing to pay for insurance than land renters and shared-croppers who pay part of their farm income as land rent. Contrary to the suggestions of Nimoh

et al. (2011), Ghazanfar et al. (2015) found a similar positive relationship between land ownership and farmers' willingness to participate, and pay for, crop insurance in Pakistan, but concluded that landowners were financially stable and did not have any incentive to participate and pay for agricultural (crop) insurance, and yet they did. Meanwhile, farmer tenants and share-croppers that should have an incentive to participate, but did not, were mostly poor and cash constrained. On the other hand, Kwadzo et al. (2013) and Aidoo et al. (2014) both in Ghana found a negative relationship between land tenure system and farmers' willingness to participate in agricultural (crop) insurance. Aidoo et al. (2014) suggest that because landowners did not have to pay for land rent, they were less likely to be bothered by a loss due to production risks. Secondly, landowners have other land and probably diversified their production hence were less likely to suffer the occurrence of a production risk on one of the farms. Land renters and share-croppers, unlike landowners, would most likely be paying land rents and not have enough land to diversify production. Although not similar to Aidoo et al. (2014)'s suggestion, Kwadzo et al. (2013) indicate that landowners experience less land tenure risk and also demonstrate a better risk-bearing capacity than renters and shared-croppers and are therefore less likely to participate in agricultural (crop) insurance.

Farmer educational level: Studies have found that a farmer's educational level influences their willingness to participate in agricultural insurance in parts of Africa (Nigeria, Ghana, Kenya), Pakistan, China, and India (Aidoo et al., 2014; Ali, 2013; Danso-Abbeam et al., 2014; Ellis, 2017b; Falola et al., 2014; Issaka et al., 2016; Jin et al., 2016; Kakumanu et al., 2012; Kwadzo et al., 2013; Okoffo et al., 2016; Wairimu et al., 2016). In Ghana, studies have found a farmer's (maize, cassava and cocoa farmers) educational level positively influencing their willingness to participate in agricultural crop insurance because such farmers could easily understand the insurance policies and the benefits associated with taking on insurance than less educated farmers (Aidoo et al., 2014; Danso-Abbeam et al., 2014; Ellis, 2017b; Issaka et al., 2016). Okoffo et al. (2016) also indicate that better-educated farmers in Ghana could make critical and better decisions as to which options are beneficial than probably less educated farmers; hence they are more likely to participate in agricultural insurance. Elsewhere in Nigeria, Kenya, Pakistan, India and China, a positive relationship was found between a farmer's educational level and willingness to participate in agricultural insurance because they understand the insurance policies and the associated benefits better than less educated farmers (Ali, 2013; Falola et al., 2014; Jin et al., 2016; Kakumanu et al., 2012; Wairimu et al., 2016). In the case of China, better-educated farmers understood the trigger levels for abnormal rainfall as well as

the compensation schedule for WII which are conceptually sophisticated, and so positively influenced their willingness to participate and purchase insurance more than less educated farmers (Jin et al., 2016). On the contrary, Kwadzo et al. (2013), found in a study that a farmer's educational level in Kintampo North District of Ghana negatively influenced their willingness to participate in agricultural crop insurance because the better-educated farmers probably better managed their farms and/or use other risk management strategies hence are less likely to use crop insurance.

Farm income level: There is a considerable amount of evidence to suggest that the farm income level of a farmer has an impact on their willingness to participate in agricultural insurance in parts of Nigeria, Ghana, Pakistan and Ethiopia (Abebe & Bogale, 2014; Aidoo et al., 2014; Danso-Abbeam et al., 2014; Falola et al., 2014; Ghazanfar et al., 2015). Studies indicate that farm income levels positively and significantly influences a farmer's willingness to participate in agricultural insurance, because farmers with higher incomes from their farms have enough income to pay the insurance premium rates than other farmers with less income from their farms (Aidoo et al., 2014; Danso-Abbeam et al., 2014; Ghazanfar et al., 2015). Abebe and Bogale (2014) suggest that higher income from farming makes it a primary income source. Therefore, the farmer is likely to take steps to protect this income stream hence are more likely to take an insurance cover for the farm. On the contrary, Falola et al. (2014) found that farm income level of cocoa farmers in Nigeria negatively influenced their willingness to take agricultural crop insurance. Because farmers with higher incomes from their cocoa farms may have adopted other risk management strategies, hence are less likely to take agricultural insurance cover due to the additional cost.

From the analysis of the literature on farm income levels, it could be said that farm income levels could negatively and positively influence a farmer's willingness to participate in an agricultural insurance programme. For households where the farm income is high and serving as a primary income source needing the protection of the income stream, the decision to adopt insurance will depend on whether other alternatives risk management measures have already been employed.

Farmer's other income sources: Research suggests that other sources of income of the farm household has an impact on their willingness to participate in agricultural insurance programmes in parts of Ghana, Ethiopia, Tamil Nadu and Andhra Pradesh India, Pakistan, and China (Abebe & Bogale, 2014; Ali, 2013; Giné et al., 2008; Issaka et al., 2016; Jin et al., 2016;

Kumar et al., 2011; Nimoh et al., 2011). In the Tamil Nadu, and Andhra Pradesh regions of India Kumar et al. (2011) and Giné et al. (2008), respectively, found that farm households who had other income sources were more likely to participate in a rainfall index crop insurance than other farm households with no alternative income sources. This is because these households were less likely to be cash constrained and therefore, could afford to buy an insurance cover than households who had no alternative incomes sources and were probably cash constraint. On the contrary, Nimoh et al. (2011) and Issaka et al. (2016) found that in parts of both southern and northern Ghana, farming households who had other sources of income were less likely to participate in an agricultural crop insurance programme. This is because farming households with other income sources felt more income secured (Nimoh et al., 2011) or did not feel the impact of a loss due to a production risk on the farm (Issaka et al., 2016) and therefore were less likely to participate in agricultural (crop) insurance. Similarly, a negative relationship was reported between a farm household's other income sources and their willingness to participate and pay for rainfall index-based crop insurance in parts of Pakistan, China, and Ethiopia (Abebe & Bogale, 2014; Ali, 2013; Jin et al., 2016). This was also because households depended on other sources such as off-farm investments in times of losses due to production risks (Jin et al., 2016) or paid less attention to the farm business as the household's off-farm activities (income) increases (Abebe & Bogale, 2014) hence were less likely to participate and pay for rainfall index crop insurance.

Working household members: The number of working household members who make remittances to the farm household has been reported to influence the household's willingness to participate, and pay for agricultural insurance premiums (Boyd et al., 2011; Kumar et al., 2011). In Tamil Nadu, India, the number of working family members, significantly and positively influenced the willingness to participate and the premium paid by farmers for weather index insurance (Kumar et al., 2011). On the contrary, the number of working family members was found to negatively affect insurance purchasing decisions of farm households in Mongolia (Boyd et al., 2011). Because, these family members provide the household with off-farm income which lessens the household's income vulnerability hence, were less likely to suffer from farm risk and therefore, less likely to buy crop insurance. This seems to suggest that depending on the relative importance of the income from the farm to the total household income stream, such remittances may or may not be invested in insurance to protect the household against production risk.

3.9.2 Farm characteristics

The literature on farm characteristic factors that influence a farmer's willingness to participate and pay for agricultural insurance include, but are not limited to, the following: farm size, severity and the frequency of farm risk occurrence, and farm diversification. They are discussed below.

Farm size: There is evidence to support suggestions that farm size influences a farmer's willingness to participate and pay for agricultural crop insurance in parts of Ghana, Kenya, India, Pakistan, and China (Aidoo et al., 2014; Ali, 2013; Danso-Abbeam et al., 2014; Ghazanfar et al., 2015; Giné et al., 2008; Jin et al., 2016; Kakumanu et al., 2012; Kumar et al., 2011; Kwadzo et al., 2013; Nimoh et al., 2011; Okoffo et al., 2016; Wairimu et al., 2016). Studies have established a positive relationship between farm size and a farmer's willingness to participate (Ali, 2013; Danso-Abbeam et al., 2014; Ghazanfar et al., 2015; Giné et al., 2008; Jin et al., 2016; Kwadzo et al., 2013; Nimoh et al., 2011), and pay for agricultural crop insurance (Ghazanfar et al., 2015; Kakumanu et al., 2012; Okoffo et al., 2016). This was because the associated losses with the occurrence of a risk on a large farm was likely to be more (Danso-Abbeam et al., 2014; Jin et al., 2016; Nimoh et al., 2011), and farmers with large farms who were associated with wealth could afford the premiums (Ghazanfar et al., 2015) than farmers of smaller size. The former assertion makes sense because the potential loss associated with say 100 acres of maize compared to that of 10 acres of the same crop in the event of a production risk say drought, cannot be the same. Hence most farmers in this situation should be willing to transfer this risk to third parties. However, other studies have found a negative relationship between farm size and a farmer's willingness to participate (Kumar et al., 2011; Okoffo et al., 2016; Wairimu et al., 2016), and pay for crop insurance (Aidoo et al., 2014; Kumar et al., 2011; Wairimu et al., 2016). Because cumulatively (it will cost the farmer more to take insurance to cover the entire farm) it cost the farm household more money to pay premiums to cover large farms (Aidoo et al., 2014; Wairimu et al., 2016). Farmers with large farms in Kenya and Tamil Nadu, India were mostly wealthier and probably adopted alternative risk management strategies like farm diversification hence, depended on these sources in times of a risk occurrence (Kumar et al., 2011; Wairimu et al., 2016). Another reason was that farmers with large farms especially in Tamil Nadu were sceptical about insurance claims and therefore, were less likely to participate in the agricultural insurance programme (Kumar et al., 2011).

Farm diversification: The literature on how farm diversification influences a farmer's willingness to participate, and pay for agricultural insurance point to a negative relationship

(Abebe & Bogale, 2014; Ali, 2013; Kumar et al., 2011; Kwadzo et al., 2013). Diversification into livestock in Ghana and Ethiopia was a form of self-insurance which enabled the household to rely on this income stream when crops failed (Abebe & Bogale, 2014; Kwadzo et al., 2013). Crop diversification in Pakistan and India enabled the farm household to spread the risk associated with drought across farms; hence they were less likely to suffer crop losses due to drought (Ali, 2013; Kumar et al., 2011).

Severity and the frequency of risk occurrence: There is a general consensus from the literature on the positive influence of the severity, and frequency of occurrence of a production risk on a farmer's willingness to participate in agricultural crop insurance as a risk management tool in Ghana, India, Mongolia, Pakistan, and China (Boyd et al., 2011; Ghazanfar et al., 2015; Issaka et al., 2016; Jin et al., 2016; Kumar et al., 2011). In Ghana, especially in the northern parts where rainfall is erratic, the frequency of, and the losses associated with, drought positively influenced a farmer's willingness to participate in WII (Issaka et al., 2016). In China, a high probability of a future farm loss occurring due to the weather was found to positively influence a farmer's willingness to participate in WII (Jin et al., 2016). In other areas as well, the more frequent a loss due to a production risk the more likely it is that farmers will adopt agricultural insurance to guard against future losses (Boyd et al., 2011; Ghazanfar et al., 2015). On the other hand, even though studies by Ellis (2017b) and Nimoh et al. (2011) in southern Ghana found a positive relationship between the frequency of farm exposure to disaster (weather variations) and willingness to participate, it had a statistically insignificant influence on farmers' willingness to participate. This finding is not surprising because southern Ghana has a better rainfall pattern than northern Ghana where Issaka et al. (2016) undertook their studies and reported a positive and significant influence on farmers' willingness to participate.

3.9.3 Institutional factors

The institutional factors that have been suggested to influence a farmer's willingness to participate and pay for agricultural insurance programmes are but are not limited to these: access to extension services, access to credit, and insurance premium rates. They are further elaborated in the following sub-sections.

Access to extension services: There is also a general consensus from the literature that suggest that a farmer's access to extension services positively influenced their willingness to participate in agricultural insurance in Ghana, Nigeria, Kenya, Pakistan, and Malaysia (Akintunde, 2015;

Ali, 2013; Amin et al., 2014; Ellis, 2017b; Falola et al., 2014; Wairimu et al., 2016). Because farmers who had access to extension services would have been provided with enough information about agricultural insurance and the associated benefits, therefore, will be more willing to take agricultural insurance than other farmers without access to extension services.

Access to credit: There is also evidence from the literature to support the claim that a farmer's access to credit influences their willingness to participate and pay for agricultural crop insurance as a risk management tool (Ali, 2013; Ellis, 2017b; Ghazanfar et al., 2015; Issaka et al., 2016; Wairimu et al., 2016). A positive relationship was found between access to credit and a farmer's willingness to participate (Ali, 2013; Issaka et al., 2016; Wairimu et al., 2016) and pay for WII (Wairimu et al., 2016). Because credit improved the farmer's disposable income or provided additional cash to enable the purchase of crop insurance. On the contrary, Ghazanfar et al. (2015) found a negative relationship between a farmer's access to credit and their willingness to adopt crop insurance in Pakistan. Because agricultural loans taken by some farmers in Pakistan were already insured and therefore farmers were less likely to take insurance. To the extreme end, both Ellis (2017b) and Kakumanu et al. (2012) found that access to credit was insignificant as an influence on a farmer's willingness to pay for WII.

Member of a farmer group: Membership of a farmer group has also been reported to influence farmers' willingness to participate in agricultural insurance (Giné et al., 2008; Wairimu et al., 2016). A farmer's membership in a farmer group did not only enable them to hear of the WII product through the group in Kenya (Wairimu et al., 2016), but the participating member farmers in the insurance scheme of such groups influenced other members to adopt the WII in India (Giné et al., 2008). Therefore, farmers in a farmer group are more likely to participate in an agricultural insurance scheme than other farmers who are not in a farmer group.

Insurance premium Rate: Research indicates that the insurance premiums paid by farmers have a negative influence on their willingness to adopt agricultural crop insurance in Tamil Nadu India, Pakistan, and Mongolia (Boyd et al., 2011; Ghazanfar et al., 2015; Kumar et al., 2011). Boyd et al. (2011) suggested that farmers would purchase insurance with a lower insurance premium rate.

3.9.4 Knowledge factors

Knowledge about insurance product: There is a general consensus from the literature that suggests that a farmer's knowledge about agricultural insurance products positively influences their willingness to participate and pay for insurance in parts of Ghana, Ethiopia, India, and China (Abebe & Bogale, 2014; Adjei et al., 2016; Boyd et al., 2011; Danso-Abbeam et al., 2014; Ellis, 2017b; Giné et al., 2008; Kakumanu et al., 2012). Because farmers with enough information about, and understand the insurance product were more likely to purchase insurance than farmers with less information and inadequate understanding. Giné et al. (2008) specifically stated that rainfall index insurance uptake was high among members of Borewell User Association because they were the primary clients of BASIX, an insurance vendor, and therefore, had more knowledge about the insurance product than non-members. Boyd et al. (2011) who found a positive but insignificant influence on a farmer's decision to adopt crop insurance, however, suggested that farmers who knew about the insurance product were more likely to purchase it than those farmers who have less knowledge about it.

In conclusion, the purpose of the review was to examine how the socio-demographic factors, as well as other factors, affect a farmer's willingness to adopt agricultural insurance as a risk management tool. From the analysis, the age of a farmer, farm diversification, and insurance premium rate was found to have a negative influence on a farmer's willingness to adopt agricultural insurance. Other factors such as severity and the frequency of risk occurrence, extension access, member of a farmer-based organisation, and knowledge about insurance positively influenced a farmer's willingness to adopt agricultural insurance as a risk management tool. There were other factors such as farm income levels, farmer's other income sources, household size, marital status, farm experience, land tenure system, educational level, working household members, access to credit, and farm size that positively or negatively influenced a farmer's willingness to adopt agricultural insurance as a risk management tool.

3.10 Agricultural extension officers' knowledge and attitudes towards agricultural insurance

The literature review in this section is in two parts. The first sub-section highlights the extent to which agricultural extension officers are knowledgeable in agricultural insurance programmes. The second sub-section examines their attitude towards agricultural insurance programmes, as well as, other innovations for farmers. Meanwhile, how these impacts on their ability to disseminate information on innovations to farmers are also highlighted.

3.10.1 Extension officers' knowledge about agricultural insurance schemes

Evidence from the literature indicates that even though agricultural extension officers educate farmers on agricultural related issues including risk management strategies, they may not necessarily be knowledgeable in all risk management strategies including agricultural insurance (Ajayi, 2013; Buzby et al., 1992; Martin et al., 2003). The purpose of this review, therefore, is to examine agricultural extension officers' knowledge about agricultural risk management strategies such as agricultural insurance and how it impacts on their ability to disseminate information on it to their clients. In Osun State, Nigeria, the assessment of extension officers' knowledge about an agricultural insurance programme found that very few extension officers were knowledgeable in the programme Ajayi (2013). Elsewhere in the USA, two different surveys carried out at different time periods provide evidence that county-level extension agents were or felt less knowledgeable in some risk management strategies particularly agricultural insurance (Buzby et al., 1992; Martin et al., 2003). In a self-assessment survey in 2002 of 296 county extension educators in Indiana, Mississippi, Nebraska, and Texas states of the USA on their level of knowledge about agricultural risk management strategies including crop yield/revenue insurance among others, found that although they gave themselves low values for all the categories, futures and options, and crop yield/revenue insurance were the ones they were less knowledgeable about (Martin et al., 2003). An earlier survey of 468 county-level agricultural extension agents in the USA in 1992 to determine how they differ in their knowledge about nine risk management strategies reported that the county level agents felt less knowledgeable in hedging and options, most felt they understood the concept of Multiple Peril Crop Insurance (MPCI) however, they did not have detailed understanding about the insurance type (Buzby et al., 1992). According to Buzby et al. (1992) as a result of their low level of knowledge, less than 40% of the county level agents felt qualified to teach each of the following risk management strategies to farmers; hedging (39.7%); price option (34%); crop, hail, and fire insurance (28.4%); and MPCI (25.6%). Similarly, Ajayi (2013) argues that the low level of awareness of agricultural insurance by the officers could make them reluctant to introduce the concept to farmers who are the ultimate beneficiaries. In a not so related field, Tiraieyari, Hamzah, Samah, and Uli (2013) asserted that extension workers were more likely to transfer sustainable agricultural practices when their knowledge on it increases. These findings although not widespread provide useful information for the examination of agricultural extension officers' knowledge about agricultural insurance

schemes, especially when farmers rely on the expert advice of these officers to purchase the insurance products.

With respect to the factors that affect agricultural extension officers knowledge about agricultural crop insurance, Ajayi (2013) found years of formal education, sex of officer and agricultural finance-related training attended to negatively affect knowledge about insurance scheme, whilst number of officers supervised, ownership of personal farm, officers' attitude towards the scheme positively affected their knowledge about agricultural insurance.

3.10.2 Agricultural extension officers' attitude towards agricultural insurance

Evidence from the literature about extension officers' attitude towards agricultural innovations indicate that it impacts on their motivation to communicate it to farmers (Afzal, Al-Subaiee, & Mirza, 2016; Ajayi, 2013; Jayaratne et al., 2007). The purpose of this review is to examine agricultural extension officers' attitudes towards agricultural innovations including agricultural insurance and how it impacts on their motivation to communicate it to farmers. It was found in Osun State, Nigeria that agricultural extension agents, in general, have an indifferent attitude towards agricultural insurance programmes (Ajayi, 2013). Further analysis had found that about 73.5% extension agents had an indifferent and 14.2% had an unfavourable attitude towards the agricultural insurance programme. Even though there are limited studies on extension officers' attitudes towards agricultural insurance programmes, there is evidence from other related fields that useful lessons could be drawn from. Agricultural extension workers were found to have a positive attitude towards Electronic (E)-extension (Afzal et al., 2016) and conservation tillage system (Jayaratne et al., 2007). Both Ajayi (2013) and Jayaratne et al. (2007) concluded that officers with a favourable attitude towards such innovations were more in a position to communicate them to farmers than other officers with unfavourable attitudes. In conclusion, the attitudes of extension officers' towards agricultural innovations could be varied and could impact on their motivation to communicate them to farmers.

CHAPTER FOUR - RESEARCH METHODOLOGY

4.1 Introduction

This chapter is organised into seven main sections. Section 4.2 describes the research study area. Section 4.3 describes the research strategy, the survey design is described in section 4.4. Sampling and sample size is covered in section 4.5. Section 4.6 highlights the data collection methods. Section 4.7 describes the data analysis methods and section 4.8 highlights ethical issues regarding the study.

4.2 Research study area

The Upper East Region was the study area. However, primary data was collected from the three municipalities, Bolgatanga, Navrongo and Bawku, in the region (Figure 4.1). The Bolgatanga Municipality, the regional capital, which is in the centre of the region shares borders to the north with the Bongo District, south and east with the Talensi and Nabdam Districts, respectively, and to the west with the Navrongo Municipality. Geographically, it is located between latitudes 10°30' and 10°50' North and longitudes 0°30' and 1°00' West and covers a total land area of 729 square kilometres (Ghana Statistical Service, 2014b).

The Navrongo Municipal formerly Kassena Nankana Municipal lies approximately between latitude 11°10' and 10°3' North and longitude 10°1' West. It is bordered to the north with Kassena-Nankana - West District and Burkina Faso, to the east with Kassena- Nankana West District and Bolgatanga Municipal, to the west with Builsa District and the south with the West Mamprusi District in the Northern Region (Ghana Statistical Service, 2014c).

The Bawku Municipal with a total land area of 247.23720sq.km is located approximately between latitudes 11°11' and 10°40' North and longitude 0°18' W and 0°6' E in the northeastern corner of the region. It borders Pusiga District to the North, Binduri District to the South, Garu-Tempane District to the East and Bawku West to the West (Ghana Statistical Service, 2014a).

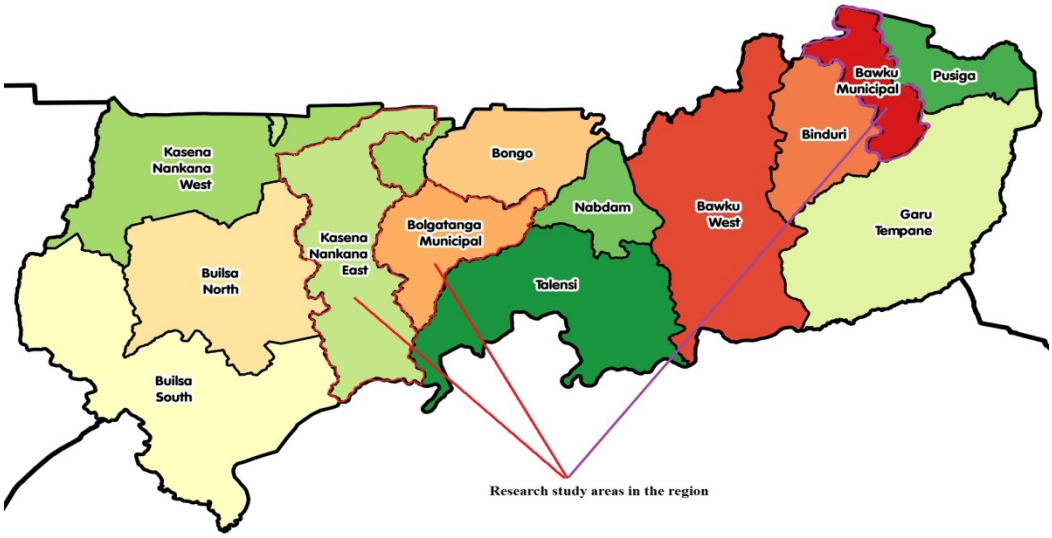

Figure 4.1 Map of the Upper East Region with study areas indicated

Source: Adapted from Wikipedia (2018)

4.3 Research strategy or design

The research strategy employed for the study was a survey. As pointed out by Yin (2009), survey research strategies are appropriate for studies, that seek to answer "what, who, where, how much, how many" research questions, have no control of behavioural events, and focuses on contemporary events. Yin (2009) points out that some types of "what" questions are exploratory in nature whereas "how many or how much" questions are predictive. The research questions in this study were "what" questions and therefore suitable for a survey. It is also suggested by Yin (2009) that surveys are suitable for studies that the researcher has no control or cannot manipulate the behaviour of subjects directly. In this study, there was no need for a control variable. A focus of the study on contemporary events rather than historical events is also appropriate for survey type studies (Yin, 2009). This study sought to obtain primary information from farmers at the time of the survey and as such focused on contemporary events which made a survey suitable for the study. Verschuren, Doorewaard, Poper, and Mellion (2010), indicated that surveys are useful when the research involves the use of random sampling methods, the collection of quantitative data and the generalisation of the results over a large population. This study employed a simple random sampling method in the selection of the primary respondents, farmers for the study. The study mostly collected quantitative data for the analysis. The study also intends to generalise the findings over the broader farming

population and agricultural extension officers in the Upper East Region at large. Given this and as suggested by Verschuren et al. (2010) a survey was thus most appropriate for the study.

4.4 Survey design

Two survey designs, one of farmers and the other of agricultural extension officers were used to solicit primary information for the study. They are both discussed further in the following two sections.

4.4.1 Farmer survey design

The design of the farmer survey instrument was aimed at answering the following research questions: 1) what production and market risks are farmers in the Upper East Region exposed to and what management strategies do they have in place? 2) What knowledge and attitude do farmers have about the WII scheme? Also, 3) Are farmers willing to participate and pay for this insurance type, and what determines these? These research questions were formulated following a literature review on farmers demand for agricultural insurance in various countries. As such the survey design was divided into four different sections. Section one has the objective of capturing the socio-demographic, farm characteristics, and institutional factors associated with the farmers. Section two was aimed at capturing information about farmers' risk profiles and risk management strategies. Section three focused on the knowledge that farmers had of WII, as well as, their attitude towards this insurance type. Section four then focused on farmers' willingness to participate in, and the maximum amount they were willing to pay for, the WII scheme to cover an acre of maize against drought.

4.4.1.1 Socio-demographic, farm characteristics and institutional factors

The socio-demographic data that was collected from the respondents included the age of the household head, gender, years of farming experience, marital status, the main occupation, and educational level of the household head, farm income levels, household size, land tenure system, and income from other sources. The respondents' farm characteristics data included total land size, farm diversification, and the severity and frequency of farm exposure to drought risk (drought index). Institutional factors were access to extension services, membership of farmer-based organisations and access to credit.

4.4.1.2 Farmers' risk profiles and risk management strategies

To identify the risks that farmers were mostly exposed to, a list of production and market risks from the literature review were presented to the farmers to indicate which applies to their situation. This follows from the fact that production and market risks have been reported to be the most important to farmers and the primary cause of income variability (Bryla & Syroka, 2007; Wossen & Berger, 2015). The farmers were then required to indicate the importance of each risk that applies to them on a five-point Likert scale ranging from very low (1) to very high (5). Similarly, farmers did the same task for the risk management strategies identified from the literature review.

4.4.1.3 Farmers' knowledge about, and attitude towards, WII scheme

Twelve questions about WII insurance were presented to the farmers for them to choose the correct answers to assess the farmers' knowledge about WII in the region. The questions required a "Yes or No" answer or the selection of a correct answer among multiple choice answers. Some of the questions were adapted from questions used by the Ghana Agricultural Insurance Programme (GAIP) in a sensitisation training programme for agricultural extension officers in 2012 on the operation of the WII and its benefits. Some of the questions adapted were: the WII covers farmers for what production risk on the farm? How many phases does the WII contract have? Which of the phases use dry days to trigger or initiate an insurance payout? How does WII assess farmers' loss due to drought?

4.4.1.4 Farmers' attitude towards WII scheme

To assess a farmer's attitude towards the insurance scheme, attitudinal statements that when considered together reflect a person's attitude based on their level of agreement to each statement were presented to the farmers for them to indicate their level of agreement with these statements. Each of the statements presented to a farmer was a Likert-type item requiring that farmers indicate their level of agreement to the statements on a five-point Likert scale that ranges from strongly disagree (1) to strongly agree (5). This approach has been employed to collect data for assessing the attitude of farmers as well as agricultural extension agents towards agricultural insurance (e.g. Ajayi, 2013; Daninga & Qiao, 2014).

4.4.1.5 Farmers' willingness to participate and pay for WII scheme

The operation of the scheme was explained to the farmers, and they were asked directly if they were interested and willing to participate to assess a farmer's willingness to participate in the insurance scheme. For farmers who were already using this type of insurance, they were asked if they were willing to continue participating in the insurance type.

To assess a farmer's willingness to pay for WII in the region, only those farmers who indicated their interest in the insurance scheme were asked further questions. The objective was to find out how much farmers were willing to pay for the insurance scheme, even though the Ghana Agricultural Insurance Programme's (GAIP) current premium rate was between 5 - 10% of the total cost of producing maize. There are various methods of eliciting willingness to pay for, and these include the revealed preference and the stated preference methods (Harris & Roach, 2016). According to Harris and Roach (2016), the revealed preference methods can only be used in certain situations. However, one of the most common stated preference methods the Contingent Valuation method could be used under any situation especially through surveys to determine willingness to pay (WTP) or willingness to accept (WTA) for a hypothetical scenario. Therefore, in this study, the Contingent Valuation (CV) technique under the stated preference method was employed to capture farmers' maximum willingness to pay for insurance scheme in the Upper East Region. This method has been used to solicit farmers' maximum willingness to pay for various insurance products for farmers in different studies usually under a hypothetical market situation, (Abebe & Bogale, 2014; Amin et al., 2014; e.g. Arshad et al., 2016; Ellis, 2017b; Ghazanfar et al., 2015; Gulseven, 2014; Kwadzo et al., 2013).

The Contingent Valuation technique also has different elicitation techniques such as Opened-ended, Payment card, Single-bounded, Double-bounded and Multiple-bounded formats (Harris & Roach, 2016). In this study, a Double-bounded Contingent Valuation method is used because it provides more precise information about a farmer's willingness to pay (Harris & Roach, 2016), in this case, for WII. It is argued that the extra efficiency gains for Multiple-bounded formats over the Double–bounded format are relatively minor and the Multiple-bounded formats could increase the likelihood of an induced response effect (Ramasubramanian, 2012). The Double-bounded Contingent Valuation method has been employed in various studies to elicit farmers' willingness to pay for crop insurances (e.g. Abebe & Bogale, 2014; Amin et al., 2014; Ellis, 2017b). The Double-bounded Contingent Valuation method usually starts with an initial bid and then depending on a respondent's Yes or No answer, the bid is either increased (in the case of a yes) or reduced (in the case of a no). This type of elicitation suffers from

several biases including starting point bias (Abebe & Bogale, 2014; Ramasubramanian, 2012). Starting point bias arises when respondents take the initial bid value in the bidding game as indicative of market information, or as representing a typical bid. As such, there is the tendency for their final bids to be influenced by the initial bid and may not represent their true maximum WTP (Bateman, Willis, & Garrod, 1994). This problem can be reduced by having a range of initial bid values to be used for different respondents and then comparing their effect on the final WTP value obtained (Ramasubramanian, 2012). In this study, three sets of initial bids (5%, 7.5% and 10%) derived from the current GAIP's insurance premium rate of 5 - 10% of the farmer's average production cost of an acre of maize were used. As such there were three sets of bid values and these were; 2.5%, 5% and 7.5%; 5%, 7.5% and 10%; and 7.5%, 10% and 12.5%. One of the initial bids from the set of bid values was randomly presented to each of the farmers and asked whether s/he will pay for the insurance at that rate. Farmers, who said "Yes", were presented with an upper bid and asked again for an answer. Farmers who said "No" the initial bid was taken as his/her WTP, if "Yes" the upper bid is taken as his/her WTP. Similarly, farmers who said "No" to the initial bid, a lower bid was presented to the farmer. The lower bid is taken as the farmer's WTP if the farmer said "Yes" to it, however, the farmer's WTP was considered to be below the second lower bid if there is a "No" answer. In this case, the possible outcomes are: Yes, Yes; Yes, No; No, Yes and; No, No.

4.4.2 Agricultural extension officer survey design

The design of this survey instrument was aimed at answering the research questions: 1) what knowledge and attitude do agricultural extension officers have about the WII scheme and what determines the officers' knowledge of this insurance type? Therefore, the survey design was divided into three sections. Section one asked questions with the objective of capturing the socio-demographic characteristics of the officers. Section two was aimed at capturing information on the officers' knowledge about WII scheme. Section three focused on the attitude held by the officers towards WII scheme.

4.4.2.1 Socio-demographic factors

The socio-demographic data that was collected from the officers included their age, years of work experience, employment grade, highest educational status, and the number of crop insurance training session attended in the past five years.

4.4.2.2 Agricultural extension officers' knowledge about WII scheme

As was done in the case of the farmer survey, the same was done to assess the agricultural extension officers' knowledge about the WII scheme in the region. As such, the twelve questions about the insurance scheme were presented to the officers' for them to choose the correct answers.

4.4.2.3 Agricultural extension officers' attitude towards WII scheme

As was done to assess the farmers' attitude towards WII scheme, attitudinal statements that when considered together reflect a person's attitude based on their level of agreement to each statement were presented to the agricultural extension officers for them to indicate their level of agreement with these statements. The statements, however, were slightly different from those used for the farmers regarding sentence wording.

4.5 Sampling and sample size

The research employed the use of both purposive and multi-staged random sampling techniques (Daniel, 2011) to collect primary data from farmers in the Upper East Region. These methods have been used to preferentially select regions, districts, communities and then respondents in various studies (e.g. Abebe & Bogale, 2014; Ackah & Owusu, 2012; Adeyonu, 2016; Jin et al., 2016; Okoffo et al., 2016). As asserted by Daniel (2011), purposive sampling is useful when the research is targeting a specific element in the population. In this study, the target was primarily municipalities/districts with weather stations used by the Ghana Agricultural Insurance Programme (GAIP). Secondly, the target was municipalities/districts that had a diverse range of farmers regarding age, level of production, types of crops produced and literacy. The need for a diverse range of farmers was to ensure that the information captured is not skewed to a particular set of farmers with similar characteristics, say smallholder or mostly illiterate farmers. Three Municipalities, Bolgatanga, Bawku West and Navrongo, out of the thirteen administrative Municipalities and Districts in the Upper East Region met these criteria. This was because they were the Municipalities that had weather stations and where GAIP had widely marketed WII scheme for drought. Secondly, they were also the most diverse Municipalities regarding the farmer above characteristics compared to the other Districts.

According to Daniel (2011), with a multi-stage sampling method, different units are sampled at each stage of the sampling. In this study, operational areas in each of the purposively selected Municipalities were randomly selected in the first stage and then the farmers randomly sampled

from the selected operational areas in the second stage. In this case, multi-stage random sampling was most appropriate and therefore, was used to select the operational areas and then the farmers in each stage. In the first stage of the multi-stage random sampling, five operational areas from Bolgatanga and Bawku West and four operational areas from Navrongo municipality were randomly selected. In the second stage of the multi-stage random sampling, fourteen farmers were randomly selected from each of the selected operational areas to give a total sample size of 200 respondents.

In the agricultural extension officers' survey, officers from the Departments of Agriculture in eleven of the thirteen Municipalities/Districts were surveyed. This was because most of the offices had less staff, hence the need to survey all available officers in the region to enhance the statistical significance of the results. In all, 90 officers were surveyed for the study.

4.6 Data collection

Structured questionnaires were used to collect data for the study. Structured questionnaires have been employed in various survey-based studies similar to this study (e.g. Abebe & Bogale, 2014; Aidoo et al., 2014; Ali, 2013). An "interviewer-administered survey approach" (Fowler Jr, 2013) was employed to collect data from the farmers in the farmer survey to avoid the problem of non-educated farmers' inability to read and write. A "self-administered survey approach" (Fowler Jr, 2013) was employed to collect data from the officers in the extension officer survey, because of their ability to read and write.

With the aid of agricultural extension officers in the selected operational areas, randomly selected respondents (heads of households), from the "holders listing" at the various offices of the Department of Agriculture, were identified and the structured questionnaire administered. The questionnaire was administered with the help of enumerators who were briefed about the objective of the study in advance as well as trained in the administration of the questionnaire to ensure consistency across the enumerators. The purpose of the study was explained to each respondent and their consent to participate in the survey sought by having them sign/thumbprint a consent form. The participants were also told that they were under no obligation to complete the survey and can opt to end the survey administration when they feel compromised. Once the consent form was signed/thumb printed, the questionnaire was then administered by the enumerators. In the absence of the head of the household, it was noted for a subsequent revisit, whilst the enumerators continued to the next household to continue with the survey. If any head

of a household was not present as at the end of the survey in the area, a different household was randomly selected for the survey.

For the agricultural extension officers, the Departments of Agriculture usually held bi-weekly meetings where all the staff attend. During one such meeting, and with advance approval from the various Municipal Directors of Agriculture at these offices, the objective of the study was explained to the staff. The officers were provided with an information sheet which contained information about their rights and consent to participate in the survey by signing the consent form attached, once this was done the structured questionnaires were distributed to each to complete.

4.7 Data analysis

The data analysis was divided into two parts. First, analysis of the farmer survey is presented. Second, analysis of the agricultural extension officer survey is also presented.

4.7.1 Farmer survey

The farmer survey for this study was divided into various sections for ease of analysis. The first section described the descriptive statistics of the socio-demographic, farm characteristics, and institutional factors. The second section described the analysis of the respondents' risk profiles and the risk management strategies they have in place. Section three described the analysis of the knowledge respondents have about the WII scheme, whilst section four described the analysis of the respondents' attitudes towards the WII scheme. Section five then described the analysis of the respondents' willingness to participate, and pay for the WII scheme. The determinants of the respondents' willingness to participate, and pay for the scheme, were also described.

4.7.1.1 Descriptive statistics

The descriptive statistics of the socio-demographic, farm characteristics and institutional factors were described using frequency distribution tables, percentages, mean, minimum and maximum. Chi-square tests and t-tests were performed to determine any significant differences between respondents who were willing to participate in a WII scheme and those who were not. RStudio statistical package was used to facilitate these analyses.

4.7.1.2 Farmers' risk profiles, and risk management strategies

Descriptive statistics like frequencies were used to analyse the risks that respondents were mostly exposed to in the Upper East Region. The frequency of each risk that was indicated by the respondents was determined. If most respondents were exposed to a particular risk, many of them would indicate it hence its frequency will be high. Therefore, the risks with the highest frequencies of indication by the respondents were identified as the risks that they were mostly exposed to in the region. The same approach was used to analyse the risk management strategies that are mostly used by the respondents in the region.

The risk that was most important to the respondents in the region was also determined by calculating the weighted scores of each ranked risk applicable to a respondent on a five-point Likert scale (ranges from very low (1) to very high (5)). The weighted scores of each risk applicable to the respondents were determined. This was done by multiplying the number of respondents, say 50, with the same ranking of a risk by the rank score for each risk and then summing them up. The most important risks to the respondents in the region were those risks with the highest weighted scores. This method has been used by Kwadzo et al. (2013) to determine the most important risk on crop production for farmers in the Kintampo North Municipality of Ghana. The same approach was used to analyse the risk management strategies that were most important to farmer respondents in the region.

4.7.1.3 Farmers' knowledge about WII scheme

An "insurance awareness index" (Ackah & Owusu, 2012) was employed to analyse the respondents' knowledge about the WII scheme in the region. An insurance awareness index was calculated using the sum of correct answers obtained from Yes or No or multiple-choice questions about the insurance scheme divided by 12, the number of questions. In this study, there were three types of awareness levels, that is, low, moderate and advanced awareness level. For the set of 12 questions used to assess the respondents' knowledge about the insurance scheme, the minimum score was 0, and the maximum was 12 with a range of 12. An index range of 0 – 0.33 represents low, a range of 0.34 – 0.67 represents moderate, and a range of 0.68 – 1.0 represents advanced awareness of the insurance scheme. The percentage of farmers in each of these categories was calculated.

4.7.1.4 Farmers' attitude towards WII scheme

In this study, attitude was classified into three, unfavourable, indifferent or favourable attitude. A five-point Likert scale was used to analyse the attitude of respondents towards the WII scheme in the region. This approach has been used to analyse farmers and agricultural extension officers' attitude towards agricultural insurance in Tanzania and Nigeria respectively, (e.g. Ajayi, 2013; Daninga & Qiao, 2014). The use of a Likert scale rating is common with survey-type research where opinions of something are rated from high to low or best to worst (Allen & Seaman, 2007). The use of Likert scale ratings over the attitudinal statements to analyse the respondents' attitudes towards the WII scheme enabled the capturing of the respondents' opinion rather than a Yes or No answer. Therefore, the mean score of each attitudinal statement was calculated by obtaining the total score for a statement and dividing it by the number of respondents. The total score for each statement was the sum of the products of the number of respondents under each rating and the rating score value. An overall mean (mean of the mean scores) was obtained by averaging the means of all the attitudinal statements. Since a five-point Likert scale was used, the least and the maximum mean scores can only be 1 and 5 respectively, with a range of 4. A mean score range of 1 - 2.33 represented an unfavourable attitude, a mean score range of 2.34 - 3.67 represented an indifferent attitude and a mean score range of 3.68 - 5.0 represented a favourable attitude towards WII scheme. From this, the statements to which the respondents had a favourable, indifferent or an unfavourable attitude towards was determined. Again, the collective attitude of the respondents towards the insurance scheme in the region was determined by the value of the overall mean score.

It must be noted that the 20 attitudinal statements for the study in all consisted of ten (10) positive and ten (10) negative statements during the administration of the questionnaire. However, for ease of analysis, the 10 negative statements were turned to positive statements after the administration of the questionnaire and their respective level of agreements reversed appropriately during data entry. That is, a negative statement whose level of agreement was strongly disagreed, when turned into a positive statement, its level of agreement, becomes strongly agree. Table 4.1 contains the original attitudinal statements and the converted negative statements, into positives (in italic), after the administration of the questionnaire.

Table 4.1 The original, and converted attitudinal statements for the respondents

SN	Original attitudinal statements with both positive and negative statements	Converted attitudinal statements with positive statements only
1	Weather insurance is not needed to cushion the effects of crop losses due to drought because other effective risk management strategies exist.	*Weather insurance is needed to cushion the effects of crop losses due to drought because other effective risk management strategies do not exist.*
2	Weather insurance is not needed because drought is not a problem here.	*Weather insurance is needed because drought is a problem here*
3	Although weather Insurance for drought is important, farmers prioritise other needs	*Weather Insurance for drought is important because farmers do not prioritise other needs*
4	Weather insurance is appropriate to tackle the incidence of drought for farmers in this area	Weather insurance is appropriate to tackle the incidence of drought for farmers in this area
5	Agricultural losses are acts of God that can't be mitigated even with insurance.	*Agricultural losses are acts of God that can be mitigated with insurance.*
6	I fear that the claims may not be paid by the insurance company when they are due.	*I do not fear that the claims may not be paid by the insurance company when they are due.*
7	I fear that the payment of compensation will be very late.	*I do not fear that the payment of compensation will be very late.*
8	The insurance providers could manipulate the rainfall volumes to avoid paying farmers their claims.	*The insurance providers will not manipulate the rainfall volumes to avoid paying farmers their claims.*
9	I believe the insurance providers will compensate farmers fairly.	I believe the insurance providers will compensate farmers fairly.
10	The design of the contract will always favour the insurer and not the farmer.	*The design of the contract will always be fair for both the insurer and the farmer.*
11	The insurance providers will never run away with the farmer's money.	The insurance providers will never run away with the farmer's money.
12	I believe the insurance contracting will not involve much paperwork for farmers.	I believe the insurance contracting will not involve much paperwork for farmers.
13	I believe the premium for weather insurance against drought will be affordable.	I believe the premium for weather insurance against drought will be affordable
14	I believe the insurance programme will be simple for me to understand.	I believe the insurance programme will be simple for me to understand.
15	Only farmers in the city can take this insurance type because the providers will not be in the communities.	*Farmers everywhere can take this insurance type because the providers will be in the communities.*
16	I believe the insurance providers will treat and respect me even though I am a farmer and possibly uneducated.	I believe the insurance providers will treat and respect me even though I am a farmer and possibly uneducated.
17	I think with this insurance cover, I may be able to access a loan now from a bank which will not have been possible without it.	I think with this insurance cover, I may be able to access a loan now from a bank which will not have been possible without it.
18	With insurance, it is easy for me to expand my scale of production because the drought was my primary concern.	With insurance, it is easy for me to expand my scale of production because the drought was my primary concern.
19	Weather insurance is only meant for large-scale farmers and not smallholder farmers.	*Weather insurance is not only meant for large-scale farmers but smallholder farmers too.*
20	I will buy the insurance cover even if it is not sold to me by an Agricultural extension officer.	I will buy the insurance cover even if it is not sold to me by an Agricultural extension officer.

4.7.1.5 Farmers' willingness to participate and pay for WII scheme

This section was divided into two parts. First, analysis of the respondents' willingness to participate in the insurance scheme and the factors affecting it. Second, analysis of the respondents' willingness to pay (WTP) for the insurance scheme in the region and the factors affecting it.

- **Analytical methods**

The analytical methods used in various willingness to pay studies are varied. There were studies where only the factors affecting farmers' willingness to participate in insurance schemes have been determined without looking at the factors affecting willingness to pay (Adeyonu, 2016; Akintunde, 2015; Boyd et al., 2011; Issaka et al., 2016; Jin et al., 2016). In most of these studies, either probit or logistic regression models are used to estimate the model. Other studies besides determining the factors affecting farmers' willingness to participate with the help of a binary logistic model have estimated the maximum willingness to pay for the insurance type (e.g. Gulseven, 2014; Kwadzo et al., 2013). However, there were studies on willingness to pay for agricultural insurance that had determined both the factors affecting farmers' willingness to participate, and the maximum willingness to pay for the insurance (e.g. Aidoo et al., 2014; Arshad et al., 2016; Ellis, 2017b; Ghazanfar et al., 2015; Okoffo et al., 2016).

In these studies, different analytical methods have been employed to estimate the econometric models for participation and paying for insurance. Arshad et al. (2016) used the double-bounded logit model to estimate the probability of a household's willingness to pay for crop insurance in a study to determine the drivers of the willingness to pay for crop insurance against extreme weather events in Pakistan. Ghazanfar et al. (2015) in a study to determine farmers' willingness to pay for crop insurance in Pakistan used the Heckman selection model which takes care of selectivity bias, to estimate the econometric model for farmers' participation and willingness to pay. A probit model is used in the first stage to estimate farmers' participation and the Ordinary Least Square method is used to estimate farmers' willingness to pay. Ellis (2017b) in a study of farmers' willingness to pay for crop insurance used the Heckman two-stage model to estimate farmers' willingness to participate and to pay for crop insurance. The Heckman two-stage model was used because the decision to participate and to pay for crop insurance were two independent decisions that a farmer makes which are affected by different factors. It also takes care of selectivity bias since in the estimation of the willingness to pay, only farmers who are interested, are considered (Ellis, 2017b). Aidoo et al. (2014) in assessing

the prospects of crop insurance as a risk management strategy used binary logistic regression and an Ordinary Least Square model to estimate the factors affecting farmers' willingness to adopt crop insurance, and the premiums to be paid, respectively. Okoffo et al. (2016) in the estimation of cocoa farmers' willingness to pay for crop insurance, used the double-hurdle model and also argues that the decision of a cocoa farmer to pay for crop insurance is made first before deciding on how much to pay. Therefore, there are two decisions, and their equations are assumed to be independent of each other.

This study recognises that a farmer who decides to participate must also make another independent decision as to how much to pay for the WII scheme. The two analytical methods suitable for this type of analysis are the Heckman two-stage model and the Double Hurdle model.

- **Heckman Two-Stage model**

Sample selection bias arises when non-random samples, as in the case of the second stage regression, are used to estimate behavioural relationships (Heckman, 1979). Sample selection as asserted by Heckman (1979) can be as a result of self-selection by the individuals or the data units under study. According to Heckman (1979), this can lead to incorrect estimates of parameters as some of the parameters may appear to be statistically significant when applied to the selected sample. However, it is possible for the estimated values of the omitted variables, which results in sample selection, estimated and incorporated as independent variables to estimate behavioural functions. This is done by estimating the inverse of Mill's ratio, a function of the probability that an observation is selected into the sample, (Heckman, 1979) and incorporating it in the second stage regression.

- **Double Hurdle Model**

According to Okoffo et al. (2016) the Double-Hurdle model is appropriate for situations where an adoption behaviour has to do with two decisions, that is an adoption decision which is binary and can be estimated with a logit model, and a how much to pay decision which can be estimated with a truncated regression model. Unlike the Heckman model that assumes that there are no zero responses in the second hurdle of the process, the double hurdle model recognises this possibility of zero responses especially at the second hurdle stage (Okoffo et al., 2016; Wodjao, 2007). These zero responses, especially in the second stage of the hurdle, may arise due to a farmer's inability to provide answers to some questions on their willingness

to pay. It may be a lack of knowledge or inadequate information on the part of the farmer to provide such answers (Okoffo et al., 2016; Yu & Abler, 2010).

Following from the review of these models, the Heckman two-stage model was used to estimate the willingness to participate in the scheme (probit model) and the willingness to pay for it (interval regression model) in the region. This was because firstly, there were no zero responses in the willingness to pay. Secondly, there could be selection bias with the non-inclusion of the respondents who were not willing to participate in the scheme.

Conceptual Framework

The conceptual framework on which basis the factors affecting the respondents' participation in the insurance scheme was determined was the theory of Utility Maximisation. As such, the first stage of the econometric model in this study follows from the work of Guo (2016) and Long, Minh, Manh, and Thanh (2013).

Let U_0 and U_1 denote the utility levels for a farmer without and a farmer with crop insurance, respectively. Then the utility level, U_0, of a farmer without crop insurance is affected by the individual's income level (Y_0), the price (p_0) of a vector of goods (q_0), and a vector of the demographic characteristics (X). The utility level, U_1, of a farmer with crop insurance is also affected by the new income level after buying the insurance (Y_1), the price (p_0) of a vector of goods (q_0), the price of the insurance (p_i), and a vector of the demographic characteristics (X). Naturally this should give the farmer a new income (Y_1) which is equal to the original income minus the price of insurance, that is, $Y_1 = Y_0 - p_i$, and the new vector of goods owned by farmer after buying the crop insurance q_1 is q_0 plus one more good which is the insurance product.

From the above, a farmer would participate in crop insurance if the new utility after participating in the crop insurance is not lower than his/her original utility without insurance. That is:

$$U_0(Y_0, p_0, q_0, X) \leq U_1(Y_0 - p_i, p_0, q_1, X) \quad (1)$$

Therefore, the farmer's probability of participating in the insurance is equal to the probability that equation (1) holds:

$$\Pr(yes) = \Pr(U_0(Y_0, p_0, q_0) \leq U_1(Y_0 - p_i, p_0, q_1)) \quad (2)$$

Rewriting equation (2) gives the following form as shown below:

$$U_0(Y_0, p_0, q_0, \mathrm{X}) \leq U_1(Y_0 - \mathrm{p}_i, p_0, q_0 + 1, \mathrm{X}) \quad (3)$$

A farmer would participate in WII scheme for drought cover so that in the event of a drought the household is covered. The farmer receives a pay-out (G) in the event of losses (L) associated with drought under the insurance cover. Incorporating this information into equation (3) gives the following equation:

$$U_0(Y_0, p_0, q_0, \mathrm{X}) \leq U_1(Y_0 - \mathrm{p}_i + G - L, p_0, q_0 + 1, \mathrm{X}) \quad (4)$$

Therefore, the probability of a farmer participating in Insurance scheme for drought is given by:

$$\Pr(yes) = \Pr(U_0(Y_0, p_0, q_0, \mathrm{X}) \leq U_1(Y_0 - \mathrm{p}_i + G - L, p_0, q_0 + 1, \mathrm{X})) \quad (5)$$

The econometric model can thus be estimated from equation (4) where:

$$\Pr(yes) = f(Y, \mathrm{p}_i, L, \mathrm{X}) \quad (6)$$

From equation (6), a farmer's willingness to participate in the insurance scheme for drought is a function of the household income, the price of the insurance, the potential loss from drought, and a vector of the household characteristics as well as other institutional factors. The frequency of drought occurring and its severity on the household as perceived by the farmer, calculated as a drought index, was used as a proxy for losses associated with drought occurrence (L).

The second stage of the econometric model follows from the work of Wan (2014) . Supposing a farmer *i's* characteristic vector is X_{iq} and income is Y_i, then the utility U_{i0} of not paying for weather-index based insurance is given by:

$$U_{i0} = \alpha_{i0} + \alpha_q X_{iq} + \alpha_Y Y_i + \varepsilon_i \quad (7)$$

Where α_0 is a constant; α_q and α_Y are coefficients to be determined; ε is the error term of the utility. Given also that WTP_i is the random variable for a farmer i*'s* WTP for the insurance premium, then the utility U_{i1} of paying for the insurance scheme is given by:

$$U_{i1} = \alpha'_{i0} + \alpha'_q X_{iq} + \alpha_Y (Y_i - WTP_i) + \varepsilon_i \quad (8)$$

Following from this, a respondent *i* will be willing to pay WTP_i if the utility of paying for the insurance scheme or not, is exactly equal, that is $U_{i0} = U_{i1}$. Setting equation 7 and 8 to equal and rearranging result in:

$$WTP_i = \beta X_i + \varepsilon_i \quad (9)$$

Where βX is the difference between the deterministic parts of the two utilities (7) and (8). Assuming a latent variable *WTP** represents the actual willingness to pay (WTP) of respondent *i,* then;

$$WTP^* = \beta X'_i + u_i \text{ and } WTP^*|x \sim Normal\ (\beta X', \sigma^2) \quad (10)$$

Where, σ^2 = Var $(WTP^*|x)$ is assumed not to depend on x, and u_i is a mean zero constant variance error term.

- **Willingness to participate in the insurance scheme and the factors affecting it**

A probit regression model was used in the first stage of the Heckman two-stage regression model to estimate the factors affecting the respondents' participation in the scheme. Following the works of Kouame and Komenan (2012) and Ellis (2017b) , the Heckman two-stage model was specified as follows:

$$Z_i^* = \alpha X_i + u_i \quad u \sim N(0,1) \quad (11)$$

$$Z = 1 \text{ if } Z^* > 0$$

$$Z = 0 \text{ if } Z^* \leq 0$$

Z^* is an unobserved latent variable determining the respondent's participation in the insurance scheme, X is a vector of explanatory variables, u is a random error term, α is parameter vector. The probit model was therefore given by:

$$Y_i = C + \beta_i X_i + u_i$$

Where Y_i is the binary dependent variable expressed as $Y = 1$, if willing to participate and $Y = 0$, if otherwise

C = is the intercept

β_i = the regression coefficients for each independent variable

X_i = independent explanatory variables

u_i = the error term.

The marginal effects were used to explain the effect of the explanatory variables on the dependent variable since the coefficients of the probit model only indicate the direction of the relationship. Following from the work of (Ellis, 2017b), the marginal effect was expressed as:

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

- **Willingness to pay (WTP) for the insurance scheme and the factors affecting it**

An interval regression model was used to estimate the respondents' willingness to pay for the scheme in the second stage of the Heckman model. The Inverse Mill Ratio (IMR), which takes care of sample selection bias and reflects the probability that an observation belongs to the selected sample, which is estimated from parameter estimates from the probit model (Ellis, 2017b; Kouame & Komenan, 2012) was not catered for in this analysis. This was as a result of the statistical package "DCchoice" used to run the analysis, especially, the second model in R.

The double-bounded dichotomous choice contingent valuation method (Hanemann, Loomis, & Kanninen, 1991) was employed to estimate the WTP for the insurance scheme in the region. As stated earlier in the data collection section, the respondents were presented with two bids, an initial bid and a second bid which was contingent on the response to the initial bid. This resulted in four outcomes: No, No; No, Yes; Yes, No; or Yes, Yes. This places upper and lower bounds on each respondents' true WTP for the scheme and leads to the partitioning of the WTP into four intervals $(-\infty, B_L)$, (B_L, B_O), (B_O, B_H) or $(B_H, +\infty)$ depending on the response to the bids. Following the work of Tozer, Galinato, Ross, Miles, and McCluskey (2015), Gabrielyan, McCluskey, Marsh, and Ross (2014) and Yang, McCluskey, and Ross (2009), in estimating WTP, the discrete outcomes of the bidding process are:

$$Y_i = \begin{cases} 1 & WTP_i \le B_L \quad (\text{No, No}) \\ 2 & B_L \le WTP_i \le B_0 \quad (\text{No, Yes}) \\ 3 & B_0 \le WTP_i \le B_H \quad (\text{Yes, No}) \\ 4 & B_P \le WTP_i \quad (\text{Yes, Yes}) \end{cases} \tag{12}$$

Where Y_i, is the bid function for each respondent, WTP_i is the respondent *i's* willingness to pay, B_L, is the lower bid, B_O, is the initial bid, and B_H is the upper bid. The WTP bid function is therefore given as:

$$WTP_i = \alpha - \rho B_i + \lambda' z_i + \varepsilon_i \qquad for\ i = 1, \ldots, n \tag{13}$$

Where B_i is the initial bid presented to respondent *i,* z_i is a vector of explanatory variables, ε_i is the error term and assumed to follow a cumulative logistic distribution with a mean of zero and variance of σ^2.

Since the respondents' WTP fall within intervals, the interval regression model is estimated using the maximum likelihood method to estimate the respondents' WTP for the scheme. The log-likelihood function is given by:

$$\ln L = \sum_{i=1}^{n} \left\{ \begin{array}{c} I_{Y_{i=1}} \ln F\left(\alpha - \rho B_{L_i} + \lambda' Z_i\right) + \\ I_{Y_{i=2}} \ln\left[F\left(\alpha - \rho B_{O_i} + \lambda' Z_i\right) - F\left(\alpha - \rho B_{L_i} + \lambda' Z_i\right)\right] + \\ I_{Y_{i=3}} \ln\left[F\left(\alpha - \rho B_{H_i} + \lambda' Z_i\right) - F\left(\alpha - \rho B_{O_i} + \lambda' Z_i\right)\right] \\ I_{Y_{i=4}} \ln\left[1 - F\left(\alpha - \rho B_{H_i} + \lambda' Z_i\right)\right] \end{array} \right\} \tag{14}$$

Where $I_{Y_{i=j}}$ is the indicator for each j outcome $(j = 1,2,3,4)$ for the individual i. The $F(\ )$ function is defined to be the standard logistic distribution with mean zero and variance $\sigma^2 = (\pi / \sqrt{3})^2$.

The WTP was estimated using the package "DCchoice", a function for analysing dichotomous choice contingent valuation data in Rstudio (Nakatani, Aizaki, & Sato, 2016).

- **Choice of explanatory variables for the regression models**

The choice of explanatory variables included in the Heckman two-stage regression model and their expected signs are presented in Table 4.5. These were chosen following a literature review on the factors that influence farmers' willingness to participate and pay for agricultural crop insurance.

Table 4.2 Explanatory variables and the expected signs for the regression models

Variable code	Definition	Measurement	Sign
Socio-demographic			
Age	Age of respondent	In years	-
Gender	Gender of respondent	Male=1, female=0	+
Marital_Status	Respondents' marital status	Married=1, otherwise=0	-/+
Educ_Years	Education in years	Years of schooling	-/+
Yrs_Farm_Exp	Years of farm experience	In years	-/+
HH_Size	Household size	Numbers	-/+
Pri_Occup	Primary occupation	Farmer=1, otherwise=0	+
Land_Tenure	Land tenure system	Owner=1, otherwise=0	-/+
Wrk_HH_Mem	Working household members	Numbers	-/+
TCrop_Income	Total crops income	In Ghana Cedis	-/+
Maize_Income	Income from Maize only	In Ghana Cedis	+
Other_Income	Income from other sources	Yes=1, otherwise=0	-/+
Attitude_Score	Attitude towards the scheme	Numbers	+
Farm Factors			
Land_Size	Area put to crops production	In acres	-/+
Maize_Landsize	Area put to maize production	In acres	-/+
Farm_Diver	Diversification of the farm	Yes=1, otherwise=0	-
Drought_Index	Drought index of respondent	Numbers	+
Institutional Factors			
Cred_Access	Respondent access to credit	Yes=1, otherwise=0	-/+
Ext_Access	Respondents access to extension services	Yes=1, otherwise=0	+
Mem_FBO	Member of FBO	Yes=1, otherwise=0	+
LogBids	Natural log of the initial bids	Numbers	-
Knowledge Factors			
Know_Insu	Knowledge of insurance	Yes=1, otherwise=0	+
WII_Know	Knowledge of WII	Yes=1, otherwise=0	+

4.7.2 Agricultural extension officer survey

The agricultural extension officers' survey was divided into various sections for ease of analysis. The first section described the descriptive statistics of the socio-demographic variables of the extension officers. The second section described the analysis of the knowledge officers had about the WII scheme, whilst section three described the analysis of the officers' attitudes towards the insurance scheme. Section four described the analysis of the factors affecting the officers' knowledge about the insurance scheme.

4.7.2.1 Descriptive statistics

The descriptive statistics of the socio-demographic variables of the officers were done using frequency distribution tables, percentages, mean, minimum and maximum. Chi-square or Fisher's exact tests and t-test were carried out to determine any significant differences between officers who knew about the insurance scheme and those who did not.

4.7.2.2 Agricultural extension officers' knowledge about WII scheme

A similar approach used to analyse the farmers' knowledge about the WII scheme in the region was employed to analyse the officers' knowledge about the insurance type in the region. As such an insurance awareness index over the twelve questions was used where a score range of 0 - 0.33 represented low, a range of 0.34 – 0.67 represented moderate and a range of 0.68 – 1.0 represented advanced awareness of the insurance scheme.

4.7.2.3 Agricultural extension officers' attitude towards the WII scheme

The same approach that was used to analyse the farmer respondents' attitude towards the insurance scheme was used to analyse the officers' attitude towards the insurance scheme. However, it must be noted that the attitudinal statements for the study were 20 and consisted of 9 positive and 11 negative statements during the administration of the questionnaire. For ease of analysis, the 11 negative statements were turned to positive statements after the administration of the questionnaire and their respective level of agreements reversed appropriately during data entry. Table 4.3 contains the original attitudinal statements and the converted negative statements, into positives (in italic), after the administration of the questionnaire.

Table 4.3 The original, and converted attitudinal statements for the officers

SN	Original attitudinal statements with both positive and negative statements	Converted attitudinal statements with positive statements
1	Weather insurance is not needed to cushion the effects of crop loss due to drought because farmers have other effective risk management strategies.	*Weather insurance is needed to cushion the effects of crop loss due to drought because farmers do not have other effective risk management strategies.*
2	Weather insurance is not needed because drought is not a problem for farmers.	*Weather insurance is needed because drought is a problem for farmers.*
3	Weather Insurance for drought though important, it is not a primary need of farmers.	*Weather Insurance for drought is important because it is a primary need of farmers.*
4	Weather insurance is appropriate to tackle incidence of drought for farmers.	Weather insurance is appropriate to tackle incidence of drought for farmers.
5	Agricultural losses are acts of God that can't be mitigated even with insurance.	*Agricultural losses are acts of God but can be mitigated with insurance.*
6	This insurance type may not pay farmers their claims at all when it is due.	*This insurance type will pay farmers their claims when it is due.*
7	This insurance type even if it is to pay farmers their compensation, it will likely be done very late which will not be helpful to farmers.	*This insurance type will pay farmers their compensation, and it will be done immediately for it to be helpful to farmers.*
8	The insurance providers could manipulate the rainfall data to avoid paying so many farmers.	*The insurance providers will not manipulate the rainfall data to avoid paying so many farmers.*
9	I believe the insurance providers will compensate farmers fairly.	I believe the insurance providers will compensate farmers fairly.
10	The design of the contract will always favour the insurers and not the farmer.	*The design of the contract will always be fair to both the insurers and the farmers.*
11	The insurance providers will never run away with the farmer's money.	The insurance providers will never run away with the farmer's money.
12	I believe the insurance contracting will not involve much paperwork for farmers.	I believe the insurance contracting will not involve much paperwork for farmers.
13	I believe the premium for weather insurance against drought will be affordable for farmers.	I believe the premium for weather insurance against drought will be affordable for farmers.
14	I do not think that the farmers will understand the insurance contract design to buy it.	*I think that farmers will understand the insurance contract design to buy it.*
15	Only farmers in the city can take this insurance type because the providers will not be in the communities.	*Farmers everywhere can take this insurance type because the providers will be in the communities.*
16	I believe the insurance providers will treat and respect the farmers even though some farmers may be uneducated.	I believe the insurance providers will treat and respect the farmers even though some farmers may be uneducated.
17	I believe with this insurance cover, farmers may be able to access loans now from a bank which will not have been possible without it.	I believe with this insurance cover, farmers may be able to access loans now from a bank which will not have been possible without it.
18	With the insurance, it will be easy for farmers to expand their scale of production because the drought was their concern.	With the insurance, it will be easy for farmers to expand their scale of production because the drought was their concern.
19	Weather insurance is only meant for large-scale farmers and not smallholder farmers.	*Weather insurance is not only meant for large-scale farmers but smallholder farmers too*
20	Farmers will buy the insurance cover even if it is not sold to them by the Agricultural extension officer.	Farmers will buy the insurance cover even if it is not sold to them by the Agricultural extension officer

4.7.2.4 Factors affecting agricultural extension officers' Knowledge about WII

Since an agricultural extension officer either know or not about the WII scheme, it is a binary variable, that is 1 when "Yes" and 0 when "No". A probit regression model was used to determine the factors that influenced the officers' knowledge about the insurance scheme in the region. Kumar et al. (2011) used a similar method to analyse the factors influencing farmers' awareness of agricultural insurance in Tamil Nadu India. The advantages of this model compared to a linear regression model is that; (1) It avoids heteroskedasticity in the error term when the variable is binary and (2) It also avoids the inaccurate prediction of Y when it is greater than 1 and when it is less than 0 and therefore, ensures that the probability is bounded by 0 and 1 (Boyd et al., 2011).

The probit regression model is generally expressed as:

$$Y_i = C + \beta_i X_i + \varepsilon_i$$

Where Y_i is the binary dependent variable expressed as $Y = 1$, if Aware and $Y = 0$, if Not

C = is the intercept

β_i = the regression coefficients for each independent variable

X_i = independent variables which might influence extension officers' knowledge of WII

ε_i = the error term.

The choice of the explanatory variables included in the probit regression model and their expected signs are presented in Table 4.2

Table 4.4 Explanatory variables and the expected signs for the probit model

Variable code	Definition	Measurement	Sign
Age	Age of respondent	In years	-
Gender	Gender of respondent	Male=1, female=0	-/+
Educ_Status	Education in years	Years of schooling	+
Yrs_Work_Exp	Years of work experience	In years	+
Insu_Trainings	Insurance training session attended	Numbers	+
Grade	Grade of Officer	Supervisor=1, Agent=0	+
Insu_Know	Knowledge of insurance	Yes=1, otherwise=0	+
Attitutde_Score	Attitude towards the scheme	Numbers	+

4.8 Ethical consideration

Peer review evaluated the study and judged it to be low risk. As such, the study was approved by the Massey University Human Ethics Committee: Southern A, with application No. 4000018062.

CHAPTER FIVE - RESULTS

5.1 Introduction

In this chapter, the results of the study are presented into two main sections. Section 5.2 summarises the results of the farmer survey. Section 5.3 summarises the results of the agricultural extension officer survey in the Upper East Region.

5.2 Farmer survey

In this section, the descriptive statistics of the socio-demographic, farm, and institutional factors from the farmer survey are described. This is followed by a description of the respondents' risk profiles, and risk management strategies. Subsequently, the respondents' knowledge about the WII scheme for drought in the region, and their attitude towards the insurance scheme are described. Finally, the results about the respondents' willingness to participate, and to pay, for the insurance scheme as well as the factors that influence this in the Upper East Region are also presented.

5.2.1 Descriptive statistics

5.2.1.1 Socio-demographic factors

The descriptive statistics of the socio-demographic factors of the respondents are presented in frequency distribution tables, percentages, mean, minimum and maximum. Statistical tests of significant difference between respondents who are willing, and those unwilling to participate in the WII scheme, such as t-test, and χ^2 tests or Fisher's exact tests are also presented.

A total of 200 respondents took part in the farmer survey. These respondents were from 15 randomly selected operational areas within the three municipalities of the Upper East Region that is, Bolgatanga, Bawku East, and Navrongo Municipalities. Table 5.1 provides information on the number of operational areas as well as farmers from each of the municipality surveyed.

Table 5.1 The municipalities, operational areas and respondents in the study

Municipality	Number of operational areas	Number of Respondents surveyed
Bolgatanga	5	70
Bawku East	5	70
Navrongo	4	60
Total	**14**	**200**

Of the 200 respondents in the survey, 159 (79.5%) were male whilst 41 (20.5%) were female (Table 5.2). The χ^2 test indicates that there was no significant difference between the gender of the respondents and their willingness to participate[3].

Table 5.2 The gender of the surveyed respondents

Gender	Number of Respondents	Willingness to Participate		Percentage of Respondents
		No	Yes	
Males	159	46 (28.9%)	113 (71.1%)	79.5%
Females	41	15 (36.6%)	26 (63.4%)	20.5%
Total	**200**	**61 (30.5%)**	**139 (69.5%)**	**100%**

($\chi^2 = 0.58$, df =1, p-value=0.45)

The results revealed that the majority of the respondents 187 (93.5%) were married, whilst single and widowed respondents were 7 (3.5%) and 6 (3.0%), respectively (Table 5.3). The χ^2 test and Fisher's exact test revealed that there was no significant difference between the marital status of the respondents and their willingness to participate.

Table 5.3 The marital status of the respondents in the survey

Marital Status of Respondents	Number of Respondents	Willingness to Participate		Percentage of Respondents
		No	Yes	
Married	187	57 (30.5%)	130 (69.5%)	93.5%
Single	7	2 (28.6%)	5 (71.4%)	3.5%
Widowed	6	2 (33.3)	4 (66.7%)	3.0%
Total	**200**	**61 (30.5%)**	**139 (69.5%)**	**100.0%**

($\chi^2 = 0.04$, df = 2, p-value = 0.98, Fisher's p-value = 1)

The results revealed that the average age of the respondents was approximately 44 years, the minimum and maximum ages were 25 and 84 years, respectively. There was no significant difference between the mean ages of respondents who are, and those who are not, willing to participate, (t = -0.4731, df = 118.12, p-value = 0.637). The data showed that there was no respondent in the study that was below the age of 19 years (Table 5.4). The majority of the respondents were within the age categories of 31 – 40 years (33.5%) and 41 – 50 years (33.0%). The percentage of respondents within the age category of 51- 60 was 19.0%, whilst respondents in the age categories of 20 – 30 years (7.5%) and 60+ years (7.0%), respectively, were in the

[3] This means willingness to participate in the WII scheme in the region

minority in the study. There was no significant difference between the age categories of the respondents and their willingness to participate.

Table 5.4 Age categories of the respondents in the region

Age Categories of Respondents	Number of Respondents	Willingness to Participate		Percentage of Respondents
		No	Yes	
0-19	0	0	0	0.0%
20-30	15	4 (26.7%)	11(73.3%)	7.5%
31-40	67	25 (37.3%)	42 (62.7%)	33.5%
41-50	66	18 (27.3%)	48 (72.7%)	33.0%
51-60	38	12 (31.6%)	26 (68.4%)	19.0%
60+	14	2 (14.3%)	12 (85.7%)	7.0%
Total	**200**	**61 (30.5%)**	**139 (69.5%)**	**100.0%**

(χ^2 = 3.6528, df = 4, p-value = 0.455, Fisher's p-value = 0.49)

The average household size in the study was approximately 7 people and the minimum and maximum household sizes were 2 and 23 people, respectively. There was a significant difference in the mean household size of the respondents and their willingness to participate, (t = -2.342, df = 165.77, p-value = 0.0204).

The data revealed that almost half of the respondents, 95 (47.5%), received no formal education (Table 5.5). The data also shows that as the educational level increases, there were fewer respondents except for senior high school (SHS) and tertiary level where the number of farmers remained the same for both cases. There was no significant difference in the educational status of respondents and their willingness to participate.

Table 5.5 Educational status of the surveyed respondents in the region

Educational Status of Respondents	Number of Respondents	Willingness to Participate		Percentage of Respondents
		No	Yes	
Did not go	95	33 (34.7%)	62 (65.3%)	47.5%
Primary	39	11 (28.2%)	28 (71.8%)	19.5%
JHS	27	5 (18.5%)	22 (81.5%)	13.5%
SHS	19	3 (15.8%)	16 (84.2%)	9.5%
Tertiary	19	8 (42.1%)	11 (57.9%)	9.5%
Postgrad	1	1 (100.0%)	0 (0.0%)	0.5%
Total	**200**	**61 (30.5%)**	**139 (69.5%)**	**100.0%**

(χ^2 = 8.1555, df = 5, p-value = 0.1479, Fisher's p-value = 0.15)

The occupation of the majority of the respondents, 168 (84%), was farming (Table 5.6). A few respondents were teachers, the second main occupation. Other occupations included: nurses, traders, civil servants, students, drivers, and mason/carpenters, among others. There was a significant difference between the main occupation of the respondents and their willingness to participate.

Table 5.6 Main occupations of the surveyed respondents in the region

Main Occupation of Respondents	Number of Respondents	Willingness to Participate		Percentage of Respondents
		No	Yes	
Farmer	168	46 (27.4%)	122 (72.6%)	84.0%
Teacher	7	2 (28.6)	5 (71.4)	3.5%
Nurse	2	0 (0.0%)	2 (100.0%)	1.0%
Trader	5	4 (80.0%)	1 (20.0)	2.5%
Civil Servant	5	2 (40.0%)	3 (60.0%)	2.5%
Student	2	1 (50.0%)	1 (50.0%)	1.0%
Driver	3	2 (66.7)	1 (33.3)	1.5%
Mason/Carpenter	3	0 (0.0%)	3 (100.0)	1.5%
Others	5	4 (80.0%)	1 (20.0%)	2.5%
Total	**200**	**61 (30.5%)**	**139 (69.5%)**	**100.0%**

($\chi^2 = 16.96$, df = 8, p-value = 0.0305, Fisher's p-value = 0.02)

Almost half of the respondents, 106 (53%), did not have other sources of income besides farming, whilst 94 (47%) did have other sources of income (Table 5.7). However, there was no significant difference in the respondents' other sources of income and their willingness to participate.

Table 5.7 Proportion of respondents with other income sources in the region

Other Income Sources	Number of Respondents	Willingness to Participate		Percentage of Respondents
		No	Yes	
Yes	94	33 (35.1%)	61 (64.9%)	47.0%
No	106	28 (26.4%)	78 (73.6%)	53.0%
Total	**200**	**61 (30.5%)**	**139 (69.5%)**	**100.0%**

($\chi^2 = 1.389$, df = 1, p-value = 0.2386)

The average income accrued from total crop production by the respondents was GH¢6,113[4] the minimum and maximum incomes were GH¢308 and GH¢44,712 per annum, respectively.

[4] Exchange rate – NZD1 : GH¢3.15 as at March, 2018

There was no significant difference between the mean incomes of total crop production and the respondents' willingness to participate, (t = -0.8234, df = 82.645, p-value = 0.4126). The average income from maize production per annum was GH¢2,252 whilst the minimum and maximum income from maize production were GH¢77 and GH¢12,308, respectively. There was no significant difference between the mean incomes from maize production and the respondents' willingness to participate, (t = -0.8134, df = 101.06, p-value = 0.4179).

Table 5.8 shows that 155 (77.5%) respondents indicated that some members of their household work outside of the farm enterprise and remit money to the household, whilst 45 (22.5%) indicated otherwise. There was no significant difference between respondents with working household members and their willingness to participate. On the average, the number of household members who work outside of the farm enterprise and remit money to the household was approximately 2 people, whilst the minimum and maximum working household members were 1 and 11 people, respectively.

Table 5.8 Respondents with working household members in the region

Working Household members	Number of Respondents	Willingness to Participate		Percentage of respondents
		No	Yes	
Yes	155	47 (30.3%)	108 (69.7%)	77.5%
No	45	14 (31.1%)	31 (68.9%)	22.5%
Total	**200**	**61 (30.5%)**	**139 (69.5%)**	**100.0%**

(χ^2 = 0.0, df = 1, p-value = 1)

The results revealed that the average years of farming experience was approximately 18 years, the minimum and maximum were 2 and 50 years, respectively. There was no significant difference in the mean years of farming experience and the respondents' willingness to participate, (t = -0.3672, df = 112.09, p-value = 0.7142).

Regarding the land tenure system in the Upper East Region, the majority, 166 (83.0%), of the respondents owned their land (Table 5.9). Only a few respondents, 21 (10.5%), practised share-cropping, whilst 13 (6.5%) rented pieces of land for farming. There was a significant difference between the land tenure system of respondents and their willingness to participate.

Table 5.9 The land tenure system of the respondents in the region

Land Tenure System	Number of Respondents	Willingness to Participate		Percentage of Respondents
		No	Yes	
Owner	166	41 (24.7%)	125 (75.3%)	83.0%
Rent	13	6 (46.2%)	7 (53.8%)	6.5%
Share-cropper	21	14 (66.7%)	7 (33.3%)	10.5%
Total	**200**	**61 (30.5%)**	**139 (69.5%)**	**100.0%**

(χ^2 = 17.097, df = 2, p-value = 0.0002, Fisher's p-value = 0.0002)

The respondents' average area under crop production on an annual basis was 7.1 acres. The minimum and maximum areas under crop production were 1.5 and 35.0 acres, respectively. There was no significant difference in the mean area under cultivation and the respondents' willingness to participate, (t = -1.6232, df = 122.41, p-value = 0.1071). The average area put to maize production was 3.0 acres whilst the minimum and maximum areas were 0.5 and 20.0 acres, respectively. There was also no significant difference in the mean areas under maize cultivation and the respondents' willingness to participate, (t = -0.0078, df = 112.49, p-value = 0.9938).

The crops cultivated in the region were maize, rice, millet, groundnuts, sorghum, soya beans, cowpea, dry season vegetables and sweet potatoes (Table 5.10). However, the top five crops cultivated in the region were maize, rice, millet, groundnuts, and sorghum respectively.

Table 5.10 Crops cultivated by the respondents in the region

Cultivated Crops	Frequency	Percentage of Respondents
Maize	200	100.0%
Rice	118	59.0%
Millet	93	46.5%
Groundnuts	87	43.5%
Sorghum	67	33.5%
Soya Bean	57	28.5%
Cowpea	50	25.0%
Dry season vegetables	31	15.5%
Sweet Potato	12	6.0%
Total	**715**	

(NB: Respondents gave multiple responses to this question)

5.2.1.2 Farm characteristic factors

The majority of the respondents, 139 (69.5%), have diversified their farms into livestock, poultry rearing and forestry, whilst the remaining, 61 (30.5%), respondents had not (Table

5.11). There was a significant difference between the farm diversification status of respondents and their willingness to participate. Table 5.12 shows the areas into which the 139 respondents had diversified. It can be observed that most of the respondents diversified into livestock rearing as a major farm activity followed by poultry rearing. The number of respondents engaged in forestry is negligible.

Table 5.11 Farm diversification status of the respondents in the region

Farm Diversification	Number of Respondents	Willingness to Participate		Percentage of Respondents
		No	Yes	
Yes	139	34 (24.5%)	105 (75.5%)	69.5%
No	61	27 (44.3%)	34 (55.7%)	30.5%
Total	**200**	**61 (30.5%)**	**139 (69.5)**	**100.0%**

(χ^2 = 6.9359, df = 1, p-value = 0.0084)

Table 5.12 Farm activities respondents are engaged in, in the region

Farm Activities Engaged in	Frequency	Percentage of respondents
Livestock	129	92.8%
Poultry	93	66.9%
Forestry	1	1.0%
Total	**223**	**100.00%**

(NB: respondents gave multiple responses hence the frequency is more than 139)

5.2.1.3 Institutional factors

The results revealed that most of the respondents, 129 (64.5%), in the region do not have access to credit for crop production purposes, whilst 71 (35.5%) do have access to credit (Table 5.13). The χ^2 test shows that there was a significant difference between respondents' access to credit and their willingness to participate in the insurance scheme.

Table 5.13 Access to credit by the respondents in the region

Access to Credit	Number of Respondents	Willingness to Participate		Percentage of Respondents
		No	Yes	
Yes	71	12 (16.9%)	59 (83.1%)	35.5%
No	129	49 (37.9%)	80 (62.1)	64.5%
Total	**200**	**61 (30.5%)**	**139 (69.5%)**	**100.0%**

(χ^2 = 8.634, df = 1, p-value = 0.0033)

Of the 71 respondents who access credit for crop production the most common sources of credit were rural banks followed by commercial banks and other organisations such as the Ministry of Food and Agriculture (MOFA), and some agricultural Non-Governmental Organisations (NGOs) in the region (Table 5.14). Whilst social networks were the least common source of credit, money lenders and micro-financial institutions also were not common sources of credit for the respondents in the region.

Table 5.14 Sources of credit for crop production by the respondents in the region

Credit Sources	Frequency	Percentages
Rural Banks	40	56.3%
Commercial Banks	14	19.7%
Others (MOFA & NGOs)	14	19.7%
Money Lenders	6	8.5%
Micro - Financial Inst.	5	7.0%
Social Networks	3	4.2%
Total	**82**	**100%**

(NB: The respondents gave multiple responses for their sources of credit)

The results revealed that the majority, 185 (92.5%), of the respondents have access to extension services, whilst a few, 15 (7.5%), respondents do not have access (Table 5.15). The χ^2 test shows that there was a significant difference between the respondents' access to extension services and their willingness to participate. The results also revealed that, on average, the respondents in the region have access to extension services approximately 3 times per month whilst the minimum and maximum were 1 and 6 times, respectively. The 15 respondents who do not have access to extension services in the region provided the following reasons for their inability to access the service: no extension personnel at all, extension personnel too busy, and inadequate extension personnel, respectively (Figure 5.2).

Table 5.15 Access to extension services by respondents in the region

Access to Extension Services	Number of Respondents	Willingness to Participate		Percentage of respondents
		No	Yes	
Yes	185	53 (28.6%)	132 (71.4)	92.5%
No	15	8 (53.3%)	7 (46.7%)	7.5%
Total	**200**	**61 (30.5%)**	**139 (69.5%)**	**100.0%**

($\chi^2 = 2.9089$, df = 1, p-value = 0.0881, Fisher's p-value = 0.0757)

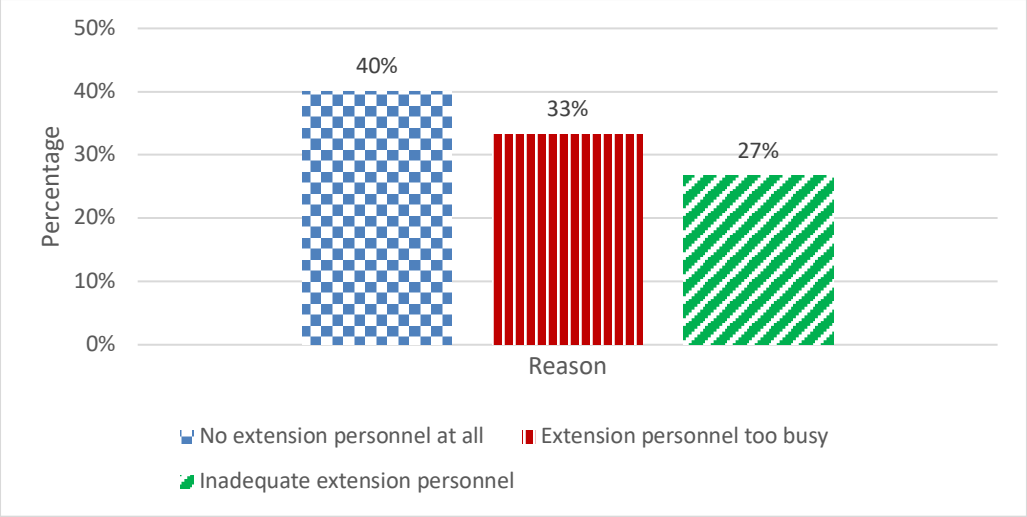

Figure 5.1 Reasons for some respondents' inability to access extension services

The results indicate that 96 (48%) of the respondents do belong to a farmer-based organisation, whilst about half, 104 (52%), of the respondents, do not (Table 5.16). The χ^2 test shows that there was a significant difference between respondents' membership of FBO and their willingness to participate in the insurance scheme.

Table 5.16 The respondents' membership of FBOs

Member of FBO	Number of Respondents	Willingness to Participate		Percentage of Respondents
		No	Yes	
Yes	96	18 (18.8%)	78 (81.2%)	48.0%
No	104	43 (41.3%)	61 (58.7%)	52.0%
Total	**200**	**61 (30.5%)**	**139 (69.5%)**	**100.0%**

($\chi^2 = 10.982$, df = 1, p-value = 0.0009)

The 96 respondents, who do belong to farmer-based organisations, provided the following reasons for belonging to an FBO: access credit, have access to information, learn from other farmers, have access to extension services, have access to farm inputs, and access markets (Figure 5.3). Whilst the data shows that the respondents join an FBO first and foremost to have access to credit, followed by access to information, learn from others, access extension services, there is not much difference among these. The least of the reasons is to have access to markets.

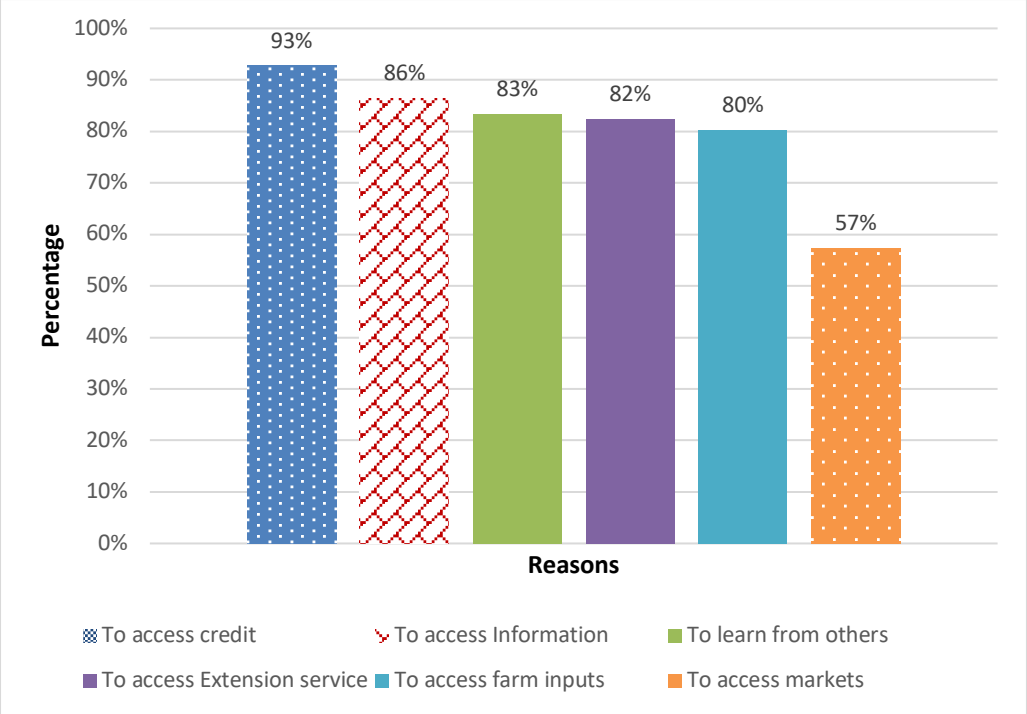

Figure 5.2 Reasons for belonging to FBOs in the region

5.2.2 The respondents' risk profiles and risk management strategies

In this section, the risks that the respondents are frequently exposed to, as well as the risks that are deemed important, are presented. Secondly, the risk management strategies that are frequently used and also ranked as important by the respondents are also presented.

The risk profiles of the respondents in the three municipalities in the region are summarised in Table 5.17 and Figure 5.4. The data shows that (second and last column) the risk that is frequent as well as ranked the most important by the respondents is pests and diseases. This is followed by drought, erratic rainfall, input price variation, and output price variation. Windstorms, input access, floods, and bushfires, respectively, are the less frequent risks and also viewed as less important by the respondents.

Table 5.17 The risk profiles of the respondents in the region

Risks	N	Rank					Total Weighted Score
		Very Important (5)	Important (4)	Average (3)	Not Important (2)	Not Very Important (1)	
Pests and diseases	**191**	135	30	14	7	5	**856**
Drought	**185**	110	36	21	10	8	**785**
Erratic rainfall	**164**	71	66	15	7	5	**683**
Input price variation	**158**	59	45	38	13	3	**618**
Output price variation	**146**	63	38	34	9	2	**589**
Windstorms	**122**	25	32	35	23	7	**411**
Input access	**114**	46	35	22	7	4	**454**
Floods	**86**	19	19	24	16	8	**283**
Bushfires	**77**	15	22	22	11	7	**258**

It must be noted that the weight/rank and the number of respondents under each weighting of a risk affect its total score. That is why even though, more respondents deemed output price variation (63) to be very important than the number of respondents under input price variation (59), input price variation ended up with the higher score than it because it had more respondents in the other rankings than this risk. The same can be said of input access and windstorms risks.

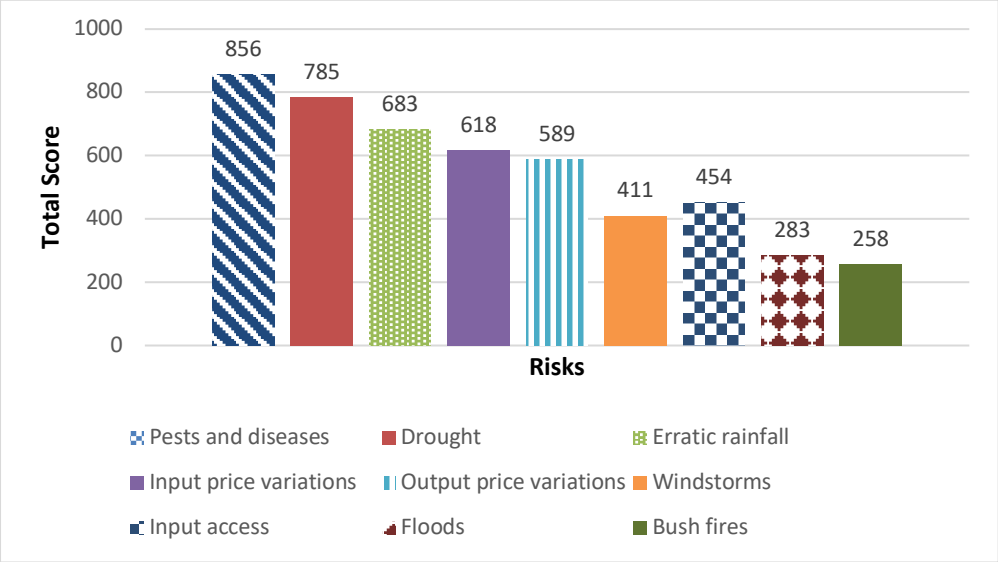

Figure 5.3 Important risks to farmers in the region

Table 5.18 summarises the risk management strategies that the respondents in the region use to manage risk on their farm and which risk management strategies are deemed important to the respondents. The top five risk management strategies (second and last column) that the respondents adopt to manage risk on their farms are farm/crop diversification, use of improved crop varieties, soil and water conservation methods, variation in planting dates, and planting of trees, respectively (Table 5.18). The less commonly used risk management strategies by the respondents in the Upper East Region are the use of savings, engaging in off-farm activities, borrowing from friends and relatives (social networks), the sale of productive assets, out-migration to find jobs, and the use of crop insurance, respectively. It must be noted that the weight/rank and the number of respondents under each weighing of a risk management strategy affect its total score. That is why even though, there were more respondents who deemed the use of improved crop varieties (95), and soil and water conservation methods (91), respectively, to be very important than the number of respondents under farm/crop diversification (78), farm/crop diversification ended up with the highest score because it had more respondents in the other higher rankings than these strategies.

Table 5.18 The risk management strategies of the respondents in the region

Risk Management Strategy	N	Rank					Total Score
		Very Important (5)	Important (4)	Average (3)	Not Important (2)	Not Very Important (1)	
Farm/Crop diversification	**198**	78	97	22	1	0	**846**
Use of improved crop varieties	**177**	95	65	15	2	0	**784**
Soil and water conservation methods	**162**	91	58	11	2	0	**724**
Variation in planting dates	**150**	65	60	20	5	0	**635**
Intercropping	**148**	54	74	15	4	1	**620**
Planting of trees	**124**	44	61	17	1	1	**518**
Use of savings	**117**	46	51	13	5	2	**485**
Engaging in off-farm activities	**99**	30	41	14	13	1	**383**
Borrowing from friends and relatives (social networks)	**95**	8	24	34	21	8	**288**
Sale of productive assets	**64**	18	23	13	8	2	**239**
Out-migration to find jobs	**54**	7	8	16	19	4	**157**
Use of crop insurance	**3**	0	2	0	1	0	**10**

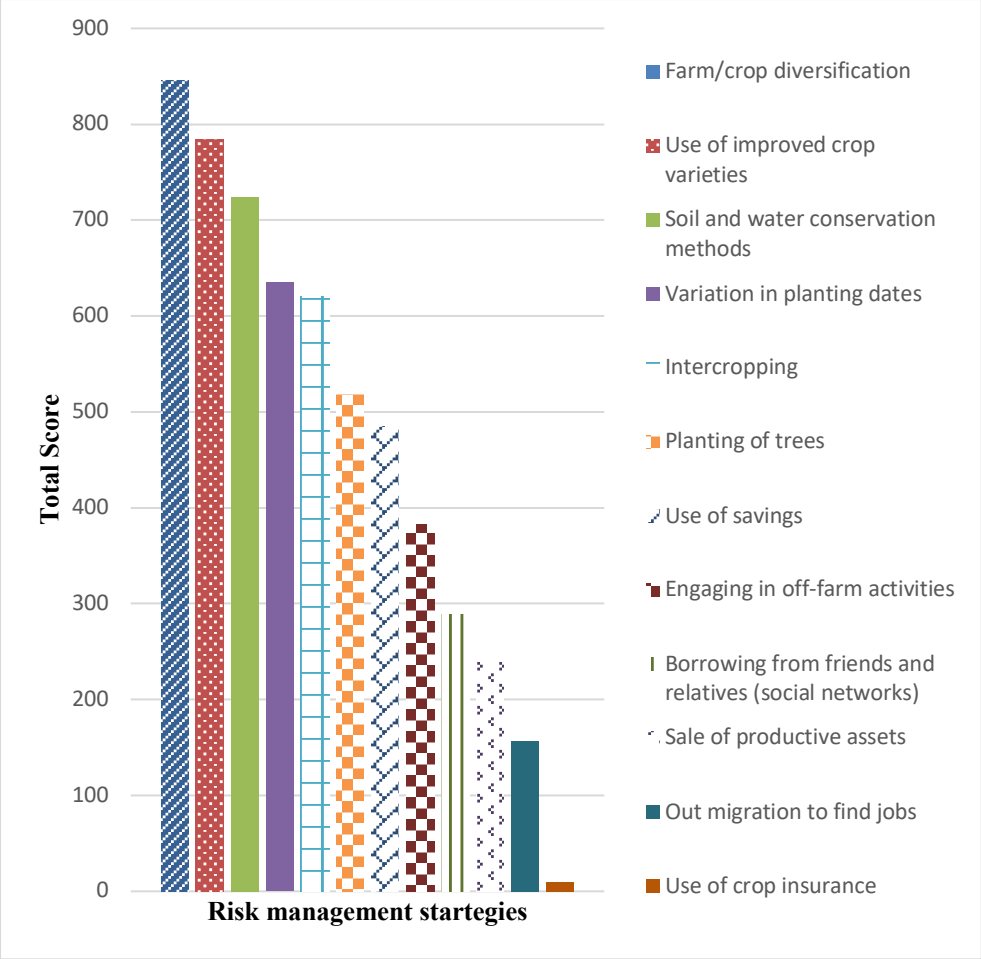

Figure 5.4 The respondents' important risk management strategies

5.2.3 The respondents' knowledge about, and attitude towards WII scheme

In this section, the respondents' knowledge about the WII scheme is presented first. Secondly, respondents' attitude towards the scheme is also reported.

5.2.3.1 The respondents' knowledge about WII scheme

The results of the study revealed that 189 (94.5%) respondents knew about insurance in general whilst 11 (5.5%) knew nothing about it. However, the χ^2 and Fisher's exact tests showed that there was no significant difference between the respondents' knowledge of general insurance and their willingness to participate in the insurance scheme at 10% confidence level, (χ^2 = 0.3318, df = 1, p-value = 0.5646, Fisher's p-value = 0.5091). The data shows that the most well-known insurance type in the Upper East Region is that of the National Health Insurance Scheme (Table 5.19). Crop insurance is the third most known insurance type with 34 (18%)

respondents indicating knowledge of it. Building insurance is the least known type of insurance in the region.

Table 5.19 The respondents' knowledge about insurance types in the region

Insurance Types	Frequency	Percentage
National Health Insurance Scheme	174	92.1%
Vehicle/motor	57	30.2%
Crop	34	18.0%
Life	20	10.6%
Education	15	7.9%
Building	3	1.6%
Total	**303**	

(NB: Respondents gave multiple responses to this question)

All the respondents surveyed were asked about the weather index-based insurance scheme, irrespective of whether a respondent answered "yes" or "no" to the knowledge of general insurance. The results revealed that 69 (34.5%) of the respondents knew or had heard about the WII scheme for drought, whilst 131 (65.5%) knew nothing about the scheme. The χ^2 test reveals that there was a significant positive difference between the respondents' knowledge about the WII scheme and their willingness to participate, at 10% confidence level, ($\chi^2 = 3.2094$, df = 1, p-value = 0.0732).

The 69 respondents who knew or had heard about the scheme indicated the following as sources of information about it: radio/TV, extension agents, and fellow farmers, respectively (Table 5.20). It is also clear from Table 5.20 that insurance providers were the least reported source of information about the WII scheme in the region.

Table 5.20 The respondents' sources of information about the WII scheme

Sources of Insurance knowledge	Frequency	Percentage
Radio/TV	46	66.7%
Extension Agents	32	46.4%
Fellow Farmers	22	31.9%
Others (NGOs)	14	20.3%
FBO	9	13.0%
Insurance Providers	2	2.9%
Total	**125**	

(NB: Respondents gave multiple responses to this question)

Concerning how much these 69 respondents knew about or understood the WII scheme for drought, the insurance awareness index was calculated for each respondent who responded yes to knowing about the insurance scheme. Figure 5.6 provides information on the respondents' insurance awareness index. The data revealed that almost half of the respondents, 34 (49%) had a moderate level of knowledge about the WII, whilst 27 (39%) respondents had a low level of knowledge and 8 (12%) respondents had an advanced level of knowledge.

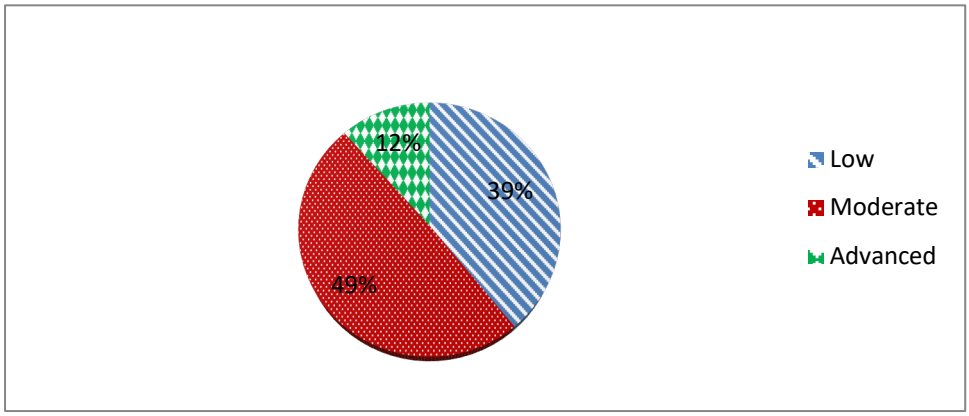

Figure 5.5 WII awareness levels of the respondents

A detailed analysis of the responses to the 12 WII questions by the respondents revealed the following information presented in the Table 5.21. The data shows that only five questions out of the twelve had a correct answer response rate of over 50%, and these were questions 1 (86%), 2 (54%), 7 (86%), 8 (58%) and 12 (57%), respectively. The other seven questions had a correct answer response rate of less than 50% (Table 5.21). Further analysis of the results revealed that the frequency of correct answers (354) by the respondents to each question was 50 more than the "I don't know" (304) answers whilst the incorrect answers (170) were the lowest response type to the questions. Irrespective of this, the frequency of correct answers about the scheme was less than the other answer types combined.

Table 5.21 The respondents' response to 12 WII questions

Q	WII Questions	Freq of Correct Answers	% of Correct Answers	Freq of I don't know Answers	% of I don't know Answers	Freq of Wrong Answers	% of Wrong Answers	Total
1	The WII covers farmers for what production risk on the farm?	59	86%	9	13%	1	1%	**100%**
2	How many phases does the WII contract have?	37	54%	25	36%	7	10%	**100%**
3	What is the definition of a dry day as used in this insurance type?	25	36%	27	39%	17	25%	**100%**
4	Which of the phase's use dry days to trigger or initiate an insurance payout?	16	23%	30	43%	23	33%	**100%**
5	How many dry days in each of the phases indicated above are enough to trigger (initiate) insurance pay-out to farmers?	4	6%	43	62%	22	32%	**100%**
6	How does WII assess farmers' loss due to drought? Through:	32	46%	21	30%	16	23%	**100%**
7	Who is responsible for collecting rainfall data for this type of insurance?	59	86%	9	13%	1	1%	**100%**
8	A farmer will receive an insurance payout even if s/he is the only one to have experience drought in the area.	40	58%	15	22%	14	20%	**100%**
9	What crops are covered by this type of insurance?	10	14%	20	29%	39	57%	**100%**
10	How much claim in % will you receive for each of the phases (1 - 3) respectively, in this insurance scheme?	23	33%	42	61%	4	6%	**100%**
11	How much in % do farmers have to pay for this insurance type as premium?	10	14%	35	51%	24	35%	**100%**
12	At the end of the farming season, farmers are paid back all or part of their premium when there was no drought.	39	57%	28	41%	2	3%	**100%**
	Total	**354**		**304**		**170**		

5.2.3.2 The respondents' attitude towards the WII scheme

In this section, the results of the study are in two parts. Firstly, the percentages of respondents that fall within each of the three attitudinal categories (unfavourable, indifferent, and favourable) towards the insurance scheme in the region are presented. Secondly, the overall attitudinal score which represents the attitude of the respondents in the region towards the scheme is presented. It should be noted that an attitudinal score of 1 - 2.33 represents an unfavourable attitude, a score of 2.34 - 3.67 represents an indifferent attitude, and a score of 3.68 – 5.00 represents a favourable attitude towards the WII scheme for drought in the region.

The results from the study revealed that 155 (77.5%) of the respondents in the region had attitudinal scores falling between 2.34 and 3.67, indicating an indifferent attitude towards the

scheme, 39 (19.5%) of the respondents had attitudinal scores falling between 3.68 and 5.0 which indicates a favourable attitude, whilst 6 (3%) of the respondents had attitudinal scores falling between 1.0 and 2.33, indicating an unfavourable attitude towards the insurance scheme. Figure 5.7 presents a graphical representation of the attitude of the respondents towards the insurance scheme.

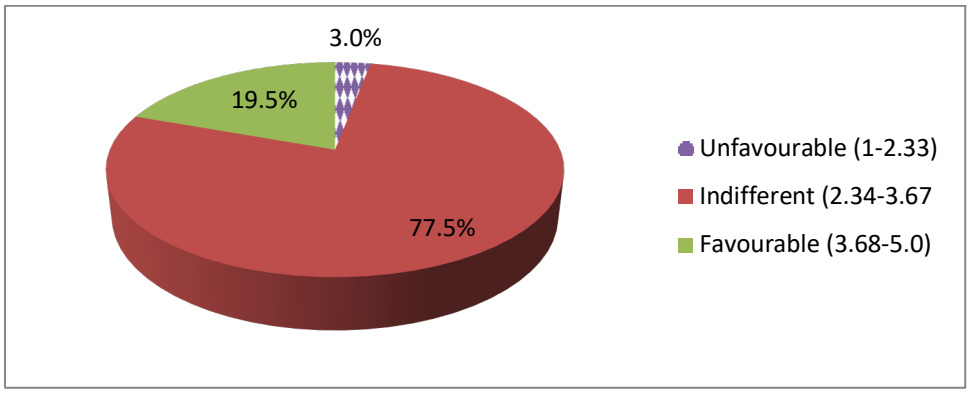

Figure 5.6 The respondents' attitude towards WII scheme

Regarding the overall attitude of the respondents in the Upper East Region towards the WII scheme, Table 5.23 provides information concerning the attitudinal responses. The overall mean score which represents the collective attitude of the respondents to the insurance scheme for drought is 3.28 (Table 5.23). This figure falls in the range of 2.34 - 3.67, which represents an indifferent attitude. However, there is a significant difference between the respondents' attitude score and their willingness to participate in the insurance scheme, ($t = -7.5012$, $df = 110.42$, p-value = 0.0000).

Examining the individual statements revealed that four statements, statements 1, 2, 4, and 15 on average, received favourable scores from the respondents, regarding attitude, whilst 16 statements, on average, received indifferent scores. Figure 5.8a and Figure 5.8b show a graphical representation of the scores to the first ten, and the last ten, attitudinal statements, respectively, by the respondents in the region.

Table 5.22 The respondents' attitudinal scores in the region

SN	Statements	N	Strongly Agree (5)	Agree (4)	Neutral (3)	Disagree (2)	Strongly Disagree (1)	Mean Score
1	Weather insurance is needed to cushion the effects of crop losses due to drought because other effective risk management strategies do not exist.	200	64	79	28	19	10	***3.84***
2	Weather insurance is needed because drought is a problem here.	200	79	88	20	8	5	***4.14***
3	Weather Insurance for drought is important because farmers do not prioritise other needs.	200	17	34	58	84	7	**2.85**
4	Weather insurance is appropriate to tackle the incidence of drought for farmers in this area.	200	38	102	36	18	6	***3.74***
5	Agricultural losses are acts of God that can be mitigated with insurance.	200	47	79	35	21	18	**3.58**
6	I do not fear that the claims may not be paid by the insurance company when they are due.	200	20	47	45	48	40	**2.80**
7	I do not fear that the payment of compensation will be very late.	200	10	36	47	65	42	**2.54**
8	The insurance providers will not manipulate the rainfall volumes to avoid paying farmers their claims.	200	12	45	53	45	45	**2.67**
9	I believe the insurance providers will compensate farmers fairly.	200	17	67	74	28	14	**3.23**
10	The design of the contract will always be fair for both the insurer and the farmer.	200	19	46	61	40	34	**2.88**
11	The insurance providers will never run away with the farmer's money.	200	18	52	83	34	13	**3.14**
12	I believe the insurance contracting will not involve much paperwork for farmers.	200	9	63	85	26	17	**3.11**
13	I believe the premium for weather insurance against drought will be affordable.	200	21	73	86	16	4	**3.46**
14	I believe the insurance programme will be simple for me to understand.	200	17	94	71	12	6	**3.52**
15	Farmers everywhere can take this insurance type because the providers will be in the communities.	200	60	80	40	12	8	***3.86***
16	I believe the insurance providers will treat and respect me even though I am a farmer and possibly uneducated.	200	21	107	59	10	3	**3.67**
17	I think with this insurance cover, I may be able to access a loan now from a bank which will not have been possible without it.	200	18	54	75	34	19	**3.09**
18	With insurance, it is easy for me to expand my scale of production because drought was my main concern.	200	23	64	67	36	10	**3.27**
19	Weather insurance is not only meant for large-scale farmers but smallholder farmers too.	200	39	77	63	17	4	**3.65**
20	I will buy the insurance cover even if it is not sold to me by an Agricultural extension officer.	200	10	44	60	41	45	**2.67**
	Overall Mean Score							**3.28**

(Mean scores in underlined italic correspond to statements with a favourable score)

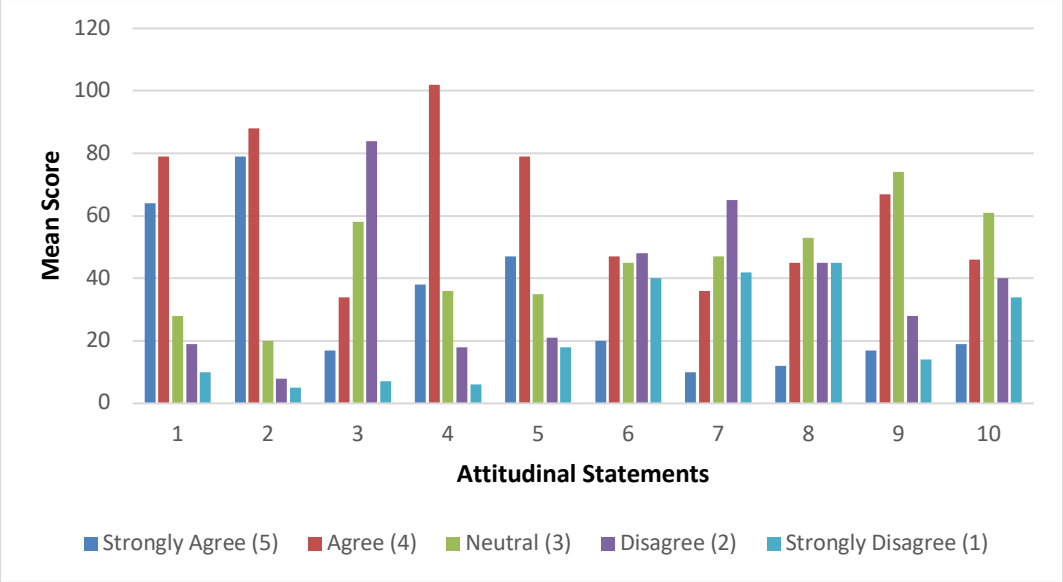

Figure 5.7 Response to first ten attitudinal statements by respondents in the region

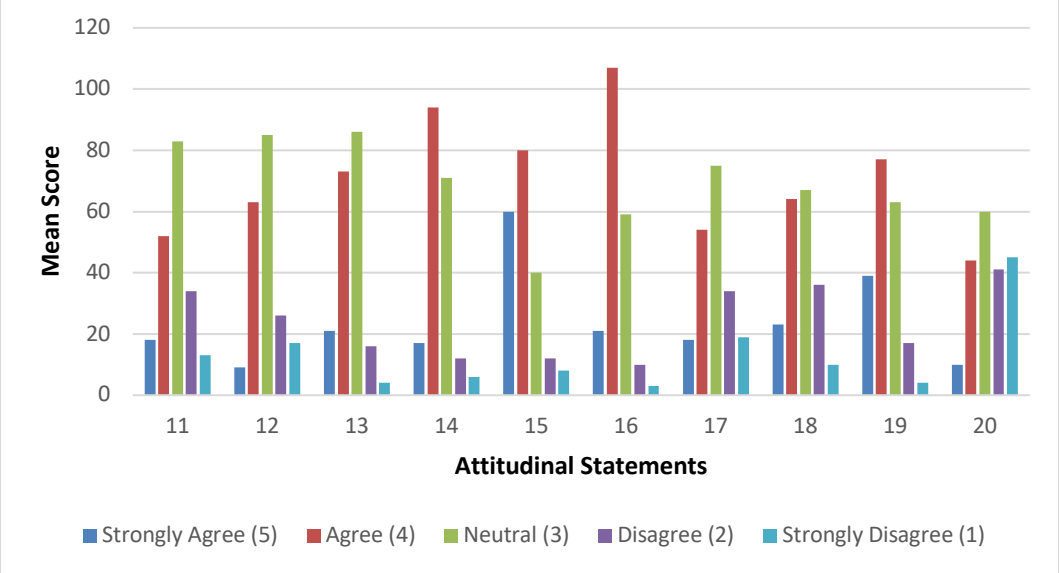

Figure 5.8 Response to last ten attitudinal statements by respondents in the region

From Figure 5.8a, it can be observed that statements 1, 2, and 4 have most of the responses skewed towards "strongly agree" and "agree" hence the favourable score to these statements. Statement 5, has responses skewed towards "strongly agree", "agree" and "neutral", these are not enough to give it, on average, a favourable score hence the indifferent score. Statements 3, 6, 7, 8, 9, and 10, have most of the responses clustered in the middle around "agree", "neutral" and "disagree" but not enough agree or disagree hence the indifferent score to these statements. It is also observed from Figure 5.8b that only statement 15 has most of its responses skewed towards "agree" and "strongly agree" hence the favourable score to this statement.

Statements 11, 12, 13, 14, 16, 17, 18, 19 and 20 also have most of the responses centred on "agree", "neutral" and "disagree" but not enough agree or disagree hence the indifferent score to these statements by the respondents in the region. This trend is what has contributed to the respondents' overall indifferent attitude towards the scheme in the region.

5.2.4 The respondents' willingness to pay for WII scheme

In this section, the results presented are in two parts. First, the respondents' willingness to participate and the factors affecting participation are presented. This is analysed using a probit regression model, the first stage of the two-stage Heckman regression model. Second, the respondents' willingness to pay for the scheme and the factors affecting it, is presented. This is also estimated with an interval regression model, the second stage of the two-stage Heckman regression model.

5.2.4.1 The respondents' willingness to participate in the WII scheme

The results revealed that 3 (1.5%) of the respondents had purchased this insurance type before, whilst the remaining 197 (98.5%) of the respondents had not. The results also indicated that most, 139 (69.5%), of the respondents, were willing to participate in the weather index-based insurance scheme in the region, whilst 61 (30.5%) of the respondents were not willing (Table 5.23). The reasons for the respondents' willingness to, and not to, participate in the insurance scheme for drought in the region are shown in Table 5.24

Table 5.23 Respondents' willingness to participate in the WII scheme

Willingness to Participate	Frequency	Percentage of Respondents
Yes	139	69.5%
No	61	30.5%
Total	**200**	**100.0%**

The most important reason (68.3%) for the respondents' willingness to participate was to "cover the farm against drought" (Table 5.24). By protecting the farm against drought with insurance, the respondents do not have to worry about drought in the course of the season since the farm is covered. The second most important reason given by the respondents to participate in the scheme was to receive compensation (51.1%) when a drought occurs. This was followed by an opportunity to expand the area under cultivation (9.4%), respectively. Participating in the scheme to try it out was the last reason the respondents were willing to participate in the

insurance scheme. For those respondents not willing to participate in the insurance scheme the three most important reasons for not participating were: their lack of trust in the scheme (32.7%), followed by the perceived non-payment of claims or difficulties in making a claim (31.1%), and inadequate household income (21.3%). Other reasons were: a lack of interest in the scheme (14.8%), small scale of production (9.8%), and basis risk (3.3%), respectively.

Table 5.24 Respondents' reasons for willing to, and not to, participate in the WII

Reasons for Willingness to participate in WII	Frequency	Percentage	Reasons for not willing to participate in WII	Frequency	Percentage
To cover farm against drought	95	68.3%	Lack of trust in the scheme	20	32.7%
To receive compensation	71	51.1%	Non-payment/ difficulties in making a claim	19	31.1%
Opportunity to expand the area under cultivation	13	9.4%	Inadequate household income	13	21.3%
For trial	1	1.0%	Lack of Interest in the scheme	9	14.8%
			Small-scale production	6	9.8%
			Basis risk	2	3.3%
Total	**180**		**Total**	**69**	

(NB: respondents gave multiple responses for willingness to, and not to participate)

The results also revealed that of the 139 respondents who were willing to participate in the insurance scheme, the crops that they were likely to purchase insurance for are: maize, rice, millet groundnuts, soya beans, sorghum and cowpeas (Table 5.25). The data shows that the respondents were most likely to insure maize (98.6%) and rice (33.8%) crops, respectively, millet, groundnuts, soya beans, sorghum and cowpea, are less likely to be insured against drought in the region. The respondents also provided the following reasons for why they may purchase the WII for these crops: cash crop for income (53.2%), drought susceptible (45.3%), and a major household food source (31.7%) (Table 5.26).

Table 5.25 Crops for insurance coverage against drought in the region

Crops for insurance coverage against drought	Frequency	Percentage
Maize	137	98.6%
Rice	47	33.8%
Millet	18	12.9%
Groundnut	16	11.5%
Soya Beans	10	7.2%
Sorghum	4	2.9%
Cowpea	2	1%
Total	**234**	

(NB: respondents gave multiple responses for which crops to be insured)

Table 5.26 The respondents' reasons for insurance coverage against drought

Reasons for wanting to insure crops against drought	Frequency	Percentage of respondents
Cash crop for income	74	53.2%
Drought susceptible	63	45.3%
Major household food source	44	31.7%
Total	**181**	

(NB: Respondents gave multiple responses for the reasons)

Concerning the factors that affect the respondents' willingness to participate, Table 5.27 provides information on the estimated outcome of the probit regression model. The McFadden value, which indicates how well the included explanatory variables explain the dependent variable, was 0.43. This means that the significant variables together explain 43% of the variations in the dependent variable, willingness to participate. This could be because the data collected for the study was from a cross-sectional survey of the selected respondents in the study area.

The data revealed that seven explanatory variables included in the model were significant. These variables were; primary occupation – farmer, total income from crops, maize income, land tenure – owner, attitude score, drought index and access to credit. Of the significant variables, only the total crop income variable had a negative relationship with willingness to participate in the scheme. The marginal effects of the significant explanatory variables are primary occupation as a farmer (0.2019), total income from crops (-0.0000), maize income (0.0001), land tenure – owner (0.1757), attitude score (0.4152), drought index (0.3004) and access to credit (0.1524). This means that a unit change in these variables would lead to a change in the dependent variable, participation in the scheme by their various marginal effects.

For example, a unit change in the attitude score of the respondents leads to a 41.5% change in the willingness to participate.

Table 5.27 Estimated outcome of the probit regression model

Variable	Estimate	Std. Error	z value	Pr(>|z|)	Marginal Effect
(Intercept)	-9.1580	1.9170	-4.7770	0.0000***	-1.7897
Socio-demographic factors					
Age	-0.0257	0.0236	-1.0930	0.2745	-0.0050
Gender	-0.3434	0.3815	-0.9000	0.3681	-0.0671
Marital status	-0.0923	0.5960	-0.1550	0.8770	-0.0180
Education in years	0.0421	0.0338	1.2470	0.2125	0.0082
Household size	0.0680	0.0538	1.2650	0.2058	0.0133
Primary occupation	1.0330	0.4667	2.2130	0.0269 **	0.2019
Other income sources	0.0152	0.3071	0.0500	0.9605	0.0029
Total crop income	-0.0001	0.0000	-2.1540	0.0312**	-0.0000
Maize income	0.0003	0.0001	1.7380	0.0822*	0.0001
Working household mem.	-0.0902	0.3284	-0.2750	0.7836	-0.0176
Land tenure as owner	0.8991	0.3685	2.4400	0.0147 **	0.1757
Years of farm experience	0.0244	0.0234	1.0480	0.2946	0.0048
Attitude score	2.1250	0.4220	5.0350	0.0000***	0.4152
Farm characteristics					
Total land size	0.0821	0.0798	1.0290	0.3035	0.0160
Maize land size	-0.2178	0.1463	-1.4890	0.1365	-0.0426
Farm diversification	0.1517	0.3142	0.4830	0.6293	0.0296
Drought index	1.5370	0.4401	3.4920	0.0005***	0.3004
Institutional factors					
Credit access	0.7800	0.3137	2.4860	0.0129 **	0.1524
Extension access	0.4579	0.5136	0.8920	0.3726	0.0895
Member of FBO	0.0641	0.2910	0.2200	0.8258	0.0125
Knowledge factors					
Knowledge of insurance	-0.0568	0.6679	-0.0850	0.9322	-0.0111
Knowledge of WII	0.4101	0.2983	1.3750	0.1692	0.0801
Null deviance	246.02 on 199 df				
Residual deviance	139.38 on 177 df				
McFadden	0.4334				

Significance codes: '***' 0.01 '**' 0.05 '*' 0.1

5.2.4.2 The respondents' willingness to pay for the WII scheme

During the data collection for the double-bounded dichotomous contingent valuation, three sets of initial bids, 5% (GH¢36.0), 7.5% (GH¢54.0) and 10% (GH¢71.0), of the total cost of

producing maize at GH¢714.00 in the region were randomly presented to the respondents. The following number of respondents, 42, 47 and 50 answered the initial bids of 5%, 7.5% and 10% respectively. A second bid (lower or higher) which is contingent on the response to the initial bid was asked of the respondents. The respondents' maximum willingness to pay (WTP) for the scheme was the bid they finally agreed to pay. The data revealed that 89% of the willing to participate respondents accepted the first bids of 5%, 7.5% and 10%, whilst 11% declined it. Coincidentally, 88% of the respondent who accepted the initial bid accepted the higher bid whilst 12% declined it. Table 5.28 presents the distribution of the respondents' maximum WTP for the scheme.

Table 5.28 The distribution of the respondents' maximum WTP

Premium rate	**Bid value**	**Respondents**	
% %	**(GH¢)**	**Number of respondents**	**Percentage of respondents**
2.5%	18.0	6	4.3%
5%	36.0	2	1.4%
7.5%	54.0	43	30.9%
10%	71.0	45	32.4%
12.5%	89.0	43	30.9%
Total		**139**	**100.0%**

The data shows that most of the respondents' maximum WTP for the scheme was in the range of 7.5% to 12.5% premium rates (Table 5.28). Few respondents (5.7%) had their maximum WTP less than 7.5% premium rate.

The analysis of the factors that influence the respondents' maximum WTP for the scheme and the mean WTP, which is an interval regression model, was estimated with package "DCchoice" in R statistical package. Table 5.29 presents the outcome of the interval regression model. The data shows that five explanatory variables and the intercept were significant (Table 5.29). These explanatory variables were attitude score, farm diversification, drought index, knowledge of the weather index-based insurance scheme, and the natural logarithm of the bids. Except for the attitude score variable, the other significant explanatory variables had a negative relationship with the dependent variable, maximum WTP. For example, with an increase in the farm diversification level, the respondents were less likely to pay for the insurance scheme.

The truncated mean from the maximum bid from the interval regression was given as GH¢84.66 with the lower and upper bounds being GH¢80.28 and GH¢86.858 respectively.

The probability of the respondents' selecting "Yes" to the bids decreases with higher bids (Figure 5.9).

Table 5.29 Estimated outcome of the interval regression model

Variable	Estimate	Std. Error	z value	Pr(>|z|)
(Intercept)	19.8222	6.8828	2.8800	0.0039 **
Socio-demographic factors				
Age	0.0446	0.0333	1.3386	0.1807
Gender	1.0086	0.6746	1.4951	0.1349
Marital status	-4.7619	4.9437	-0.9632	0.3354
Education in years	-0.0414	0.0516	-0.8020	0.4225
Household size	-0.0364	0.0834	-0.4359	0.6629
Primary occupation	-1.2170	1.3587	-0.8957	0.3704
Other income sources	0.0416	0.5224	0.0797	0.9365
Maize income	0.0004	0.0002	1.5845	0.1131
Land tenure as owner	-0.4376	0.7938	-0.5513	0.5815
Attitude score	1.0397	0.6255	1.6621	0.0965 *
Farm Characteristics				
Farm diversification	-3.2057	0.9753	-3.2870	0.0010 ***
Drought index	-2.7067	1.0516	-2.5739	0.0101 **
Institutional factors				
Credit access	0.4578	0.5837	0.7842	0.4329
Extension access	0.3284	2.8999	0.1132	0.9098
Member of FBO	-0.5270	0.5913	-0.8913	0.3728
Knowledge factors				
Knowledge of WII	-1.1297	0.6075	-1.8594	0.0629 *
log(bid)	-3.2479	0.5979	-5.4315	0.0000 ***
Distribution:	log-logistic			
Number of Obs.:	138			
Log-likelihood:	-104.0965			

Significance codes: '***' 0.01 '**' 0.05 '*' 0.1

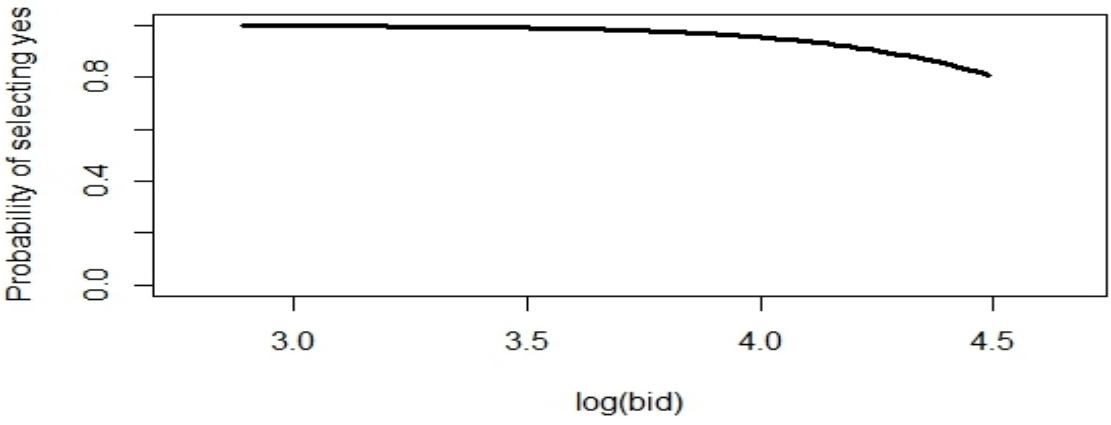

Figure 5.9 The respondents' probability of selecting a Yes

(NB: Log bid is a natural logarithm)

5.3 Extension officer survey

This section of the agricultural extension officers' survey is in three sub-sections. Section 5.2.1 describes the socio-demographic data of the extension officers. Section 5.2.2 describes the extension officers' knowledge about, and attitude towards the WII scheme for drought in the region. Finally, section 5.2.3 describes the factors influencing the extension officers' knowledge about the WII scheme in the region.

5.3.1 Descriptive statistics

The socio-demographic data of the agricultural extension officers are described with the aid of frequency distribution tables, mean, minimum and maximum, and percentages. Due to the low staff strength in various offices of the municipal/district Departments of Agriculture in the Upper East Region, all available staff, that is, agricultural extension officers from eleven of the thirteen municipalities/districts were surveyed. Table 5.30 provides information on the number of staff surveyed from each of the municipalities/districts of the Upper East Region.

Table 5.30 Surveyed staff of the various Departments of Agriculture in the region

Municipality/District	Frequency	Percentage
Bolgatanga	14	15.6%
Navrongo	11	12.2%
Bawku West	9	10.0%
Nabdam	9	10.0%
Bongo	9	10.0%
Kassena West	8	8.9%
Bawku	7	7.8%
Garu	7	7.8%
Talensi	6	6.7%
Binduri	5	5.6%
Pusiga	5	5.6%
Total	**90**	**100.0%**

A total of ninety agricultural extension officers participated in the survey. There were 75 (83%) male agricultural extension officers and 15 (17%) females. The average age of the agricultural extension officers in the study was approximately 40 years, and the minimum and maximum ages were 26 and 60 years, respectively. There was no significant difference in the respondents mean ages and their knowledge of WII scheme, ($t = -0.0264$, $df = 47.016$, p-value = 0.9791).

Regarding grade, there were 65 (78%) officers who were agricultural extension agents, that is they were full-time field staff, and 25 (28%) district development officers, that is they

combined field work with administrative work. There was no significant difference between the officers' grade and their knowledge of WII scheme, (χ^2 = 0, df = 1, p-value = 1).

Most agricultural extension officers had Agricultural College as their highest educational level, followed by Bachelors, and High National Diploma. Few respondents had post-graduate diplomas or masters as their highest educational status (Table 5.31). There was no significant difference between the educational status of agricultural extension officers and their knowledge of the WII scheme.

Table 5.31 Educational statuses of agricultural extension officers

Educational Status	Frequency	Knowledge of WII		Percentage of officers
		No	Yes	
Agricultural College	31	10 (32.3%)	21 (67.7%)	34.4%
High National Diploma	20	4 (20.0%)	16 (80.0%)	22.2%
Bachelors	24	8 (33.3%)	16(66.7%)	26.7%
Postgrad	7	2 (28.6%)	5 (71.4%)	7.8%
Masters	8	3 (37.5%)	5(62.5%)	8.9%
Total	**90**	**27 (30.0%)**	**63 (70.0%)**	**100.0%**

(χ^2 = 1.3757, df = 4, p-value = 0.8484, Fisher's p-value = 0.844)

The average years of work experience of the agricultural extension officers in the region was approximately 13 years, the minimum and maximum were 2 and 41 years, respectively. There was no significant difference in the officers' years of work experience and their knowledge of WII scheme, (t = 0.3339, df = 48.053, p-value = 0.7399).

On average, an extension officer attended 1 insurance related training session whilst the minimum and maximum training sessions attended are 0 and 3 sessions. There was, however, a significant negative difference in the number of insurance related training sessions attended and their knowledge of WII scheme, (t = -2.2883, df = 51.454, p-value = 0.0263).

5.3.2 Extension officers' knowledge about, and attitudes towards WII scheme

Agricultural extension officers' knowledge about the WII scheme is first presented. This is followed by their attitude towards the insurance scheme.

5.3.3 Extension officers' knowledge about WII scheme

In this section, the officers' knowledge of general insurance was presented. Secondly, the officers' knowledge about the WII scheme, as well as their WII awareness/knowledge index was also presented.

The study revealed that 86 (96%) officers knew various types of insurance, whilst 4 (4%) did not. The χ^2 test shows that there was a significant positive difference between knowledge of insurance and the officers' knowledge of the insurance scheme (χ^2= 6.5905, p-value = 0.010). Of the 86 officers' who knew various types of insurance, Table 5.32 provides information on which insurance type/s is/are most known by them.

Table 5.32 Insurance types known by agricultural extension officers

Insurance Type	Frequency	Percentage of Officers
Crop	70	81.4%
Life	42	48.8%
NHIS	37	43.0%
Vehicle/Motor	31	36.0%
Education	8	9.3%
Building/Housing	7	8.1%
Total	**195**	

(NB: Agricultural extension officers gave multiple responses to this question)

It can be observed that the four most commonly known insurance types to the officers were: crop insurance, life insurance, National Health Insurance Scheme, and vehicle/motor insurance, respectively (Table 5.32). Regarding their knowledge about the WII scheme in the Upper East Region, 63 (70.0%) of the officers were aware of it, whilst 27 (30.0%) were not. Of the 63 officers who were aware of the WII for drought (drought index insurance), the three most common sources of information were NGOs, the Ministry of Food and Agriculture (MOFA), and TV/Radio, respectively (Table 5.33). The Ghana Agricultural Insurance Programme (GAIP), fellow extension officers, and the internet were the least familiar sources of information about the weather index-based insurance scheme.

Table 5.33 Agricultural extension officers' sources of knowledge about WII

Sources	Frequency	Percentage of officers
NGOs	32	50.8%
MOFA	31	49.2%
TV/Radio	26	41.3%
GAIP	14	22.2%
Fellow Extension officers	12	19.0%
Others (internet)	1	1.6%
Total	**116**	

(NB: The officers gave multiple responses to this question)

The results after the computation of the WII awareness index, from the twelve (12) questions on the WII scheme, showed that 33 (52.4%) officers had a low awareness index of between 0 – 0.33, 24 (38.1%) had a moderate awareness index of between 0.34 – 0.66, and 6 (9.5%) had an advance awareness index of between 0.67 – 1.0.

Table 5.34 presents a detailed analysis of the responses to the 12 WII questions by the officers. It can be observed from the data that only three questions out of the twelve, had a correct responses rate of over 50% and these were questions 1 (87%), 6 (63%) and 7 (75%), respectively. Question 12 (49%) was just on the border. It is also important to point out that there were more "I don't know" (304) answers than either correct (273) and incorrect (179) answers to the 12 WII questions, looking at the frequency of responses to each answer category. Irrespective of this, the frequency of correct answers about the scheme was less than the other answer types combined.

Table 5.34 Agricultural extension officers' response to the 12 WII questions

Q	WII Questions	Freq of Correct Answers	% of Correct Answers	Freq of I don't know Answers	% of I don't know Answers	Freq of Wrong Answers	% of Wrong Answers	Total
1	The WII covers farmers for what production risk on the farm?	55	87%	2	3%	6	10%	**100%**
2	How many phases does the WII contract have?	10	16%	35	56%	18	29%	**100%**
3	What is the definition of a dry day as used in this insurance type?	28	44%	28	44%	7	11%	**100%**
4	Which of the phase's use dry days to trigger or initiate an insurance payout?	3	5%	36	57%	24	38%	**100%**
5	How many dry days in each of the phases indicated above are enough to trigger (initiate) insurance pay-out to farmers?	3	5%	34	54%	26	41%	**100%**
6	How does WII assess farmers' loss due to drought? Through:	40	63%	16	25%	7	11%	**100%**
7	Who is responsible for collecting rainfall data for this type of insurance?	47	75%	10	16%	6	10%	**100%**
8	A farmer will receive an insurance payout even if s/he is the only one to have experience drought in the area.	23	37%	19	30%	21	33%	**100%**
9	What crops are covered by this type of insurance?	15	24%	12	19%	36	57%	**100%**
10	How much claim in % will you receive for each of the phases (1 - 3) respectively, in this insurance scheme?	9	14%	43	68%	11	17%	**100%**
11	How much in % do farmers have to pay for this insurance type as premium?	9	14%	42	67%	12	19%	**100%**
12	At the end of the farming season, farmers are paid back all or part of their premium when there was no drought.	31	49%	27	43%	5	8%	**100%**
	Total	**273**		**304**		**179**		

5.3.4 Agricultural extension officers' attitude towards the WII scheme

The results from the study revealed that 52 (57.8%) agricultural extension officers in the region had attitudinal scores falling between 2.34 and 3.67, indicating an indifferent attitude towards the WII scheme, whilst 38 (42.2%) had attitudinal scores falling between, 3.68 and 5.0, which indicates a favourable attitude. There was no record of an unfavourable attitude towards the scheme by the officers.

The overall mean score which represents the collective attitude of the officers towards the WII scheme for drought in the Upper East Region is 3.58 (Table 5.35). This figure falls in the range of 2.34 - 3.67, which represents an indifferent attitude. There was no significant difference in the officers' attitude towards the scheme and their knowledge about the scheme, ($t = 0.1473$, $df = 58.452$, p-value = 0.8834).

Examining the individual statements revealed that eight statements, statements 1, 2, 4, 5, 8, 15, 16, and 19 on average, received a favourable score from the officers in the region regarding attitude, whilst 13 statements, on average, received an indifferent score. The figures below provide a graphical representation of the scores to the twenty attitudinal statements by the officers.

From Figure 5.10a, it can be observed that statements 1, 2, 4, 5 and 8, have most of the responses skewed towards "strongly agree" and "agree" hence the favourable scores to these statements. Statements 6, 7, 9, and 10 have most of the responses clustered in the middle around "agree", "neutral" and "disagree" hence the indifferent scores to these statements. It can also be observed from Figure 5.10b that statements 15, 16, and 19, have most of their response skewed towards "agree" and "strongly agree" hence the favourable scores to these statements. Statements 11, 12, 13, 14, 17, 18, and 20 also have most of the responses centred on "agree", "neutral" and "disagree" hence the indifferent scores to these statements by the officers in the region. This trend in a way has contributed to the officers' indifferent attitude towards the scheme in the region.

Table 5.35 Agricultural extension officers' attitudinal scores

SN	Statements	N	Strongly Agree (5)	Agree (4)	Neutral (3)	Disagree (2)	Strongly Disagree (1)	Mean Score
1	Weather insurance is needed to cushion the effects of crop loss due to drought because farmers do not have other effective risk management strategies.	**90**	51	27	2	10	0	***4.32***
2	Weather insurance is needed because drought is a problem for farmers.	**90**	64	23	1	1	1	***4.64***
3	Weather Insurance for drought is important because it is a primary need of farmers.	**90**	15	34	12	25	4	**3.34**
4	Weather insurance is appropriate to tackle incidence of drought for farmers.	**90**	34	41	7	2	6	***4.06***
5	Agricultural losses are acts of God but can be mitigated with insurance.	**90**	46	28	5	8	3	***4.18***
6	This insurance type will pay farmers their claims when it is due.	**90**	13	34	26	16	1	**3.47**
7	This insurance type will pay farmers their compensation, and it will be done immediately for it to be helpful to farmers.	**90**	7	17	28	27	11	**2.80**
8	The insurance providers will not manipulate the rainfall data to avoid paying so many farmers.	**90**	28	32	16	12	2	***3.80***
9	I believe the insurance providers will compensate farmers fairly.	**90**	3	48	27	11	1	**3.46**
10	The design of the contract will always be fair to both the insurers and the farmers.	**90**	5	34	30	15	6	**3.19**
11	The insurance providers will never run away with the farmer's money	**90**	10	27	37	10	6	**3.28**
12	I believe the insurance contracting will not involve much paperwork for farmers	**90**	2	34	32	21	1	**3.17**
13	I believe the premium for weather insurance against drought will be affordable for farmers.	**90**	9	48	23	9	1	**3.61**
14	I think that farmers will understand the insurance contract design to buy it.	**90**	7	39	17	21	6	**3.22**
15	Farmers everywhere can take this insurance type because the providers will be in the communities.	**90**	29	45	3	9	4	***3.96***
16	I believe the insurance providers will treat and respect the farmers even though some farmers may be uneducated.	**90**	19	57	7	4	3	***3.94***
17	I believe with this insurance cover, farmers may be able to access loans now from a bank which will not have been possible without it.	**90**	5	45	21	7	12	**3.27**
18	With the insurance, it will be easy for farmers to expand their scale of production because drought was their concern.	**90**	12	35	21	14	8	**3.32**
19	Weather insurance is not only meant for large scale farmers but smallholder farmers too.	**90**	23	45	5	12	5	***3.77***
20	Farmers will buy the insurance cover even if it is not sold to them by Agricultural extension officer.	**90**	3	33	21	16	17	**2.88**
	Overall Mean							**3.58**

(Mean scores in underlined italic correspond to statements with a favourable score)

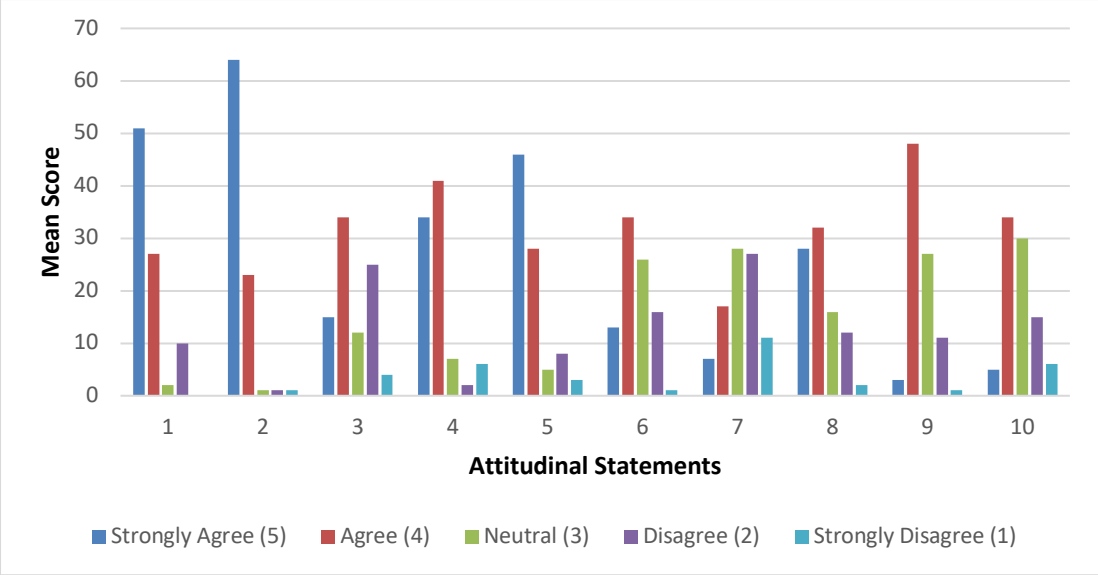

Figure 5.10 Scores to the first ten attitudinal statements by the officers

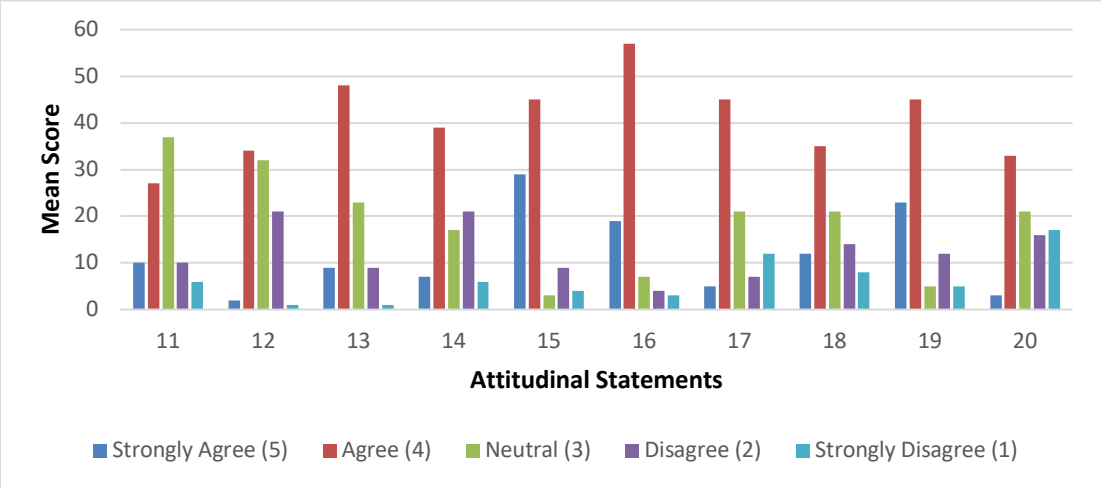

Figure 5.11 Scores to the last ten attitudinal statements by the officers

5.3.5 The factors affecting the officers' knowledge about WII in the region

In this section of the results, the estimated outcome of the probit regression model used to determine factors that affect the agricultural extension officers' knowledge about the WII scheme in the region is presented. Subsequently, the interpretation of the results of the probit regression model is provided.

Table 5.36 provides the estimated outcome of the probit regression model. The McFadden value, which indicates how well the explanatory variables explain the dependent variable, is 0.1486. This means that the significant variables together explain 14.86% of the variations in

the dependent variable. The low McFadden value can be attributed to the fact that other variables that affect the officers' knowledge were not included in the model.

Table 5.36 Probit regression estimates of knowledge of WII

Variable	Estimate	Std. Error	z value	Pr(>|z|)	Marginal Effect
(Intercept)	-4.5543	296.8687	-0.015	0.9878	1.3354
Gender	-0.0694	0.4085	-0.170	0.8652	-0.0203
Educational status2	0.4148	0.4678	0.887	0.3752	0.1216
Educational status3	-0.3019	0.4947	-0.610	0.5417	-0.0885
Educational status4	0.4306	0.6656	0.647	0.5177	0.12624
Educational status5	-0.0685	0.6505	-0.105	0.9161	-0.0201
Years of work Exp	-0.0057	0.0135	-0.421	0.6737	-0.0017
Insurance trainings	0.3878	0.2099	1.847	0.0647 *	0.1137
Grade	0.2619	0.4512	0.580	0.5616	0.0768
Insurance Knowledge	6.0336	296.8653	0.020	0.9838	1.7691
Attitude score	-0.3071	0.4013	-0.765	0.4440	-0.0901
Null deviance:	109.956 on 89 df				
Residual deviance:	93.621 on 79				
McFadden	0.1486				

*Significance codes: '***' 0.01 '**' 0.05 '*' 0.1*

The estimates of the probit model on the factors affecting the agricultural extension officers' knowledge of the insurance scheme revealed that only one explanatory variable, the number of insurance training sessions attended was significant with a positive relationship with the knowledge about the insurance scheme. The rest of the explanatory variables included in the model were not significant. The marginal effect of insurance training sessions attended was -0.1137, meaning that a unit increase in the number of insurance training sessions attended by an officer, results in an 11.37% increase in the knowledge about the insurance scheme.

CHAPTER SIX - DISCUSSION

6.1 Introduction

In this chapter, the discussion of the results is done in two main sections. Section 6.2 discusses the farmer survey. Section 6.3 discusses the agricultural extension officer survey.

6.2 Farmer survey

In this section, the discussion is done with respect to achieving the objectives of the research for the farmer survey as stated in the introductory chapter. As such, this section is organised into three sub-sections. Section 6.1.1 discusses the results with the aim of achieving objective one: to identify the major risks farmers are exposed to, and the risk management strategies they use to manage these risks. Section 6.1.2 discusses the results to achieve objective two: to assess the knowledge about and the attitude held by farmers towards the WII scheme in the region. The discussion in section 6.1.3 is aimed at achieving objective three: to determine farmers' willingness to participate and pay for the scheme, and the factors determining these in the region.

6.2.1 The respondents' risk profiles and risk management strategies

6.2.1.1 The respondents' risk profiles

The results of the study revealed that the majority of the risks the respondents were exposed to in the region that is, crop pests and diseases, drought, erratic rainfall, input access, windstorms, floods, bushfires, and input and or output price variation, were mostly production, and market risks. Production and market risks have been identified and discussed extensively by Hardaker et al. (2015), Kahan (2013) and Shadbolt and Martin (2005). Previous scholarly studies have mostly identified production risks as some of the main risks faced by farmers in developing countries and these include: bushfires (Ellis, 2017a; Kwadzo et al., 2013), drought (Abebe & Bogale, 2014; Assan et al., 2009; Ellis, 2017a; Kouamé, 2010; Kwadzo et al., 2013), floods and windstorms (Ellis, 2017a; Kwadzo et al., 2013), pest and diseases (Abebe & Bogale, 2014; Ellis, 2017a; Kouamé, 2010; Kwadzo et al., 2013), and access to inputs (Kouamé, 2010). This current finding is not surprising because these risk categories have been identified as being the most important regarding their impact on the incomes of agricultural producers and agribusinesses in most developing countries (Bryla & Syroka, 2007; Wossen & Berger, 2015). It can also be said that most of the risks that the farmers are exposed to, except for input access

and bushfires which affect farmers independently, are systemic risks. This means that when any of these risks occur, an entire community, area, or even the region is usually affected (Mahul & Stutley, 2010). As such, it is most likely that farmers will not be able to ask nearby relatives or neighbours for help during such occurrences. The fact that most of these risks are systemic means that farmers and policymakers must, or should, make room for alternative risk management strategies such as agricultural crop insurance which can reduce the impact on farmers when such events occur.

The results, however, revealed that of the production and market risk, crop pests and diseases was the most frequent and important risk followed by drought, erratic rainfall, input and or output price variations, respectively (Table 5.17). Regarding this study, the reason most farmers considered crop pests and diseases as the most frequent and important risk could be because of the recent fall armyworm infestation of farms in the region, the wider country, and across some sub-Saharan African (SSA) nations in 2016 (Patt et al., 2010). To some extent, these findings are similar to previous research in Ghana and some parts of sub-Saharan Africa. Crop pests and diseases have been identified as one of the major risks, not necessarily the first most important, farmers are exposed to in the Central Rift Valley of Ethiopia, Côte d'Ivoire, and Embu County, Kenya (Abebe & Bogale, 2014; Isaboke et al., 2016; Kouamé, 2010). Drought was reported as one of the most frequent and major production risks in the Bongo District in the Upper East Region (Assan et al., 2009), and the three northern regions of Ghana (Choudhary et al., 2015). Not only was drought reported as an important source of risk in the three northern regions, but it was also identified as an important source in the Eastern Region and Kintampo North Municipality of Ghana, respectively, (Ellis, 2017a; Kwadzo et al., 2013). Importantly, these latter regions are in the southern part of the country where the rainfall pattern is more reliable than the north. Abebe and Bogale (2014) also reported drought followed by crop failure due to disease as the major sources of risk in the Central Rift Valley of Ethiopia. Drought, followed by crop pests and diseases, and output price fluctuations have also been reported as the most common sources of risks for cocoa farmers in Côte d'Ivoire (Kouamé, 2010). These results show that some risks especially drought and crop pests and diseases are common risks that affect farmers in some sub-Saharan African countries. Therefore, technically, it can generally be said that drought is the most frequent and important risk to farmers in the region. This to some extent concurs with the findings of Choudhary et al. (2015), that drought is among the major risks faced by farmers in the three northern regions of Ghana. It is not surprising that besides pests and diseases, drought and erratic rainfall were among the

important risks of farmers in the region. Agriculture in the region is rain-fed and prone to climate variability (Choudhary et al., 2015) therefore, weather-related risks (drought and erratic rainfall) should pose serious production risks to farmers in the region. Concerning input and or output price variations, most farmers in the region are not linked to value chains, nor do they practice contract farming, where both the input and output prices are negotiated and determined before production and supply; hence they are exposed to these price variations.

Risks like windstorms, input access, floods, and bushfires, respectively, in this study, were considered to be less frequent and less important in comparison to other risks. The reasons farmers considered these risks to be so could be attributed to the fact that windstorms and floods are occasional events in the region. Also, floods do not usually affect the entire region but areas in the valleys and along the banks of major rivers (White and Black Volta) in the region. Most farmers use less agricultural inputs and are less likely to be affected by the absence of farm inputs. Again, bush-fires most often occur during the dry season when most food crops would have been harvested. In contrast, other studies have found windstorms and bush-fires (Kwadzo et al., 2013), input access (Kouamé, 2010), and floods (Choudhary et al., 2015) in parts of Ghana and Côte d'Ivoire to be among the most frequent and major risks to which farmers are exposed. As stated earlier, risks like crop pests and diseases, drought, and erratic rainfall which are systemic require farmers to adopt a combination of risk management strategies that can provide them with an alternative livelihood even with the occurrence of such systemic risk. The risk management strategies that are used by farmers to mitigate risks are discussed in the next sub-section.

6.2.1.2 The respondents' risk management strategies

The study revealed that respondents used some risk management strategies to manage risk on their farms in the region. However, of the available risk management strategies, the most frequently used and important among these were farm/crop diversification, use of improved crop varieties, soil and water conservation methods, variation in planting dates, and the planting of trees, respectively (Table 5.18). These findings were somewhat similar to those reported from previous studies where the major risk management strategies employed by farmers in developing countries to manage risk were identified. Crop diversification and improved crop varieties (Aidoo et al., 2014; Ellis, 2017a; Kwadzo et al., 2013) were the most commonly used risk management strategies in southern Ghana to manage bush-fires and weather-related farm risks. Crop diversification, variation in planting dates, and soil and water conservation methods

were reported to be the most commonly used risk management strategies in Ekiti State and Southwest of Nigeria to manage climate variability (Apata, 2011; Obayelu et al., 2014). Crop diversification (Kouamé, 2010) and soil conservation methods (Berman et al., 2015) respectively, were also reported as the most commonly used risk management strategies to manage output price variation, and crop pests and diseases in Côte d'Ivoire, and floods in Western Uganda, respectively. From these other studies in most cases, irrespective of the risk farmers are exposed, crop diversification in combination with other strategies are the most commonly used measures to manage the risks. Farm/crop diversification as the most frequently used and important risk management strategy in the region is understandable because this strategy ensures that at least the farm household has some crops or livestock on which to survive when either crops or livestock fail due to an event. It can also be said that it is the strategy that provides the household with an alternative livelihood on which to depend even with the occurrence of a severe event such as crop pest infestation, disease outbreak, or drought.

Farmers in this study considered the following as less frequently used risk management strategies in the region: use of savings, engaging in off-farm activities, borrowing from friends and relatives (social networks), the sale of productive assets, out-migration to find jobs, and the use of crop insurance (Table 5.18). In contrast to these findings, out-migrating or engaging in off-farm economic activities was found as the most used risk management strategy in the Bongo District of the Upper East Region (Assan et al., 2009). Other studies have also reported precautionary savings or reliance on social networks (Kouamé, 2010), off-farm income generating activities, use of savings, and dependence on social support (Berman et al., 2015) as the most commonly used risk management strategies by farmers. The lower use of savings, off-farm income generating activities, and dependence on a social support can be attributed to the near absence of other economic activities in the region and also that the region is the second most impoverished region in the country (Ghana Statistical Service, 2014d).

The results have also indicated that most of the risk management strategies in this study are technical rather than financial measures. Therefore, it is not surprising that crop insurance as a risk management strategy in the region is the least used by farmers. The infrequent use of crop insurance as a risk management tool is not new, Isaboke et al. (2016) found that among ten risk management strategies, farmers ranked weather index insurance as the seventh most preferred measure. With systemic risk being the major sources of risk to farmers in the region, it is important that farmers adopt a combination of technical and financial risk management strategies that can give them better protection against such events in the future. However, it is

possible that farmers' reliance on these other risk management strategies could hamper the introduction and acceptance of a financial risk management strategy such as the WII scheme. As pointed out by Guo (2016), farmers' over-dependence on their local risk management strategies in Nepal made it less likely for them to engage in crop insurance schemes. The next section discusses the farmers' knowledge and attitudes towards the WII scheme in the region.

6.2.2 The respondents' knowledge about, and the attitude towards WII scheme

In this section, the respondents' knowledge about the scheme is first discussed. Secondly, the respondents' attitude towards the scheme in the region are discussed.

6.2.2.1 The respondents' knowledge about the WII scheme

Few respondents in this study knew about the WII scheme, and the knowledge levels of the respondents regarding the WII scheme can be said to be low. The results of the study revealed that about 34.5% of the 200 respondents knew about the weather index-based insurance scheme in the region. This finding is similar to the findings of other scholars such as Nimoh et al. (2011) and Okoffo et al. (2016) who found that few cocoa farmers in the Dormaa District and Sekyere West Municipality of Ghana, respectively, all in the southern part of the country, were aware of any weather index crop insurance programme. In contrast, Ellis (2017b) and Jin et al. (2016) found that about 51% and 70%, respectively, of their respective sample populations, were aware of WII schemes. However, being aware of the insurance scheme does not necessarily mean that farmers understand the operation of the scheme.

The results of the current study revealed that of the 34.5% who stated they were aware of the scheme, only 12% had advanced knowledge, 49% with moderate knowledge and 39% had limited knowledge about the WII scheme. As such, only about 21% of the 200 respondents have a moderate to an advanced level of knowledge about the WII scheme in the region. This is rather a low number for an insurance scheme for the very farmers for which it is meant. This is somewhat similar to the finding of Patt et al. (2010), who reported that farmers after learning about the WII through a simulation game or conventional educational learning session, still did not understand the basic concept of the scheme to make an informed decision. Giné et al. (2008) also reported similar findings of most households' inability to understand the concept of WII scheme to make an informed decision. Further analysis of the 12 WII questions depicted in Table 5.21 in the previous chapter revealed that 5 out of 12 questions had a correct answer response rate of over 50%. There were more "I don't know" (307), and "incorrect" (174)

answers combined than correct answers (354). This confirms the claims of Barnett and Mahul (2007) that in most low-income countries many potential clients may not be conversant with the operation of the WII scheme even if they are familiar with other insurance schemes. It should also be noted that in this study, more respondents knew about the WII scheme than crop insurance, an insurance type under which the WII falls. This could mean that some of the respondents did not know that the scheme was a crop insurance type. This leads to a question of what were the respondents' sources of knowledge about the WII scheme in the region.

The study found that the most common source of information on the scheme was radio and TV, followed by extension officers and fellow farmers. This is somewhat consistent with the findings of Ellis (2017b), Jin et al. (2016), Nimoh et al. (2011) and Okoffo et al. (2016), who found the media, extension officers, insurance companies, and friends and relatives were the most common sources of information on crop insurance. Unlike these studies, the insurance provider/s in this current study was instead found to be the least frequent source of information about the WII scheme. However, how well radio and TV, fellow farmers (whom themselves have little understanding of the scheme), and especially agricultural extension officers explain the insurance scheme to farmers, could as well explain the low knowledge, and understanding of the insurance scheme in the region. The limited understanding of WII by smallholder farmers and how this has affected the effectiveness of such schemes have been reported extensively in the literature (Churchill, 2006; Cohen & Sebstad, 2006; Dercon et al., 2009).

The results revealed that 189 (94.5%) respondents knew about insurance in general. The National Health Insurance Scheme (NHIS) (57.43%) was the most commonly known insurance type, whilst crop insurance (11.22%), the insurance type under which the WII falls, was the third best-known insurance type after motor/vehicle insurance (18.81%). This concurs with Nimoh et al. (2011) finding that the NHIS was the best-known insurance type in the Sekyere West Municipality in Ghana. These current findings are not surprising because the NHIS has become a household name not only due to the several advertisements in different languages it has had, but also the political controversies about which political party has made it worse in the country (Fusheini, Marnoch, & Gray, 2012). Motor vehicle insurance is not only mandatory, but it is a crime to use a motor/vehicle without insurance in Ghana; hence the respondents' higher awareness about this insurance type compared to crop insurance which is a relatively new concept in Ghana. The findings from the current study that few respondents have knowledge about agricultural crop insurance in the region is inconsistent with the findings of studies undertaken by Akintunde (2015), Falola et al. (2014) and Kumar et al. (2011).

Akintunde (2015) reported that about 60% of poultry farmers in South West, Nigeria were aware of agricultural insurance policies for livestock, whilst Falola et al. (2014) also reported that about 77% of cocoa farmers in the Ondo States of Nigeria were aware of agricultural insurance for crops. Kumar et al. (2011) also reported that about 50% of farmers in Tamil Nadu were aware of crop insurance products.

6.2.2.2 The respondents' attitude towards the WII scheme

The results from the study revealed that the overall mean score which is indicative of the respondents' attitude towards the WII scheme was 3.28, an indication of an indifferent attitude towards the scheme. This finding is contrary to previous research work in the same area. Other studies have either reported a positive attitude (Ajieh, 2010; Chizari et al., 2003; Guo, 2016; Nimoh et al., 2011) or a negative attitude (Daninga & Qiao, 2014; Ellis, 2017b; Issaka et al., 2016; Kakumanu et al., 2012; Kumar et al., 2011), not an indifferent attitude, towards agricultural insurance including WII. This could have arisen due to the methods used in measuring attitude (e.g. Likert type scale or Yes/No answers). This finding is understandable because from the results only 1.5% of the respondents had purchased or used the scheme previously and so may have experienced the effectiveness of the scheme. Individual farmer attitude analysis also indicated that few (3%) respondents had a negative attitude and only 19.5% of respondents had a positive attitude. In contrast, the majority, 77.5% of respondents had an indifferent attitude towards the scheme. These findings are significant because they provide the insurance provider/s with information about how respondents perceive the scheme. With the majority of the farmers having an indifferent attitude towards the scheme, whether they end up with a positive or a negative attitude, depends on whether the WII product and the insurance provider/s, in the long run, meet the expectations of the respondents in the region.

Examining the attitudinal statements revealed that the respondents chose to be neutral to most of the statements, hence the indifferent attitude, unlike other farmers from previous research work who assigned negative or positive responses to some of these attitudinal statements. This underscores the fact that most of the farmers may not have had enough information about the scheme hence would rather stay neutral. Therefore, this could be an opportunity for the insurance providers to supply further information, as well as clarify these statements for which farmers were not sure of, about the scheme. These statements: 1) weather insurance is needed because other effective strategies are absent; 2) drought is an important risk; 4) weather insurance is appropriate for drought, and 15) farmers are able to access weather insurance in

the communities, in Table 5.22 in the previous chapter, that received positive scores previous research by Ajieh (2010), Chizari et al. (2003), Guo (2016) and Nimoh et al. (2011) reported similar results for a positive attitude towards agricultural insurance. In Nepal most farmers (87%) agreed that WII was the best way to deal with climate variability impacts (Guo, 2016), whilst farmers elsewhere in Sekyere West Municipal, Ghana, Delta State, Nigeria and Isfahan Province, Iran, also agreed that agricultural insurance has the ability to protect farmers against uncertainties (Ajieh, 2010; Chizari et al., 2003; Nimoh et al., 2011). In contrast, most of the statements such as insurance can mitigate acts of God; prompt claims payment; fair loss assessment and compensation; insurance providers absconding with insurance premiums; affordable premium rates; less bureaucracy in insurance contracting; access to credit with insurance; insurance is meant for large and not small-scale farmers; and not purchasing insurance if not sold by extension officers, to which the respondents remained neutral about in this research, farmers elsewhere attributed a negative attitudinal scores to them. These included: insurance contracts are not beneficial to farmers and only suit the insurers (Daninga & Qiao, 2014), long bureaucracies involved in accessing their services (Daninga & Qiao, 2014; Kumar et al., 2011), late payment of insurance claims (Daninga & Qiao, 2014; Ellis, 2017b; Kakumanu et al., 2012), non-payment of claims even after suffering losses (Daninga & Qiao, 2014; Issaka et al., 2016; Kakumanu et al., 2012), unfair loss assessment (Kumar et al., 2011), and high premium rates (Ellis, 2017b; Issaka et al., 2016). The difference here is that in some of these studies, the farmers purchased or learnt from the experiences of fellow farmers about the insurance products; hence their attitudes were based on either use of the product or the experience of fellow farmers with the product.

6.2.3 The respondents' willingness to participate and pay for WII scheme

In this section, the respondents' willingness to participate in the scheme is first discussed. Secondly, their willingness to pay (WTP) for the scheme are discussed.

6.2.3.1 The respondents' willingness to participate in WII scheme

The results of the study revealed that 69.5% of the total respondents were willing to participate in the insurance scheme even though only 1.5% had previously purchased or used the insurance product. This finding is consistent with the findings of Abebe and Bogale (2014), Aidoo et al. (2014), Ellis (2017b), and Issaka et al. (2016) who found that most farmers were willing to participate in WII schemes. This finding is reasonable because drought was identified in this

current study to be the second most important risk after crop pests and diseases in the region. Therefore, any risk management strategy such as the WII scheme that insures against drought will be of interest to farmers. However, this finding is in contrast with Christiaensen et al. (2006), who found that less than 50% of households in Tanzania were interested in rainfall-based insurance. They explained that the reason for this was that in the region they conducted the study, drought was infrequent and even when drought occurred the losses were insignificant.

Most of the respondents in the current study were willing to participate mainly to cover their farms against drought so as not to worry about the cost of a drought. Other reasons were to receive compensation whenever drought occurs on their farms irrespective of the situation in the area or region, and an opportunity to expand the area under cultivation as the impact of drought risk is reduced. These findings are consistent with the findings from other studies where it was found that farmers were willing to participate in insurance schemes for protection against drought (Aidoo et al., 2014; Ellis, 2017b; Jin et al., 2016), and uncertainties (Giné et al., 2008; Nimoh et al., 2011). Farmers' willingness to participate in the insurance scheme to receive compensation in this current study is consistent with the findings of Giné et al. (2008) who reported that farmers purchased insurance cover to obtain harvest money (compensation). The finding is somewhat similar to the findings of Nimoh et al. (2011) who found that farmers patronised insurance to access government assistance. This finding is reasonable because, from the respondents' risk profiles, drought came second to crop pests and diseases in the hierarchy of risks. Besides, drought has been reported to cause the most cumulative losses on livelihoods particularly in the northern savannah zones of Ghana (Choudhary et al., 2015). Therefore, it was not out of place for the respondents to be interested in an insurance scheme to protect their farms against the impact of drought and subsequently to receive compensation. This, therefore, implies that the insurance scheme must be effective in protecting the farmers against drought, as well as pay compensation whenever a farmer suffers drought. The results also revealed that, even though the respondents were willing to insure some crops against drought, if they were to purchase the insurance product, in most cases it would be to cover mainly maize and rice. Crops that first and foremost, provide cash to the household, were more susceptible to drought, and serve as primary household food sources, in that order, were more likely to be insured by the respondents. Therefore, an insurance scheme like the WII scheme should endeavour to target such crops instead of attempting to cover all crops in the region.

The following were the reasons respondents who were unwilling to participate in the insurance scheme gave: lack of trust in the scheme (33%), perceived non-payment of claims or difficulties in making a claim (31%), and inadequate household income to make insurance purchases (21%). These findings concur with the findings reported by Abebe and Bogale (2014), Christiaensen et al. (2006), Ellis (2017b) , Kouame and Komenan (2012) and Nimoh et al. (2011) on the reasons for some farmers' unwillingness to participate in crop insurance schemes. The number of respondents unwilling to participate in this current study indicates that the insurance provider/s, policymakers and other stakeholders must make a significant effort at winning the trust of the respondents, as well as, undo the perception that they have about making insurance claims. The insurance provider/s, as well as policymakers, will need to facilitate, the financially constrained respondents to have access to credit for them to make insurance purchases.

Concerning the factors that affect the respondents' willingness to participate in the WII scheme, it was found that of the factors included in the probit regression model seven explanatory variables were significant at various levels, $p \leq 0.01$, $p \leq 0.05$ or $p \leq 0.1$. These variables were: primary occupation as a farmer, total income from crops, maize income, land tenure system as owner, attitude score, drought index, and access to credit. The McFadden value, an indication of the goodness of fit of the model, was 0.43. That is, the significant variables together explain 43% of the variations in the dependent variable, willingness to participate in the scheme.

The current study attempted to identify if the occupations of the respondents influenced their willingness to participate in the scheme. Therefore, the respondents' other income sources and their primary occupations were included as variables in the regression model. The respondents' other income sources were found to be statistically insignificant to influence their willingness to participate in the scheme. This finding is inconsistent with previous research that determined the effect of farmers' other income sources on their willingness to participate in agricultural insurance schemes. Giné et al. (2008) and Kumar et al. (2011) both reported a positive relationship between farmers' other income sources and their willingness to participate in agricultural insurances schemes because they were less likely to be cash constrained and not able to afford the premiums. In contrast, a negative relationship was reported between farmers' other income sources and willingness to participate in insurances schemes because they were more income secured and or depended on these other income sources (Abebe & Bogale, 2014; Ali, 2013; Issaka et al., 2016; Jin et al., 2016; Nimoh et al., 2011). Primary occupation as a farmer was, however, found to have a significant positive relationship with the respondents'

willingness to participate at a 5% significance level. This finding is consistent with findings reported by Abebe and Bogale (2014), who asserted that as farming contributes a higher proportion of income to the household, it makes it a primary occupation of the household, as such, they are more likely to protect this income stream with insurance. The marginal effect of this variable was 0.2019. This means that a respondent that changed their primary occupation to farming was 20.19% more likely to participate in the insurance scheme than if they remained in their other occupation. This finding is reasonable because farmers suffer drought events more than any other occupation. Therefore, as farming is the main contributor to household income, they are more likely to participate in the scheme to protect this income source from drought events.

Total crop income, a proxy for total household farm income, was found to have a significant negative relationship with the respondents' willingness to participate in the scheme at a 5% significance level. This finding is consistent with the findings of Falola et al. (2014), who also reported a negative relationship. They explained that such households might have adopted other risk management strategies, and hence were less likely to take out agricultural insurance cover due to the additional cost. However, this finding is in contrast to the findings of Aidoo et al. (2014), Danso-Abbeam et al. (2014) and Ghazanfar et al. (2015), who found a positive relationship between total household farm income and willingness to participate in agricultural insurance schemes. They explained that these farmers with higher household income could afford the insurance premiums and hence were more likely to participate in the scheme. The marginal effect of this was -0.0000. This effect is almost negligible to influence their willingness to participate in the scheme negatively, even with incremental total crop income. Nonetheless, the negative relationship could indicate that these households have adequate incomes, so are less likely to suffer financially from a drought event in a season, and hence are less likely to participate in the WII scheme.

Income from maize, as a proxy for household farm income, was included as a variable to understand its influence on the respondents' willingness to participate in the scheme. This was found to have a significant positive relationship with willingness to participate at a 10% significance level. This is consistent with the findings of Aidoo et al. (2014), Danso-Abbeam et al. (2014) and Ghazanfar et al. (2015), who found a positive relationship between total farm income and willingness to participate, and contradict that of Falola et al. (2014) who found a negative relationship between household farm income and willingness to participate in insurance schemes. This, therefore, means that the proportion of maize income from the

household farm income is important in positively influencing the respondents' willingness to participate. The marginal effect of 0.0001 however, means that a unit increase in maize income will increase their participation by about 0.1%. This result is reasonable because if the maize income is not substantial compared to the total crop income, why would a farmer bother to protect such an income stream with insurance? From the previous sections, maize was a cash crop providing income to households, susceptible to drought, and also served as a major household food source. Therefore, it is only prudent for households to want to protect such an important crop with the WII scheme.

Land tenure as an owner was found to have a positive relationship with willingness to participate at a 5% significance level. This is consistent with the findings from Danso-Abbeam et al. (2014) and Nimoh et al. (2011). It was explained that share-croppers and renters did not have any incentive to participate in the schemes because they did not own the land (Nimoh et al., 2011). This, however, is not consistent with the findings from Aidoo et al. (2014) and Kwadzo et al. (2013) who found a negative relationship with willingness to participate. It was explained that landowners owned land and probably diversified their production (Aidoo et al., 2014) and or faced less land tenure risks (Kwadzo et al., 2013). This finding is reasonable because as a landowner, cash that would have been used to rent a piece of land if they were renters, could now instead be used to pay for the insurance scheme and hence they are more likely to participate than land renters who would see it as an additional production cost. The marginal effect of 0.1757 means that as farmers become landowners, they were 17.57% more likely to participate in the scheme than if they were share-croppers and or land tenants.

The attitude score, a proxy for the attitude of the respondents towards the insurance scheme, was included among the variables to understand its impact on their willingness to participate, and this variable has not been included in previous research. The attitude score of the respondents was found to have a positive relationship with their willingness to participate at a 1% significance level. The marginal effect of 0.4152, means that as the respondents' attitude changed from an unfavourable to a favourable attitude, they were 41.52% more likely to participate in the scheme. This is reasonable because if the respondents' do not have a positive attitude towards the scheme, they are less likely to participate in it. Such a large marginal effect underscores the importance of the respondents' attitude towards the WII scheme and the subsequent demand for it in the region. This means that the insurance provider/s and policymakers must or should make a significant effort to ensure that the WII scheme is effective in meeting the needs of farmers in the region. Transparent loss assessment, timely and prompt

compensation schedules, affordable premiums, fair insurance contract designs, less paperwork, and simple terms and conditions are some of the features that could give the respondents a positive attitude towards the WII scheme in the region.

Drought index, a proxy for drought frequency and severity, was found to have a positive relationship with willingness to participate in the scheme at a 1% significance level. This is consistent with the findings from Issaka et al. (2016) and Jin et al. (2016) who found a positive relationship between farmers' willingness to participate and the frequency and severity of drought or future loss due to the weather. This finding is reasonable because as drought becomes frequent and the losses from drought have a substantial effect on household income, and or food supply, the respondents would be looking to adopt a risk management strategy that can protect income or food supply such as the WII scheme. The marginal effect of 0.3004 means that as a respondent's probability of suffering a drought event increases, to the extreme, from very low to very high, they are 30.04% more likely to participate in the WII scheme in the region.

Credit access was found to have a positive influence on the respondents' willingness to participate in the scheme at a 5% significance level. This finding concurs with those of Ali (2013), Issaka et al. (2016) and Wairimu et al. (2016), who found a positive relationship between credit access and farmers willingness to participate in WII schemes. It was explained that the credit provides farmers with the ability or cash to purchase the insurance. However, this finding contradicts the findings of Ghazanfar et al. (2015), who reported a negative relationship between a farmer's access to credit and their willingness to participate and the subsequent adoption of crop insurance in Pakistan. However, they reported that this was because agricultural loans taken out by farmers were already insured, and hence there was no need to obtain further crop insurance.

Farmers' access to extension services, a focus of this research, was found to be statistically insignificant concerning its influence on farmers' willingness to participate in the scheme. This is inconsistent with previous studies in the same area. A positive relationship was reported between access to extension services and willingness to participate in agricultural insurance schemes (Akintunde, 2015; Ali, 2013; Amin et al., 2014; Ellis, 2017b; Falola et al., 2014; Wairimu et al., 2016). This was because extension officers had briefed farmers about the benefits of purchasing insurance cover. The marginal effect of the variable, 0.0895 implies that if a farmer were to move from, inability to access, to the ability to access extension services,

they were 8.95% more likely to participate in the insurance scheme. This could imply that the officers are not communicating much about the scheme to the farmers, hence its insignificance at influencing farmers' willingness to participate in the scheme in this study.

6.2.3.2 The respondents' willingness to pay for the WII scheme

The results revealed that of the 89% of respondents willing to participate in the scheme, and who accepted an initial bid as shown in Table 5.28 in the previous chapter, 88% of them also accepted the higher bid, whilst 12% declined it. As such, most of the respondents' maximum WTP for the scheme was in the range of 7.5% (GH₵54.00) to 12.5% (GH₵89.00) of the total production cost of maize per acre (GH₵714)[5]. The truncated mean maximum WTP, estimated from the interval regression model, was also GH₵84.66 with the lower and upper bounds being GH₵80.28 and GH₵86.86 per acre, respectively. This confirms that the respondents' maximum WTP for this scheme for maize lies within the 7.5% and 12.5% premiums rate. This finding contradicts those of Ellis (2017b), concerning how much the farmers were willing to pay for the scheme. Ellis (2017b) found that most farmers were willing to pay less than a 10% premium rate of the production cost of maize per acre (GH₵1,000) set by the Ghana Agricultural Insurance Programme (GAIP). This could be attributed to the fact that the Upper East Region experiences more drought than that in the Eastern region of Ghana, or that the maize production cost per acre in this current study (GH₵714)[6] is less than that used by Ellis (2017b) (GH₵1,000). As such, Ellis (2017b) may have presented relatively higher premium rates which is the reason why farmers were unwilling to pay at 10% premium rate. Notwithstanding this, the probability of the respondents selecting a yes to the bids was found to decrease as the bids increased, in other words, demand decreases as the bids increased. This is consistent with the findings from Abebe and Bogale (2014) and Ellis (2017b) who found demand for the insurance product falls as the premium increases.

The following factors were found to significantly affect the maximum WTP for the insurance scheme in the region at various levels, with probabilities of $p \leq 0.01$, $p \leq 0.05$ or $p \leq 0.1$: attitude score, farm diversification, drought index, knowledge about the WII scheme, and the logarithm of the bid value.

[5] Exchange rate – NZD1 : GH₵3.15 as at March, 2018

[6] Subsidized prices of fertilizers (NPK and Sulphate of Ammonia) in the 2017 cropping season were used

The attitude score of the respondents was included to ascertain its effect on the respondents' WTP for the scheme in the region. The effect of farmers' attitude on their WTP has not been established in previous research. It was found to have a significant positive relationship with the WTP for the scheme at a 10% significance level. This means that as the respondents' attitude changed from an unfavourable to a favourable attitude towards the scheme, they were more likely to pay more for the scheme. This makes sense because most people would not spend money on a product that they do not have a favourable attitude towards. This finding, therefore, re-emphasises the importance of farmers' attitude towards the scheme and its demand in the long run.

Farm diversification was found to have a significant negative relationship with the respondents' WTP for the scheme at a 1% significance level. This is consistent with the literature on the impact of farm diversification on farmers' WTP for crop insurance (Abebe & Bogale, 2014; Ali, 2013; Kumar et al., 2011; Kwadzo et al., 2013). The literature has shown that diversification into livestock enabled households to rely on these enterprises when crops failed (Abebe & Bogale, 2014; Kwadzo et al., 2013), whilst crop diversification also enabled the spreading of risk associated with drought across the farm (Ali, 2013; Kumar et al., 2011). This implies that farmers use of farm diversification as a risk management strategy will likely pose severe challenges to the WII scheme as farm diversification was identified as the most important and frequently used risk management strategy in the region.

The drought index was found to have a significant negative relationship with the respondents' WTP for the scheme at a 5% significance level. This finding is inconsistent with the findings of Issaka et al. (2016) and Jin et al. (2016) as they found a positive relationship between farmers' willingness to participate and the subsequent payment, and frequency and severity of drought or future loss due to the weather. This result means that as the respondent's drought index increases, in other words, the probability of suffering a drought event increases, they are less likely to pay for the scheme. This is an unusual result, however, the following may be plausible explanations for the outcome. First, drought affects farmers so much that they no longer have the resources to afford the premium rate. Second, as the drought index increases, they have to spend more money on insurance premiums to cover their farms hence they will look for cheaper alternatives. Third, they may believe that the insurance scheme is not effective in protecting them from such frequent droughts and therefore, they rely on other risk management strategies and as such, they are less likely to pay for the scheme.

Knowledge about the WII scheme was found to have a significant negative relationship with the respondent's WTP for the scheme at a 10% significance level. This is inconsistent with the literature on farmers' knowledge about crop insurance and their WTP for it. The literature has reported that farmers with more knowledge and understanding of the insurance product are more likely to purchase it (Abebe & Bogale, 2014; Adjei et al., 2016; Boyd et al., 2011; Danso-Abbeam et al., 2014; Ellis, 2017b; Giné et al., 2008; Kakumanu et al., 2012). The result from the current research implies that respondents who have a good understanding of the WII scheme in the region are less likely to pay for it. The explanation for this result could be attributed to basis risk associated with this insurance product. Basis risk is the low correlation or mismatch between actual losses suffered and the amount of the insurance pay-out received by individual clients (Bryla & Syroka, 2007; Collier et al., 2009; Jensen & Barrett, 2017). The respondents who understand the insurance scheme may know about the downside of this product, basis risk; hence they are less likely to pay for it. Basis risk has been reported to be one of the problems smallholder farmers have with the WII scheme, especially, in low income countries (Barnett et al., 2008; Clarke, 2016; Cole et al., 2013; Hill et al., 2013; Osgood et al., 2007).

The natural logarithm of the bids was found to have a negative and significant influence on the respondents' WTP at a 1% significance level. This is consistent with Boyd et al. (2011), Ghazanfar et al. (2015) and Kumar et al. (2011), who found a negative relationship between crop insurance purchase and the premium rate. The implication of this is that as the premium rate of the insurance scheme increases the less likely, it is that farmers will pay for the scheme. As already determined, the ideal premium rate would be between 7.5% (GH¢54.00) to 12.5% (GH¢89.00) premium rates of the cost of producing maize per acre. The next section is the discussion of the results of the extension officer survey.

6.3 Agricultural extension officer survey

The discussion of the results of the extension officer survey was aimed at achieving objectives four and five as set out in the introductory chapter. As such, this section is organised into two sub-sections. Section 6.2.1 discusses the results concerning objective four: to assess the knowledge about and the attitude held by agricultural extension officers towards the WII scheme in the region. Also, section 6.2.2 discusses the results concerning objective five: to identify the determinants of the agricultural extension officers' knowledge about the scheme in the region.

6.3.1 The agricultural extension officers' knowledge about, and the attitude towards, the WII scheme

The discussion in this section is in two parts. First, the officers' knowledge about the scheme, and second, the officers' attitude towards the scheme in the region are discussed.

6.3.1.1 The agricultural extension officers' knowledge about the WII scheme

The majority of the agricultural extension officers were aware of the WII insurance scheme, however, most had little understanding of the scheme in the region. This corroborates the findings of Ajayi (2013) who found that few extension officers from Osun State, Nigeria were knowledgeable about agricultural insurance programmes. The findings are also consistent with Martin et al. (2003) and Buzby et al. (1992), who found that county-level extension agents in the United States of America in a survey felt they were less knowledgeable in agricultural insurance to teach farmers. The current results indicated that about 70% of the officers were aware of the insurance scheme. Of the 70% of officers with knowledge about the scheme, 52% had low, 38% moderate, and 10% advanced insurance awareness indexes. In other words, 33% of the total sample of officers (90) had between moderate to advance knowledge levels about the scheme in the region. This implies that the majority of the officers may not be able to communicate effectively to the farmers about the insurance scheme. As asserted by Ajayi (2013) the officers' low insurance awareness level could make them reluctant to introduce the concept to farmers, the ultimate beneficiaries. This explains why farmers' access to extension services was found to insignificantly influence their participation in the insurance scheme in the previous section (page number here).

The current results indicated that the GAIP (22%) was among the least used sources of information about the scheme for the officers. NGOs (51%), the Ministry of Food and Agriculture (49%) and radio and TV (41%) were the officers' most frequently used sources of information about the scheme. This is surprising because it is the GAIP that operates the scheme. It is possible that as the information is passed to the officers from these other sources rather than the GAIP, key terms and concepts about the scheme are left out, hence the officers' low level of insurance awareness. The data suggest that the GAIP has an ineffective communication system for reaching key stakeholders.

6.3.1.2 The agricultural extension officers' attitude towards the WII scheme

The attitude that the agricultural extension officers in the region have towards the insurance scheme, in general, was an indifferent attitude. The current results revealed that the overall mean score, which is indicative of the officers' attitude towards the scheme, was 3.58, an indifferent attitude towards the scheme. This finding is similar to that reported by Ajayi (2013), who found that the majority of agricultural extension agents in Osun State, Nigeria had an indifferent attitude towards the agricultural insurance scheme. This indifferent attitude could be attributed to the majority of the officers' low level of insurance awareness about the scheme. As a result, most were comfortable staying neutral about the scheme rather than indicating a positive or negative response to the attitudinal statements. The individual officer attitude analysis revealed that no officer expressed an unfavourable attitude towards the scheme, 58% expressed an indifferent attitude, whilst 42% expressed a favourable, attitude towards the WII scheme. Table 5.35 in chapter 5 showed that of the 20 statements, the officers were positive about eight statements. These statements were: 1) weather insurance is needed because other effective strategies are absent; 2) drought is an important risk; 4) weather insurance is appropriate for drought; 5) agricultural insurance can mitigate acts of God; 8) insurance providers would provide fair loss assessment; 15) farmers are able to access weather insurance in the communities; 16) insurance providers would respect farmers; and 19) weather insurance is meant for all farmers irrespective of scale of production. They were, however, neutral on the rest of the statements. This is important because, at least, it is an indication that the officers hold nothing against the scheme to not want to communicate to farmers about it. Regular training on the scheme would, in the long run, provide the officers with enough knowledge and understanding to potentially change their overall attitude to favourable towards the scheme. This is important because as concluded by Ajayi (2013) and Jayaratne et al. (2007), officers with a favourable attitude towards innovations such as agricultural insurance or conservation tillage systems were more in a position to communicate these innovations to farmers than officers with an unfavourable attitude.

6.3.2 The determinants of the extension officers' knowledge about the WII scheme

The objective of this section was to determine the factors that affect the officers' knowledge about the WII scheme in the region. The factors that were found to affect the officers' knowledge about the scheme in the probit model was the number of insurance related training sessions attended, whilst all other factors were statistically insignificant. The McFadden value, an indication of the goodness of fit of the model, was 0.1486. That is, the significant variables

together explain only 14.86% of the variation in the dependent variable, knowledge about the scheme. This is an indication that, other factors other than those included in the regression model explain the variation in the dependent variable. The number of insurance related training sessions attended by an officer had a significant positive relationship with the officers' knowledge about the scheme at a 10% significance level. This finding is somewhat inconsistent with the findings reported by Ajayi (2013), who found that the number of financial training sessions attended by the officers negatively affected their knowledge about the insurance scheme. This current finding is reasonable because attending such training sessions on insurance will eventually improve one's knowledge and understanding of the scheme. The implication of this is that more of such training sessions should be organised monthly or quarterly by the insurance provider/s in collaboration with the Departments of Agriculture for the officers to improve their knowledge and understanding of the scheme. This would enable them to be able to communicate information regarding the insurance scheme to farmers effectively. This, in turn, would improve farmers' knowledge and understanding of the concept of the scheme, possibly changing positively the perceptions that farmers have about the scheme, to increase adoption of the scheme. More socio-demographic as well as work-related data about the officers such as ownership of a farm, number of promotions earned, and field of specialisation among others could be included in subsequent studies to identify the factors affecting the officers' knowledge about the scheme. This is because those variables included in this study did not have enough explanatory power to determine the variation in the officers' knowledge about the scheme.

CHAPTER SEVEN - CONCLUSION AND RECOMMENDATIONS

7.1 Conclusion

Ghana's agriculture is rain-fed, and drought causes problems such as reductions in farm household food supply, and income especially, in the three northern regions of the country (Choudhary et al., 2015). Due to the impact of drought on farm household livelihoods, the WII scheme for drought was introduced to cushion farmers and other value chain actors from the impact of drought events in the Upper East Region of Ghana (Ghana Insurers Association, 2015). There is a consensus from the literature that the demand for WII, especially, in low-income countries is low. Previous studies have suggested that the risks to which farmers are exposed, and the risk management strategies that they have in place impact on the adoption of agricultural insurance. Other studies have established that socio-demographic, farm, and institutional factors, including access to extension services, play a role in determining farmers' adoption of agricultural insurance. The main aim of this study was to assess farmers' willingness to participate and pay for a WII scheme and to determine agricultural extension officers' disposition to communicate information regarding the scheme to farmers in the Upper East Region. The information arising from this research would enable the Ghana Agricultural Insurance Programme (GAIP), the Departments of Agriculture at the regional, municipal and district levels, and policymakers to make changes to ensure the success of the programme in the region and the country at large. The following research questions were specified to achieve the main research aim:

1. What production and market risk are farmers in the Upper East Region exposed to and what management strategies do they have in place?
2. What knowledge and attitude do farmers have about the WII scheme?
3. Are farmers willing to participate and pay for this insurance type, and what determines these?
4. What knowledge and attitude do agricultural extension officers have about the WII scheme, and what determines the officers' knowledge of this insurance type?

Two surveys, one of farmers and the other of agricultural extension officers were designed to answer these research questions. Through an interviewer-administered survey approach (farmer survey) and self-administered survey approach (extension officer survey) data were collected for analysis. Three municipalities in the region were purposely selected, fourteen farmers from each of five randomly selected operational areas from Bolgatanga, and Bawku

Municipalities and four operational areas from Navrongo Municipality were randomly selected. This resulted in a sample size of 200 farmers. All available agricultural extension officers from eleven of the thirteen Municipal/Districts in the region were surveyed giving a total of 90 respondents. A double-bounded contingent valuation technique was used to collect data on the farmers' willingness to pay for the insurance scheme in the region. The data were analysed using frequency distribution tables, percentages, mean, minimum and maximum. Chi-square tests and t-test were carried out to determine any statistically significant difference between groups. A Heckman two-stage regression model was employed to analyse farmers' participation and subsequently, their willingness to pay for the scheme, without considering sample selection bias. A probit regression model was used to determine the factors that influenced agricultural extension officers' knowledge about the weather index-based insurance scheme in the region.

This current study revealed that most of the risks respondents were exposed to in the region were production and market risks: pests and diseases, drought, erratic rainfall, input access, windstorms, floods, bushfires, and input and or output price variation. The study also revealed that besides input access and bushfires which affect farmers independently, all the other risks in the region were systemic risks, that is, risks that affect an entire area, district, or region, concurrently. However, the study revealed that pests and diseases was the most frequent and important risk followed by drought, erratic rainfall, and input and or output price variation, respectively. Because of the mix of risks, farmers must adopt a combination of risk management strategies to reduce the impact of any of these events on them and their farm system. The farmers can transfer some of these risks to third parties through insurance, especially, drought in the case of the WII scheme. The study revealed that even though farmers used many risks management strategies, the most frequently used and important among them was farm/crop diversification, use of improved crop varieties, soil and water conservation methods, variation in planting dates, and planting of trees, respectively. Crop insurance was rarely used. That is to say, financial risk management strategies are rarely used by the farmers and where they are used, they are often deemed not important compared to other technically-based measures like farm/crop diversification. Farm/crop diversification normally ensured farmers had an alternative source of food and, or income in the advent of an event, hence was deemed the most important of all the strategies. This implies that any financial risk management strategy such as the WII scheme should be equal to farm/crop diversification or better concerning risk management value for farmers to consider its usage. In short, the risks

to which the farmers are exposed to are systemic risks, as well as, insurable risks especially drought. However, the risk management strategies in place, especially, farm/crop diversification could limit the adoption of the WII scheme, particularly if the scheme does not provide a similar level of protection to that of farm/crop diversification strategy.

The current study also revealed that regarding farmers' knowledge about, and their attitude towards the scheme, they had a low level of knowledge, as well as, an indifferent attitude towards the WII scheme in the region. Only 34.5% of the 200 respondents had knowledge about the insurance scheme in the region. However, only a little over half of these farmers had moderate to advanced knowledge levels about the insurance scheme. In other words, about 21.0% of the 200 farmers had moderate to advanced knowledge levels about the insurance scheme in the region. This implies that most farmers either do not know about the scheme or have little understanding of the concept. Importantly, the GAIP was found to be the least used source of information about the scheme. In contrast, radio and TV, followed by extension officers, and fellow farmers were the most frequent sources of information about the scheme. The current study also revealed that farmers, in general, had an indifferent attitude towards the scheme which could have arisen because 1) only 1.5% of the respondents had purchased it previously, and 2) most farmers did not know about WII scheme until asked about it during the survey. Nonetheless, on an individual basis, 3% had a negative attitude, and 19.5% had a positive attitude towards the scheme, an indication that not all farmers are indifferent about the scheme. This implies that there is much that insurance providers could do concerning raising farmer awareness and, or training to alter this indifferent attitude that the farmers hold towards the scheme in the region.

The study revealed that 69.5% of the surveyed farmers were willing to participate in the insurance scheme, whilst only 1.5% had previously purchased or used the insurance product. The majority of the respondents were willing to participate mainly to cover their farms against drought so as not to worry about the impact of drought. Other reasons were to receive compensation whenever drought occurs on their farms, irrespective of the situation in the area or region; and an opportunity to expand the area under cultivation as the impact of drought risk is reduced. The results showed that crops such as maize and rice that provide cash to the household were more susceptible to drought, and serve as primary household food sources, in that order, were more likely to be insured by the farmers in the region. This implies that an insurance scheme such as the WII scheme should endeavour to target such crops instead of attempting to cover all crops in the region. On the other hand, 30.5% of the farmers were

unwilling to participate in the scheme because of; a lack of trust in the scheme, perceived non-payment of claims or difficulties in making a claim, and inadequate household income to purchase the scheme. These results suggest that the insurance providers will have to put effort into winning the trust of farmers, as well as, changing farmers' negative perceptions about the difficulty of making insurance claims. The insurance providers, as well as policymakers, will need to facilitate, especially in the case of financially constrained farmers, access to credit for them to make insurance purchases. The factors that were found to significantly affect farmers' willingness to participate in the scheme in a positive manner were: primary occupation as a farmer, maize income, land tenure system as an owner, attitude score, drought index, and access to credit. In contrast, total income from crops was also a significant factor, but it negatively influenced farmers' willingness to participate in the scheme. This implies that farmers with farming as their primary occupation, with higher levels of maize income, who are landowners, in areas that have a high probability of suffering a drought, with a favourable attitude towards the scheme, and access to credit are more likely to participate in the insurance scheme for maize. However, farmers with high levels of total crop income are less likely to participate in the scheme for maize because they rely on the income from their other crops to cope with drought.

The study revealed that farmers' maximum WTP for the WII scheme lies between a 7.5% and a 12.5% premium rate for the cost of producing an acre of maize (GH¢714). The truncated mean WTP of GH¢84.66 from the interval regression also validated this assertion. The following factors were found to negatively and significantly influence farmers' maximum WTP for the scheme: farm diversification, drought index, knowledge about the WII scheme, and the bid price. However, the attitude score was found to positively and significantly influence farmers' maximum WTP for the scheme in the region. This implies that farmers who have diversified their farm, in areas with a high probability of suffering a drought event, and have knowledge about the scheme are less likely to pay for the scheme. For these same farmers, higher premium rate will likely lower the demand for the WII scheme. Farm diversification helps spread the risk or provide alternative livelihood sources that are less affected by drought. Farmers in areas with high a probability of suffering drought imply that these farmers will be spending more money cumulatively on premiums for protection. Farmers with knowledge and a good understanding of the scheme get to know the scheme's association with basis risk; hence they are less likely to pay for the scheme. On the other hand, farmers with a favourable attitude towards the scheme are more likely to pay for the scheme in the region than farmers who do

not have a positive attitude. This re-emphasises the importance of farmers' attitude towards the scheme and its demand in the long run.

This study also revealed that although 70% of the agricultural extension officers knew about the scheme, only about 33% of the total sample had moderate to advanced levels of knowledge about the scheme in the region. This implies that the majority of the agricultural extension officers in the region may not be able to communicate effectively with farmers about the WII scheme. As such, farmers may consider that the information provided by agricultural extension officers about the scheme to be of marginal value. This may explain why access to agricultural extension officers was found to not influence farmers' willingness to participate in the WII scheme in the region. As with the farmers, the GAIP was found to be among the least used sources of information about the scheme. In contrast, NGOs, the Ministry of Food and Agriculture, and radio and TV were the agricultural extension officers' most frequently used sources of information about the scheme. It can thus be said that the GAIP is ineffective in communicating to its primary clientele, the farmers and important individuals that could influence farmers' perceptions of the scheme, namely agricultural extension officers. In general, extension officers had an indifferent attitude towards the WII scheme in the region. This could have arisen because most of the extension officers did not fully understand the concept of the WII scheme, hence were reluctant to attribute a positive or negative attitude towards it. On an individual basis, no agricultural extension officer expressed an unfavourable attitude towards the scheme, whilst 48% expressed a favourable attitude. This is an indication that agricultural extension officers held nothing against the scheme.

The number of insurance related training sessions attended by an agricultural extension officer was the only factor found to positively and significantly influence their knowledge about the scheme in the region. This implies that frequent training of the extension officers by the GAIP and, or the Departments of Agriculture about the scheme would improve their knowledge and understanding in the long run.

7.2 Recommendations

Most farmers, as well as most agricultural extension officers, do not know about the WII scheme and those who do have a limited understanding of the scheme. It is, therefore, recommended that the insurance providers in collaboration with the various Departments of Agriculture in the region organise more community, district, and, or regional sensitisation and,

or training programmes for farmers and agricultural extension officers. This would improve farmers' and agricultural extension officers' understanding of the WII scheme, in the long run, invariably resulting in farmers' willingness to adopt it, and extension officers' communication of information regarding the scheme to farmers.

In as much as farmers' understanding of the WII scheme is important for its adoption, in this study basis risk is likely to reduce farmers' patronage of the WII scheme as their knowledge and understanding about the scheme improves in the Upper East Region. Therefore, the insurance providers and policymakers must make a significant effort at reducing basis risk either through improving the quality of the data they use or by increasing the number of weather stations used for the insurance scheme in the region.

Farmers' positive attitude towards the WII scheme was found to influence the willingness to participate and pay for the scheme positively. Therefore, the insurance providers and policymakers must or should make a significant effort to ensure that the WII scheme is effective in meeting the needs of farmers in the region. They must also endeavour to change farmers' negative perceptions about making insurance claims. A transparent loss assessment process, timely and prompt compensation schedules, affordable premiums, the design of fair insurance contracts, a reduction in paperwork, and the use of simple terms and conditions are some of the features that could be implemented to change farmers' perceptions of the WII scheme.

The results showed that crops that, provide cash to the household, were more susceptible to drought, and serve as primary household food sources, such as maize and rice, were more likely to be insured by the farmers in the region. Therefore, the insurance providers should endeavour to target these crops instead of attempting to cover all crops in the region.

Access to credit by the farmers significantly influenced the adoption of the WII scheme in the region. Therefore, either the insurance providers and, or policymakers should link the scheme to credit or provide financially constrained farmers with access to credit, since most financially constrained farmers may not have the collateral to access credit by themselves.

The GAIP, the insurance provider, was found to be the least frequently used source of information about the scheme by farmers. It is, therefore, recommended that the insurance providers improve their communication strategy with their primary clientele, to enable them frequently source information about the scheme from them.

7.3 Areas for future research

This study found that the farmers' most important risk management strategy was farm/crop diversification and that if farmers adopted this strategy, they were less likely to adopt the WII scheme. There is, therefore, the need to research the effectiveness of the farm/crop diversification strategy in protecting farmers against drought events. Such research would highlight the strengths and weaknesses of this risk management strategy, as well as, provide an indication as to whether the WII scheme should be promoted by itself or in combination with the farm/crop diversification strategy as a risk management tactic.

This study also found that farmers' attitude towards the scheme positively influenced their participation and maximum WTP for the scheme. Therefore, it would be beneficial investigating the factors that influence farmers' attitudes towards the insurance scheme in the region. This would help identify those factors that contribute positively to farmers' attitudes towards the scheme in the region.

Another area of interest is basis risk as this has been claimed to affect the demand for WII schemes in low-income countries. In this study, basis risk was attributed to the unwillingness of farmers to pay for the scheme as the farmers' knowledge about the scheme improved. It may be worthwhile investigating the relationship between farmers' knowledge and understanding, especially, about the WII scheme and their unwillingness to pay for the scheme as a result of basis risk in other studies. It is also important to investigate the maximum acceptable distance to a rainfall station that farmers associate less basis risk with the scheme in the region, as the current distance to a rainfall station is in a radius of about 20km.

7.4 Limitations of the study

The research only focused on production, and market risks although farmers are exposed to different types of risks. It is possible that other risk categories, such as institutional, financial, or human risks, other than production, and market risks, not included in this study are frequent and important to farmers in the region.

The study was cross-sectional and explorative, and as such the data used pertains to the year 2017. It may not be possible to examine changes in the risks to which farmers are exposed and the management strategies employed against these risks over time with this study. It is also not possible to examine over time the changes in the knowledge, and attitudes of farmers towards weather index-based insurance in the region with this study. Therefore, the risks to which

farmers are exposed and the strategies' used, as well as, farmers' knowledge and attitudes towards the scheme, should be interpreted in the light of farmers' situations in the region in 2017.

Without considering for sample selection bias, it is possible that some of the parameter estimates in the interval regression may have been inflated. As such parameters that were supposed to be statistically insignificant, if sample selection had been considered, may be statistically significant with sample selection bias and lead to inaccurate prediction of the model.

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APPENDICES
APPENDIX 1 INFORMATION SHEET

MASSEY UNIVERSITY
COLLEGE OF SCIENCES
TE WĀHANGA PŪTAIAO

Project Title:

Farmers' willingness to participate and pay for, and agricultural extension officers' disposition to communicate weather index-based insurance scheme in Ghana: The Case of the Upper East Region

INFORMATION SHEET

My name is Joseph Ayetewene Adjabui. I am a Ghanaian from the Upper East Region, Gbedemah in the Builsa South District to be precise. I am a student in the School of Agriculture in the College of Sciences, Massey University, New Zealand. In partial fulfillment for the award of a degree of Master of Agricommerce, Massey University, New Zealand, I am undertaking a research project on Farmers' willingness to participate and pay for, and agricultural extension officers' disposition to communicate the weather index-based insurance scheme in Ghana: The case of the Upper East Region. The objectives of the research project are:

1. To identify the major risks to which farmers are exposed, and the risk management strategies they use to manage these risks.
2. To assess the knowledge about and the attitude held by farmers towards the WII scheme in the region.
3. To determine farmers' willingness to participate and pay for the scheme, and the factors determining these in the region.
4. To assess the knowledge about and the attitude held by agricultural extension officers towards the WII scheme in the region.
5. To identify the determinants of the agricultural extension officers' knowledge about the scheme in the region.

Because the region is one of the most affected in terms of climate variability, the Ghana Agricultural Insurance Programme (GAIP) introduced the Weather Index-Based Insurance Scheme for drought to help farmers and other actors along the value chain to mitigate the impact of climate variability on their livelihoods. This study seeks to achieve the aforementioned objectives above in the context of the Upper East Region in relation to the insurance scheme. As such I will be interviewing a number of farmers and agricultural extension officers in the Bolgatanga, Bawku, and Kassena Nankana West (Navrongo) Municipalities to solicit information for the purposes of the research project. You have been identified as a potential participant for this study and are hereby invited to participate in this survey so that the information you will provide can be used to realize the objectives of the study. You and other

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participants making a total of 200 farmers in the region were randomly selected from the "holders' lists" of the three Municipal Departments of Agriculture. If you do decide to participate which is voluntary, you will be required to sign a consent form. The interview will take about 60 minutes and I will be asking you questions and writing your responses in the questionnaire.

You are under no obligation to accept this invitation. However, if you decide to participate, you have the right to:

- decline to answer any particular question;
- withdraw from the study during the interview;
- ask any questions about the study at any time during participation;
- provide information on the understanding that your name will not be used unless you give permission to the researcher;
- be given access to a summary of the project findings when it is concluded.

The data collected will be used solely for the purpose of my Masters of Agricommerce thesis and for other academic publications. The data will be analyzed collectively so that no one participant can be identified from the results of the study. All data will be stored securely in a safe place for five years for auditing purposes if required. The data will be disposed of after five years.

This project has been reviewed and approved by the Massey University Human Ethics Committee: Southern A, Application No. 4000018062. If you have any concerns about the conduct of this research, please contact Dr. Lesley Batten, Chair, Massey University Human Ethics Committee: Southern A, telephone 06 356 9099 x 85094, email humanethicsoutha@massey.ac.nz.

"This project has been evaluated by peer review and judged to be low risk. Consequently, it has not been reviewed by one of the University's Human Ethics Committees. The researcher(s) named below are responsible for the ethical conduct of this research. If you have any concerns about the conduct of this research that you wish to raise with someone other than the researcher(s), please contact Dr. Brian Finch, Director, Research Ethics, telephone 06 356 9099 x 86015, email humanethics@massey.ac.nz". If you have any enquiries about the survey, you are welcome to contact me or any of the supervisors with the following contact details below.

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Postgraduate Student
Institute of Agriculture and Environment
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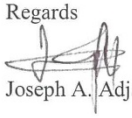
Regards



Joseph A. Adjabui

APPENDIX 2 PARTICIPANT CONSENT FORM - INDIVIDUAL

MASSEY UNIVERSITY
COLLEGE OF SCIENCES
TE WĀHANGA PŪTAIAO

Project Title:

Farmers' willingness to participate and pay for, and agricultural extension officers' disposition to communicate weather index-based insurance scheme in Ghana: The Case of the Upper East Region

PARTICIPANT CONSENT FORM - INDIVIDUAL

I have read the Information Sheet and have had the details of the study explained to me. My questions have been answered to my satisfaction, and I understand that I may ask further questions at any time.

I wish/do not wish to have data placed in an official archive.

I agree to participate in this study under the conditions set out in the Information Sheet.

Signature: ..... **Date:** .....

Full Name - printed .....

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APPENDIX 3 FARMER SURVEY QUESTIONNAIRE

Municipality:..... **Op. Area:**..... **Questionnaire No:**..... **Date:**

Section one – Socio-demographic data

1.1 Sex: ☐ Male ☐ Female

1.2 Marital status: ☐ Married ☐ Single ☐ Divorced ☐ Widowed

1.3 What is your age? ..... (In years)

1.4 What is your highest educational status: ☐ Did not go to school

☐ Primary (level....) ☐ JHS (level....) ☐ SHS (level...)

☐ Tertiary (level...) ☐ Postgraduate

1.5 What is your household size?..... (In numbers)

1.6 Occupation of the farmer and income from these occupations:

Occupation		Income/year (GH¢)
Major occupation		
Others (list them)		

1.7 How many household members work and earn an income?.....

1.8 How many years of farming experience do you have? .....

1.9 What is your land tenure system? ☐ Own land ☐ Rent ☐ Share-cropper

Section two – Farm characteristic data

2.0 What crops do you cultivate? List them and complete the table below.

SN	Crops cultivated	Acres	Output(bags)
1			
2			
3			
4			
5			
6			
7			

2.4 Besides crops production, are you involved in any other farm activities? Example livestock rearing, fish farming, forest plantation etc.

☐ Yes ☐ No if yes, go to question 2.5, if no, go to question 2.6

2.5 What other farm activities are you involved in? List them below.

.....

.....

2.6 How frequent is drought on your farm? (E.g. every year or two years etc.):.....

2.7 On a scale of 1 to 5 (1 is not very important, 5 is very important) indicate how important drought is on your farm regarding its impact on crop yields, household food supply, and income:.....

Section three – Institutional data

2.8 Do you have access to credit for crops production from any financial institution?

☐ Yes ☐ No if yes, go to question 2.9, if no, go to question 3.0

2.9 Indicate from the following list your sources of credit over the past 5 years

No	Source of credit	Tick
1	Commercial banks	
2	Rural banks	
3	Micro-financial institutions	
4	Money lenders	
5	Social networks	
6	Others (list them)	
7		
8		
9		

3.0 Did you access extension services in the last 12 months? ☐ Yes ☐ No

If yes, go to question 3.1, if no, go to 3.2

3.1 How many times in a month do you access extension services? .....

3.2 Choose from the following options the reasons why you do not access extension service:

No	Reason	Tick
1	No extension agent available	
2	An extension agent is available in the area, but they are difficult to access because they are too busy	
3	Extension service is not necessary to me	
4(List others)		
5		
6		
7		

3.3 Do you belong to any farmer-based organisation (FBO)? ☐ Yes ☐ No

If yes, go to question 3.4, if no, go to 3.5

3.4 Choose from the following options why you belong to an FBO. Multiple answers are acceptable.

No	Reason	Tick
1	To access information	
2	To access credit	
3	To access extension services	
4	To access farm inputs	
5	To learn from other farmers	
6	To access markets	
7	**Others (list)**	
8		
9		
10		

Section four – Farmers' risk profile and management strategies

3.5 From the list of production and market risks below in the table, indicate the ones that apply to you and rank each applicable risk from not very important (1) to very important (5).

Risk	Indicate which is applicable	Rank				
		Not very important	Not important	Average	Important	Very important
Pest and disease						
Erratic rainfall						
Floods						
Droughts						
Bushfires						
Windstorms						
Input price variations						
Output price variations						
Input access						
Others (list)						

3.6 From the list of risk management strategies below in the table, indicate the ones that apply to you and rank each applicable risk management strategy from not very important (1) to very important (5).

Risk management strategy	Indicate which is applicable	Rank				
		Not very important	Not important	Average	Important	Very important
Farm/crop diversification						
Use of improved crop varieties						
Engaging in off-farm activities						
Out-migration to find jobs						
Use of savings						
Borrowing from friends and relatives (social networks)						
Soil and water conservation methods						
Variation in planting dates						
Intercropping						
Sale of productive assets						
Planting of trees						
Use of crop insurance						
Others (list below)						

Section five – Farmer's knowledge of Weather Index-Based Insurance

3.7 Do you know about insurance? ☐ Yes ☐ No

If yes, go to question 3.8, if no, go to question 3.9

3.8 Which insurance types do you know about? List them.

…… ……
…… ……
…… ……

3.9 Have you heard about an insurance that covers your farm against drought?

☐ Yes ☐ No If yes, go to question 4.0, if no, go to question 4.2

4.0 From where did you hear about this? Provide multiple responses as possible:

☐ Extension Agents ☐ Radio/TV stations ☐ Insurance Agents ☐ Fellow farmers

☐ Farmer-based organisations ☐ Others (list):……

……

4.1 In this section, questions are asked to assess your knowledge of the **Weather Index-Based Insurance** product. Therefore, from the table below tick the

appropriate answer to each of the questions from among the options provided for each question.

No	Questions about Weather Index Insurances	Tick the appropriate answers
1	The weather index insurance covers you for what production risk on the farm?	☐ Drought ☐ Fire ☐ Flood ☐ Theft ☐ I don't know
2	How many phases does the weather index insurance contract have?	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ I don't know
3	What is the definition of a dry day as used in this insurance type?	☐ A day without rain or with rainfall equal to or less than 2.5mm ☐ A day with rainfall less than 10mm ☐ I don't know
4	Which of the phases use dry days to trigger or initiate an insurance payout?	☐ All phases ☐ The first two phases ☐ The last two phases ☐ The first and the last phases ☐ I don't know
5	How many dry days in each of the phases indicated above are enough to trigger (initiate) insurance pay-out to farmers?	☐ 5 days ☐ 8 days ☐ 10 days ☐ 13 days ☐ 15 days ☐ I don't know
6	How does Weather index insurance assess farmers' loss due to drought? Through:	☐ Measuring the amount of rainfall on each farmer's field ☐ Measuring a farmer's actual loss ☐ Rainfall readings from the nearest weather station within a 20 km radius ☐ I don't know
7	Who is responsible for collecting rainfall data for this type of insurance?	☐ The Farmer ☐ The Insurer ☐ The weather station (Meteorological services) ☐ I don't know
8	A farmer will receive an insurance payout even if s/he is the only one to have experience drought in the area?	☐ True ☐ False ☐ I don't know
9	What crops are covered by this type of insurance?	☐ All crops ☐ Maize, sorghum, millet, soybeans and groundnuts ☐ Maize and soybeans ☐ Maize Only ☐ I don't know
10	How much claim in % will you receive for each of the phases (1 - 3) respectively, in this insurance scheme?	☐ 30%, 50% and 100% ☐ 20%, 30% and 50% ☐ 40%, 30% and 30% ☐ I don't know
11	How much in % do you as a farmer have to pay for this insurance type as premium?	☐ Free ☐ 5% of revenue ☐ 10% of revenue ☐ 5 - 10% of production cost ☐ 15% of production costs ☐ I don't know
12	At the end of the farming, season farmers are paid back all or part of their premium when there was no drought.	☐ True ☐ False ☐ I don't know

Section six – Farmer's attitude towards Weather Index-Based Insurance

Please explain the operation of the **Weather Index-Based Insurance** for drought to the respondent **(on the last page)**, and then ask them to answer question 4.2 below.

4.2 In this part of the survey, you will be required to express your level of agreement with some statements that are presented to you about the insurance type. Therefore, for each statement in the table below, tick your level of agreement.

SN	Statements	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	Weather insurance is not needed to cushion the effects of crop losses due to drought because other effective risk management strategies exist					
2	Weather insurance is not needed because drought is not a problem here					
3	Although weather Insurance for drought is important, farmers prioritise other needs					
4	Weather insurance is appropriate to tackle the incidence of drought for farmers in this area					
5	Agricultural losses are acts of God that can't be mitigated even with insurance.					
6	I fear that the claims may not be paid by the insurance company when they are due					
7	I fear that the payment of compensation will be very late					
8	The insurance providers could manipulate the rainfall volumes to avoid paying farmers their claims.					
9	I believe the insurance providers will compensate farmers fairly.					
10	The design of the contract will always favour the insurer and not the farmer					
11	The insurance providers will never run away with the farmer's money					
12	I believe the insurance contracting will not involve much paperwork for farmers					
13	I believe the premium for weather insurance against drought will be affordable					
14	I believe the insurance programme will be simple for me to understand					
15	Only farmers in the city can take this insurance type because the providers will not be in the communities					
16	I believe the insurance providers will treat and respect me even though I am a farmer and possibly uneducated					
17	I think with this insurance cover, I may be able to access a loan now from a bank which will not have been possible without it.					
18	With insurance, it is easy for me to expand my scale of production because drought was my main concern					
19	Weather insurance is only meant for large-scale farmers and not smallholder farmers					
20	I will buy the insurance cover even if it is not sold to me by an Agricultural extension officer					

Section seven–Willingness to participate and pay for WII for drought

Willingness to Participate: In this section, you will be asked questions concerning your willingness to participate or not, and your possible reasons for either.

4.3 Have you purchased this insurance type or are you using this type of insurance?

☐ Yes ☐ No If yes, go to question 4.4, if no, go to question 4.7

4.4 Are you willing to continue with this insurance type?

☐ Yes ☐ No If yes, go to question 4.5, if no, go to question 4.6

4.5 Why? .....

.....

.....

..... **Go to 5.0**

4.6 Why not?.....

.....

...../**Please stop here.**

4.7 Are you willing to participate in this insurance type?

☐ Yes ☐ No If yes, go to question 4.8, if no, go to question 4.9

4.8 Why? .....

.....

.....

..... **Go to 5.0**

4.9 Why not?.....

.....

...../**Please stop here.**

(NB: If you answered 4.6 or 4.9 that is the end of the survey for this respondent)

5.0 If yes to question 4.4 and/or 4.7, which of the crops listed previously will you buy drought insurance for and why? List them:

.....

...../

Why:.....

.....

.....

NB: Questions in this part forward are only meant for respondents who have answered YES to question 4.4 and/or 4.7

Willingness to Pay: In this section, you will be asked questions concerning how much you are willing to pay for this type of insurance to cover maize against drought.

NB: Please randomly present part A or B or C to each farmer to answer. No one farmer should answer more than one part.

With a total production cost of producing one acre of maize at GH¢713.00, and with an insurance pay-out of the cost, GH¢713.00 in the event of a drought occurring .....

Part A:

5.1 Are you willing to pay GH¢71.00 (10% of the total cost of production) for this insurance cover? ☐ Yes ☐ No If yes, go to question 5.1, if no, go to question 5.2

5.2 Are you willing to pay GH¢89.00 (12.5% of the total cost of production) for this insurance cover? ☐ Yes ☐ No

5.3 Are you willing to pay GH¢54.00 (7.5% of the total cost of production) for this insurance cover? ☐ Yes ☐ No

Part B:

5.1 Are you willing to pay GH¢54.00 (7.5% of the total cost of production) for this insurance cover? ☐ Yes ☐ No If yes, go to question 5.1, if no, go to question 5.2

5.2 Are you willing to pay GH¢71.00 (10% of the total cost of production) for this insurance cover? ☐ Yes ☐ No

5.3 Are you willing to pay GH¢36.00 (5% of the total cost of production) for this insurance cover? ☐ Yes ☐ No

Part C:

5.1 Are you willing to pay GH¢36.00 (5% of the total cost of production) for this insurance cover? ☐ Yes ☐ No If yes, go to question 5.1, if no, go to question 5.2

5.2 Are you willing to pay GH¢54.00 (7.5% of the total cost of production) for this insurance cover? ☐ Yes ☐ No

5.3 Are you willing to pay GH¢18.00 (2.5% of the total cost of production) for this insurance cover? ☐ Yes ☐ No

END OF SURVEY, THANK YOU

APPENDIX 4 EXTENSION OFFICER SURVEY QUESTIONNAIRE

Municipality:..... **Questionnaire No:**..... **Date:** / /18

Section one – Socio-demographic data

1.1 Sex: ☐ Male ☐ Female

1.2 What is your age? .....

1.3 Your highest educational qualification? ☐ Agric College Certificate ☐ HND ☐ Bachelor degree ☐ Postgraduate certificate/diploma ☐ Master's degree

1.4 What is your current employment grade? .....

1.5 How many years of working experience do you have? .....

1.6 How many crop insurance training sessions have you attended in the past 5 years?.....

Section two – Agricultural extension officer's knowledge of WII for drought

1.7 Do you know about insurance? ☐ Yes ☐ No
If yes, go to question 1.8, if no, go to question 1.9

1.8 Which insurance types do you know about? List them

....

....

1.9 Have you heard about **Weather Index-Based Insurance**, an insurance that covers farmers' production against drought? ☐ Yes ☐ No
If yes, go to question 2.0, if no, go to question 2.2

2.0 From where did you hear about this insurance type? Provide multiple responses as possible: ☐ MOFA ☐ Radio/TV stations ☐ GAIP ☐ NGOs ☐ Fellow extension officers ☐ Others (list).....
.....

2.1 In this session, questions are asked to assess your knowledge of the **Weather Index-Based Insurance (WII)** product. Therefore, from the table below tick the appropriate answer to each of the questions from among the answer options provided for each question.

No	Questions about Weather Index Insurances	Tick the appropriate answer
1	The weather index insurance covers farmers for what production risk on the farm?	□ Drought □ Fire □ Flood □ Theft □ I don't know
2	How many phases does the weather index insurance contract have?	□ 1 □ 2 □ 3 □ 4 □ I don't know
3	What is the definition of a dry day as used in this insurance type?	□ A day without rain or with rainfall equal to or less than 2.5mm □ A day with rainfall less than 10mm □ I don't know
4	Which of the phases use dry days to trigger or initiate an insurance payout?	□ All phases □ The first two phases □ The last two phases □ The first and the last phases □ I don't know
5	How many dry days in each of the phases indicated above are enough to trigger (initiate) insurance pay-out to farmers?	□ 5 days □ 8 days □ 10 days □ 13 days □ 15 days □ I don't know
6	How does Weather index insurance assess farmers' loss due to drought? Through:	□ Measuring the amount of rainfall on each farmer's field □ Measuring a farmer's actual loss □ Rainfall readings from the nearest weather station within a 20 km radius □ I don't know
7	Who is responsible for collecting rainfall data for this type of insurance?	□ The Farmer □ The Insurer □ The weather station (Meteorological services) □ I don't know
8	A farmer will receive an insurance payout even if s/he is the only one to have experience drought in the area.	□ True □ False □ I don't know
9	What crops are covered by this type of insurance?	□ All crops □ Maize, sorghum, millet, soybeans and groundnuts □ Maize and soybeans □ Maize Only □ I don't know
10	How much claim in % will you receive for each of the phases (1 - 3) respectively, in this insurance scheme?	□ 30%, 50% and 100% □ 20%, 30% and 50% □ 40%, 30% and 30% □ I don't know
11	How much in % do farmers have to pay for this insurance type as premium?	□ Free □ 5% of revenue □ 10% of revenue □ 5 - 10% of production cost □ 15% of production costs □ I don't know
12	At the end of the farming season, farmers are paid back all or part of their premium when there was no drought.	□ True □ False □ I don't know

Section three – Extension officer's attitudes towards Weather Index-Based Insurance

Please request for the explanation of the operation of the **Weather Index-Based Insurance** for drought if you don't know or not sure and feel the need for it, and then proceed with question 2.2 below.

2.2 In this part of the survey, you are required to express your level of agreement or disagreement with each statement in the table below about the **Weather Index-Based Insurance** for drought. You can express your level of agreement with a statement from strongly disagree (1) to strongly agree (5) as indicated in the table below. Please tick or mark the box that is most appropriate to you.

SN	Statements	Strongly Agree (5)	Agree (4)	Neutral (3)	Disagree (2)	Strongly Disagree (1)
1	Weather insurance is needed to cushion the effects of crop loss due to drought because farmers do not have other effective risk management strategies.					
2	Weather insurance is needed because drought is a problem for farmers.					
3	Weather Insurance for drought is important because it is a primary need of farmers.					
4	Weather insurance is appropriate to tackle incidence of drought for farmers.					
5	Agricultural losses are acts of God but can be mitigated with insurance.					
6	This insurance type will pay farmers their claims when it is due.					
7	This insurance type will pay farmers their compensation, and it will be done immediately for it to be helpful to farmers.					
8	The insurance providers will not manipulate the rainfall data to avoid paying so many farmers.					
9	I believe the insurance providers will compensate farmers fairly.					
10	The design of the contract will always be fair to both the insurers and the farmers.					
11	The insurance providers will never run away with the farmer's money					
12	I believe the insurance contracting will not involve much paperwork for farmers					
13	I believe the premium for weather insurance against drought will be affordable for farmers.					
14	I think that farmers will understand the insurance contract design to buy it.					
15	Farmers everywhere can take this insurance type because the providers will be in the communities.					
16	I believe the insurance providers will treat and respect the farmers even though some farmers may be uneducated.					
17	I believe with this insurance cover, farmers may be able to access loans now from a bank which will not have been possible without it.					
18	With the insurance, it will be easy for farmers to expand their scale of production because drought was their concern.					
19	Weather insurance is not only meant for large-scale farmers but smallholder farmers too.					
20	Farmers will buy the insurance cover even if it is not sold to them by the Agricultural extension officer.					

END OF SURVEY, THANK YOU FOR YOUR PARTICIPATION