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PROSPECTS OF CROP INSURANCE AS A RISK MANAGEMENT TOOL AMONG ARABLE CROP FARMERS IN GHANA

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ABSTRACT

The aim of this study was to assess the willingness of farmers to adopt crop insurance and the critical factors that influence the premium they are willing to contribute towards such a scheme. Two out of the eleven (11) agricultural operational areas in the Sunyani Municipality were selected purposively due to their dominance in maize and cassava production. Four (4) communities were randomly selected from each operational area through balloting and fifteen farmers were then selected from each community through the use of random numbers. A total of 120 farmers were selected from the Municipality for personal interviews to elicit primary information with the help of a structured questionnaire. A binary logistic regression model was used to identify the factors that influence farmers' willingness to adopt crop insurance as a risk mitigation strategy. A double logarithmic multiple regression model was employed to determine the factors that influence the premium farmers were willing to pay towards a crop insurance scheme. Evidence from the study indicates that majority (76%) of farmers were willing to adopt crop insurance; age of farmer, land tenure system practiced and educational level were found to be the key drivers of crop insurance uptake, ex ante. The study revealed that government subsidy would be required for such an insurance scheme since the premium farmers pledged to pay was quite low and likely to be uneconomical from the perspective of private insurers. It was revealed that on-farm income, farm *size, land tenure, educational level and amount of savings by farmers significantly influenced the premium farmers pledged to pay towards a crop insurance scheme. The study recommended periodic training and education of farmers to improve their knowledge on crop insurance as a risk management tool and the need for farmers to save in order to enhance the uptake of crop insurance when it is introduced in the study area.*

Keywords: Crop insurance, Logistic regression, Risks, Willingness to adopt.

1. INTRODUCTION

Agricultural production is subject to many risks. Any farm production decision plan is typically associated with multiple potential outcomes with different probabilities. Many risks directly affect farmers´ production decisions and welfare. Agricultural producers face many risks in their economic activity due to weather conditions, plant or animal diseases, price volatility, and policies such as agricultural trade liberalization and restrictions on the use of crop protection products (World Bank, 2005). Weather, market developments and other events cannot be controlled by the farmer but have a direct effect on the returns from farming (Baquet *et al.,* 1997). In this context, the farmer has to manage risk in farming as part of the general management of the farming business.

The spectrum of risks that affect the income of agricultural producers and agribusinesses is quite broad. However, the two predominant risks are: price risk, reflecting variations in market prices for agricultural commodities and production inputs; and production risk, which encompasses variations in the volume or quality of the commodity produced (Freshwater and Jette-Nantel, 2008). Weather is one of the most pervasive sources of production risks, and it impacts all aspects of the agricultural supply chain, particularly in countries that rely on rain-fed agriculture (Swiss Re, 2007). Even with the introduction of new crop varieties, production technologies such as irrigation, and new management practices that offer the potential to increase yields and improve resistance to weather perils, the majority of agricultural activities in developing countries remain highly susceptible to extreme, uncontrollable weather events that can severely impact both quality and yield of a crop. Such events include excessive or insufficient rainfall and extreme temperatures. The effects of weather risk are felt most acutely at the household level, particularly by poor, vulnerable agricultural households, the majority of whom are subsistence farmers.

Traditionally, farmers have managed risks by using less risky technologies of lower but reliably yielding drought-resistant crops; by seeking diversification both in terms of production activities on-farm and income generating activities off-farm; and by devising informal and formal risk sharing arrangements (Friedberg, 2003). While these mechanisms may work well for low-magnitude losses, even if they are frequent, they often prove to be inadequate for risk that is infrequent but severe (Hazell *et al.*, 1986). There is the potential for these major risks to increase in the future - price risk due to liberalization of trade and production risk due to the effects of climate change (World Bank, 2005). The trend towards agricultural specialization is likely to continue and this will increase risks as producers rely on the production of a smaller range of crops and consequently cannot diversify away risks effectively (Glauber, 2004).

Weather risks such as drought in particular typically affect entire regions at once, rendering informal risk sharing arrangements insufficient. Affected farmers are often forced to employ short term coping strategies such as borrowing from money lenders or neighbours, selling assets, or cutting already small expenditures on household goods and services. In many cases, farmers could benefit from investing in agricultural activities that require higher initial investments but ultimately would generate higher income if the risks affecting these investments such as weather could be managed. This calls for a third party to employ an insurance package in the management of risks which are difficult for farmers to deal with in their occurrence.

In Ghana, almost all insurance companies are specialised in the provision of auto insurance, life and health insurance, fire insurance and burglary to the neglect of crop insurance. Crop insurance scheme in the country is still at the pilot stage in selected districts. The purpose of this study was, therefore, to assess the willingness of farmers to adopt crop insurance and the premium they will be willing to pay should any of the insurance companies decide to diversify into agricultural insurance.

1.1. The Objectives of the Study were to

1. Determine the percentage of farmers who are willing to adopt crop insurance as a risk management tool, and evaluate the factors that influence maize and cassava farmers' willingness to adopt crop insurance;

2. Estimate the average amount maize and cassava farmers are willing to pay as premium for crop insurance; and

3. Evaluate the most important factors that influence the amount maize and cassava farmers are willing to pay as crop insurance premium.

2. THE STATE OF THE ART

There are several management strategies used by farmers to mitigate risks in their farm activities. Some of the strategies used are diversification, hedging, planting of resistant crops in areas where those crops are susceptible, contract farming and crop insurance. Crop insurance is not so common in the developing world compared to the other forms of strategies mentioned above. Insurance has been defined as a form of risk management strategy used to hedge against a contingent loss (Ramiro, 2009). The conventional definition is the equitable transfer of a risk of loss from one entity to another in exchange for a premium or a guaranteed and quantifiable small loss to prevent a large and possibly devastating loss (Swiss Re, 2007). Agricultural insurance is a special line of property insurance applied to agricultural firms. There are many difficulties involved in insuring crop losses. Crop insurance is very different from life insurance and livestock insurance products in many ways, and this makes crops difficult to insure. Firstly, spatially correlated risks make crop insurance difficult. Output or yields can be devastated over a wide region, creating large financial loss as a result of drought or floods. Conversely, independent or idiosyncratic risks are what life, health or livestock insurance products try to address most of the time. Secondly, the range of losses in crop insurance may be highly variable ranging from meagre, moderate to severe losses. This is what Karthikeyan (2005) describes as long tail distribution of losses. It is a situation where severe losses come at low frequencies; thus making the premium very costly for farmers. Furthermore, information asymmetry presents a challenge in crop insurance. Farmers know more information on the risks faced by their crops than the insurers (Karthikeyan, 2005). There is also a problem of adverse selection where the most risky farmers buy and less risky farmers stay out making the scheme unsustainable. The issue of moral hazard is also a problem with crop insurance. People change their behaviour after they are insured and risk becomes greater since some may throw caution to the wind. Finally, a high administrative cost is a challenge for crop insurance. Controlling the above mentioned problems requires high monitoring and administrative cost. These tend to increase the premium beyond the pockets of crop farmers (Karthikeyan, 2005).

Due to these difficulties, traditional indemnity-based crop insurance has not been successful throughout the world. To address these difficulties all over the world there has been a shift from indemnity-based insurance to area yield index-based insurance and recently to weather index-based insurance (Ramiro, 2009). However, the main issues related to area yield insurance are technical and implementation problems (Karthikeyan, 2005). The main technical problems relate to the fact that risks are based on geographic area, unavailability of area yield data for all crops and all regions, insufficient time-series of area yield data for a given region, and unreliability of historical area yield data. Also, if there are continuous three drought years, the expected block yield will be very low. Current year area yield estimates are also subject to manipulation by farmers and politicians.

The implementation problems identified by Karthikeyan (2005) in India included limited reach (less than 5 % of the total number of farmers) and compulsory coverage where the product is tied to the crop loans given by rural public sector banking system. The coverage is compulsory for the borrowers and not voluntary. In many cases farmers themselves did not know that they were covered. Also, there is lack of transparency in operations. Claims are assessed by crop cutting (loss adjustment) experiments in which yield assessment is made on few farms and the results are supposed to represent a large geographical area, usually a block. The experiment results are not available for public verification and therefore the objectivity of the experiments is always in doubt. Again, the premium rate is uniform for a crop across the whole country while the risk is not uniform nationwide. The issue of very late payment of compensation is also a challenge. The claim settlement process takes a very long time (from six months to two years in some cases), thereby allowing all the bad consequences of the yield loss to occur before the compensation reaches the insured. This considerably reduces the developmental impact of the insurance scheme.

There is also the question of lack of viability. Estimates from 1985/6 through 1999 showed that the loss ratio, excluding huge management expenses, stood at 5.72 (Hess, 2003). The claim to premium ratio was 4.17 in a particular season of 2002, showing that this intervention is not viable. Again, administrative cost is very high as crop cutting method is used for loss assessment. There is also a question of inequality of benefits in India where the premiums and claims were not "equitably" distributed across crops and states, favouring paddy, groundnut and wheat farmers from Gujarat, Maharashtra and Andhra Pradesh. Political interference at times converts this crop insurance intervention into an instrument of popular politics, as it is used as a sop.

Weather insurance which is the alternative to address the above mentioned issues also has other problems. The main problem faced is described as 'basis risk' which is the difference in the risk assessed by the insurance product and the actual risk faced by farmers due to variation in rainfall between villages and the reference weather station and difference in crop period and cover period (Karthikeyan, 2005). Effectiveness of the product largely depends on synchronizing the policy initiation date and owing date, and in calculating compensation based on actual rainfall in each village. According to the World Bank (2005), in India insurance companies rely on a reference station, which is usually an Indian Meteorology Department (IMD) station, meant for a large number of villages and so are not capable of offering customized policies on a micro scale. For example, the weather insurance product for Groundnut could not reflect the *"pattam (optimum season)"* effect as it only takes one or two weather parameters. It has been the repeated experience of farmers to get better yield, if the crop is sown in the optimum sowing period between June 25th and July 15th and lower yields if sown after that. But the rainfall insurance showed that the premiums were more for the optimum sowing period than for the delayed sowing, indicating that there is more risk of loss if sown in the optimum season and that yield is influenced by factors beyond just 'quantity of rainfall' that is taken for designing rainfall insurance product (Karthikeyan, 2005). Lack of reliable historical weather data for a given weather station in most parts of the country and lack of secured and objective source of current weather measurements from weather stations for most parts of the country are some of the problems associated with the weather indexed crop insurance in India (Karthikeyan, 2005).

Studies on vegetable producers by CREDA-UPC-IRTA Centre for Research in Agro-food and Development Economics revealed that in Catalonia (North-East of Spain) farmers' participation in crop insurance for vegetables was low. Only 5 per cent of the vegetable area was insured, and in Spain as a whole, this percentage was around 20 per cent (Glauber, 2004). Different reasons such as low risk perception, risk diversification, insurance cost or crop damage assessment rules, among others, have been suggested to explain this low participation ratio. Results from a survey of 93 vegetable farmers in the main productive areas in Catalonia showed that insurance cost and crop damage assessment rules are among the most important factors that explain farmers' behaviour towards crop insurance. Enjolras *et al.* (2012) noted that the system of insurance in France and Italy is highly subsidized and transforming from a public fund to private policies. They reported that insurance coverage has developed into more cost and less profit, and indicated that farmers' attitude will be more secured by overcoming the high costs. Garrido and Zilberman (2008) observed that Spanish farmers' insurance strategies rely strongly on their actual insurance experience. They noted that individuals with loss ratios greater than one (1) did not show more responsiveness compared to those facing more balanced premium charges. They further revealed that adverse selection was not the key source of inefficiency in the Spanish insurance system. Timothy and Richards (2000) examined the demand for specialty crop insurance in California, USA and found out that an increase in premium reduces much more participation. Karbasi and Kambozia (2003) reported that education level increases wheat, barley and sugar beet insurance demand in Iran but side jobs by farmers and high saving reduce insurance demand. However, agricultural credit was found to increase the probability of acceptance of insurance for barley. In their study on effective factors that affect demand for crop insurance in Iran, Sargazi *et al.* (2013) found out that farmers with higher income levels have a greater tendency to insure their crops. Whereas older farmers were found to be exceptionally more willing to be insured, farming experience was not found to affect the demand for insurance. Smith and Boqluet (1996) noted that risk factors such as history, debt to credit institutions, fluctuations of the product, education level of farmers and insurance claims are sources of effective crop insurance scheme in Montana, USA.

3. RESEARCH METHODOLOGY

3.1. Sampling Method and Data

The study was conducted in the Sunyani Municipal area of the Brong-Ahafo Region of Ghana where farmers are noted for maize and cassava cultivation. There are about six insurance companies operating in the area with focus on non-farm activities; insuring against fire, burglary, life, automobiles. Primary data for the study was obtained from farmers through a combination of purposive and simple random sampling techniques. Two out of the 11agricultural operational areas in the Sunyani Municipality were selected purposively due to their dominance in maize and cassava production. Four (4) communities were randomly selected from each operational area through balloting and fifteen farmers were then selected from each community through the use of the village list and random numbers table. In all, one hundred and twenty (120) farmers cultivating both maize and cassava were selected for the study. Primary data was collected through face-to-face interviews with the use of a standardized structured questionnaire. A checklist was also used to elicit information from some key informants in the municipality.

3.2. Data Analysis

Descriptive statistical tools such as arithmetic mean, standard deviation and frequency distribution tables were used to summarize the characteristics of respondents and the amount farmers were willing to pay as insurance premium. Binary logistic regression model was used to determine the factors that influence farmer's willingness to adopt crop insurance.

Farmers' adoption for a given technology is based on the utility maximization assumption (Nchinda *et al.*, 2010). A farmer will adopt a technology if his marginal utility for adoption is greater than that of non-adoption. The utility obtained by a farmer that adopts the technology is not observable and depends on a set of observed exogenous factors (Nchinda *et al.*, 2010). What is observed is the decision to adopt. The dependent variable in the model is therefore a binary choice variable. For such situations, binary logistic regression models are usually used for analysis. The logistic regression model is simply a non-linear transformation of the linear regression. The logistic distribution is an S-shaped distribution function (cumulative density function) which is similar to the standard normal distribution and constrains the estimated probabilities to lie between 0 and 1. A dichotomous or binary logistic random effects model has a binary outcome (Y = 0 or 1) and regresses the log odds of the outcome probability on various predictors to estimate the probability that Y = 1 happens, given the random effects (Li *et al.*, 2011). The simplest dichotomous model is given by:

$$\ln\left(\frac{P(Y_{ij}=1|x_{ij},u_j)}{P(Y_{ij}=0|x_{ij},u_j)}\right)=\alpha_1+\sum_{k=1}^{K}\beta_k x_{kij}+u_j$$

$$u_j \sim N(0,\sigma^2) \quad j=1,2,\ldots,J \quad i=1,2,\ldots,n_j$$

Where Y_{ij} is the dichotomized willingness to adopt crop insurance variable (with Y_{ij}= 1 if the i^{th} farmer in community j is willing to adopt crop insurance and Y_{ij}= 0 if otherwise). Further, x_{ij}= (x_{1ij},...,x_{kij}) represents the covariates, α_1 is the intercept and β_k is the k^{th} regression coefficient. Furthermore, $u_j$is the random effect representing the effect of the j^{th} community. It is assumed that u_j follows a normal distribution with zero (0) mean and variance σ^2. The coefficient β_k measures the effect of increasing $x_{kij}$by one unit on the log odds ratio. Here x_{kij} represents the covariates (independent variables) which included:

X_1 = age of respondent

X_2 = Farm size (acres)

X_3= land tenure system practiced by the respondent (*1=owner; 0=otherwise*)

X_4 = number of years of schooling of respondent

X_5 = annual income of the respondent (GHC)

X_6 = farming experience of respondent

X_7 = Sex of respondent (*1=male; 0=female*)

The logit model was estimated using the random effect maximum likelihood estimation method. To identify the factors that affect the premium farmers were willing to pay for crop insurance, a multiple regression analysis was conducted using the Ordinary Least Square (OLS) estimation approach.

The implicit form of the insurance premium model is stated as;

$P_i = f(X_1, X_{2,} X_{3\ldots} X_n) + \varepsilon_i$

Where P_i = amount farmers are willing to pay as premium for insurance

X_1= sex of respondent (*1=male; 0=female*)

X_2= farm size of respondent (in acres)

X_3= farming experience of respondent (in years)

X_4= on-farm income of respondent (in GHC)

X_5= household size of respondent

X_6= amount saved by respondent in the last production season (in GHC)

X_7= ownership of a bank account by respondent (*Yes=1; No=0*)

X_8= land tenure system practiced by respondent (*own land=1; rented land=0*)

X_9= number of years of schooling of respondent

ε_i= Error term

Apart from dichotomous variables, the natural logarithms of all variables were computed before the multiple regression model was estimated.

4. RESULTS AND FINDINGS

4.1. Descriptive Analysis

Table 1 provides some important information about the sampled farmers interviewed. About 80% of the farmers were males with maize as the main crop cultivated during the immediate past planting season. As high as 79% of respondents indicated that crop farming was their main source of income. This reinforces the need for risk management in crop production since any negative occurrence is likely to impact farmers' livelihoods negatively. About 53% of the sample cultivated crops on their own/family land. Crop enterprise diversification and hedging were the main strategies currently adopted by food crop farmers to mitigate risks. Results in Table 1 shows that about 76% of maize and cassava farmers are willing to adopt crop insurance as a risk management tool. Bad weather was reported as the most important peril against which crop enterprises would be insured and the most preferred premium payment plan was found to be one-off annual payment.

Table-1. Descriptive information about respondents

Variable	Frequency(N=120)	Percent
Gender:		
Male	96	80.0
Female	24	20.0
Main crop cultivated:		
Maize	82	68.3
Cassava	10	8.3
Cocoa	13	10.8
Tomato	8	6.8
Others	7	5.8
Land tenure:		
Own/family land	56	46.7
Share cropping/rented land	64	53.3
Main source of income:		
Crop farming	95	79.2
Artisanal/vocational work	9	7.5
Formal salaried work	11	9.2
Others	5	4.2
Current risk management strategies adopted:		

Diversification	60	50.0
Resistant crop varieties	6	5.0
Hedging	43	35.8
Vertical integration	11	9.2
Willingness to adopt crop insurance:		
Yes	91	75.8
No	29	24.2
Perils farmers want to insure against:		
Bad weather	68	56.7
Low yield	16	13.3
Lower output prices	12	10.0
Bush fires	24	20.0
Premium payment plan preferred:		
Monthly	8	6.7
Quarterly	10	8.3
Half-yearly	11	9.2
Yearly	91	75.8

Source: Field survey, 2012.

Table 2 provides descriptive statistics on respondents and their production activities. On average farmers interviewed were economically active with basic level of education and a household size of six people. Respondents were typical smallholder farmers with farm sizes less than 3acres but with about 20years experience in arable crop farming. The average household income for the farmers interviewed was estimated at GHC1,739.80 (US$828.48) per annum which translates to GHC263.61 (US$125.53) per annum per capita, given average household size of 6.6 people. Further analysis shows that these farmers obtain about US$0.35 per day per capita which is an indication of severe income poverty.

Table- 2. Descriptive statistics

Variable	**Min.**	**Max.**	**Mean**	**Std dev.**
Age (years)	23	69	46.0	11.3
Years in school	3	16	9.6	4.4
Household size	1	19	6.6	2.9
Years of farming	4	45	20.3	10.7
Farm size for maize (acres)	0.5	15	2.7	2.0
Maize output (100kg)	1	35	8.0	5.0
% of harvested maize sold	25	100	79.1	17.1
Maize price received (GH¢/100kg)	40.00	100.00	63.86	15.11
Farm size for cassava (acres)	0.5	10	1.8	1.5
Cassava output (Kg)	925	22,200	5,094.1	4,008.9
% of harvested cassava sold	10.0	100.0	73.5	25.4
Cassava price received (GH¢/120kg)	10	12	10.0	0.20
Annual Household income (GH¢)	150	8,340	1,739.80	1,784.83
Annual savings (GH¢)	24	3,000	374.80	452.46
Premium pledged per annum per acre of maize	20.74	31.26	24.12	8.38
Premium pledged per annum per acre of cassava	12.61	25.55	19.44	9.73

Source: Survey Data, 2012.

Results in the table shows that farmers are willing to pay about GHC24 and GHC19 as annual premium for maize and cassava respectively. These figures appear to be quite low given the value of crops harvested per acre, and the huge administrative and transaction costs associated with crop insurance schemes. But these figures are not surprising given the family sizes and the income levels of maize and cassava farming households in the study area. At such low levels of premium, however, a very large number of insurance subscribers and possible subsidy from the local government authority or central government would be required to make any future crop insurance scheme for maize and cassava sustainable.

4.2. Determinants of Willingness to Adopt Crop Insurance

Table 3 provides results of the binary logistic regression model to determine the most critical factors that affect farmers' willingness to adopt crop insurance as a risk management tool. The model's log likelihood ratio of -57.09674 and χ^2 value of 28.86 indicate that all variables in the model significantly influence the probability of adoption of crop insurance at 1%.

Table-3. Binary Logistic Regression model Estimates

Variable	Coefficient	Std Error	T value	Sig. level
Ln_ Age	-0.0801996	0.0485116	-1.65	0.098*
Ln_ Farm size	-0.1312256	0.1005104	-1.31	0.192
Land Tenure (*1=own land; 0=otherwise*)	-2.20683	0.725833	-3.04	0.002***
Ln_ Farming Experience	0.0679904	0.0516964	1.32	0.188
Ln_ Years of formal education	0.4897337	0.2018685	2.43	0.015**
Ln_ Household income	0.00000155	0.0002654	0.01	0.995
Sex *(1=male;0=female)*	1.380737	1.152151	1.20	0.231
Constant	0.8141278	1.89127	0.43	0.667

LR χ^2 = 28.86; Prob>χ^2=0.0003; Pseudo R^2 =0.2018; Log likelihood = -57.096739

Dependent variable: Willingness to adopt crop insurance (1=Yes; 0=Otherwise)

***sig@1%; **sig@5%; *sig@10%

The results reveal that land tenure, years of education and age of farmers were significant at 1%, 5% and 10% respectively. Age of the farmer was found to influence willingness to adopt crop insurance negatively. Age of the farmer implies knowledge gained over time and plays an integral role in evaluating willingness to adopt an innovation (Feder *et al.*, 1985; Baidu-Forson, 1999). Older farmers have gained experience in producing cassava and maize and are more likely to accept risks than younger farmers. Because of their risk-loving ability, they are less likely to adopt insurance in crop production compared to their younger cohorts. Baidu-Forson (1999) noted that the negative influence of age is due to the changing life cycle effect on the farmer since as farmers grow older they gain more experience in farming through learning by doing. Also, Langyintuo and Mulugetta (2005) pointed out that older farmers lack receptivity towards newly introduced technology, all things being equal. Land tenure had a significant negative coefficient; implying that farmers who owned land were less willing to adopt crop insurance compared to tenants and sharecroppers. Farmers who own lands do not have to pay anything to anybody in times of crop failure but rather manage the little at their disposal. Also, such farmers have the capacity to diversify into other crops and enterprises since they have easy access to land compared to farmers who are either tenants or sharecroppers. It is therefore not surprising that tenants and sharecroppers tend to be more willing to adopt new innovations such as crop insurance to mitigate against production risk. However, this finding goes contrary to finding by Soule *et al.* (2000) who reported a positive relation between land tenure and willingness to adopt an innovation. They argued that if one has overall rights to his land, he will be willing to invest for the betterment of his land. However, this argument applies to land conservation technologies that enhance land fertility and the overall value of the land. In the case of crop insurance, adoption does not add any value to farm land and so the same relationship is not expected.

With regards to educational level, a positive relationship was obtained due to the fact that as one's number of years of schooling increases his level of knowledge increases and therefore enhances his ability to receive, decode and understand information. Education may facilitate the diffusion of new technology and as such has a positive relation with innovation adoption and the payment of accompanying charges. More educated farmers are likely to appreciate crop insurance issues better than their less educated counterparts.

4.3. Determinants of Crop Insurance Premium

Table 4 provides results of the insurance premium models for maize and cassava.

Table-4. Insurance Premium Model Estimates for maize and cassava

Variable	**Maize model**	**Cassava model**
Constant	4.696 (1.714)+	3.060 (1.577)
Ln_ Farming Experience	-0.496 (-1.090)	-0.296 (-0.919)
Sex *(1=male;0=female)*	0.513 (0.835)	0.479 (1.100)
Ln_ farm-income	0.474 (2.565)**	0.273 (2.081)*
Ln_ Farm size	-0.448 (-1.932)*	-0.391 (-2.384)**
Ln_ household size	0.399 (0.993)	0.429 (1.507)
Ln_ amount_ saved	0.485 (1.562)	0.623(2.834)***
Bank account *(1=yes;0=no)*	0.196 (0.575)	0.086 (0.356)
Land Tenure (*1=own land;0=otherwise*)	1.916 (2.494)**	1.641 (3.015)***
Ln_ Years of formal Education	-1.497 (-2.602)**	-1.390 (-3.410)***
Model summary	R=0.72; R^2=0.396; F=3.29 (df=13.67;sig@0.052)	R=0.87; R^2=0.584; F=4.367 (df=18.85;sig@0.006)

Dependent Variable: Ln_ Amount of Insurance Premium (GHC)

+T-values are in parenthesis; ***sig@1%; **sig@5%; *sig@10%

It may be evident that the main determinants of the premium farmers are willing to pay for a maize insurance scheme are; farm size, on-farm income, land tenure type and years of formal education. These factors were also significant determinants of cassava insurance premium in addition to amount of money saved per annum. On-farm income had a positive correlation with the amount farmers are willing to pay as insurance premium for both maize and cassava. Premiums are paid with income and hence farmers with high farm income tend to have higher payment capacity than those with low farm income, *ceteris paribus*. Serman and Filson (1999) noted that high farm income improves the capacity to adopt agricultural innovations and the amount farmers are willing to pay for innovations. Farm size was found to have a negative correlation with the amount a farmer was willing to pay as premium for crop insurance. This means that farmers with larger farm sizes will tend to pay less as premium on per acre basis. This is quite understandable since the total premium they will pay for their total farm size will be far higher than their counterparts with smaller farms. In other adoption studies (Nowak, 1987), a positive correlation was found between amount farmers are willing to pay for an innovation and farm size. However, this was because larger farm sizes tend to have more advantage from adoption of innovations due to economies of scale. In the insurance business, however, payments are likely to be made on per acre basis and therefore the larger your farm the higher the amount you are likely to pay as premium.

Land tenure had a positive relation with the premium a farmer is willing to pay for crop insurance. Farmers who owned land and were willing to adopt crop insurance tended to offer a higher amount for crop insurance since they have full control over the land and the entire produce obtained from the farming business. They therefore have enough resources to enable them pledge higher premium for crop insurance. This finding is consistent with the work done by Arellanes and Lee (2001) who found out that farmers with security of their own land were four times likely to employ more of new technology and thus offer higher amounts for innovations due to security of land access and usage. The amount of premium farmers were willing to pay and the number of years of schooling were negatively correlated. This is as a result of the fact that the higher the number of years of education, the more one gets the opportunity for a formal work and so takes farming as a secondary occupation. Such farmers also have other income sources and can therefore be cushioned in the case of crop failure resulting from bad weather or diseases and pests incidence. It is also possible that the highly educated farmers are aware of the risks inherent in farming and have adopted other risk mitigating strategies such as diversification into other non-farm businesses. The amount of savings per annum was found to have a positive effect on insurance premium for cassava. Since premium will be paid from current income or accumulated income (represented by savings), the positive relation is consistent with *a priori* expectation. It implies that future uptake of crop insurance can be accelerated in Ghana when the level of savings by farmers improves.

5. CONCLUSION

In the face of growing variability in weather patterns and many sources of risks in agriculture, the role of crop insurance in risk management at the farm level cannot be overemphasized. This study has assessed the prospects of using crop insurance as a risk mitigation strategy in arable crop production in Ghana. The study has demonstrated that about 76% of maize and cassava farmers are willing to adopt crop insurance. Evidence from the study shows that land tenure system practiced by the farmer, educational level and age of farmer are the significant determinants of farmers' willingness to adopt crop insurance. On average, farmers were willing to pay GH¢ 19 and GH¢ 24 as premium per year for an acre of cassava and maize respectively. The critical factors that influenced the amount pledged as insurance premium were identified as farm size, farm income, educational level, land tenure arrangement and savings. Arable crop farmers generally preferred a one-off annual premium payment plan and the most important peril against which farmers would like to insure their farms was identified to be bad weather. Any future crop insurance scheme in the study area should consider weather-based schemes. Intense education of farmers on the need to insure their farms and improve their savings behaviour would be very necessary to stimulate crop insurance uptake when it is introduced. Growth in farmers' returns would impact positively on the demand for crop insurance; therefore, any policy aimed at increasing farm income might eventually create a market for crop insurance. Finally, given the relatively low premium farmers are willing to contribute towards crop insurance schemes, government subsidy might be required if future crop insurance schemes are to be sustainable.

REFERENCES

Arellanes, P. and R.D. Lee, 2001. The determinants of adoption on sustainable agricultural technologies. Evidence from the hillsides of honduras. Department of Applied Economics and Management, Cornell University, Ithaca, NY, 14853, USA.

Baidu-Forson, J., 1999. Factors influencing adoption of land-enhancing technology in the sahel: Lessons from a case study in Niger. Agric. Econ., 20(3): 231-239.

Baquet, A., R. Hambleton and D. Jose, 1997. Introduction to risk management, risk management agency, Usda. Washinton DC: USA.

Enjolras, G., F. Capitanio and F. Adinolfi, 2012. The demand for crop insurance. Combined approaches for France and Italy. Agri. Eco. Rev., 13(1): 5-22.

Feder, G., E.R. Just and D. Zilberman, 1985. Adoption of agriculture innovation in developing countries: A survey. Economic Development and Cultural Change, 33(2): 255- 298.

Friedberg, L., 2003. The impact of technological change on older workers: Evidence from data on computer use. Industrial and Labor Relations Review, 56(3): 511.

Garrido, A. and D. Zilberman, 2008. Revisiting the demand of agricultural insurance: The case of Spain. Euro.Asso.Of.Agric, J.: 1-22.

Glauber, J.W., 2004. Crop insurance reconsidered. American Journal of Agricultural Economics, 86(5): 1179-1195.

Hazell, P., C. Pomareda and A. Valdes, 1986. Crop insurance for agricultural development; issues and experience. Baltimore, MD (USA), John Hopkins.

Hess, U., 2003. Innovative financial services for rural India: Monsoon-indexed lending and insurance for small holders. Agriculture and Rural Development Working Paper No. 9. World Bank, Washington, DC.

Karbasi, A. and N. Kambozia, 2003. Survey effective factors on agricultural crops insurance demand. Agric. Econ. Dev., 11: 167-185.

Karthikeyan, M., 2005. Insuring small and Marginal farmers against crop losses on a large scale: A note for Twelfth Five Year Plan, DHAN Foundation.

Langyintuo, A.S. and M. Mulugetta, 2005. Modeling agricultural technology adoption using the software STATA. International Maize and Wheat Improvement Center (CIMMYT) Training Manual No. 1/2005 (Part two).

Li, B., F. L. Hester, W. S. Ewout and L. Emmanuel, 2011. Logistic random effects regression models: A comparison of statistical packages for binary and ordinal outcomes. BMC Medical Research Methodology, 11: 77.

Nchinda, V.P., T.E. Ambe, N. Holvoet, W. Leke, M.A. Che, S.P. Nkwate, S.B. Ngassam and D.K. Njualem, 2010. Factors influencing the adoption intensity of improved yam (dioscorea spp.) seed technology in Western Highlands and Guinea Savannah of Cameroon. Journal of Applied Biosciences, 36: 2389-2402.

Nowak, P.J., 1987. The adoption of agricultural conservation technologies: Economic and diffusion explanations. Rural Sociol., 52(2): 208-220.

Ramiro, I., 2009. Agricultural insurance, Primer series on insurance issues: 2-3.

Sargazi, A., S. Mashalla and I.H. Malek Mehd, 2013. Effective factors on the demand of insurance of agricultural crops in sistan area of Iran. Journal of Agricultural Economics and Development, 2(3): 90-94.

Serman, N. and G.C. Filson, 1999. Factors affecting farmers' adoption of soil and water conservation practices in Southwestern Ontario. Paper Presented at the Fourth Biennial Conference of the International Farming System Association, Guelph, Ontario.

Smith, V. and A. Boqluet, 1996. The demand for multiple peril crop insurance from montana wheat farms. Am. J. Agric. Econ., 78(1): 189-201.

Soule, M.J., T. Abebayehu and D.W. Keith, 2000. Land tenure and the adoption of conservation practices. Am. J. Agric. Econ., 82(4): 993-1005.

Swiss Re, 2007. Insurance in emerging markets: Sound development; Greenfield for agricultural insurance. Swiss Reinsurance Company, Zurich.

Timothy, J. and S. Richards, 2000. A two-stage model of the demand for specialty crop insurance. J. Agric. Res. Econ., 25(1): 177-194.

World Bank, 2005. Managing agricultural production risk; Innovations in developing countries; Agriculture and Rural development Department- World Bank.