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Farmers' Willingness to Pay for Crop Insurance: Evidence from Eastern Ghana

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Abstract

Crop insurance is a risk management tool with the potential of dealing with risk more efficiently. This study uses a dichotomous contingent valuation method to elicit the willingness to pay for crop insurance among cereal farmers in the Eastern region of Ghana. The study employed descriptive statistical techniques to analyze primary data obtained from 208 sampled farmers in the region. Approximately, 52.9% of the farmers expressed interest in crop insurance. A Heckman two stage approach was employed to estimate the factors influencing the WTP for crop insurance. The results revealed that farmers were willing to pay approximately $18.36 per cropping season. The demand for insurance was found to be negatively correlated with the premium amounts suggesting that it is a normal good. The Probit model revealed that marital status and awareness of crop insurance had a positive correlation with the willingness to purchase insurance. The coefficient for education was positive and statistically significant at the 5% significance level in relation to farmers' WTP. Borrowing and savings were, however, found to be negative and significant at the 1% and 10% levels respectively in relation to WTP. Farmers' WTP amount estimated with the interval regression model was shown to be influenced by key variables such as age, crop type, farm size, farm experience, income, weather variation, savings and access to extension agents. Innovative insurance products and the appropriate distribution channels are also recommended to incite demand for crop insurance.

Keywords:
Contingent valuation, Heckman two stage analysis, Interval Regression, Weather Index Insurance

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INTRODUCTION

Agricultural risks are common in both developed and developing countries. Although, the predominant sources and consequences may differ between countries, they are generally experienced by most farmers in most countries. Agriculture in sub-Saharan Africa (SSA) is an important sector of the economy serving as a stimulus for growth, assisting in poverty reduction and the provision of food security. Yet, food insecurity and poverty are critical issues for most developing countries in SSA. Among the numerous reasons, one cause of this problem could be attributed to agriculture's susceptibility to production, price and policy risks which impact farmers' income and welfare (Cervantes-Godoy et al., 2013).

In Ghana, agriculture produces value approximately 22 percent of GDP (GSS, 2014) and provides 51% of the employment in the country (Stutley, 2010). It also provides 75% of foreign exchange earnings (Armah et al., 2011) with crop production making up approximately two-thirds of the sector. Ghana's agriculture is risky as it is mainly rain fed and prone to a number of climatic, natural and biological hazards and most of these risks can't be controlled by the farmers themselves (Baquet et al., 1997). The effects of climate risks in developing countries are still prevalent among farming households and most often experienced by poor vulnerable subsistence farmers in rural communities (Aidoo et al., 2014).

Production risks have always presented a challenge to farmers whose livelihoods are closely linked to the environment. They put a constraint on their income generation and loan acquisition due to the resulting high risk profile. In the case of production risks, farmers do not only suffer from crop failure but this can lead to a reduction or even elimination of their entire livelihood. Farmers have dealt with production risk, economic fluctuations and individual specific shocks through self-insurance and a large array of informal coping strategies. These tend not to be very effective, efficient or profitable. These coping strategies may not be adequate to manage large levels of risk (Kurukulasuriya et al., 2006). As a result, risk and risk management strategies of smallholder farmers in developing countries might in fact push them into poverty.

There are projections suggesting that changes in climate will result in increasing global temperatures in addition to frequent and extreme weather events (Intergovernmental Panel on Climate Change, 2007), with Ghana in particular predicted to experience rainfall reductions and higher temperatures (Stutley. 2010). This is predicted to have an impact on agricultural production and poverty reduction in SSA by the end of the 21st century (Obeng & Assan, 2009). The development of a risk management tool which will enable poor vulnerable farmers adapt to these changes is, therefore, essential. One adaptation mechanism that has the potential to enable smallholder farmers to manage climate related risks in developing countries is agricultural (crop) insurance (Kwadzo et al., 2013; Sundar & Ramakrishnan, 2013).

Ex-ante micro insurance has gained attention over the years with various developing countries exploiting the market due to unpredictable climate conditions and frequency of production risks that impose significant challenges for sustainable production (Gulseven, 2014; Long et al., 2013. Ghana has recently introduced its first crop insurance scheme to enable poor, and thus vulnerable farmers to have access to a market-based risk management strategy in order to deal with risks that are beyond their control (Stutley, 2010). Crop insurance aids in protecting farmers by transferring the risk to another entity by indemnification with several types of schemes being implemented in different countries. It protects farmers against uncertainties and cushions them from shocks when there is a bad year, improving their risk bearing capacity. It reduces the impact of crop damage and losses as well as providing them with income and production smoothing (ILO, 2011). These benefits suggest that crop insurance is a tool that can reduce the impact of production risk.

The country's new focus appears to be on yield risk with the intension of relying on insurance based products as one of the solutions to risk. But it's not clear if this new focus and product will lead to increased adoption of the scheme. The risk portfolio of farmers and their

demand options need to be studied and understood with emphasis on the characteristics that influence producers' decision to join or otherwise. One major constraint with the implementation and expansion of an intervention such as crop insurance in Ghana is the absence of knowledge on farmers' willingness to pay for insurance. Crop insurance is new to farmers in Ghana and attempts being made to increase its adoption, therefore, necessitating research to investigate its demand. The study, therefore, seeks to assess the demand for crop insurance by cereal farmers in Ghana and specifically addressed two research questions. Firstly, are farmers interested in the crop insurance scheme and which of them will be early entrants into the insurance market? Secondly, how much are farmers willing to pay for the insurance scheme and what are the factors influencing the various premium amounts?

This study provides an understanding of farm households' need for insurance, aiding the enhancement of the product and the search for the best ways to protect farmers' livelihood from risk. It can be vital for policy action and the design of insurance contracts by providing information on the demand for insurance, the prospective farmers and locations to target as well as the various risks farmers desire to protect themselves against.

Risks and Risk Management Strategy

Farmers are faced largely with yield, price, and resource risks which make production and incomes unsteady year after year. Risks can be categorized into individual or household risk (micro), group or community risk (meso) and regions or national risk (macro). Natural hazards often lead to a reduction in or total loss of food produced for consumption and income earned from the harvest. Ghana faces two major hazards namely drought and floods with unfavorable effects on production and lives (Agyemang, 2010). Weather related and other production shocks determine the coping mechanisms farmers adopt which are quite heterogeneous across households. As economic and climatic environments change, farmers adopt and create new innovations to assist in coping with these changes. Coping strategies are adopted either before, in anticipation of a risk or after the occurrence of the hazard.

Some ex-ante coping strategies generally adopted by farmers are low risk, low return production technology, limited use of new and risky technology, crop and income diversification (Cervantes-Godoy et al., 2013). Ex-post strategies utilized by farmers are diversification through income earning activities, reduced food consumption and expenditure, borrowing, off-farm investments such as petty trading, selling of assets and reliance on external help from family (Kwadzo et al., 2013; Machetta, 2011; Obeng & Assan, 2009). Self-insurance does not imply that farmers are able to successfully cope with risk especially large shocks such as drought. They often have negative impacts on the well-being of farmers (Mjonono et al., 2009) enhancing survival chances in a limited way. Ex-ante efforts to reduce risk exposure can dampen asset accumulation creating a low-level equilibrium while ex-post consequences of a shock can put people back into poverty (Barnett & Mahul, 2007). These measures can lead to a decrease in growth and investment and further translate into reduced household welfare (Jones et al., 2009).

Willingness to pay (WTP) for Agricultural insurance

Hill et al. (2013) studied the willingness to pay for weather insurance by households in Ethiopia with the availability of panel data. The study revealed that the rich, educated, proactive and younger farmers were more likely to purchase insurance. Basis risk and high priced contracts were likely to reduce the likelihood of purchase. Abebe and Bogale (2014) revealed in a study among farmers in the Central Rift Valley of Ethiopia that the income of the household and ownership of a radio have positive and significant effects on the willingness to pay for insurance. Off-farm income and age on the other hand were found to have negative and significant influences on WTP. Responses to the contingent valuation single bounded dichotomous choice model revealed that the majority of farmers who were interested in purchasing insurance were willing to pay less than 100 birr as premium.

Long et al. (2013) pointed out that households' total value of assets, size of field and ability to borrow had positive correlations with farmers' willingness to buy insurance. Results from the Ordinary Least Square (OLS) estimation in the Heckman procedure showed a negative correlation between households' expenditure per capita as well as coping strategies and their willingness to participate and pay for insurance. Gulseven (2014) performed a twofold empirical analysis, first using the logit model to determine farmers' demand for insurance and a contingent valuation open ended and take it or leave it type questions to derive farmers' WTP amounts. Education and farm income were shown to have positive and significant effects on farmers' WTP but household size and union membership were not found to be statistically significant. The authors found strong evidence that demand is downward sloping with farmers' willingness to pay declining sharply with lower coverage levels. Falola et al. (2013) examined the willingness of cocoa farmers to take agricultural insurance in Nigeria. Out of the sampled farmers, 39% of the sample with knowledge of the product were willing to participate. Age, farm income, education, access to extension services, farm income and household size were revealed to influence the willingness to take agricultural insurance according to the explanatory model developed using the probit model.

Abdullah et al. (2014) examined the willingness of paddy farmers in Malaysia to pay for crop insurance by applying the bidding game elicitation technique to estimate farmers' mean willingness to pay. Farmers were willing to pay about 8% of the total coverage per crop season. Results from the logit regression model revealed that farmers' WTP is affected positively by attendance to paddy production courses, farming experience and farm size but negatively by age. Kwadzo et al. (2013) reported the WTP for crop insurance among farmers in the Kintampo north municipality of Ghana who were predominantly male, married with more than 50% having no formal education. Educated farmers were assumed to have exposure to more sophisticated risk management practices since they were not observed to have interest in the scheme. Moreover, farmers with large families above the mean average of 4.6 persons were likely to purchase insurance since with a large number of people depending on the farm, the responsibility to reduce potential losses is high. Farmers who were likely to purchase were willing to pay a maximum premium of GHC 80 for insurance coverage.

Danso-Abbeam et al. (2014) studied cocoa farmers' willingness to pay for farm insurance in the Western region of Ghana using the dichotomous contingent valuation approach. Results from the probit regression revealed that married farmers with a lot of responsibility and educated farmers who are more likely to understand the scheme were willing to participate. Farm size and income, land ownership and farming experience were the determining factors of the willingness to insure. The truncated regression results revealed similar findings on determinants of farmers' WTP amounts. Nimoh et al. (2011) revealed that most farmers were willing to purchase insurance for protection against uncertainties and to serve as a buffer. The lack of awareness and income were found to deter farmers from insuring their crops. Though insurance companies indicated their interest in farm insurance, only 30% were willing to carry it out due to the high risk involved. This outcome is likely to be a barrier to agricultural insurance establishment and expansion in Ghana.

Ramasubramanian (2012) made a clear distinction between the willingness to join and the willingness to pay for rainfall index insurance among farmers in India The study employed a Heckman selection model for analyses with a first stage ordered probit and a second stage interval regression. A higher percentage of farmers were observed to be willing to join the micro insurance scheme and this was highly dependent on wealth. Insurance literacy and basis risk were positively correlated with WTJ. Risk averse and younger individuals were less likely to join. Using an open ended interactive bidding process, the amount farmers were willing to pay was found to be driven by the availability of other coping mechanisms, acres planted and risk attitudes.

Crop Insurance in Ghana

To deal with the threatening influence of climate change on agriculture in Ghana a project was implemented in December 2009 by German International Co- Operation (GIZ). The goal of the project was to assist Ghana tackle climate risk by developing an insurance product which is economically sustainable and demanded by farmers. Ghana Agricultural Insurance Program (GAIP) provided the first agricultural insurance during the pilot stages and is currently the only agency providing crop insurance to farmers in Ghana since it was launched in June 2011. The type of scheme that was provided and currently being provided is the weather index insurance specifically the drought index insurance (GAIP, 2013). Insurance is offered to farmers who are able to purchase directly from GAIP to protect them against weather variability. It is not bundled with any other product such as credit or farm inputs such as seeds or fertilizer.

The scheme is dependent on automated weather stations that record climatic data on rainfall, temperature, wind and relative humidity. Data on rainfall amount are used to determine what occurs on the farm and to determine claim payments. If recorded rainfall falls below a specified level, it signifies an expected crop loss on the field and payouts are made. The scheme works by farmers paying one tenth of the cost of their farm production to GAIP (local agents) at the beginning of the farming season and receive a payout when there is no rain (less than 2.5mm of rain) for 12 consecutive dry days. On average farmers pay 10% of whatever amount is spent on an acre of land which is calculated for each crop. Payouts are made within 30 days after the cropping season to insured farmers.

Willingness to Pay (WTP) Technique Employed in the Study

A farm household survey was used to elicit farmers' willingness to pay for crop insurance after a detailed description of how a weather index insurance contract works was presented to them. The study area was selected through a multistage sampling technique with priority given to the Eastern region due to it susceptibility to drought and also because it is a major cereal producing region. Steps were taken to purposively sample districts and communities for the survey. The criterion used for the selection of the districts was the production levels of cereals in each district, with those districts having high production levels being chosen for the survey. Data were obtained by using a structured questionnaire designed specifically to gather information through personal face-to-face interviews with cereal farmers. The questionnaire included modules on household demographics, income, assets, details on farm characteristics, farmers' perception and awareness of insurance. The total sample size for this study was 208 cereal farmers.

The index based crop insurance scheme was described to farmers in as much details as possible focusing more intently on how it works. The basic principle was communicated to farmers as an insurance guaranteeing a minimum payout for a specific peril over a predetermined period of time in exchange for a charge known as the premium. The product description is that of the crop insurance (weather index insurance) package provided by GAIP. The premium rate for this product is charged at 10% of the total production cost of the farmer, which has been estimated for maize and rice farmers as GHc 57.40 and GHc 180.00 respectively (Munkaila, 2015).

By employing the contingent valuation dichotomous choice technique, farmers were asked if they were interested in the product after which questions on farmers' willingness to pay for different amounts for the contract were presented only to farmers who indicated their interest in the insurance scheme. Farmers responded to their willingness to pay for these bids (amounts) with a Yes or No indicating their willingness or lack of willingness to pay for insurance.

All farmers were asked if they were willing to pay a 10% premium rate (since this is the current premium rate used by GAIP), a follow up question depending on their response to the initial bid. If they answered Yes a higher bid was again offered to the farmer while if they responded No, a lower one was offered to the farmer. The maximum bid with a positive response is taken as the amount the farmer was

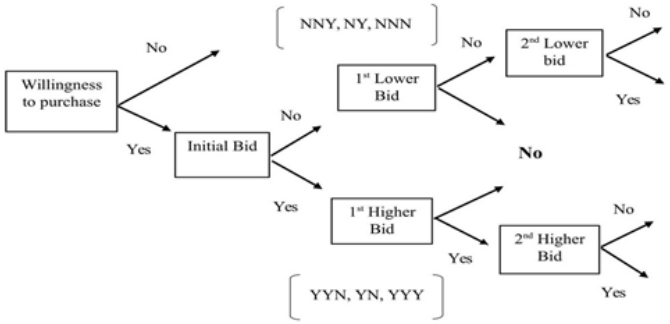

Figure 1: Possible responses of the bidding game

willing to pay. Three consecutive bids were, therefore, presented to farmers with the third bid contingent on the second bid and that bid being contingent on the first bid. The initial bid was set at GHc 57.40 and GHc 180.00 (i.e. 10% premium rate) for maize and rice respectively per Ha for a maximum pay-out of GHc 574.00 and GHc 1,800.00 per Ha for the respective crops. The follow up lower and upper bids as well as the possible responses of the bidding game are shown in Table 1.

Conceptual model

Farmers' WTP for index based crop insurance was modeled using the discrete model framework in this study. A two-stage model was employed with the assumption that the farmers' decision to purchase insurance and the amount they are willing to pay are two different and sequential decisions. Therefore, in this model different latent variables were used to model each decision process. An important consideration in the empirical analysis is that, it is expected that not all households will be interested in crop insurance leading to biased estimates if unwilling households are excluded (Long et al., 2013). Farmers who are willing to pay for insurance are a subset of the total number of sampled farmers leading to a non-randomly selected sample from the entire set of farmers. Sample selection issues come about when observations selected are not independent of the outcome variable and may lead to biased inferences. Ruling out farmers who are not willing to pay, the data becomes censored and the sum of residuals is no longer zero as expected. This would result in inefficient, inconsistent and biased parameter estimates of the regression model analyzed based only on the sub sample.

To draw conclusions on the entire population of farmers as well as the sub population of farmers from which WTP amounts were solicited, the Heckman two-stage procedure for a continuous decision variable is used. The model assumes that both decisions are made concurrently and, therefore, the assumption that the error terms of the two equations could be correlated is made. The model was applied to deal with the problem of sample selection bias following Kuoame and Komenan (2012).

The Heckman two-stage model is specified as;

Selection equation

$$z^* \text{ (unobserved)} = \gamma' + u \quad u \sim N(0,1) \quad (1) \quad (1^{st} \text{ stage})$$

$$z = 1 \text{ if } z^* > 0 \qquad z = 0 \text{ if } z^* \leq 0$$

Regression/ Observation equation

Table 1
Bid Design

Bid levels	Premium rate	Maize	Rice
2nd Lower bid	2%	11.48	36.00
1st Lower bid	5%	28.70	90.00
Initial bid (GAIP rate)	10%	54.40	180.00
1st Higher bid	12%	68.88	216.80
2nd Higher bid	15%	86.10	270.00

Source: Munkaila (2015)

$$y = \beta' x + e \; e \sim N(0, \sigma^2) \qquad (2)\ (2^{nd}\ \text{stage})$$

y observed only if z is equal to 1. The variance of u is normalized to 1 because z^* is not observed but only z is observed. u and e are the error terms and are assumed to be bivariate and normally distributed with the γ and β as parameter vectors. Equation (1) is the participating function where w represents the factors influencing WTP for insurance or not. The Mills ratio is determined from this function and used in the second stage as a parameter estimate, regressed on y. Equation (2) represents the factors influencing the amount farmers are willing to pay which is determined by the significance of β. y is WTP amount, x represents the explanatory variables.

The Heckman two-stage model first estimates the impact of several characteristics on the probability of purchasing crop insurance and additionally analyses the factors influencing the amount farmers are willing to pay. A binary choice probit model was used in estimating the first stage of the model (selection equation), the dependent latent variable is 1 if the farmer is willing to purchase crop insurance and 0 if otherwise. A normal distribution of ε, mean of zero and a variance of σ^2 is assumed with the use of the probit model (Greene, 2002). The model was chosen due to the binary nature of the dependent variable. In the second stage the model analyzed the factors influencing farmers' WTP amounts using the interval regression model.

Sample selection bias is controlled by the Heckman two-stage model and accounted for with the inverse Mills ratio (estimated expected error) which was generated from parameter estimates in the first equation. The inverse Mills ratio (IMR), λ_i, indicates the selectivity problem and is incorporated into the second stage of the model as an additional explanatory variable. It is a procedure to identify and eliminate the selection bias problem by removing the part of the error term that correlates with the explanatory variable.

Empirical Model

Farmers' willingness to purchase crop insurance was estimated by means of a Probit model using maximum likelihood method based on information on farmers who are willing and not willing to purchase insurance, followed by an Interval regression analysis to estimate premiums farmers are willing to pay.

Probit Model

The general Probit model is expressed as follows:

$$Yi^* = \beta_0 + \sum_{i=1}^{n} \beta_n X_i + \mu_i \qquad (3)$$

where Yi^* is a latent variable not observed, a dummy variable defined by Y_i is what is observed.

Where Y_i is the dichotomous dependent variable expressed as

$Y_i = 1$, if farmer is willing to purchase crop insurance, $Y_i = 0$, if farmer is not willing to purchase crop insurance, β_o = is the intercept, βi = the regression coefficients that explains the probability to farmers willingness to purchase insurance, X_i = independent variables, it is, therefore, assumed that $\beta n X_i$ is normally distributed random variable, μ_i = the stochastic error term.

To interpret the relationship in terms of the willingness to purchase or not, the marginal effects were used. The marginal effect for the estimated coefficients is expressed as;

$$\frac{\partial pr(y_i=1|x_i;\beta)}{\partial x_{ij}} = \frac{e^{x\prime\beta}}{\left[1+e^{x\prime\beta}\right]^2} \cdot \beta_j \qquad (4)$$

After the marginal effects have been estimated following the probit estimation, the next step is to estimate the mills ratio which is incorporated into the WTP model (Interval regression).

$$\lambda_i = \Phi(p + \partial X_i)/\varphi(p + \partial X_i) \qquad (5)$$

where λ_i = Mills ratio variable, X_i = the vector of the factors that influence the willingness to participate, Φ = the density function of a standard normal variable, φ = the cumulative distribution function of a standard normal distribution, δ, ρ are parameters of explanatory variables.

Interval regression analysis

The interval regression was used to estimate the price premium farmers were willing to pay for crop insurance denoted by WTP_i. Farmers

who were willing to pay chose from a range of premium rates which gave an indication of their maximum WTP for the product. In the bidding game each individual provided one of six responses (YYY, YYN, YN, NNY, NNN, NY) to the premium rates offered. Assuming a functional form for WTP specified by Ramasubramanian, (2012) as:

$$WTP_i^* = x_i'\beta + \varepsilon_i \qquad where \quad \varepsilon_i \sim (0, \sigma^2) \qquad (7)$$

x_i is an independent variable, β is a vector of parameter and ε_i is the random error term with mean of zero and variance σ^2.

Bid Definition

If t^0 is the first bid, t^L is the third lower bid and t^H is the third higher bid. The WTP_i^* can be defined as follows $WTP \geq t^H$ for yes-yes responses; $t^0 \leq WTP < t^H$ for yes-no responses; $t^L > WTP \geq t^0$ for no-yes responses; $WTP < t^L$ for no-no responses. WTP responses, therefore, fall in a range with an upper and lower bound, for instance for yes-yes responses, the lower limit is the second higher bid and the upper limit is positive infinity.

The lower (upper) bound shows the minimum (maximum) premium price the farmers are willing to pay for insurance. Farmers' responses to a sequence of contingent valuation questions enabled the classification of respondents WTP into various premium price intervals (Wu et al., 2011). If L and U are the lower and upper bounds of WTP, the final likelihood function is defined as follows (using the framework in Wu et al., 2011), then the probability of the farmers' premium falling into the range is expressed as:

$$P\ (L \leq WTP_i^* \leq U) = (P \ln(L) - \sum_{j=1}^{n} \beta_j x_j \leq \varepsilon_i \leq ln(U) - \sum_{j=1}^{n} \beta_j x_j) \text{ Eqn.} \qquad (8)$$

Assuming the random error term (ε_i) follows a normal distribution with zero mean and variance σ^2 with ϕ being the standard normal distribution function, the WTP now takes the form

$$P\ (L \leq WTP_i^* \leq U) = \phi\left(\frac{\ln(U) - \sum_{j=1}^{n} \beta_j x_j}{\sigma}\right) - \phi\left(\frac{\ln(L) - \sum_{j=1}^{n} \beta_j x_j}{\sigma}\right) \text{ Eqn.} \qquad (9)$$

RESULTS

A total of 208 respondents were interviewed for the study, out of this sample 110 (52.9%) were willing to purchase crop insurance while 98 (47.1%) were not willing to purchase crop insurance (Munkaila, 2015). Of the total respondents, 74.0% were males while 26.0% were females. The majority of the survey respondents, that is 161, were married. The majority of the widowed respondents (94.1%) were not willing to purchase insurance. 91 of the respondents had only basic education, 57 had further education and 60 had no formal education. Educated respondents were more willing to purchase insurance compared to uneducated respondents (Table 2). The mean ages for those willing to purchase insurance and not willing to purchase insurance was 45.7 and 47.7 years, respectively. Most of the farmers, 148 out of the 208 respondents, have been producing cereals for at least 10 years with the majority of them having 10 to 20 years of farming experience. More than 60.0% of farmers with less than 5 farming experience were willing to pay for insurance (Table 2). The survey results indicate that a majority of the farmers had monthly income below 500GH cedis; approximately 52.9% of the survey sample. Approximately, 45.5% of the farmers with incomes less than 500GH cedi were willing to purchase insurance. 53.9% of respondents who engaged in agriculture as their major occupation were willing to purchase insurance. Most of the respondents, 169 out of 208 respondents, had small size farms. Of the small size farm owners, 50.0% were willing to purchase crop insurance. A high percentage of both maize (51.0%) and rice farmers (62.0%) were willing to purchase insurance.

Of the sampled farmers, 108 respondents had contact with extension agents. When one had a visit from an extension agent, 61.1% of the respondents were willing to purchase insurance, while if there was no visit only 44.0% were willing to purchase insurance. Out of the total respondents, 81 had access to credit while 127 did not. 59.3% of the respondents who had

Table 2
Description of Household Characteristics

Variable		Number of Respondents	Not Willing To Pay		Willing to Pay	
			Number of Respondents	(%)	Number of Respondents	(%)
Gender	Male	154	62	40.3	92	59.7
	Female	54	36	66.7	18	33.3
Marital Status	Single	14	3	21.4	11	78.6
	Married	161	71	44.1	90	55.9
	Divorced	9	2	22.2	7	77.8
	Widower	17	16	94.1	1	5.9
	Other	7	6	85.7	1	14.3
Education	No formal education	60	42	70.0	18	30.0
	Basic education	91	41	45.1	50	54.9
	Secondary education	40	11	27.5	29	72.5
	Tertiary education	17	4	23.5	13	76.5
Age	≤ 30	9	2	22.2	7	77.8
	< 31- 50	118	57	48.3	61	51.7
	>51	81	39	48.2	42	51.9
Household Size	0 - 3	37	14	37.8	23	62.2
	4 - 6	115	57	49.6	58	50.4
	7 - 10	50	25	50.0	25	50.0
	11 - 15	6	4	66.7	2	33.3
Farming Experience	< 5	5	2	40.0	3	60.0
	5 – 10	55	23	41.8	32	58.2
	11 – 15	60	27	45.0	33	55.0
	16 – 20	40	24	60.0	16	40.0
	21 -30	40	17	42.5	23	57.5
	>30	8	5	62.5	3	37.5
Income(GHS) $1=GHS 3.79	< 500	110	60	54.5	50	45.5
	500 – 1000	55	23	41.8	32	58.2
	1000 - 2000	19	8	42.1	11	57.9
	2000 - 3000	11	2	18.2	9	81.8
	>3000	13	5	38.5	8	61.5

access to credit were willing to purchase insurance while 48.8% of the farmers without credit were willing to purchase insurance (Table 3).

Willingness to Pay Analysis

GAIP's current premium rate was offered to farmers as the initial bid after which a follow up bid which was either higher or lower than the

Table 3
Description of Farm and Institutional Characteristics

Variable		Number of Respondents	Not Willing To Pay		Willing to Pay	
			Number of Respondents	(%)	Number of Respondents	(%)
Farm Size	Small Size	169	84	50.0	85	50.0
	Medium Size	26	11	42.0	15	58.0
	Large Size	13	3	23.0	10	77.0
Crop Type	Maize	166	82	49.0	84	51.0
	Rice	42	16	38.0	26	62.0
Extension visit from agent		108	42	38.9	66	61.1
FBO membership		160	76	47.5	84	52.5
Access to credit		81	33	40.7	48	59.3

Table 4
Distribution of Farmers According To Their Maximum WTP Amount

Premium Rate	Farmers	Bid values	Maize farmers		Bid Values	Rice Farmers	
(%)	(%)		Number of respondents	(%)		Number of respondents	(%)
2	38.2	11.48	33	39.3	36.00	9	34.6
5	35.5	28.70	31	36.9	90.00	8	30.8
10	20.0	57.40	16	19.0	180.00	6	23.1
12	4.6	68.88	3	3.6	216.00	2	7.7
15	1.8	86.10	1	1.2	270.00	1	3.8
Total	100		84	100		26	100

Maize and rice farmers are presented with the same premium rates as a percentage of the cost of production, however, the absolute values differ because the cost of production for each crop differs. The cost of production for rice is substantially higher than for maize.

initial bid was proposed to farmers depending on the response to the initial bid. The proposed bid which the farmer agreed to as the amount he/she was willing to pay was taken as the maximum WTP amount. A high percentage (52.9%) of the farmers indicated their interest and willingness to pay for crop insurance which shows that a majority of the farmers were interested in insuring their crops from production risks and uncertainties. Another 47.1% of the respondents were unwilling to accept and pay for crop insurance.

Approximately 52.0% of the farmers who were not willing to purchase crop insurance offered a number of reasons for their decision. A large number of farmers (23.1%), indicated that they did not have enough information about the GAIP's insurance program. 8.7% indicated that they did not have the funds to purchase insurance, 9.7% mentioned high premium rates, 3.4% were of the opinion that the compensation time might be delayed and 6.7% of the farmers signaled that they needed time to decide. A number of these reasons were similar to those observed by Nimoh et al. (2011), who reported that 9% and 2% of the sampled farmers were not willing to insure due to a lack of income and inadequate knowledge respectively.

A description of the number and percentage of farmers who accepted to pay for each bid or premium rate is presented in Table 4. Of the total number of maize farmers who were willing to purchase insurance, 19.0% of them were willing to pay at the current premium rate of 10% of production costs. 76.2% were willing to pay below the current GAIP premium rate and only 4.8% were willing to pay above this rate. The number of farmers willing to purchase insurance decreased as the premium rate increased. The distributions observed for maize farmers was not different from those observed for rice farmers. The majority of the rice farmers (65.4%) were willing to pay lower bids than the current premium rate of 10% while 23.1% were willing to pay the current premium.

Generally, farmers who were willing to purchase crop insurance were willing to pay premium rates lower than the current premium rate offered by GAIP. It can be inferred that the insurance premium charged by GAIP may be out of reach for the sampled farmers since on average most of them were willing to pay lower bids. For both crop farmers, less than 5% were willing to pay the highest bid or premium (15%). Only approximately 20% were willing to purchase insurance at the current premium values of 10% of the cost of production.

Maize and rice farmers are presented with the same premium rates as a percentage of the cost of production, however, the absolute values differ because the cost of production for each crop differs. The cost of production for rice is substantially higher than for maize.

Derivation of a Demand Curve

The aggregate demand curves were derived using the various amounts farmers were willing

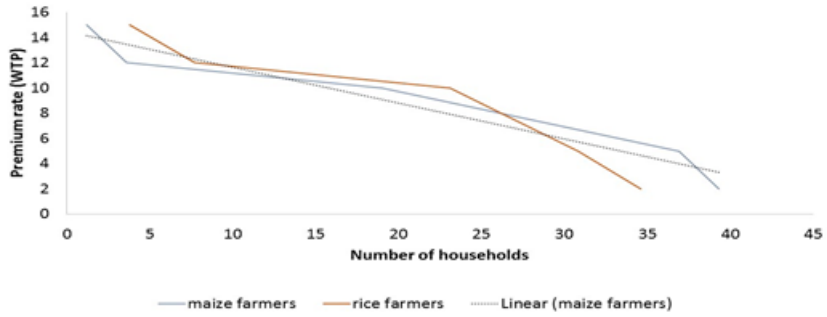

Figure 2: Estimated demand curve for crop insurance

to pay per hectare and the number of respondents willing to pay the different amounts. The points on the curve represents the households who would prefer to pay for crop insurance at the corresponding premium price on the WTP axis (Figure 2).

Both curves are downward sloping indicating that crop insurance is a normal good. The demand for crop insurance decreased as the premium price increased. Similar findings were observed by Abebe and Bogale (2014) and Ramasubramanian (2012) who found the demand for index based insurance to be downward sloping.

Heckman two-stage Model

The estimated outcome of the Probit selection used to analyze farmers' willingness to purchase crop insurance contracts is presented in Table 5. The analytical statistics showed that the estimated model has a good fit with a chi-square value statistically significant at the 1% level. Another measure of good fit is the Pseudo R^2 value of 0.2108 which indicates that 21.08% of the variations in the farmer's decision to purchase insurance was explained by the explanatory variables in the model. This is quite reasonable considering that the data for the study were obtained from a cross sectional survey of selected farmers in the study area.

Marital status was found to be positively correlated with farmers' willingness to purchase insurance. This conformed to the a-prior expec-

Table 5
Probit Regression Estimates of Farmers' Willingness to Purchase Crop Insurance

Variable	Coefficients	Std error	p-value
Constant	-1.419824	0.7514365	0.059
Single	1.307516***	0.4734448	0.006
Married	0.865154***	0.2928332	0.003
Education level	0.0544138**	0.0230625	0.018
Income level	-0.0328991	0.0621687	0.597
Medium size	-0.0236218	0.3003424	0.937
Large size	0.2130821	0.4735089	0.653
Farm experience	0.1712289	0.2199987	0.436
Major occupation	0.0625728	0.2079084	0.763
Using Extension service	0.543269**	0.2660043	0.041
Accessibility to credit	-0.2667648	0.2691257	0.322
Weather Variation	0.2404156	0.2045329	0.240
Borrowing	-0.8678956**	0.2680025	0.001
Having Savings	-0.4593909*	0.2708054	0.090
Marketing contracts	0.0369573	0.5325026	0.945
Aware of crop insurance	0.5635645**	0.2240927	0.012
Number of Obs.	= 208	Wald Chi2 (17)	= 55.75
Pseudo R^2	= 0.2108	Prob > chi2	= 0.0000
Log likelihood	= -113.5143		

Note: Robust standard errors. ***, ** and * indicate significance level at 1%, 5% and 10% respectively

tation and is also consistent with other studies (Danso-Abbeam et al., 2014). Married farmers have the responsibility of reducing their household's vulnerability to risks and the resulting negative impacts and are therefore more likely to purchase a crop insurance policy. The coefficient for education was positive and statistically significant at the 5% significance level and was also in line with previous studies by Ali (2013). The positive effect on the willingness to purchase insurance implies that better educated farmers are more likely to receive and understand the insurance policy and are thereby more willing to purchase insurance compared to those with lower educational levels. Income had a negative and insignificant relationship with farmers' willingness to purchase insurance. This was contrary to a-prior expectation. This implies that farmers with higher household incomes are probably less vulnerable to production risks and its effects on their welfare and therefore have a lower willingness to purchase insurance.

In line with a prior expectation, farmers' adoption of various risk management strategies particularly borrowing and savings had a significant and inverse relationship with the willingness to purchase insurance. Individuals who borrowed or used savings were less willing to insure their crops. Farmers who use borrowing as a risk management strategy may have a lower ability to pay for insurance premiums while farmers who use savings may be obtaining security from this strategy thereby decreasing the likelihood of purchasing insurance as a risk management strategy. Access to agricultural extension services positively affected farmers' willingness to purchase insurance. Extension services provide farmers with important information concerning modern technologies and management strategies and thereby influence their purchasing decision positively. In accord with a prior expectation, the more farmers had access to these services, the higher the probability of engaging in crop insurance. Farmers who had knowledge about GAIP and the crop insurance scheme that was being offered had a higher probability of purchasing insurance compared to their counterparts who didn't have any information.

WTP Amount

The interval regression model was employed in the second stage Heckman model to assess the factors influencing the amount farmers were willing to pay conditional on a positive decision to purchase insurance. The estimated results are shown in Table 6. The inverse mills ratio (IMR) was statistically significant at 1% implying that employing the two stage procedure was appropriate and justifies the use of the Heckman model (Arasheibani & Lau, 1999; Chen & Hamori, 2008). This indicates that the sample selection problem (dependence of error term on outcome models) is evident in the model and thus estimating the determinants of the amounts farmers were willing to pay using an ordinary interval regression model would be inaccurate and have yielded biased estimates. From the regression estimates, it can be observed that the coefficient of the Inverse Mills Ratio is negative and shows that the selection problem would have provided a downward biased estimate (Irfan, 2011). This was in line with a number of studies authored by Khitarishvili, 2009; Mfungwe, 2012; Ramasubramanian, 2012.

The amount farmers were willing to pay increased significantly with age which was contrary to the first stage results on farmers' decision to purchase. This suggests that older farmers were willing to pay higher amounts probably because they were quite confident that the scheme could enable them to manage risks especially since they have lifelong experience with weather risk. This reduces the need to search for and try out alternative risk management strategies. Earlier studies by Abebe and Bogale (2014) found contradicting results.

Farmers with higher education were more willing to pay a lower amount for insurance contracts which was demonstrated by the negatively significant relationship between education and farmers WTP amount. Educated farmers are likely to have other risk management strategies or have opportunity to engage in a secondary occupation which provides them with additional income. This reduces the incentive to pay for crop insurance as a risk management strategy and was consistent with work done by Aidoo et al. (2014).

Also a positively significant correlation was observed between marital status and farmers WTP amount indicating that married individuals had a higher probability of paying a higher amount for crop insurance.

Household income positively and significantly influenced the amount farmers were willing to pay to insure their crops. This means that higher income farmers were more willing to pay a higher amount to insure their crops compared with lower incomes farmers. Hence, it can be concluded that though lower income farmers would be willing to purchase insurance to better manage risk, and secure their welfare, they may not be able to afford it. This was similar to the results obtained by Abebe and Bogale (2014) who observed that the probability that farmers would pay a higher amount for insurance increased if they had higher incomes (Table 6).

It was observed that farm experience was statistically significant and had a negative relationship with the amount farmers were willing to pay for insurance. Cereal farmers with more experience were less willing to pay a higher amount for insurance compared to those with much less experience. Individuals with more experience in farming may tend to rely on their experience in managing risks over the years and therefore will be less willing to pay a higher amount to adopt a new risk management strategy (Table 6).

Unlike the Probit results, a negative and significant relation was observed between WTP amount and extension services. Farmers who had received extension services were less willing to pay more to insure their crops since they are more likely to have information on different types of risk management strategies and therefore are exposed to a number of options in managing risk.

Farm size was found to have a positive correlation with the amount farmers were willing to pay for crop insurance with the variable large farm size having a statistically significant influence on the WTP amount at the 1% significance level. This means that farmers with larger farms who were willing to purchase insurance were more likely to pay a higher premium per hectare. This is not only due to the fact that these farmers face severe risk when there is a hazard but also because they have higher incomes and can afford to pay more. The type of crop produced by the farmer was found to have a negative and

Table 6
Interval Regression Estimates of the Premiums Farmers Are Willing to Pay

Variable	Coefficients	Std error	p-value
Constant	3.819512	0.808434	0.000
Age	0.3053125*	0.1768141	0.084
Education	-0.1402301*	0.0761001	0.065
Marital status	0.3249409**	0.131671	0.014
Income	0.128338***	0.0350526	0.000
Other Occupation	0.1369576	0.1190657	0.250
Farm experience	-0.0261521***	0.0070826	0.000
Medium size	0.1334337	0.0974702	0.171
Large size	0.3386458***	0.0917068	0.000
Crop Type	-0.9633848***	0.1460578	0.000
Extension service	-0.3273955**	0.1771104	0.065
Access to Credit	0.1974964	0.1244234	0.112
Weather variation	-0.1865922**	0.0826617	0.024
Savings	0.4714187***	0.1402218	0.001
Borrowing	0.631917***	0.2447612	0.010
Marketing contracts	0.2038149*	0.1227498	0.097
Aware of crop insurance	-0.3522729**	0.1704707	0.039
Mills Ratio	-1.194255***	0.4574923	0.009
Ln Sigma	-1.110259	0.1222888	0.000
Number of Obs.	= 110	Wald Chi2 (17)	= 393.24
Log likelihood	= -115.17277	Prob > chi2	= 0.0000

Note: Robust standard errors. ***, ** and * indicate significance level at 1%, 5% and 10% respectively

Table 7
Mean WTP for Cereal Farmers

Variable	WTP	Std. error	z	p>z	[95% Conf. Interval]	
Absence of selection bias						
Mean	69.58467	32.80078	2.12	0.034	5.296319	133.873
Presence of selection bias						
Mean	29.84569	24.73672	1.21	0.228	-18.63738	78.32877

significant relation with the amount farmers were willing to pay to insure their crops. Maize farmers were willing to pay a lower amount for insurance premiums compared to rice farmers.

Weather variation had a negative and significant effect on farmers WTP amount. It can be argued that the negative effect of this variable could be a reflection of households' limited willingness to experiment with a new product. This could probably be due to a lack of trust or bad past experiences. Long et al. (2013) observed that experiencing shocks positively and significantly affected the amount farmers are willing to pay for insurance which is contrary to the findings obtained in this study.

Farmers who used savings as a coping strategy were likely to pay more for insurance. This is in line with findings by Aidoo et al. (2014). Premium payments will be made either with current or saved income and, therefore, farmers who save are more capable of obtaining funds to purchase insurance. Adopting borrowing and marketing contracts as a risk management tool was also found to have a positive correlation with farmers' WTP amount. Farmers who borrowed were expected to be willing to pay less to insure their crops especially because of inadequate income and lack of savings. However, it can be argued that the farmers were aware of the negative effect of borrowing and thus were more likely to pay more for an alternative risk management strategy. The effect of the use of marketing contracts on farmers' willingness to purchase insurance and the amount they were willing to pay was not contradictory if the farmers use the insurance as a risk aversion vehicle. Ramasubramanian (2012) observed that farmers who had adopted other coping strategies were willing to pay less for insurance but this study concludes otherwise.

Having information about insurance had a negative and significant relationship with the premium the farmer was willing to pay. Awareness of insurance which was mostly from the media may have served as an incentive to influence farmers' willingness to purchase insurance but it didn't seem to be enough motivation for farmers to pay more for crop insurance. This could be due to the quality of information obtained from this source and also the credibility of the various sources from which farmers obtained information about GAIP and the crop insurance scheme that was being offered.

Mean Willingness to Pay

The Mean WTP for cereal farmers who were willing to pay for crop insurance was estimated using the fitted values from the interval regression. In this study, only the significant values were used in computing the mean WTP for insurance. This was done for scenarios where the sample selection problem was accounted for using the inverse mills ratio in the Heckman model and not accounted for with the use of a simple interval regression model. The results show that the Mean WTP for farmers are different depending on whether the selection bias is taken into account. The mean WTP estimate when the selection bias problem was taken into account was significantly higher than the estimated mean WTP without accounting for selection bias. Not taking the selection bias into account results in a lower WTP amount for insurance (Table 7).

Cereal farmers in the Eastern region were willing to pay a premium of approximately 69.58 GH cedi for protection coverage for each cropping season. This is relatively low compared with the study by Kwadzo et al. (2013) who re-

ported that food crop farmers in the Kintampo North Municipal of Ghana were willing to pay a maximum of GHc 80.00 as a premium for crop insurance.

CONCLUSION AND RECOMMENDATIONS

The study established that the crop insurance scheme offered by GAIP; which is a weather index insurance scheme, will be an appropriate alternative risk management strategy for cereal farmers in the Eastern region. This is because majority of the farmers stated drought and weather variation as the major risks faced in the study area. The results indicated that there was a considerably high demand for crop insurance because 52.9% of the farmers were willing to purchase insurance. Generally, cereal farmers who were willing to purchase and pay more for insurance were married, cultivated larger farms and had farming as their major occupation. The factors identified to affect demand for insurance were education, access to extension services and awareness of insurance. Education is a key factor because knowledge about insurance and the ability to understand the concept of insurance play an important role in farmers' participation in the insurance program. Further, past experiences with innovations and the limited desire to experiment with new products could be a negative factor with respect to farmers' decision to participate and fully involve themselves in the crop insurance program. Crop insurance was less attractive to low income farmers as the premium rate increased to 10% of the cost of production, although low income farmers were more willing to purchase crop insurance at lower premium rates. Crop insurance was established to be a normal good with a downward sloping demand curve with majority of the farmers willing to pay for crop insurance at premium rates lower than the current rate of 10% of the cost of production offered by GAIP.

If the crop insurance program is expensive and unpopular, it may not be sustainable. The following recommendations are thus proposed by the study. Household income and WTP amount were positively related, development policies should aim at increasing income of households particularly low income smallholder farmers. Furthermore, the WTP analysis revealed that maize and rice farmers were willing to pay an average of 69.58 GH cedi for insurance, 73.6% of both crop farmers were willing to pay for insurance at a lower premium rate relative to the 10% premium rate charged by GAIP. Government subsidies should also be considered to assist farmers with premium payments. To enhance farmers demand for insurance, awareness campaigns through extension services and different Medias as well as the content of information on crop insurance and its mode of presentation to farmers should be of high importance in the implementation of crop insurance in Ghana.

Further studies should investigate the appropriate percentage of total production cost farmers should pay as the crop insurance premium which would either confirm GAIP's approach or provide insight on a more feasible method of estimating insurance premiums. Other types of insurance programs apart from the current program which pays the producers their cost of production when the risk occurs should be investigated to determine their feasibility and acceptability by farmers.

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