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Food Crop Farmers' Willingness to Participate in Market-Based Crop Insurance Scheme: Evidence from Ghana

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Abstract

The study assesses food crop farmers' willingness to participate in market-based crop insurance scheme in the Kintampo North Municipal of Ghana, using primary data solicited from 120 farmers in April 2010. The study employed descriptive statistical techniques to analyze the social, economic, demographic characteristics of farmers as well as their current risk management practices. Further, farmers' willingness to participate in a hypothetical market-based insurance scheme was estimated using the contingent valuation method. The results reveal that the mean willingness to pay premium for a hypothetical loss of GH¢ 1,000 of farm income is GH¢24.43. The minimum and maximum willingness to pay premium, in the insurance scheme are GH¢5.00 and GH¢80.00 respectively. The empirical results of the Binary Logit Model reveal that farm size, family size and diversification via livestock are factors that influence farmers' willingness to participate in crop insurance. Recommendations drawn for consideration by Government of Ghana (Ministry of Food and Agriculture), policy makers, insurance companies, development organizations and non-governmental organizations in rural poverty reduction are that the design and implementation of any crop insurance scheme in the Kintampo North Municipality and areas with similar characteristics should consider critical factors such as family size, farm size and livestock activities in the design. Further, a weather index-based insurance product should be piloted especially for droughts and floods while considering the current risk-management strategies employed by farmers. It is imperative that the Government subsidizes this program in the initial stages to encourage participation in the form of providing weather station equipment that would enable insurance companies to effectively validate liability claims by farmers.

Keywords: insurance premium; food crops farmers; willingness to pay; market based insurance; farm size

JEL Classification: G02, G11, G22, D84

1. Introduction

According to the 2008 World Development Report (WDR), Agriculture is a vital development tool for achieving the Millennium Development Goal (MDGs) that calls for halving by 2015 the share of people suffering from extreme poverty and hunger (World Bank, 2008). Three out of every four people living in rural areas of developing countries depend directly or indirectly on agriculture for their livelihoods. In much of Sub-Saharan Africa, agriculture is a strong avenue for spurring growth, overcoming poverty, and enhancing food security.

Agriculture is an important economic sector in Ghana, employing about two-thirds of the labour force in formal and informal employment and accounting for an average of 30 percent of Gross Domestic Product (GDP) in the past ten years and contributing 60% of export earnings (Government of Ghana (GoG), 2009; Institute of Statistical, Social and Economic Research (ISSER), 2010). Even though, the share of Agriculture in GDP continues to decline it remains important (ISSER, 2007, 2008, 2009, 2010, 2011; GoG, 2008).

According to a PSIA study by Assuming-Brempong *et al.* (2004) small-scale producers form about 90 percent of the farming population in Ghana. Available statistics show average farm size of 3.9 hectares and more than 50 percent of households own less than 3 hectares of land. Nyanteng and Seini (2000) stated that over 90 percent of Ghana's food production is derived from holdings of 3 hectares (ha) or less. Chamberlin (2007) also found that more than 70 percent of Ghanaian farms are 3 hectares (ha) or smaller in size. Crop production in Ghana is predominantly rain-fed with outputs heavily dependent on the amount and distribution of rainfall (Seini, 2002). As a result, crop output in Ghana is highly correlated with the rainfall pattern. Food crop production should receive more attention not only to resolve Ghana's food security problem but also to take advantage of growing demand from Ghana's middle-income class, which provides the opportunity for developing a local food industry (OECD, 2008) and also increasing demand for food worldwide.

Ghana's economy was reported to have grown at 6.3 percent in 2007 and 7.3 percent in 2008. The main driving factor behind the rapid agricultural growth is the crop subsector (including cocoa), the largest subsector in agriculture, accounting for more than two-thirds of the agricultural economy. According to Breisinger *et al.* (2009), staple crops such as maize, sorghum, rice, cassava, yam, plantain, pulses, and oilseeds dominate this subsector with some high value crops such as vegetables and fruits contributed modestly to overall agricultural growth.

The business of crop production, however, is inherently risky due to its heavy dependence on unpredictable weather factors. Poor households in Ghana, who mostly depend on small-scale, rain-fed agriculture for their livelihood, face substantial yield and income risks arising out of their individual idiosyncrasies and also risks that are inextricably linked with the production environment. These poor households lack resources with which to absorb shocks of natural and manmade disasters. Consequently, small disruptions in the flow of incomes due to natural and manmade hazards do have serious implications for poor households, hence poor farmers commonly avoid risk by adopting self-insurance and informal measures, and

avoiding investing in potentially profitable but risky ventures. The management of inherent risks associated with agricultural crop production has remained the key challenge in the development and poverty reduction programme of Ghana since independence. Protection of small farmers from agricultural risks is a special concern in rural poverty alleviation programmes. (GoG, 2007; Molini *et al.*, 2007).

To mitigate the plight of crop farmers, researchers and policy makers have made a number of risk-minimizing recommendations. For instance, Hess (2003) and Skees *et al.*, (2001) have identified modern risk mitigating measures such as production contracts, marketing contracts, forward contracts, futures and options contracts, leasing inputs, custom hiring and crops and revenue insurance. Unfortunately, small holder resource-poor farmers invariably lack the capacity to adopt these recommendations as they are disadvantaged, have limited resources and are often outside the usual flow of agricultural information. They seldom read agricultural publications aimed at more sophisticated farmers and supported by advertisers who sell products and services to the more profitable farmers as well as commercial farms. Small- scale, resource poor farmers in developing countries are therefore obliged to adopt traditional/informal mechanisms for coping with and managing risks (Wenner and Arias, 2003).

Many agricultural risks are systemic or covariate in nature, with a single event leading to multiple, highly correlated crop losses (Kalavakonda and Mahul, 2003; Diaz Nieto *et al.*, 2006). Traditional risk-coping mechanisms cannot deal effectively with the covariability problem because a drought for instance could affect an entire region. When this happens support from relatives is absent and borrowing for consumption is costly when risk affects most of the area residents. During such crisis, liquidated assets fetch low prices because many farmers are trying to sell at the same time. Barret *et al.*, (2001); Brown and Churchill (1999); Rozenweig and Binswanger (1993) in various studies have established that self-insurance or traditional risk coping measures are not only a barrier to poverty alleviation but re-enforce poverty. The tradeoff between the impact of the hazard and production culminates in loss of substantial incomes. Thus, reliance on traditional risk coping strategies has the potential to trap poor smallholder farmers in perpetual poverty (Diaz Nieto *et al.*, 2006).

Thus, when farmers anticipate risk of crop loss due to drought, flood, windstorms, bushfire, pest infestation, diseases attack and a plethora of other natural disasters, they tend to reduce risk by minimizing investments in the crop by not applying vital inputs such as fertilizer and pesticides since investment in these inputs increase their loss should the crop fail. Therefore, traditional risk coping can boost the chances of survival of the poor crop farmer to a limited extent as it is not an efficient and sustainable risk management tool. Modern risk management measures are not readily available in developing countries (Wenner and Arias, 2003), due to absence of thriving risk management market tools, hence farmers in these areas are obliged to adopt traditional informal mechanisms for coping and managing risk.

Market-based crop insurance is a risk management tool that farmers can use in today's agricultural industry. The principle of insurance seeks to exchange irregular uncertainty of large losses for small regular premium payments. As a general rule, the larger the potential

loss of assets and incomes to a household posed by a given risk and the fewer alternatives there are to recover from such losses the higher the probability of taking insurance (Brown and Churchill, 1999). Formal crop insurance schemes are the most effective means known to date where there is a high degree of uncertainty and when there is high associated lose. Hess (2003) contend that crop insurance can play a vital role as an alternative ex-ante risk coping instrument to enable poor farmers in developing economies cope with weather related production risk.

Unfortunately, earlier crop insurance schemes in even the United States of America and Canada were not financially viable due to the fact that they covered multiple perils, resulting in excessive indemnity payments (Skees *et al.,* 2001). Multi-Peril Crop Insurance schemes in the USA failed as the schemes were exposed to substantial moral hazards in which the insured farmer has no incentive to take prudent care to avoid crop losses. Miranda and Glauber (1997) argued that crop insurance schemes fail because crop risk are systematic or covariate, that is they occur over geographically extensive areas. The normal solution to covariate risk is re-insurance or other long range risk sharing mechanisms, which is unlikely to be offered except at prohibitive cost.

Crop Insurance is not widely used in Africa, except by large scale commercial farms. Even then, only machinery, equipment, farm building and structures are the major items insured (Anaman, 1988). In Ghana there is only a pilot formal market based insurance scheme to effectively insure the farmer against production risk. The absence of widely available formal insurance schemes preserves high production and marketing risks. The objectives of the study are fourfold: to identify the perils facing the crop farmers; to examine the impact of the of the identified perils; to examine the factors that influence the willingness to participate in the market based crop insurance; and to examine the factors that influence the willingness to pay premium for the market based crop insurance. The rest of the study is structured as follows. Section 2 provides the methodology; section 3 provides the empirical application and results; and section 4 provides the conclusions and recommendations.

2. Methodology

2.1 Theoretical and analytical techniques

The demand for a hypothetical insurance scheme can be measured with the contingent valuation method (CVM), which is often used to value nonmarket commodities (Kealy and Turner, 1993). The two most widely used methods of eliciting for insurance demand are the open-ended, willingness-to-pay (WTP), and the closed-ended or a dichotomous choice questioning method, willingness-to-accept (WTA). The participation question under research can be formulated in both formats. In general, the elicited value by framing it as the cost of a loss exceeds the elicited value by framing it as the benefit of a gain (Turner, *et al.,* 1994). The open-ended willingness- to-pay approach does not specify the possible premiums a priori. The open ended willingness to participate format was used because of practical considerations. Respondents were asked to state the maximum amount of premium they were

willing to pay per GHS 1,000 (hypothetically insured sum) of farm income loss due to the impact of a peril. The amounts were analyzed using descriptive statistics.

The demand for insurance is often hypothesized to be influenced by numerous explanatory variables (Goodwin, 1993). Expected utility maximization is the usual framework in which the determinants of insurance demand are examined. The maximum amount that farmers would be willing to pay for crop insurance is assumed to be equal to the cost of other risk management strategies currently providing the same protection. Within this framework, farmers who value the security provided by insurance more highly would be willing to pay higher premiums (Smith and Baquet, 1996). Consequently, this analysis is focused on the following, more or less conventional, explanatory variables: socio-economic and demographic characteristics, relative risk and capacity to bear the risk, risk perception, farm characteristics included farm size, crop-centered diversification, diversification via livestock and use of improved crop varieties.

A Binary Logit Regression Model was used to determine the factors that influence farmers' willingness to participate in a crop insurance scheme in the Kintampo North Municipal. The use of Binary Logit Regression Model, which gives the maximum likelihood estimates, overcomes most of the problems associated with linear probability models and provides estimators that are asymptotically consistent, efficient and Gaussian so that the analogue of the regression t-test can be applied. The Binary Logit Model based on the cumulative logistic probability function is computationally easier to use than the Probit models and was used in this study (Pindyck and Rubinfeld, 1981).

The theoretical model is given as follows. The cumulative logistic probability model is specified as:

$$P_i = F(Z_i) = 1 + \frac{1}{1 + e^{-(\alpha + \sum \beta_i x_i)}} \quad (1)$$

Where P_i is the probability that an individual is willing to participate in the market based crop insurance, given X_i (the explanatory variables); α and β_i are parameters to be estimated. The log odds of the probability that an individual is willing to insure is given by:

$$\log\left(\frac{p_i}{1 - p_i}\right) = Z_i = \alpha + \beta_1 x_1 + \beta_2 x_2 + \ldots\ldots + \beta_k x_k \quad (2)$$

The Binary Logit Model is used to determine the effect of the explanatory variables on farmers' willingness to participate in crop insurance scheme in the Kintampo North Municipal. The dependent variable is a binary variable representing the willingness to participate (1) and Otherwise (0). Independent variables included are farmer characteristics such as age, educational level, household income, years of farming (experience), farm size, land tenure, enterprise diversification, total asset and total debt (Table 1).

The empirical model is specified as in (3) as follows.

$$WTP = \beta_0 + \beta_1 AGE + \beta_2 AGE^2 + \beta_3 EDUC + \beta_4 YFARM + \beta_5 FMLSIZE + \beta_6 FINCM + \beta_7 OFINCM + \beta_8 FRMSIZE + \beta_9 TENURE + \beta_{10} GEODIV + \beta_{11} TOTASS + \beta_{12} TOTDEBT + \beta_{13} LSTOCK + \beta_{14} CROP + \beta_{15} IMPVAR + \varepsilon \quad (3)$$

where WTP denotes willingness to participate in crop insurance scheme, and the explanatory variables are as described in Table 1 below.

Table 1: Explanatory variables, descriptions, and their measurements

Variable	Description	Measurement	Expected/Sign
AGE	Age of the respective farmer	Absolute measure of age of farmers was obtained in years(completed whole years)	-
EDUC	The education of the respective farmer.	Dummy (formal education =1, Otherwise = 0)	+
YFARM	Number of years the farmer has been engaged in farming	The number of completed years of farming of the respective farmers was measured as an absolute figure in years	+
FMLSIZ	Family size (number of family members who are dependent on the farm)	The family size of farmers was measured as an absolute figure	+
FINCM	The farmer's farm income; measured as the sum of proceeds of individual farm enterprises	GHS	-
OFINCM	The farmer's off-farm income; measured as the sum of all declared off-farm earnings per cropping season.	GHS	-
FRMSIZ	Total farm size is measured by summing the total hectares.	Farm sizes measured in hectares	+
TENURE	Dummy indicating whether farmer owns land or otherwise. (Owner =1, otherwise =0)	Dummy (Owner =1, otherwise =0)	-
GEODIV	Ownership of parcels of land located in different geographical areas	Dummy (single location =1; otherwise=0)	-
TOTASS	Total value of farm assets	GHS	-
TOTDEBT	Total debt of farming operation	GHS	+
LSTOCK	Livestock enterprise	Dummy (livestock = 1; otherwise = 0)	-
CROP	Intercropping	Dummy (intercrop =1; otherwise = 0)	-
IMPVAR	Use of improved seeds/seedlings/varieties	Dummy (Improved variety = 1; otherwise =0)	+

2.2 Sampling and data collection

A representative sampling method was used in the survey. A random sample of one hundred and twenty (120) farmers was drawn from ten (10) communities in the Municipality. Twelve (12) farmers were randomly selected from each of these communities for the study: Dawadawa, Babatorkuma, Cheranda, Asantekwa, New Longoro (Mantukwa), Mansera, Kunsu, Badukura, Nyamebekyere and Busuama. The study involved field interview of food crop farmers using a structured questionnaire, which was administered face-to-face. The questionnaire covered several areas including the following; personal and demographic information on farmers, crop production, farm assets, risk management and insurance measures as well as sources of income. It is worth noting that the study area (town and villages) is made up of about 71 percent farmer population (www.ghanadistricts.com).

2.3 Perils affecting crops production

A predetermined list of perils: drought, windstorms, flood, pest infestation, diseases, and destruction by grazing livestock herds, bushfires and theft, was presented to farmers to select from the list, perils they perceived to pose a threat to their crop production. Multiple responses technique was employed to collect the data on perils. Percentages of farmers identifying the various perils were calculated and ranked.

2.4 Estimation of the frequency of occurrence and severity of perils

Farmers were asked for the number of times they were affected by perils identified in the preceding five years. Mean frequencies of actual occurrence of these perils were calculated. The peril with highest mean frequency was the most frequently occurring peril. The relationship between frequency of occurrence and severity of peril was also examined. The frequency and severity of various perils were rated by farmers on a 5 point likert scale of 1 = very low, 2 = low, 3 = average, 4 = high, 5 = very high. Descriptive statistics was used to describe farmers' perceived effect of various perils on crop production.

2.5 Determination and analyses of how food crop farmers manage risks

Traditional risk management strategies such as farm enterprise diversification, the distress sale of farm assets, the use of family labour and shifting from farming to engage in non-farm enterprises were used to examine how farmers currently manage risk. Descriptive statistics was used to analyze various risk management strategies identified.

2.6 Study area

The Kintampo North Municipal is located between latitudes 8º45'N and 7º45'N and Longitudes 1º20'W and 2°1'E in the Brong Ahafo Region of Ghana. It is in the transitional zone between the forest and northern savannah zones. The Municipal has a surface area of about 5,108 square km, making up about 12.9 percent of the total land area of Brong Ahafo Region (39,557 square km). The Municipal is located at the centre of Ghana and serves as a transit point between the northern and southern sectors of the country. The vast nature of the Municipal with an estimated population of 96,538, gives a low density of 18.90 persons per square kilometer. The implication in terms of agriculture is that there is abundant land for

farming and other socio-economic activities. This is further buttressed by the comparatively easy acquisition of agricultural land in the Municipal. The Municipal is a net receiver of immigrants. About 48 percent of the total population surveyed was immigrants, mainly from the northern part of the country. These migrants mainly came in as settler farmers. They settled along the trunk road that runs through Kintampo to Tamale form Kumasi but others are scattered over the Municipal.

Agriculture is the major economic activity and constitutes the main source of household income in the area. The major food crops produced are Yam, Maize, Cowpea, Cassava, Rice, Plantain, Egushie, Groundnut and Beans. Cashew, Mango, Tomatoes, Onions, Water Mellon, Garden eggs and Soya beans have potential to increase the incomes of farmers. Despite efforts of farmers, frequent bush-fires, High cost of inputs, inadequate extension and other services, prevalence of pests and diseases, lack of access to credit, poor market prices and market facilities account for the low yields of farm produce in the area (www.ghanadistricts.com)

3. Empirical Application and Results

3.1 Socio-demographic characteristics

The age distribution of surveyed farmers in the Kintampo North Municipality ranges between 20 and 100 years with a mean age of 46 years. The data generally reveals a young farmer population (20 and 60 years) represented by 86 percent of the farmers interviewed compared with national average. The implications of having a young population of food crop farmers in the Kintampo North Municipality is that it has the potential of providing social support for the dependent groups who fall within age groups of 0-19 years and 61years and above.

In terms of gender, 69 percent were male whiles 31 percent were female. Therefore, we contend that farming in the Kintampo North Municipality a male dominated venture.

Twenty one percent of the farmers interviewed were single while 79 percent were married. In terms of education, 72 percent of farmers have no formal education; 13 percent of farmers have primary education, 9 percent have middle school or Junior high school education whiles only 6 percent of farmers have secondary, vocational, commercial or technical educational. The study area therefore is predominantly made of farmers with little or no formal education.

The household size distribution of the 120 farmers interviewed indicates that almost all (99 percent) have household sizes ranging between 1 and 10. Only one farmer has household size greater than 10. The mean household size is 4.6 for the sample which is slightly higher than the Brong Ahafo Regional mean of 4.1 and the national mean of 4.0 (GSS,2008). Data available indicates that the farmer population in the Kintampo North Municipality is quite experience with 54 percent of the farmers interviewed having more than 21 years of farming experience, 33% have between 11 to 20 years of farming experience and with a mean of 23 years experience.

Eighteen percent of the farmers have farm sizes between 0 and 2 hectares, 58 percent have

farms sizes between 3 and 4 hectares whiles 24 percent have farms sizes greater than 5 hectares. Sherrick *et al.,* (2004) stated that larger farm sizes reflect greater managerial capacities and perhaps economies of size in the utilisation of various risk management practices. Land holdings according to crop type in the study area reveals a range of 0.2 hectares and 8 hectares and a mean of 1.8 hectares. Generally, farms sizes of farmers are lower than land holding due to constraints associated with inputs for production.

3.2 Perils of food crop production in Kintampo north municipality

Perils identified by farmers as having effect on crop production were bushfires, drought, windstorms, grazing livestock, theft, floods, pests and diseases. Figure 1 shows the assessment of respondent on multiple perils that affect their operations. Bushfires are the most important peril based on the fact that 98 percent of farmers stated it. Ninety-one percent of farmers identified both drought and windstorms as perils affecting crop production. Grazing livestock, theft, floods, diseases and pests attack were also reported by 80, 61, 47, 38 and 29 percent respectively of the farmers as perils.

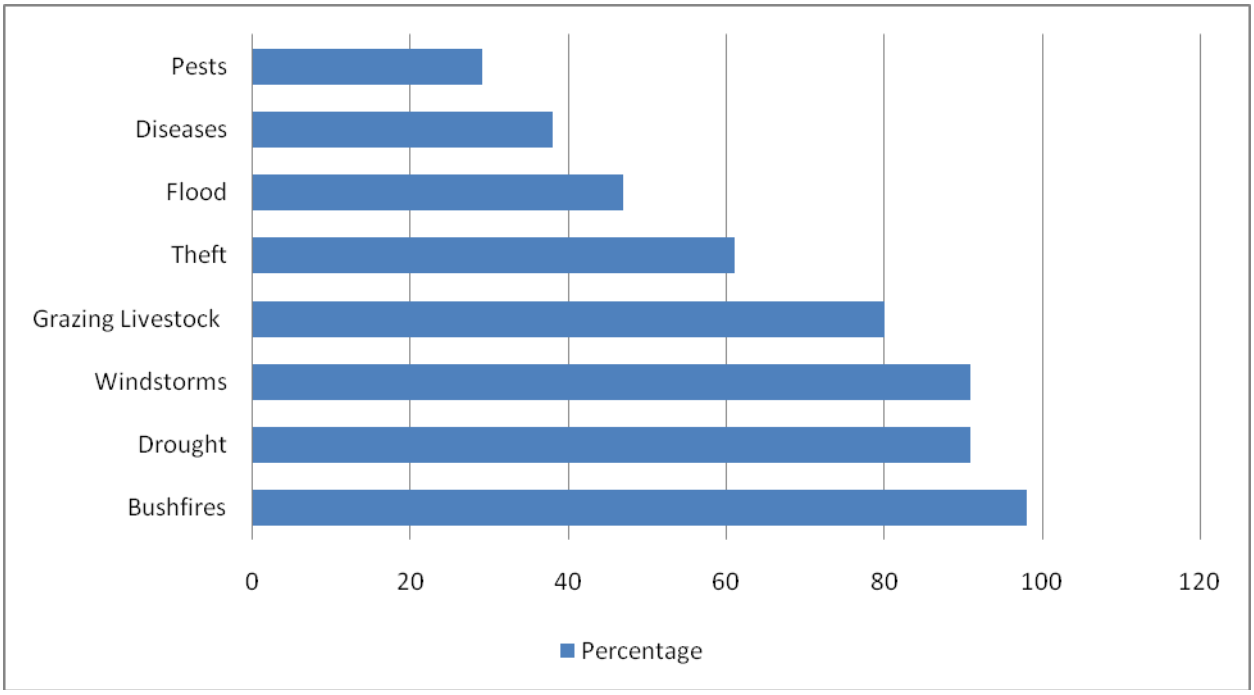

Figure 1: Perils that adversely affect food crop production

Source: Survey data (2010)

3.3 Impact and frequency of perils in the Kintampo north municipality

The results (Table 2) represent respondents' perception on the severity of perils on crop production and their general welfare. Respondent were made to rate the impacts of perils as very low, low, average, high and very high using a five point Likert scale. Farmers generally rated bushfires as the most important peril as evidenced by its rank. Drought, floods and windstorms were rated second, third and fourth respectively. Others such as theft, grazing

livestock, pests and diseases were rated fifth, sixth, seventh and eighth respectively on the scale.

Majority (83%) of the farmers rated the occurrence of bushfires as very high, 16 percent rated bushfires as high, and one percent each rated bushfires as very low and average. No farmer rated bushfires as low. Similarly, a high percentage of farmers (72%) rated the impacts of drought on production as very high. Twenty-two percent rated drought as high while 3 percent and 4 percent of farmers rated impacts of drought as low and average respectively. No farmer again rated drought as very low. Twenty-nine percent rated impacts of flood as very high whiles 46 percent of farmers rated the impacts of floods as high.

Table 2: Perils and their perceived impact on farmers' crop production

		Perceived Effects of Perils on Crop Production						
Perils		**Very Low**	**Low**	**Average**	**High**	**Very high**	**Score (value)**	**Weighted Ranking (value)**
Bushfires	# of farmers	1	0	1	19	99		
	%	1%	0%	1%	16%	83%	575	1
Drought	# of farmers	0	3	5	26	86		
	%	0%	3%	4%	22%	72%	555	2
Floods	# of farmers	5	7	18	55	35		
	%	4%	6%	15%	46%	29%	468	3
Windstorms	# of farmers	11	21	55	19	14		
	%	9%	18%	46%	16%	12%	364	4
Theft	# of farmers	16	37	26	28	13		
	%	13%	31%	22%	23%	11%	345	5
Grazing Livestock	# of farmers	11	37	39	27	6		
	%	9%	31%	33%	23%	5%	340	6
Pests	# of farmers	52	54	10	3	1		
	%	43%	45%	8%	3%	1%	207	7
Diseases	# of farmers	56	50	11	0	3		
	%	47%	42%	9%	0%	3%	204	8

Source: survey data (2010)

Farmers indicated that windstorms characteristically and preceded rainfall in the Kintampo North Municipal and could result in fatal consequences. Twelve percent rated the impacts of

windstorms as very high, 16 percent of farmers rated the impacts of windstorms as high whiles 46 percent rated windstorm impacts on food crops as average. Eighteen and 9 percent of farmers rated windstorms as having low and very low impacts on crop production respectively. According to the farmers, activities of Fulani herdsmen in the municipality pose a great danger to growing crops. Table 2 shows 5 and 23 percent of farmers rated the impacts of grazing livestock as "very high" and "high" respectively. Thirty-three percent of farmers rated impacts of grazing livestock as average while 31 percent and 9 percent rated the impacts as low and very low respectively.

Other perils such as pest attack, disease and theft were rated by farmers from very low impact to very high on crop production. Finally, the impact of the activities of thieves on outputs and incomes of farmers was rated by 13 percent and 31 percent as very low and low respectively. Twenty-two percent of farmers rated impacts of theft as average whiles 23 percent and 11 percent of farmers rated theft as high and very high respectively.

Figure 2 shows the mean frequencies of occurrence of the perils in the preceding five years (i.e. 2005-2010). The result shows that the occurrence of bushfires in the study area is the highest with a mean frequency of 5 in five years. Grazing livestock, theft and windstorms have mean frequencies of 4, 3 and 3 respectively in five years. The results further depict low mean frequencies of 2 for both pest and diseases.

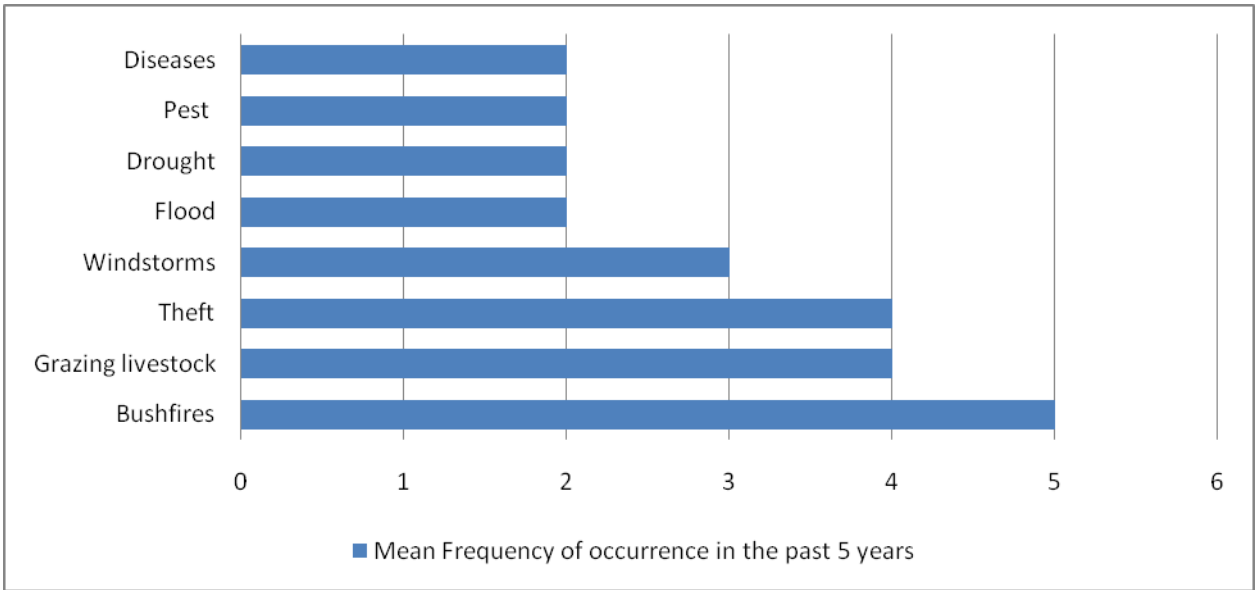

Figure 2: Frequency of perils in five years (2005- 2010)

Source: survey data (2010)

A comparison of the effects of perils in Table 3 and the mean frequencies of occurrence in Figure 2 reveals that a peril such as bushfire, is rated as having 'high impact' by 83 percent of farmers and a corresponding mean frequency of 5 can conveniently be described as a "high impact, high frequency" peril. Drought can also be described as a "high impact, low frequency" peril. Similarly, pest and diseases can also be described as "low impact, low

frequency" perils (Table 3).

Table 3: Classifications of perils

Frequency	Effect	
	High	**Low**
High	Bushfires, Windstorm	Livestock grazing, Theft
Low	Drought, Flood	Pest, Diseases

Source: Survey data (2010)

The study further assessed the effect of all these perils (drought, flood, windstorms, livestock, pest, diseases, bushfires and theft) on the various crops cultivated by farmers and found that the effects of drought, flood, windstorms, livestock and bushfires were the most damaging (Table 4). The study also revealed rampant theft of root and tuber crops especially, yam. The impacts of pests and diseases on cassava as well as the devastating impact of windstorms on plantain in the field were also emphasized by the research.

Table 4: Percentage distribution of food crops impacted by perils

Crops/Perils	Drought	Flood	Windstorms	Livestock	Pest	Disease	Bushfires	Theft
Yam	7.5	4.6	3.8	1.8	1.9	6.5	**18.0**	**76.7**
Cassava	0.8	1.9	9.4	7.3	**57.1**	**47.2**	**16.0**	**12.9**
Plantain	4.2	7.4	**42.5**	3.7	8.6	9.3	2.0	0.0
Cocoyam	0.0	0.9	0.9	0.9	0.0	0.0	1.0	0.9
Maize	**75.8**	**42.6**	**38.7**	**77.1**	**20.0**	**20.4**	**54.0**	8.6
Rice	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sorghum	0.0	0.0	1.9	1.8	0.0	0.9	2.0	0.0
Cowpea	5.0	**15.7**	1.9	5.5	2.9	5.6	5.0	0.9
Groundnuts	1.7	5.6	0.0	0.0	1.9	1.9	0.0	0.9
Soya bean	1.7	3.7	0.9	1.8	1.9	1.9	1.0	0.0
Tomato	2.5	**16.7**	0.0	0.0	5.7	6.5	1.0	0.0
Okro	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Pepper	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
G/eggs	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Onion	0.0	0.9	0.0	0.0	0.0	0.0	0.0	0.0
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: Survey data (2010)

The impact of perils on farm assets (land, livestock, machinery, harvested produce and

produce in the field) was also examined (Table 5). Bushfires were identified to have devastating impact on both harvested produce and produce still in the field.

Table 5: Percentages of farm assets impacted by perils

	Farm Assets		
Perils	**Building**	**Growing Crops**	**Commodity Losses**
Drought	0.0	73.3	0.0
Flood	0.0	11.7	1.7
Windstorm	0.0	15.0	0.0
Livestock grazing	0.0	10.0	0.0
Pest Attack	0.0	4.2	4.2
Diseases	0.0	2.5	0.0
Bush Fires	19.2	93.3	89.2
Theft	0.0	4.2	35.0

Source: Survey data (2010)

3.4 Risk management strategies of food crop farmers in the Kintampo north municipality

The study also sought to determine and analyze the various ways that food crop farmers in the Kintampo North Municipal currently manage their risks. Risk management strategies used by farmers in the study area include diversification or growing different crops, use of land tenure arrangements in which the risk associated with farming is shared with others (sharecropping). The survey results presented in Figure 3 indicate that 42 percent reduce, mitigate and cope with risks by distress sale or liquidation of productive assets. This practice has implications for the households' future productive capacity. Eight percent cope with risks by varying their cropping practices by planting a combination of drought resistant-variants, planting different fields and staggered planting over time, intercropping, and relying on low risk inputs. Thirty-nine percent of farmers add on other businesses in order to diversify their income sources. Five percent of farmers cope with natural disaster by borrowing from friends and family and also resort to the use of family labour. The increase use of family labour could have adverse consequences as children may be withdrawn from school to participate in farm activities.

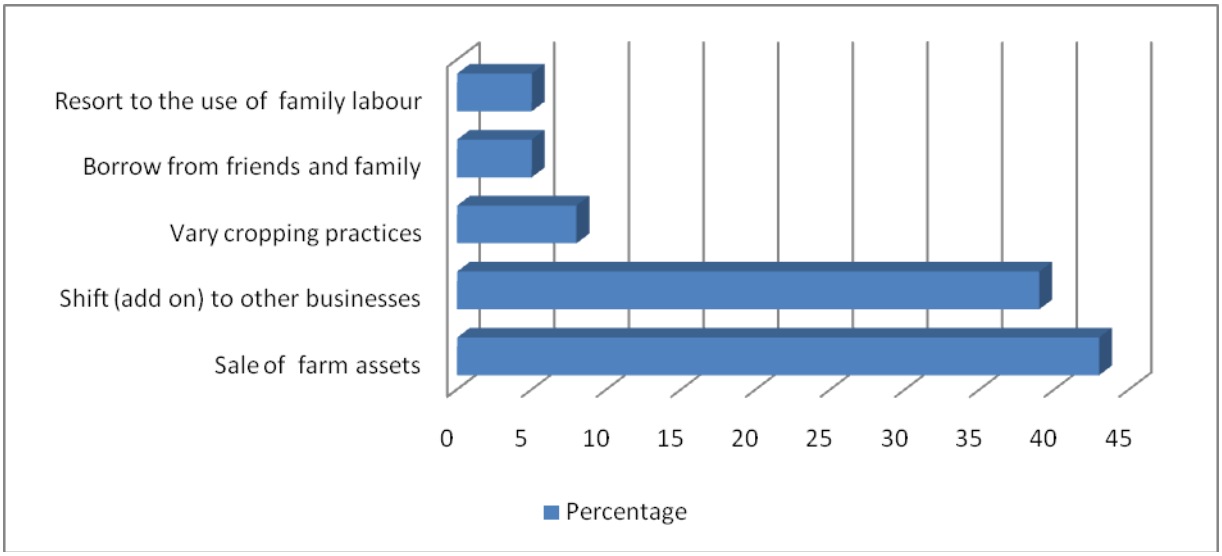

Figure 3: Risk management strategies of food crop farmers

Source: survey data (2010)

3.5 Factors influencing food crop farmers' willingness to participate in crop insurance

The Binary Logit Regression Model was used to determine the factors that influence food crop farmers' willingness to participate in crop insurance in the Kintampo North Municipal. The explanatory factors included; age, educational status, farm size, farm income, non-farm income, total asset, total debt, crop diversification, livestock enterprise, tenure status and the use of improved varieties. The Binary Logit regression results in Table 6 and the marginal effects of the significant variables in Table 7 reveal that four out of fourteen explanatory variables included in the model were statistically significance and also satisfied a priori expectations: family size (FMLSIZE), farm size (FRMSIZE), land tenure (TENURE), and livestock enterprise (LSTOCK). However, Educational status of the farmer (EDUC), showed significance at 5 percent but had negative sign contrary to a priori expectations.

The educational level of farmer is consistent with the findings of Black and Dorfman (2000) who estimated a negative coefficient for education suggesting that the more educated a farmer, the less likely he is to purchase crop insurance products which is in conformity with the theory that better educated farmers are better managers and are exposed to other sophisticated risk management practices and therefore are less likely to purchase crop insurance. The marginal effects of the education variable indicates that access to formal education decreases the probability of participating in the market based crop insurance by 51%. The result is, however, in contrast with the findings of Sherrick *et al.* (2004), Mohammed and Ortmann, (2005), and Paudel and Matsuoka (2008) who obtained results which suggested that farmers who have more years of education are more efficient and more likely to understand and buy insurance than uneducated farmers. This was demonstrated by the positive coefficient of the years of schooling of the respondent farmers. We conclude that therefore conclude that willingness to participate in crop insurance scheme is influenced by the level of education of farmers as the farmers' educational levels are generally low.

Family size was significant at 5 percent with a positive coefficient as initially hypothesized. The marginal effect of the farm size variable reveal that an increase in family size by one member will increase the probability of the farmer's willingness to participate by 13%. The result is consistent with the findings of Mohammed and Ortmann, (2005) and Paudel and Matsuoka's (2008) who studied factors influencing adoption of improved maize varieties in Nepal. Paudel and Matsuoka, (2008) defined family size as the number of able bodied and working age members of the household. Large family size provides more labour for farm operation and an increased incentive to produce more output on farm, whiles Mohammed and Ortmann, (2005) defined family size as the number of family members who are dependent on the farm. Most farmers in the study area are smallholders with average farm size of 3.7 hectares; they did not have enough capital to hire labour and relied on family labour for most of the farm operations. This implies that a farmer who has a large family size which could mean high dependence was willing to participate in crop insurance. The positive coefficient for family size indicates that as the number of family members depending on the farm increases, the responsibility of the farmer to avoid potential losses increases and hence willingness to participate in crop insurance.

Findings in Table 6 also indicate that farm size is significant at 1 percent and meets a priori expectation. This result is also consistent with the findings of Goodwin (1993) who evaluated the effect of farm size on crop insurance participation and found higher participation rates among larger farms. Sherrick *et al.*, (2004) and Mohammed and Ortmann (2005) also in similar studies established a positive relationship between crop insurance participation and farm size. The marginal effect computed for farm size is 0.075 which connotes that an increase in farm size by one hectare will lead to a corresponding increase of 7.50 percent in the probability of farmers' willingness to participate in crop insurance.

The land tenure variable showed significance at 1 percent with a negative influence on willingness to participate in crop insurance consistent with what was initially hypothesized. The marginal effect reveals that ownership of land leads to about 33% reduction in the probability of the farmer's willingness to participate in the market based crop insurance. This is consistent with the findings of Sherick *et al.*, (2004) who found a significant negative relationship between willingness to participate and ownership of farm land. Greater wealth and less land tenure risk reflect stronger risk bearing capacity and greater reliance on self-insurance rather than market based crop insurance. Black and Dorfman (2000), however, also obtained results which indicated a positive relationship between rented land and willingness to participate which contradicts the findings of Sherick *et al.*, (2004). The explanation offered by Black and Dorfman (2000) was that some farmers had non-contiguous rented land and have tracts of different soil types and therefore, provided farmers with a certain sense of protection from a diversified geographic arrangement. Geographic diversification has the tendency to lower the perceived production risk and hence the low effective demand for crop insurance. The explanation to the inverse relationship between land tenure and willingness to participate in crop insurance could be due to the fact that land in the Kintampo North Municipality belongs to the community, the village or family and individuals have usufructuary rights. Usufructuary title to land implies the right of the

individual citizen to the enjoyment of cultivation right and even to the right of transferring his individual enjoyment either by gift, will or inheritance to others (Ollenu, 1962). This provides farmers with a certain sense of protection from this system of ownership of land and incentive to invest.

Table 6: Binary logit regression estimates of farmers' willingness to participate in crop insurance

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	2.276618	3.887791	0.585581	0.5582
AGE	-0.138272	0.144783	-0.955027	0.3396
AGE^2	-0.000331	0.001284	-0.258047	0.7964
EDUC	-2.116866	0.847431	-2.497979	0.0125**
YFARM	0.070818	0.065713	1.077688	0.2812
FMLSIZE	0.538236	0.269002	2.000862	0.0454**
FINC	0.056994	0.057248	0.995563	0.3195
OFINC	0.005449	0.008522	0.639334	0.5226
FRMSIZE	0.310594	0.116196	2.673012	0.0075***
TENURE	-1.362112	0.514474	-2.647581	0.0081***
GEODIV	-1.049952	0.729949	-1.438391	0.1503
TOTASS	0.000252	0.001379	0.182664	0.8551
TOTDEBT	-0.001426	0.001102	-1.293349	0.1959
LSTOCK	-1.641756	0.705732	-2.326317	0.0200**
CROP	0.427085	1.000325	0.426947	0.6694
IMPVAR	0.627139	0.512537	1.223598	0.2211

Mean dependent var	0.591667	S.D. dependent var	0.493586
S.E. of regression	0.416168	Akaike info criterion	1.201299
Sum squared resid	18.01234	Schwarz criterion	1.572965
Log likelihood	-56.07796	Hannan-Quinn criter.	1.352235
Restr. log likelihood	-81.14954	Avg. log likelihood	-0.467316
LR statistic (15 df)	50.14316	McFadden R-squared	0.308955
Probability(LR stat)	1.14E-05		

(***), (**) and (*) are significant at 1%, 5% and 10% respectively

The other factor that met a priori expectation is ownership of livestock enterprise at 5 percent significance level. The marginal effect indicates that diversification via livestock production decreases the farmer's probability of participating in the market based crop insurance by about 40%. The variable connotes farmers who diversify via livestock which confers a certain

sense of self- insurance for such farmers. The negative coefficient of the variable (LSTOCK) reflects the relationship between farmers' willingness to participate in crop insurance and diversification of farm enterprise via livestock. The negative relationship between willingness to participate and LSTOCK is thus consistent with the findings of Sherrick *et al.,* (2004) and Mohammed and Ortmann (2005).

Table 7: Marginal effects of significant explanatory variables

Variables	Effect	Marginal Effect
EDUC**	Negative	-0.5114
FMLSIZE**	Positive	0.1300
FRMSIZE***	Positive	0.0750
TENURE***	Negative	-0.3291
LSTOCK**	Negative	-0.3966

(***), (**) and (*) are significant at 1%, 5% and 10% respectively

4. Conclusions and Recommendations

The study assesses food crop farmers' willingness to participate in market-based crop insurance scheme in the Kintampo North Municipal of Ghana using primary data solicited from 120 farmers in April 2010. The study employed descriptive statistical techniques to analyze the social, economic, demographic characteristics of farmers as well as their current risk management practices. The major perils of food crop production are: bushfires, drought, windstorms, grazing livestock, theft, floods, disease and pest attack. These were classified into four groups of perils based on their frequency of occurrence and severity or impact: high frequency, high impact; high frequency, low impact; low frequency, high impact; and low frequency, low impact. Bushfires, drought and floods are the most frequently occurring perils and cause significant output losses and need market-based insurance products. The least occurring and least severe perils are pests and diseases attack. Theft as a peril is crop specific as it tends to impact mostly roots and tuber crops such as yam, cassava and plantain which are the main staple foods in the area. Windstorms caused extensive damage to plantain crops. Family size, farm size and diversification via livestock are statistically significant factors influencing farmers' willingness to participate. Majority of the farmers in the Kintampo North Municipality employ traditional risk management techniques such as the sale of farms assets (43 percent) and adding on other businesses (39 percent).

Further, farmers' willingness to participate in a hypothetical market-based insurance scheme was estimated using the contingent valuation method. The results reveal that the mean willingness to pay premium for a hypothetical loss of GH¢ 1,000 of farm income is GH¢24.43. The minimum and maximum willingness to pay premium, in the insurance scheme are GH¢5.00 and GH¢80.00 respectively. The empirical results of the Binary Logit Model reveal that farm size, family size and diversification via livestock are the factors that influence farmers' willingness to participate in crop insurance.

Recommendations drawn for consideration by Government of Ghana (Ministry of Food and Agriculture), policy makers, insurance companies, development organizations and non-governmental organizations in rural poverty reduction are that the design and implementation of any crop insurance scheme in the Kintampo North Municipality and areas with similar characteristics should consider critical factors such as family size, farm size and livestock activities in the design.

Perils such as bushfires and drought are covariate in nature and occur over an extensive geographical area of a contiguous parcel of land. These perils have high frequency and high impact effects on crop outputs hence should be carefully considered by insurers since they could lead to heavy indemnity claims.

Further, a weather index-based insurance product should be piloted especially for bushfires and droughts, while considering the current risk-management strategies employed by farmers should also be considered in the design. It is imperative that the Government subsidizes this program in the initial stages to encourage participation in the form of providing the weather station equipment that would enable insurance companies to effectively validate liability claims by farmers.

The major policy implication revealed by this study is that farmers who have the ability to self insure generally are not interested in market-based crop insurance and therefore lead to high levels of exposure by insurance firms if care is not exercised. The research should be replicated in all agro-ecological zones in Ghana since production of food crops in the various agro-ecological zones face different challenges and conditions.

References

Anaman, K.A. (1988). *African Farm Management*. University Press: Accra, Ghana.

Asuming-Brempong, S., Al-Hassan, R., Sarpong, D. B., Kwadzo, G. T-M., Akoena, S. K. K., Sakyi-Dawson, O., Mensah-Bonsu, A., Amegashie, D. P. K., Egyir, I., & Ashley, S. (2005). Poverty and Social Impact Analysis (PSIA) Studies. Ghana: Economic transformation of the Agricultural Sector. *Report submitted to the National Development Planning Commission and Ministry of Food and Agriculture*, Accra, Ghana.

Barret, C.B., Reardon, T., & Webb, P. (2001). Non-farm income diversification and household livelihood strategies in rural Africa: Concepts, dynamics and policy implications. *Working paper*, pp. 31.

Black, D. L., & Dorfman, J. H. (2000). Identifying farmer characteristics related to crop insurance purchase decisions. Department of Agricultural and Applied Economics, University of Georgia. *American Agricultural Economics Association.*

Breisinger, C., Diao, X., Thurlow, J., & Al-Hassan, R. M. (2009). Potential Impacts of a Green Revolution in Africa – The Case of Ghana. *Paper presented at the 27th IAAE Conference*, Beijing.

Brown, W., & Churchill, C. (1999). Providing Insurance to Low income Households Part I: A primer on Insurance Principles and Products. *USAID-Microenterprise Best Practices (MBP) Product*, pp. 91.

Chamberlin, J. (2007). Defining smallholder agriculture in Ghana: Who are smallholders? What do they do and how are they linked with markets? *GSSP Background Paper 6*. Washington, DC: IFPRI.

Diaz Nieto, J., Cook, S., Lundy, M., Fisher, M., Sanchez, D., & Guevara, E. (2006) A system of drought insurance for poverty alleviation in rural areas: The feasibility of practical method of drought insurance that is self-sustaining and ready for use by poor farmers, NGOs or other development organizations. *Colombia, South America: Centro Internacional De Agricultura Tropical (CIAT).*

Godwin, B. K. (1993). An empirical analysis of the demand for Multi-Peril Crop Insurance. *American Journal of Agricultural Economics*, *75*(2), 425-434. http://dx.doi.org/10.2307/1242927

Government of Ghana (2007). *Facts and Figures*. SRID, Accra.

Government of Ghana (2008). Food and Agricultural Sector Development Policy II. (FASDEP II,). Ministry of Food and Agriculture, Accra-Ghana.

Government of Ghana (2009). Budget Statement and Economic Policies of the Budget for a brighter future. Retrieved from http//www.mofep.gov.gh

Hess, U. (2003). Innovative financial services for rural India: Monsoon-indexed lending and insurance for small holders. *Agriculture and Rural Development Working Paper 9*. World Bank, Washington, DC.

ISSER, (2007-2011). The State of the Ghanaian Economy in 2006. Accra, Ghana: *Institute of Statistical Social and Economic Research*, University of Ghana, Legon.

Kalavakonda, V., & Mahul, O. (2003). *Crop Insurance in Karnataka*. World Bank report requested by the Government of Karnataka.

Kealy, M. J., & Turner, R. W. (1993). A Test of the Equality of Closed-Ended and Open-Ended Contingent Valuations. *American Journal of Agricultural Economics*, *75*(2), 321-331. http://dx.doi.org/10.2307/1242916

Miranda, M. J., & Glauber, J.W. (1997) Systematic risk, reinsurance and the failure of crop insurance markets. *American Journal of Agricultural Economics*, *79*(1), 206-215. http://dx.doi.org/10.2307/1243954

Mohammed, M. A., & Ortmann, G. F. (2005). Factors Influencing Adoption of Livestock Insurance by Commercial Dairy Farmers in Three Zobatat of Eritrea. *Agricultural Economics Research, Policy and Practice in Southern Africa (Agrekon)*, *44*(2), 172-186.

Molini, V., Keyzer, M., Boom, B.V.D., & Zant, W. (2007). Creating safety nets through semi-parametric index-based insurance: A simulation for Northern Ghana. *World Bank.*

Nyanteng, V.K., & Seini, A. W. (2000). Agricultural policy and the impact on growth and productivity (1970-1995) In: *Economic reforms in Ghana. The miracle and the mirage*. Edited by Ernest Aryeetey, Jane Harrigan and Machiko Nissanke.

Ollenu, N. A. (1962). *Principles of Customary Land Laws in Ghana*. London. Sweet and Maxwell, London.

Organisation for Economic Co-operation and Development (OECD). (2008). Business for development: Agriculture is becoming a business. Retrieved from www.oecd.org/dev/publications/business for development

Paudel, P., & Matsuoka, A. (2008). Factors Influencing Adoption of Improved Maize Varieties in Nepal: A Case Study of Chitwan District. *Australian Journal of Basic and Applied Sciences*, *2*(4), 823-834.

Pindyck, R. S., & Rubinfeld, D. L. (1981). *Econometric Models and Economic Forecasts* (2nd Edition). London: McGraw Hill.

Rozenweig, M. R., & Binswanger, H. P. (1993).Wealth, weather risk and the composition and profitability of agricultural investments. *The Economic Journal*, *103*, 56-78. http://dx.doi.org/10.2307/2234337

Seini, A.W. (2002) Agricultural growth and competitiveness under policy reforms in Ghana. *Institute of Statistical, Social and Economic Research (ISSER) University of Ghana, Legon. Technical Publication NO. 61. ISSER Technical Publication Series*.

Sherrick, B.J., Barry, P. J., Ellinger, P. N., & Schnitkey, G. D. (2004). Factors influencing farmers' crop insurance decisions. *American Journal of Agricultural Economics*, *86*(1), 103-114. http://dx.doi.org/10.1111/j.0092-5853.2004.00565.x

Skees, J.R., Varangis, P., Larson, D., & Siegel, P. (2001). Can Financial Markets be Tapped to Help Poor People Cope with Weather Risks? *World Bank Policy Research Working Paper Series*.

Smith, H. V., & Baquet, A. E. (1996). The demand for Multi-Peril Crop Insurance: Evidence from the Montana Wheat Farms. *American Journal of Agricultural Economics*, *78*, 189-201. http://dx.doi.org/10.2307/1243790

Turner, R.K., Pearce, D., & Bateman, I. (1994). *Environmental Economics*. New York: Harvester Wheat sheaf.

Wenner, M., & Arias, D. (2003). Agricultural insurance in Latin America: Where are we? Paving the way forward for rural finance: An international conference on best practices. Agriculture for Development. *Inter-American Development Bank*. Washington, DC.

World Bank, (2008). *World Development Report. Agriculture for Development*. Washington DC.

www.ghanadistricts.com.