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Modeling the Factors that Influence Farmers' Participation in Agricultural Insurance Scheme in Kogi State, Nigeria: Implications for Agricultural Policy

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A R T I C L E I NFO

Key Words

Agricultural insurance,

Food security,

Participation

Farm credit

Food policy

ABSTRACT

The study modeled factors that influenced farmers' participation in agricultural insurance scheme in Kogi State, Nigeria. Specifically, the study identified the sources of risk of major concern among small-scale farmers and identified the determinants of use of agricultural insurance scheme. Using proportionate random sampling technique, 120 insured and 120 uninsured small-scale farmers were randomly selected from a population of 82, 365 farmers for the study. A structured questionnaire was used to collect the required information. Data obtained were analyzed using descriptive statistics and logit model. The major sources of risk among small-scale farmers were ill health/death of household members, market failure, price fluctuation, pest and diseases. The likelihood to participate in agricultural insurance scheme among farmers in the State was significantly influenced by education, farm size, access to credit, farm income, farming experience, access to insurance experts, extension contact, and number of livestock reared. By implication, policy framework towards increasing insurance uptake by crop farmers in the State should prioritize education, increasing access to formal credit, availability of insurance and extension experts.

Introduction

In recent years, farmers in Kogi State are challenged with various sources of shocks in their farming activities. For instance, in 2012 and 2018, the state recorded flood almost in all the Local Government Areas along the riverine areas including Omala, Lokoja, Koto-Karfe, Idah, Igalamela/Odolu, Bassa, Kogi, and Ibaji. There are records of pest and disease infestations, fluctuations in prices of both farm inputs and outputs, and market failures here too with implications on households' income (Olubiyo, et al. 2009). The negative effect of risk on farming as a business is not in doubt. The risk situation is complex in such a way that farmers in the State have troubles in marketing their produce. In addition, institutions that could help them cope with shocks or risks in farming enterprise are not readily available.

Existing government policy described for risk management in the state include risk sharing institutions like the Nigerian Agricultural Insurance Corporation (NAIC) that help reduce the burden of risk among the farming population. Considering their level of low incomes, farm holdings aimed at subsistence production, level of education, poverty and people's perception about the activities of insurance companies in other sectors, farmers always have negative perception about agricultural insurance and perhaps less likely to patronize the market by paying premiums in exchange for their risks (Olubiyo, et al, 2009). Several literatures have treated issues concerning agricultural insurance scheme and agricultural production (Olubiyo et al., 2009, Okwoche et al., 2012,

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Nwosu et al., 2012, Suresh, 2011, Boyd and Milton, 2011, Nmadu et al., 2012, Falola et al., 2013 and Farayola et al., 2013) but literatures that strictly treated the drivers of farmers' participation in agricultural insurance scheme in Kogi State are sketchy. Furthermore, recent empirical studies in the country that econometrically modeled farmers' decision to participate in agricultural insurance are limited.

Farmers' participation in crop insurance in Africa is not encouraging, except by large scale commercial farming enterprises. However, only machinery, equipment, farm building and farm structures are majorly insured by these commercial farms (Hill, 2010). In Nigeria and Kogi State in particular, there is only one formal market-based insurance scheme administered by the Government. The absence of widely available insurance markets, especially private sector participation, preserves high level of risks among farming communities. The above background forms the thrust of this study. The objectives of the study are to: identify major source of shocks among farmers in the State and examine factors that influence their participation in the agricultural insurance scheme.

1.2 Economic Model

This study is hinged on expected utility theory. Expected Utility (EU) is a theory of utility in which preferences of people (farmers) with regard to uncertain outcomes are represented by a function of the payouts and the probabilities of occurrence (Qniggin, 1993). Being rational, farmers pick outcome with the highest EU.

Farmers maximize utility under uncertain condition as shown below:

EU for the insured farmers is given as:

$$E(U) = \sum_{i=1}^{n} PiUin(Xi) - - - - - - - - - - -(1a)$$

For uninsured farmers:

$$E(U) = \sum_{i=1}^{n} PiUun(Xi) - - - - - - - - - - (1b)$$

Where: X_i represent environmental conditions outside the farmers' control; in and un distinguishes the utility under outcome X_i for the insured and uninsured farmers respectively and P_i is the probability of outcome X_i.

From equation 1a and 1b, the decision alternative with the highest expected utility is chosen.

Considering a simple maximization problem as given below:

$$\max_{q} PU(FI - L - \Pi d + d) + (1 - P)U(FI - \Pi d) - - - - - - -(2)$$

L = loss; Π = premium/unit of coverage; d = indemnity

With an initial level of farm income (FI), an individual farmer is supposed to lose an amount, L. To avoid this loss, the farmer can participate in agricultural insurance that will pay him/her an amount, d, in the event that he/she incurs a loss due to natural disaster. To be eligible for d or for the farmer to remain covered under the insurance program, he/she has to pay a premium per unit of coverage. A farmer can only demand for indemnity, d, if there is L. However, the premium remains as long as the farmer wishes to be covered.

In sum, farmers will participate in agricultural Insurance if d exists such that the expected utility of being insured is higher than the expected utility of being uninsured as given below:

$$\text{PU}\big(FI - L - \Pi d + d\big) + (1 - p)U\big(FI - \Pi d\big) > \text{PU}\ (FI - L) + (1 - p)U(FI) \text{---------------} (3)$$

It is important to state that solution to this simple utility maximization problem depends on the farmer's demographics, farm and institutional characteristics. It also depends on the individual farmer's attitude to risks; is the farmer risk averse, risk neutral or risk loving. A risk averse farmer will completely insure himself against loss. Such a farmer prefers a certain outcome to an uncertain one with the same expected values and has a concave utility function. Risk neutral farmer is indifferent. He is only interested in the expected values and has a linear utility function. Risk loving farmer is the direct opposite of risk averse. Such a farmer is ready to take risk and prefers uncertain outcome over a sure outcome with a convex utility function.

2.0 Research Methods

2.1 Study Area

The study area is Kogi State, North Central, Nigeria. The State is located between latitude $6^0$30'N and $8^0$5'N and longitude $5^0$51'E and $8^0$00'E. It is bounded with nine (9) States and FCT: Federal Capital Territory (FCT) to the North, Nasarawa State to the north east, Benue State to the east, Enugu and Anambra States to the south east, Edo State to the south west, Ondo and Ekiti States to the west, Kwara State to the North West and Niger State to the North. Kogi State has a total population of about 4, 457,879 people in 2016 (using the state projected growth rate of 3%) (NPC, 2006) and land area of about 30, 354, 74 square kilometers.

The population of the study comprised of farmers in Kogi State. A sample of 120 insured and 120 uninsured farmers were selected using proportionate sampling technique. Lists of registered insured farmers were

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obtained from the National Agricultural Insurance Corporation (NAIC) and Bank of Agriculture (BoA) while farming population in the State was obtained from Agricultural Development Project (ADP), Kogi office. A total of 240 farmers were sampled and used for the study. The proportionate model is specified as: nh = Nh (n/N). Where; nh = sample size from NAIC list and ADP farming population, Nh = sample frame, n = sample size from each group, N = Total number of farmers from the selected LGAs in each group. Structured questionnaire and personal interview were used to collect the primary data used for the study.

2.2 Empirical Framework

The demand for a hypothetical agricultural insurance scheme can be measured using revealed preference method to elicit information about values through survey responses. This study adopts the participation decision in agricultural insurance scheme by farmers in Kogi state due to its flexible and practical nature. The utility obtained by a farmer that adopts a technology (such as agricultural insurance use) is not observable and depends on a set of observed exogenous factors (Nchinda, *et al.* 2010).

Considering the nature of the response variable, the standard binary regression model (BRM) is used to determine drivers of farmers' participation in agricultural insurance scheme. The BRM is a nonlinear model that is used whenever the dependent variable of interest is binary (1 and 0). The model conceptually estimates the probability of the dependent variable to be 1. It is the probability that participation in agricultural insurance will happen.

Participation was modelled as a function of an individual farmer's demographics, farm and institutional characteristics. Farmers' attitudes towards risk were proxied by years spent schooling. To this effect, the logit or probit model can be adopted instead of the typical linear probability model (LPM). This is because the LPM is characterized by non-normal errors, inconsistency and exhibits heteroskedastic errors, and the flaws in the LPM do not exists in either the logit or probit models (Stock & Watson, 2012; Wooldridge, 2010).

Generally, the logit model is given as:

$$\Pr(y = 1|x) = \Pr(y^* > 0|x) = (X\beta) \quad (4)$$

$$y_i^* = \beta Xi + \varepsilon_i = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_n X_n + \varepsilon_i \quad (5)$$

Where; $y = 1\ (y^* > 0),\ i = 1, \ldots, N$

y_i^* ➔ the latent variable could be described as farmer's participation in agricultural insurance, which assumes 1 if the farmer is insured, and 0 if otherwise. Xi is a vector of observable characteristics that determines or influence participation in agricultural insurance, β is a vector of coefficients associated with observable characteristics that affects participation, ε_i is the idiosyncratic error term (Cameron & Trivedi, 2005).

For coefficient interpretation, marginal effects were generated from the logit analysis. This is so, because economic theory suggests that if the distribution of the dependent variables is not strongly skewed, the marginal effects from the estimation will be analogous with the Ordinary Least Square (OLS) coefficient and the estimation results would be consistent with this prediction (Weiguo, 2011).

The unit of measurement in estimated coefficient from the logit regression is not test points as in OLS. The unit of measurement is log odds, and a 1-point increase in log odds is not straight forward, because the logistic regression line is not straight forward, and thus the marginal effects expressed as a proportion is not stable across range of data. Two common solution to this issue exist in literature; taking the marginal effect at the mean (MEM) and the average marginal effect (AME). The average marginal effects (AME) was used instead of the marginal effects at mean (MEM) because it gives the least overestimate.

The AME is favoured by common practice and it captures average marginal effects instead of marginal effects of averages. It is preferred in this study because it is simple, straightforward and gives a representative of marginal effects across individuals as earlier pointed out by Bartus, (2005).

The AME is derived as follows (Wooldridge, 2010):

$$AME = \frac{1}{N}\sum_{i=1}^{N} F'(x_i'\beta)\beta \quad (6)$$

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Table 1: Explanatory variables used in the model

Variables	Unit of Measurement
Age	Years
Education	Years
Tenure	Dummy (1=Ownership, otherwise=0)
Farm Size	Hectares
Livestock/Poultry	Number
Farming experience	Years
Family size	Number
Awareness on agricultural insurance	Dummy (yes=1, otherwise=0)
Access to credit	Dummy (yes=1, otherwise = 0)
Access to insurance experts	Number
Access to extension messages	Number
Gender	Dummy (1=male, 2=female)
Annual farm income	NGN

3.0 Results and Discussion

3.1 Major Sources of Shocks among Farmers in Kogi State

The various sources of shocks or risks of major concern among farmers in Kogi State and the corresponding percentage of farming households affected are shown in Table 2. The case of illness was observed as a major risk source. This finding has implications on the availability of labour for agricultural production. This is because most of the farming households have household members as source of available labour for farming activities. Price fluctuation was also a major source of shocks among farmers in the State. As shown in Table 2, the effect of price fluctuation on farmers' activities could be associated with the failure of existing markets. Price fluctuation implies variability in the prices of agricultural produce overtime, while market failure referred to a situation where the prices of food crops reduced drastically (Salimonu & Falusi, 2009). The incidence of pest and disease was also on the high side. However, on farmers' recall, they agreed to gradual decline with respect to pest infestation. The gradual decline in the incidence of pest could be attributed to technological development and the adoption of Integrated Pest Management (IPM) system by the farmers as reported by Ibitoye, Orebiyi and Shaibu (2012).

Table 2: Distribution of Respondents According to Major Sources of Risks N=240

Sources of Shocks	No. of Respondents*	Percentage
Flood/storm	100	41.7
Pests and diseases	164	68.3
Drought[1]	07	2.9
Erratic rainfall[2]	71	29.6
Market failure	62	25.8
Price fluctuation	163	67.9
Fire outbreak	48	20.0
Change in government policy	76	31.7
Ill health/death of household member(s)	181	75.4
Loss of land/ethnic clash	45	18.8
Theft	40	16.7

Source: Field Survey (2016).
NOTE:

[1]= persistent extremely dry weather condition with no enough rainfall for crop growth
[2]= inconsistency, unpredictable and "changing direction" rainfall pattern
* = multiple responses

3.2 Factors that Influence Farmers' Participation in Agricultural Insurance

Table 3 provides result of the estimated binary logistic regression model on the determinants of farmers' participation in agricultural insurance. The model's log likelihood ratio and the $\chi 2$ value indicate that variables included in the model significantly influenced the probability of participation in agricultural insurance at 1%. Significant variables in the model are discussed.
The magnitude (dy/dx = -0.0035) of farmers' attitude towards risk (proxied as years spent schooling) was negatively signed and statistically significant at 10%. By implication, an increase in farmers' years spent schooling will lower the probability of participating in agricultural insurance.

The magnitude (dy/dx = -0.0192) of farm size measured in hectares was negatively signed and significant at 10% with the probability of participating in agricultural insurance. The inverse relationship implies that the probability of participating in agricultural insurance decreases with increase in farm size. This means that farmers with larger area of farm land have less probability to participate in agricultural insurance. This finding agrees with Robert, *et al.*

Table 3: Estimates of the Binary Logistic Regression

Variable	dy/dx	Std. Error	z-value	Significance level
Age (years)	-0.0019	0.0012	-1.59	0.113
Education (years)	-0.0035	0.0020	-1.73	0.084*
Farm size (ha)	-0.0192	0.0111	-1.71	0.086*
Land ownership (dummy)	-0.0302	0.0296	-1.02	0.309
Access to credit (dummy)	0.0827	0.0351	2.36	0.018**
Farm income (₦)	5.18e-07	1.53e-07	3.38	0.001***
Farming experience (yrs)	0.0037	0.0011	3.44	0.001***
Household size (No.)	0.0003	0.0033	0.08	0.935
Secondary occupation (dummy)	0.0891	0.0554	1.61	0.108
Access to insurance expert (No.)	0.0801	0.0157	5.10	0.000***
Extension contact (No.)	0.0176	0.0084	2.10	0.035**
Livestock reared (No.)	-0.00007	0.00004	-1.67	0.094*
Sex	-0.0447	0.0282	-1.59	0.113

Source: Computed from Field Survey Data, 2016. ***, **and * = coeff. Sig. @ 1%, 5% and 510 respectively
Obs. 240; Log-likelihood= -89.991; LR $\chi2$ = 152.73; Prob>$\chi2$ = 0.000; Pseudo R^2= 0.4590

(2014) who reported an inverse relationship between farm size and farmers' willingness to adopt crop insurance in Ghana. However, this finding goes contrary to the finding by Abouzar, *et al.* (2014) who reported a direct significant relationship between farm size and adoption of agricultural insurance among farmers in Iran. The magnitude (dy/dx = 0.0827) of access to credit shows a direct relationship with the probability of participating in agricultural insurance with 5% level of significance. This is in line with the *a priori* expectation. Farmers who had access to credit facilities are more likely to participate in agricultural insurance than those who had not. This result is not surprising as one of the requirements to accessing agricultural loans in the state is to be insured. Also, farm income was found to be positive and significant at 1%. By implication, if farmers' income increases, their probability of participating in agricultural insurance will increase. An increase in income will increase their ability to pay insurance premium.

Farming experience in years also shows a direct relationship with use of agricultural insurance at 1%. Farmers with more experience are less likely to accept risks and hence have more probability to participate in agricultural insurance to mitigate production risk.

Access to agricultural insurance experts and extension agents show a direct relationship with farmers' participation in agricultural insurance at 1% and 5% level of significance respectively. Farmers' contact with insurance experts and extension agents increase their level of awareness and knowledge on the adoption of agricultural innovations/technologies. The implication is that, the higher the level of this knowledge, the more the likelihood of participation in agricultural insurance scheme.

Number of livestock reared shows an inverse relationship with the probability of participating in agricultural insurance at 10% level of significance. This implies that as the number of livestock increases, there is a decrease in the probability of agricultural insurance use. This could be attributed to the fact that majority of the farmers are involved in crop production. This could also explain why most studies on agricultural insurance focused on crop insurance. This position agrees with Okwoche *et al.* (2012), when they reported similar findings among farmers in Benue State.

4.0 Conclusion

The positive and significant influence of credit access to participation in agricultural insurance, suggest for the intervention of government and other relevant agencies for the provision of loan scheme with single digit interest rate to farmers in the state. This will enable farmers to cope with the financial requirement involved in buying agricultural insurance product, and perhaps, expand their scale of production.

Furthermore, access to extension and insurance experts strongly influenced participation in agricultural insurance scheme. There is the need for insurance experts and extension agents to be encouraged to expand their scope of service delivery to enhance participation in agricultural insurance scheme in the state. This could be achieved through provision of motivation and other incentives by government to enhance their service delivery.

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