Willingness to Pay for Index-Based Livestock Insurance: Perspectives from West Africa

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Abstract:

In this paper, we examine factors influencing adoption of the index-based livestock insurance (IBLI) in Kwara State, Nigeria. We apply open-ended contingent valuation technique to determine the amount farmers are willing to pay for the IBLI offering coverage for livestock valued at N500,000 (Nigerian Naira). We carried out this study on household heads who took the traditional insurance in previous years. We also discuss important issues ranging from the IBLI premium cost to the effect of religion, education and gender on adoption of the insurance product. Our results create an initial framework for the acceptance of the IBLI since the product is not presently existing in Nigeria.

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Keywords: Index-based Livestock Insurance, Willingness to Pay and Nigeria.
USD 1 = ₦ 360 (Nigerian Naira)

1. Introduction

Climate risks pose significant threats to sustained agricultural development in developing countries and livestock production is now considered a risky business (Yesuf and Bluffstone, 2007; Cervigni et al., 2013, Mills, 2015; Takahashi *et. al*., 2016). The ability of the livestock sector to accommodate and recover from the effects of a hazardous event in a timely and efficient manner is almost non-existent in Nigeria (NARF, 2014). Agriculture accounts for nearly 40% of the country's GDP, of which livestock production plays a prominent role (Fakoya, 2007; Hirfrfot, *et. al*., 2014). The need to reduce household's vulnerability to climate shock has encouraged the adoption of various techniques, including insurance (Jensen and Barrett, 2015). Insurance in livestock production is still relatively small in developing countries because the formal insurance has remained underdeveloped with a long history of ineffectiveness in most poor, rural regions (Iturrioz, 2009). Problems such as high administrative cost, moral hazard, adverse selection, as well as the long lag in indemnity payment have discouraged reliance on this insurance option (Barnett et al., 2008).

As a result, other options that provide means of resilience against covariate climate risks for low-income farming households are increasingly being encouraged (Churchill, 2006; de Bock & Gelade, 2012). Index-based insurance is a relatively new product that has been implemented in developing countries only within the last decade, especially in east Africa. Unlike conventional insurance, which indemnifies the insured for proven losses. It provides payouts based on the value of an observable index, such as rainfall, temperature, humidity or regional yields (Barnett and Mahul 2007). The Index insurance contracts are also relatively transparent, making it possible for insurance companies to transfer their risk to international reinsurance markets (Miranda and Farrin, 2012). It offers opportunities for households to avoid problems with indemnification of losses specific to the insured in the traditional insurance. It is also devoid of the significant transaction costs associated with monitoring the behaviour and verification of actual losses.

Literatures agree that small-scale pastoral households in low income countries face critical environmental risks and there are increasing awareness for the adoption of the index-based livestock insurance. However, the hype in the potential of IBLI as being an effective weather shock mitigant has been found questionable (Morduch, 2006; Miranda and Farrin, 2012; Binswanger-Mkhize, 2012; Takahashi *et. al*., 2016). Numerous studies have rather recorded low adoption rate of rarely above 30% of the intended population. Chantarat et al., (2013) used simulations on household-level performance analysis among east African pastoralists and finds out that IBLI removes 25–40 percent of total livestock mortality risk. Even though this could pay huge economic dividends for African countries, the design of contracts still faces a number of challenges from the demand side. This has necessitated the need to reevaluate previous optimism accrued to index-based insurance and studies are beginning to consider various factors that could increase the insurance demand (Leblois *et. al*., 2014). A growing number of projects are trying to fill the void between insurance demand and supply by offering payoffs based on the realization of an aggregate performance indicator, rather than on individual-specific outcomes.

On the "Drivers of Index-Based Livestock Insurance Demand in Southern Ethiopia", Takahashi *et. al.*,(2016) explored the purchase direction of IBLI in southern Ethiopia. The study focused on the role of accurate product comprehension and price due to the fact that while index-based microinsurance has attracted considerable attention, uptake rates have been weak in many low-income countries, as also observed by Matul *et. al.*, (2013) and Miranda & Farrin, (2012). It was stressed that most studies of index insurance demand over the years have been based on crop insurance programs and not livestock. The few studies on IBLI demand are rather concentrated in East African countries (Chantarat *et. al.,* 2013; Barnett *et. al*., 2008 and Ali, 2013).

McPeak *et. al*., (2010) took an experimental approach to explain the concept of index-based livestock insurance in northern Kenya, and analyse patterns of game play. By using extension efforts, the study addressed four points on the implication of IBLI adoption for households. This includes; importance of livestock and livestock products on household income, vulnerability of livestock wealth to shocks, the covariate and idiosyncratic component of livestock mortality and long-term implication of livestock mortality on household's wellbeing. However, there is limited proof to ascertain if the extension effort and approach of the study increases more informed demand of IBLI.

Apart from the fact that studies on livestock insurance are very scarce, this study departs from the normal approach to index insurance demand by examining location-specific factors on (IBLI) adoption in West Africa. Factors such as religion, gender and access to loans, amongst others, have been found to be decisive factors that influence innovation adoption from previous studies (Ighomereho et al., 2013; Benabou *et. al.,* 2015). Although IBLI is currently not established in Nigeria, this paper creates an initial framework for its acceptance and presents preliminary findings as an indicator for a bigger adoption in West African countries, since Nigeria is the major livestock producer in the region.

This study will specifically examine the determinants of the willingness to pay for a hypothetical IBLI product. The remainder of this paper is structured as follows. Section 2 covers the methodology employed in this study. In Section 3 we describe in detail the study area, data collection as well as some preliminary survey statistics. Section 4 explains the estimation result and the paper ends in section 5 with a summary of the conclusions drawn for policy direction.

2. **Methodology**

3.1 Theoretical Framework on Index Insurance Demand

The impacts of insurance can be viewed from two theoretical channels: the production channel and the consumption channel. The production channel shows ways in which insurance could ease the costs imposed by risks before a shock occurs (ex-ante), while the consumption channel looks at its effects after a shock occurs (ex-post). To analyze the demand of index based insurance on livestock farmers' response to production shocks, this study will employ a dynamic model of livestock farmers in developing countries who face aggregate idiosyncratic production shocks. Model adaptations will be used to analyse the demand for index insurance (Gollier, 2003; Miranda, 1991; Bourgeon and Chambers, 2003 and De Nicola (2015). The model will first be in the absence of index insurance ("baseline" framework) to examine optimal consumption, production and investment decisions of farmers in the absence of index-based livestock insurance and then consider how the optimization problem changes with the introduction of index insurance ("insurance" framework).

Preliminary Framework

Let us consider a competitive herd farmer who allocates his wealth/income w_{t+1} between consumption c_t and agricultural investment I_t, which generates income according to a production function with decreasing marginal returns, and an idiosyncratic productivity shocks $\varepsilon_{i,t,}$, such as draught or unfavourable temperature. If the farmer maximizes his expected present discounted utility of consumption as $E_t \sum_{j=0}^{\infty} \beta^j u(c_t+j)$ where utility as a function of consumption c is given as $u(c_t) = \frac{c^{1-\Phi}}{1-\Phi}$ and it is assumed that the farmer have CRRA utility with coefficient of relative risk aversion Φ which can be calculated using the partial risk aversion coefficient, as calculated by Binswanger (1981) and Cole *et al*., (2012). With the absence of weather insurance, the farmer's optimization problem can thus be written as:

$$V(w_t, \varepsilon_{i,t}) = \max_{I_t} u(w_t - I_t) + \beta E V(w_{t+1})$$

$$c_t = w_t - I_t \qquad (1)$$

$$w_{t+1} = Q_i \, \varepsilon_{i,t} \, I_{\tau}^{\alpha} \, a_i^{1-\alpha} \, \eta_{t+1}$$

Where weather variation η_{t+1} is the aggregate weather shock the farmer cannot ascertain as at the time investment decisions are being made. Q_i is the individual-specific time-variant productivity coefficient, a_i represents the land owned by the farmer. It is however important to note that the idiosyncratic terms Q_i and $\varepsilon_{i,t}$ are both log-normally distributed with mean and variance σ^2_Q and σ^2_ε, respectively. It is assumed that farmers cannot adjust the amount of land with which they are endowed, so land a_i is not included in the budget constraint and does not have the time subscript.

The first-order condition for the optimal level of capital is computed by equating the marginal utility of consumption today to the expected discounted marginal utility of consumption tomorrow is given below. It is however important to note that the model implies an infinite target level of wealth towards which farmers will converge if not hit by idiosyncratic or weather shocks.

$$u'(c_t) = \beta E_t[u'(c_{t+1})\, \alpha\, Q_i\, \varepsilon_{i,t}\, I_\tau^{\alpha}\, a_i^{1-\alpha}\, \eta_{t+1}] \qquad (2)$$

Index Insurance Framework

To better understanding index insurance, the baseline framework is expanded and it is assumed that the farmer can buy ι_{t+1} unit(s) of insurance, each of which pays $(1 - \eta_{t+1})$ to offset any bad weather shocks caused through draught or temperature for a specified value of livestock. The farmer's optimization problem thus becomes

$$V(w_t, \varepsilon_{i,t}) = \max_{I_t, \iota_t \geq 0} [u(w_t - I_t) + \beta E_t V(w_{t+1})$$
$$c_t = w_t - I_t \qquad (3)$$
$$w_{t+1} = Q_i\, \varepsilon_{i,t}\, I_i^{\alpha}\, a_i^{1-\alpha}\, \eta_{t+1} + \iota_t(1 - \eta_{t+1}) - \iota_{t+1} \text{Ƥ}_t\, \varepsilon_{i,t}$$

where the term Ƥ_t is the actuarially fair price for one unit of weather insurance and is defined as

$$\text{Ƥ}_t = \int_0^1 (1 - \eta) f(\eta) d\eta.$$

Ƥ_t appears in the transition equation rather than in the budget constraint since it is assumed that farmers have credit to pay for the insurance premium and that they are able to observe their productivity level before insurance purchase. The optimization problem can then be written as follows under full insurance.

$$V(w_t, \varepsilon_{i,t}) = \max_{I_t, \iota_t \geq 0} [u(w_t - I_t) + \beta E_t V(w_{t+1})$$
$$c_t = w_t - I_t \qquad (4)$$
$$w_{t+1} = Q_i\, \varepsilon_{i,t}\, I_i^{\alpha}\, a_i^{1-\alpha}\, (\eta_{t+1} + \underbrace{(1 - \eta_{t+1})\, \text{Ƥ}_t\, \varepsilon_{i,t}}_{\text{Weather insurance component}})$$

Understanding Willingness to Pay for Weather Index Insurance for Livestock

To better understand insurance demand we can also examine the amount a livestock farmer would be willing to pay (WTP) for a fixed amount of insurance coverage, we look at the simple model of insurance demand below. The farmer from previous discussions has fixed income w_{t+1} which is subject to random weather triggered shock η_{t+1} purchase insurance policy Ƥ_t which gives a payout $1 - \eta_{t+1}$ as a function of the shock on a certain value of his livestock. The premium Ƥ_t^* that satisfies the equation below sets the expected utility from purchasing insurance equal to the expected utility from not purchasing insurance, which thus represents the maximum WTP.

$$E[u(w_{t+1} - \text{Ƥ}_t^* - \eta_{t+1} + 1 - \eta_{t+1})] = E[u(w_{t+1} - \eta_{t+1})]$$

However, the WTP for weather insurance can be understood in the simple scenario expressed below

$$u = (w_{t+1})^{1/2}$$

$E[u$(Prob of no shock) x u(no shock) + (prob of shock of occurrence x u(shock)

Assuming there is a 40% probability that there will be weather shock that would affect a livestock farmer's farm and an insurance policy payout of USD 5,000 which is also his income would be earned if there was weather shock, while there is also a 60% probability of no weather shock affecting production in which there won't be any payout to him, this is expressed as (0.6) $(0)^{1/2}$ + (0.4) $(5000)^{1/2}$. From this, the expected utility for the farmer will be 42.4. We can also estimate the actuarially fair insurance policy where full insurance coverage is assumed, meaning that in case of a weather shock to production, the farmer will be repaid the size of his loss which is USD 5,000. This is the product of the probability of shock occurrence to the size of the shock (0.4 x 5,000) and thus, an actuarially fair insurance policy would be to charge the farmer USD 2, 000 because of the high probability of shock occurrence as his insurance premium. To estimate the expected utility suppose the farmer buys a full insurance policy at an actuarially fair insurance premium, in the occurrence of weather shock he would be paid USD5,000 whose insurance he bought with USD 2,000, at the end of the year he would be left with USD3,000. However in the absence of weather shocks he would be earning an income of USD5,000 from which he has already paid the premium of USD2,000 and will not be receiving any payout, thus he would be left with USD3,000 as well. Thus regardless of the occurrence of shock or it absence, the farmer will be left with the same amount of money at the end of the year. The farmer's expected utility with insurance can then be estimated as

Since $u = (w_{t+1})^{1/2}$

$E(u$ with insurance$) = 0.4\ (3000^{1/2}) + 0.6\ (3000^{1/2}) = 54.8$

The farmer is risk averse because he gets a higher level of utility from a guaranteed USD3,000 than facing a risk with an expected value.

To estimate the farmer's maximum willingness to pay,

Since $u = (w_{t+1})^{1/2}$

Max WTP = 5,000 – w^*

Where w^* is the income/wealth level when utility is 42.4

$28.3 = (w_{t+1})^{1/2}$

$w = 800.9$

Max WTP = 5,000 – 1797.8

In the above example the maximum the farmer would be willing to pay for an insurance with a payout of USD 5,000 is USD3,202 which is also a high premium but justifiable due to the high probability of shock occurrence. Note that the insurance payout is perfectly correlated with the weather shocks and that we are thus neglecting the possible presence of basis risk.

Contingent Valuation – Open-ended Technique

Willingness to pay (WTP) for a product may be defined as the amount of money an individual or household is willing to pay for purchasing a product given her/his income, risk preferences and other background characteristics. WTP is generally analysed using the contingent valuation method (CVM). CVM helps estimate the value an individual placed on a good, usually an intangible good. The CVM was pioneered by Davis in 1963. This method is mainly used to evaluate environment and health care programmes (Blumenschein et al., 2008). However, CVM are now being increasingly used to evaluate private market goods and services. Broadly, there are two approaches to studying WTP under CVM. The first is a closed ended format also called referendum or the 'take-it-or-leave-it' approach. The other method, which is more widely used, follows an open-ended format. As described by Watson and Ryan (2007), this study employs the open-ended CV method. The open-ended contingent valuation technique was applied in this study in order to accommodate the true amount farmers would be willing to pay for index-based insurance offering coverage for livestock valued at ₦500,000 because most of the respondents are small-scale farmers. This approach was adopted firstly, because it is free from anchoring bias and does not provide respondents with cues about what the value of the change might be. Secondly, the open ended technique was used because index insurance is currently not established in Nigeria and all the respondents employed in this study currently use the traditional insurance in mitigating production shocks. The open-ended contingent valuation technique is also important in easily accessing the mean willingness to pay and maximum willingness to pay can be identified for each respondents.

Estimation Strategy

For a more rigorous study index –based livestock insurance, we employ multivariate regression analysis. Since a large number of household heads declined willingness to buy IBLI at all, parameters estimated through Ordinary Least Squares (OLS) would be biased and inconsistent. A very common problem in microeconomic data may stem from conditions in which there are information only on the regressors but not on the regressed observations. This sample is known as a censored sample. When data are censored, the distribution that applies to the sample data is a mixture of discrete and conditional distribution and the most appropriate model to analyze such distribution is commonly known as censored normal regression model or Tobit model. It assumes that many variables have a lower or upper limit that is known as threshold value and take on this limiting value for a substantial number of respondents. This is so in our data as most variables are censored around zero WTP. For the remaining sample respondents, the variable takes on a wide range of values above the limit. The explanatory variables in the model may influence both the probability of limit responses and the size of non-limit. The two parts correspond to the classical regression for the non-limit (continuous) observations and the relevant probabilities for the limit (zero) observations, respectively. Based on the above behaviour of the model, we use Tobit analysis for the estimation of determinants of willingness to pay. The structural equation of tobit model as described by long (1997) can be expressed as:

$y_i = \beta' x_i + u_i$

if RHS >0 and

$y_i = 0$

Otherwise

Where,

y_i = WTP

$\beta = k$ x 1 vector of unknown parameters to be estimated.

$x_i = k$ x 1 vector of known constants

u_i = residuals that are independently and normally distributed with mean zero and constant variance σ^2

A limitation of the Tobit model is that, in practice, protest bids are often excluded during analysis of CVM data. Halstead *et. al*., (1992) suggested that this procedure might introduce significant bias and attitude towards paying could be sensitive to methodological variations in the CV surveys. For robustness check, we also carried out probit estimation by including and removing protest zeroes from the analysis. Lastly, average marginal effects analysis was done since it provides a unified and intuitive way of describing relationships estimated with regressions.

3. Data Collection and Sampling Technique

The study was conducted in Kwara State, Nigeria. The state lies exclusively within a tropical hinterland with an estimated 203,833 farm families. Over 70% of farmers are pastoralist, whose livelihoods depend primarily on livestock. Herd migration in search of forage and water during dry seasons is common among pastoralists in this area. (Kwara state diary, 2009). The state has a total land area of about 32,500km^2, which is approximately 123,7681cm^2. The average annual maximum temperature varies between 35ºC and 31ºC throughout the year while the average annual minimum temperature is between 24ºC and 20ºC. The region experiences both wet and dry seasons each lasting for about six months and agricultural production is generally rainfed. Rainfall has a strong influence on livestock population dynamics in the State, and livestock are affected by climate shocks (Oba, 2001; Begzsuren *et. al.,* 2004). The annual rainfall of the state varies a minimum of 57mm and a maximum of 145mm.

The target population of this study are household heads that employed the traditional insurance and are insured by the Nigerian Agricultural Insurance Corporation (NAIC). A two-stage sampling technique was adopted for the study. Four Local government areas (LGAs) were randomly selected out of the 16 LGAs in the state, then 33 farming household heads were selected from each of the LGs making a total of 132 respondents. Some preliminary questions were asked about the effectiveness of the climate risk management strategies employed by each of the respondents and responses where ranked with the mean. Only 24 of the household heads confirmed the effectiveness of the traditional insurance as a risk management strategy. A major challenge with the traditional insurance is that most insurance claims associated with the traditional insurance in developing countries never get paid (Barnett and Mahul 2007; NARF, 2014). Income from other business sources ranked first as an alternative risk management strategy, with 40% of the respondents confirming its effectiveness. Other management strategies employed include; the use of vaccines, improved animal breeds and water harvest technologies.

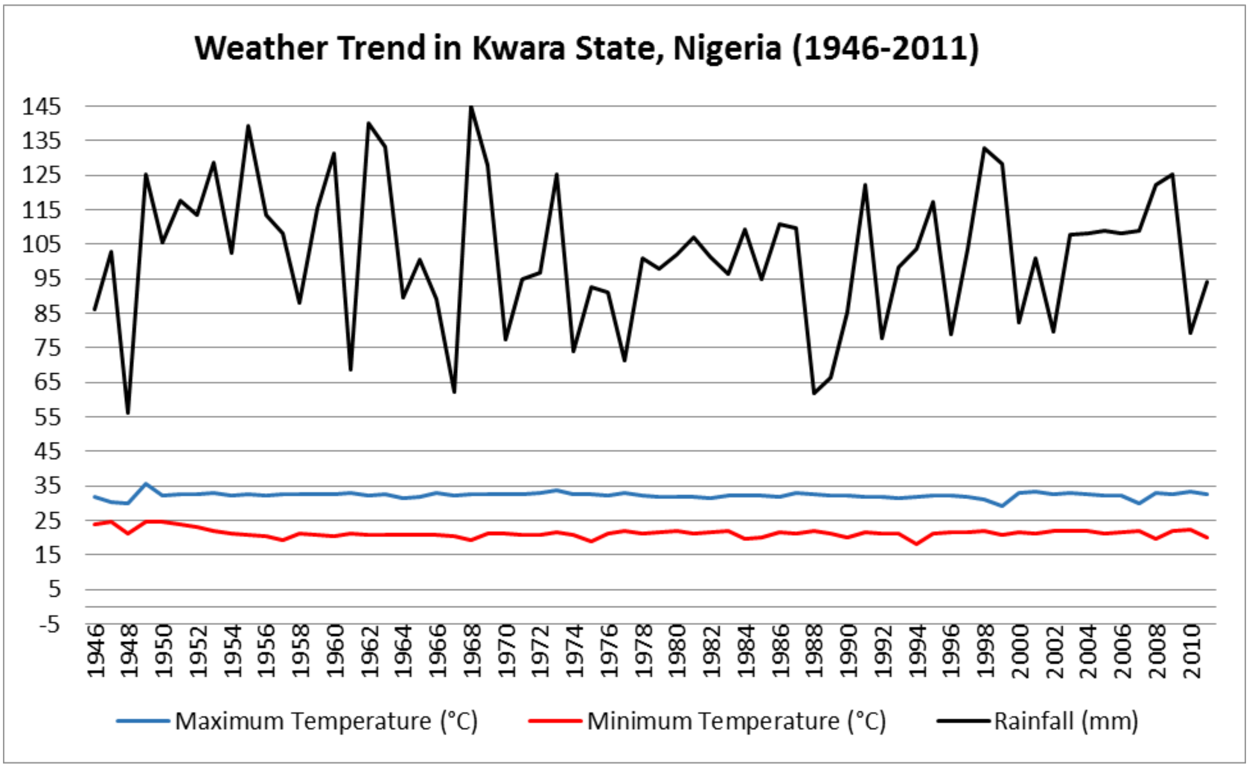

Figure 1: Weather Trend in Kwara State, Nigeria (1946-2011)

Summary Statistics

Descriptive statistics are used to summarize the household heads' socioeconomic characteristics. As from this section onward, "farmers" and "household heads" would be used interchangeably and are both referring to the same people (respondents) for the study.

Majority of the household heads (68.2%) (in Table 1) have more than secondary level education as presented in Table 1. The higher percentage of very educated farmers is likely to have an advantage on the adoption of agricultural insurance Trang (2013). A very high percentage of the farmers (94.3%) are members of at least an economic association. 36 out of the 132 Household heads have no secondary income source. About 44% of the farmers are in the low income group, implying that farming is mostly subsistence. The mean year of experience for the farmers is 5 years.

Table 1:Summary of Socio-economic Characteristics of Respondents

Variables	**Category**	**Observation**	**Percentage**	**Mean**
Gender	Male Female	118 14	89.4 10.6	
Marital Status	Single Married	8 124	6.1 93.9	
Educational Level	6 years 6-12years >12years	20 22 90	15.2 16.7 68.2	
Economic Association	No Yes	2 130	1.5 98.5	
Association Type	None Cooperative All Farmers Association	2 76 54	1.5 57.6 40.9	
Access to Extension Service	No Yes	100 32	75.8 24.2	
Age	≤25 26 - 35 36 - 45 46 - 55 ≥56	4 12 40 58 18	3 9.1 30.3 43.9 13.6	46
Household Size	≤5 6 - 10 ≥11	90 38 2	68.2 28.8 1.5	5
Off Farm Income (Naira)	Low Income Group(≤50,000) Middle Income Group(50,001-100,000) High Income Group(≥100,001)	42 44 10	43.8 45.8 7.6	72,000
Farming Experience	≤5 6 - 10 11 - 15 ≤16	72 44 12 4	54.6 33.3 9.1 3	5

In figure 2, likert scale was used to rank household head's perception of weather risk on production. The exposure to production risks, that is, the magnitude and frequency of stress experienced by the farmers during the production process is dictated by events (Sivakumar and Motha, 2007). These events are hard to control because agricultural production is basically subsistence. Most risks livestock farmers are often exposed to include weather, diseases and pests, random physical hazards and technological failure. Weather related risks had the highest ranking with 55% of the respondents rating it effects as extremely severe on their production.

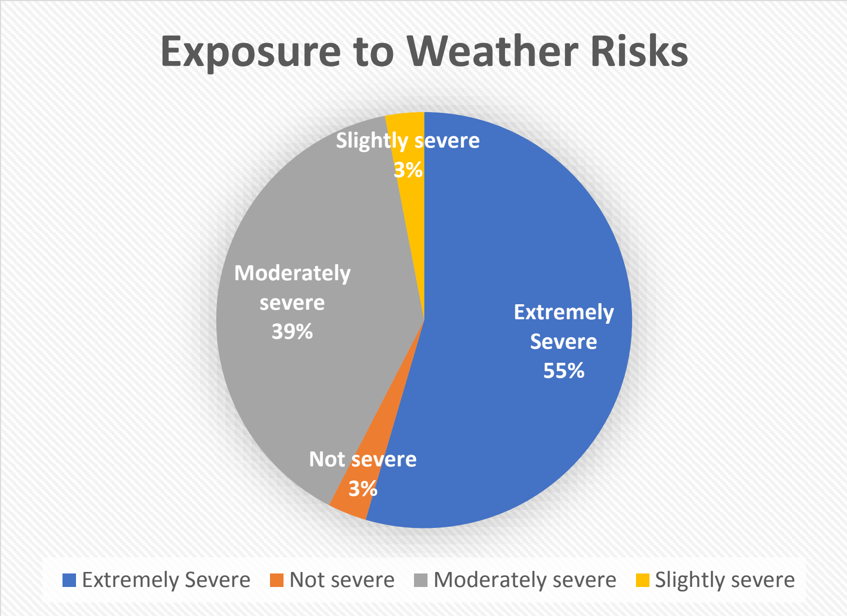

Figure 2: Exposure to weather risk among household heads

We further identified and ranked specific weather risks reported by the household heads. Table 2 shows drought as the major weather risk to livestock production from 66% of the respondents. While 63.6% reported high temperature as a challenge to their production. None of the respondents indicated that that excessive rainfall was a production risk.

Table 2: General Ranking of Specific Weather Risks to Animal Production

Weather Risk	Yes (%)	No (%)	Mean	Rank
Flood	28(21.2)	104(78.8)	0.21	3
Drought	88(66.7)	44(33.3)	0.67	1
Excessive Rainfall	0(0)	132(100)	0.00	5
Fire Outbreak	4(3.0)	128(97.0)	0.03	4
Too High Temperature	84(63.6)	48(36.4)	0.64	2

WILLINGNESS TO PAY FOR INDEX-BASED LIVESTOCK INSURANCE

Table 3: Distribution of Willingness to pay for Index-Based Livestock Insurance

Willingness to Pay	Number of Observation	%
Willing to Pay	68	51.5
Not Willing to Pay	64	48.5
Total	**132**	**100**

From the result in Table 3, 51.5% of the respondents indicate willingness to pay for index-based livestock insurance. The reasons given for not willing to pay are stated in Table 4.

Table 4: Distribution of Reasons for not willing to Pay for index-based livestock insurance

Reason for Not Willing to Pay	Observations	Percentage
True Zero Responses		
It is expensive	35	54.7
I don't think there is a problem with the traditional Insurance	7	10.9
Protest Zero Responses		
Lack of Trust in Insurance Companies	8	12.5
I think it is the responsibility of the government	14	21.9
Total	**64**	**100**

As also confirmed by Greatrex (2015), a lot respondents not willing to pay for the index-based livestock insurance product indicated high cost has reason for declining. This could be so for the initial stage of the implementation of the index-based livestock insurance. This is because whilst index insurance offers opportunities for reduced administration and operating costs, the development phase requires intensive financial and technical inputs (NARF, 2014).

Mean WTP

$$MWTP = \frac{1}{n}\sum_{i=1}^{n} y_i$$

The current government fixed premium rates for the traditional insurance in Nigeria is 2.5% for livestock farmers. Mean willingness to pay was estimated as the summation of amount respondents are willing to pay divided by the summation of the number of true zeroes and respondents with greater than zero willingness to pay. The mean amount respondents are willing to pay yearly for the IBLI offering coverage for livestock valued at ₦500,000 is given at ₦23, 500 (4.7%).

4. Estimation Result

As discussed earlier, an acceptable approach to estimating a continuous dependent variable with censored observations is the standard Tobit model. In model estimation, we excluded the 22 protest zeroes (Table 4) from the analysis in order to get a more accurate result for the WTP determinants (Halstead *et. al*., 1992; Greatrex, 2015). Table 5 presents four Tobit regression results on the factors associated with adoption of IBLI. Firstly, all variables were taken into account, then both membership of economic association and religion were jointly controlled for, the third level involved controlling for membership of economic association only and lastly, controlling for impact of religious belief only. This was done in order to examine whether the results stand up to robustness check on adoption of IBLI in the Nigerian context. Religious beliefs has been found to be a strong factor in affecting a population's degree of risk aversion (Douglas and Wildavski, 1982; Yusuf et al., 2009; Souiden, 2015). Also, access to loans from external sources like economic associations has been found to be decisive in new innovation adoption (Manganhele, 2010; Skees and Collier, 2012; IFC, 2014). Other controls are done in order to minimize potential endogeneity concerns.

From table 5, Age, marital status, size of the household, number of external dependents and frequency of premium payment all tends to be important factors influencing farmers willingness to pay for the hypothetical IBLI. They all showed similar reactions on all four levels/models. Age of household head showed negative correlation with willingness to pay for IBLI. This suggest that younger household heads are likely to rely on IBLI, implying that older heads are more risk averse probably because of more resource constraint from family demands. This view is also partly supported by the coefficient estimates of external dependents on family resources, as a household would likely not adopt the IBLI also when there are many external dependents on its income. This could be a serious factor to consider because it is not uncommon to have a family with as many as five (5) or more external dependents in Nigeria. Marital status and household size both express positive correlation to reliance on IBLI, and so do frequency of premium payment. This implies that household heads would be more willing to pay for the IBLI if the premium is split over say, 12 months, thus, giving them a higher degree of freedom than if required to pay premium more rapidly.

It is interesting to note that years of farming experience only became a significant factor in predicting adoption when membership in economic association and religious factors were not considered in the model. Also, farm income and non-farm income both became very important factors in IBLI adoption when there are no access to loans from external sources. Non-farm income had a negative correlation as also expressed by Takahashi *et. al*., (2016). This is also in line with the findings of Ramasubramanian (2012) who suggested that households who have already identified secondary income sources as a risk coping strategy would invest lower amounts of money in insurance. It is important to note that religion does not appear to influence decision on IBLI adoption as suspected earlier even though all respondents are in a society (Kwara State) where religious practices and beliefs are strong.

Membership of economic association appears very sensitive to the adoption of the IBLI. This is because economic associations in form of farmer groups and cooperatives offers information on new innovations to members and also provide opportunities to access loans. Some existing literatures (Gine´ and Yang, 2009; Giesbert *et. al*., 2011) suggests that education is positively correlated and a significant factor in adoption of microinsurance. However, in line with the finding of Takahashi *et. al*., (2016), our result also shows negative correlation. It further deviated from expectation by indicating that years of formal education may not be a good predictor of IBLI adoption although majority of the respondents had education exceeding secondary level. This stresses the fact that household heads may not always depend on formal education in making practical farm level decisions.

Table 5: Tobit Estimation Result on Determinants of Willingness to Pay for IBLI

Dependent Variable: WTP	All Independent Variables	Controlling for Economic Association Membership and Religion	Controlling for Economic Association Membership	Controlling for Religion
Age	-0.037*** (0.006)	-0.039*** (0.006)	-0.039*** (0.006)	-0.036*** (0.005)
Marital Status	1.955*** (0.257)	1.265*** (0.232)	1.281*** (0.237)	1.921*** (0.252)
Household Size	1.325*** (0.169)	1.173*** (0.177)	1.191*** (0.184)	1.293*** (0.162)
Number of Dependents	-1.257*** (0.167)	-1.13*** (0.176)	-1.150*** (0.182)	-1.225*** (0.159)
Educational Level	-0.048 (0.061)	-0.103 (0.067)	-0.107 (0.068)	-0.041 (0.060)
Years of Farming Experience	0.011 (0.010)	.0184* (0.011)	0.018 (0.011)	0.012 (0.010)
Frequency of Premium	0.426*** (0.034)	0.439*** (0.036)	0.439*** (0.037)	0.425*** (0.033)
LogFarm Income	0.296*** (0.068)	0.101 (0.064)	0.103 (0.064)	0.291*** (0.068)
LogNon-farm Income	-0.006 (0.005)	-0.018*** (0.006)	-0.018*** (0.006)	-0.006 (0.005)
Religion	-0.036 (0.048)	-	-0.023 (0.055)	-
Access to Loan	-0.943*** (0.176)	-	-	-0.936*** (0.177)
_constant	-7.045*** (1.201)	-3.323*** (1.058)	-3.343*** (1.059)	-6.986*** (1.199)

Note: Clustered standard errors are in parenthesis.

***$P < 0.01$, **$P < 0.05$, *$P < 0.1$

Obs. summary:42 left-censored observations at wtp<=0; 68 uncensored observations; 0 right-censored observations

A limitation of the Tobit model is that, in practice, protest bids are often excluded during analysis of CVM data. Halstead *et. al*., (1992) suggested that this procedure might introduce significant bias, without the possibility of knowing the direction of bias beforehand. This gives the possibility that attitude toward paying could be sensitive to methodological variations in the CV surveys. Since the predicted probability of the willingness to pay are limited between 0 and 1, we went ahead to run two different probit models by including more variables as suggested by Takahashi *et. al*., (2016). One model included all observations (132 observations) while the other excluded protest zeroes (110 observations), so as to allow us compare observations without and with the protesters. The results are presented in Table 6 with willingness to pay for IBLI as the dependent variable.

Marital status is positively correlated and significantly affect adoption of IBLI at the 5% level for both models. This infer that married household heads are more likely to adopt the IBLI as a risk mitigating option. Both household size and educational level had positive correlation and suggests reasons for reliance on IBLI. However, the higher significance level of the probit without protest zeroes could make it a more reliable estimate for both household size and educational level. This is also confirmed by the non-farm income variable as the model without protesters gave a 10% significance level while the model with protesters did not predict the variable as a determinant of IBLI adoption.

The age of the household head was squared to allow for nonlinear effects. Both age and its squared term gave consistent results with negative coefficients in predicting adoption. This goes in line with the result of the Tobit model which suggests younger household heads as more likely to rely on IBLI that olden household heads. The major inconsistencies in both probit models was highlighted by the gender of household heads. Where the probit model with protesters predicted that male headed households are more likely to take on the IBLI as a risk mitigating strategy. This also suggests to us that majority of the protest observations are male household heads.

Table 6: Probit Estimation Result on Determinants of Willingness to Pay for IBLI

Dependent Variable: Willingness to Pay	**Probit (Without Protest) 110 Observations**	**Probit (with Protest Zeroes) 132 Observations**
Marital Status	2.981** (1.219)	2.143** (0.963)
Household Size	0.380*** (0.135)	0.261** (0.111)
Educational Level	0.588** (0.257)	0.400* (0.222)
Years of Farming Experience	0.035 (0.047)	0.014 (0.041)
Cultivated Land (Acre)	-0.037 (0.125)	0.008 (0.108)
LogFarm Income	-0.239 (0.277)	-0.284 (0.251)
LogNon-farm Income	-0.042* (0.023)	-0.032 (0.020)
Religion	-0.111 (0.210)	-0.065 (0.194)
Age	-0.504** (0.228)	-0.368** (0.185)
Age Squared	0.005* (0.002)	0.004* (0.002)
Gender (Male=1)	-0.220 (0.431)	1.045*** (0.298)
Extension Visit	-0.331 (0.297)	-0.156 (0.272)
Traditional Insurance Premium	0.000 (0.000)	-0.000 (0.000)
LogAnimal Value	-0.050 (0.154)	0.0247 (0.136)
_constant	8.406 (5.930)	4.631 (5.471)

Note: Clustered standard errors are in parenthesis. ***$P < 0.01$, **$P < 0.05$, *$P < 0.1$

The average marginal effects provide a unified and intuitive way of describing relationships estimated with regression. In Table 7, it measures the effect of the conditional mean of WTP of a change in one of the regressors for both probit models. The AME for marital status in the first probit model tells us that marital status more likely predict adoption of IBLI by 92% while it goes down to 68% for the probit model with protest zeroes. Similar observations are seen in other variables when both probit models are compared. However, adoption of IBLI decreases by about 16% with yearly increase in the age of the household head for the first probit model. Religion comes up weak as a being a major determinant of IBLI adoption with a negative correlation of about 3% and 2% respectively.

Table 7: Average Marginal Effect of Probit Estimation Result

Dependent Variable: Willingness to Pay	**Average Marginal Effects (Without Protest) 110 Observations**	**Average Marginal Effects (with Protest Zeroes) 132 Observations**
Marital Status	0.922^{***} (0.353)	0.681^{**} (0.289)
Household Size	0.118^{***} (0.038)	0.083^{**} (0.033)
Educational Level	0.182^{**} (0.074)	0.127^{*} (0.068)
Years of Farming Experience	0.011 (0.014)	0.004 (0.013)
Cultivated Land (Acre)	-0.012 (0.039)	0.003 (0.034)
LogFarm Income	-0.074 (0.085)	-0.090 (0.079)
LogNon-farm Income	-0.013^{*} (0.007)	-0.010 (0.006)
Religion	-0.034 (0.065)	-0.021 (0.062)
Age	-0.156^{**} (0.067)	-0.117^{**} (0.056)
Age Squared	0.001^{**} (0.001)	0.001^{*} (0.001)
Gender (Male=1)	-0.068 (0.133)	0.332^{***} (0.082)
Extension Visit	-0.102 (0.091)	-0.050 (0.086)
Traditional Insurance Premium	0.000 (0.000)	-0.000 (0.000)
LogAnimal Value	-0.015 (0.048)	0.008 (0.043)

Note: Clustered standard errors are in parenthesis.

$^{***}P < 0.01$, $^{**}P < 0.05$, $^{*}P < 0.1$

5. Conclusions

Many studies in east Africa are increasing awareness for Index insurance as a promising innovation that offers protection for smallscale farmers from losses associated with weather shocks. However, the uptake rate of this product has been rather low. This study investigates the WTP for index-based livestock insurance in the west Africa context, offering coverage for livestock valued at ₦500,000 in Kwara state, Nigeria. It also provides some preliminary findings as indicator for a bigger adoption of IBLI in mitigating climate change effects. More specifically, this study is the first to estimate farmers' perspectives on index-based livestock insurance in Nigeria. It is important to note that availability of coping strategies and farmer's expectation of loss are key drivers of insurance coverage decision in the study area.

Purchasing the IBLI offers more effective weather risk management strategy when compared to the traditional insurance method. This study revealed that on the average farmers would be willing to adopt the index-based insurance for livestock if the cost of the premium is ₦23,500 per year and offer a coverage of ₦500,000 in livestock value. The results obtained in this study have important policy implications, by creating an initial framework for the acceptance of index based livestock insurance product. It also encourage decision on factors that influence reliance on IBLI by analyzing various models for robustness check.

Contrary to expectation that religion might be a major factor in IBLI decisions, we found this to be untrue for the observed household heads. One of the limitations of our study is that we did not observe household heads that have never taken up any type of insurance product. We are thus, unable to examine behaviors in a case where there is no prior knowledge of how insurance works. We hypothesize that previous knowledge in the use of the traditional insurance could be a key influence among the household heads in our observation. Religion could however, remain sensitive if the household have never adopted any form of insurance in past years. But the exact results remain uncertain and a topic for future research.

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