

## **Willingness to Pay for Weather Index Crop Insurance: Evidence from Daura and Mai'adua, Katsina State-Nigeria**

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### **Abstract**

*As climate change takes hold globally, weather related risk threaten the livelihood of farmers with negative implications for food and nutrition security. The continued dependence on rain-fed crop production by farmers in Katsina state increases their vulnerability to weather related risk. This paper assessed the major risk faced by farmers, the main coping strategies adopted, the effectiveness of the strategies adopted and the willingness to pay for weather index crop insurance. Primary data was collected using a structured questionnaire and analyzed by frequency distribution and percentages. The findings of the study revealed that drought was the major weather related risk experienced, as stated by 97.1% of the farmers. Also, intercropping is the major mitigation and coping strategy, as stated by 57.3% of the respondents. In addition, 72.5% of respondents stated*

that the strategies adopted were not effective in coping with the adverse effect of weather risk. About 78.9% were willing to subscribe to weather crop index insurance policy and pay N6, 208as premium per annum. The study recommends that weather crop index insurance policy should be implemented fully or as a pilot.

**Keywords:** Climate Change, Crop Insurance, Willingness to Pay, Weather Index Crop Insurance  
**JEL Classification Codes:** JEL Q15, JEL Q16, JEL Q17 and JEL Q18.

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## **1.0 Introduction**

Vulnerability of agriculture to climate and weather related risks in both developed and developing countries pose a constant threat to the economic wellbeing of farmers. This is particularly the case in developing countries where the key weather related risks faced by farmers include erratic rainfall, high temperatures and wind storms. Weather related risks could also increase or decrease biological risks from pest and diseases, migratory birds and farm rodents. Price is also a key market related risk that could be affected by weather and climatic risks. Such market risk comes in the form abnormally low or high prices and volatility in market demand and supply<sup>1</sup>.

Risks and shocks are ever-present features of life for farmers everywhere in the world(Jensen & Barrett, 2017). Weather related risks in particular are pervasive in agriculture and, when shocks such as drought occur, poor farmers may adopt detrimental coping strategies. Some of these coping strategies may include skipping meals, withdrawing children from schools, selling off of productive assets. Some farmers engaged in off-farm activities and irrigation system of farming, as a means of reducing the losses incurred during the raining season(Lewis, Monem & Impiglia, 2018). Weather shocks can trap farmers and households in poverty, and the risk of shocks also limits the willingness of farmers to invest in measures that might increase their productivity and improve their economic situation(Dick & Stoppa, 2011). Traditional risk management strategies used by farm households and small landholders, such as cutting investment, seeking for credit, diversifying economic activities, or participating in informal insurance arrangement may indeed help to reduce vulnerability(Castellani & Viganò, 2015). However, these traditional risk management strategies have some limitations as indicated by empirical studies

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<sup>1</sup>There are also labor risks such as injury, illness and death as well as institutional and political risks such as policy changes, regulatory changes, political upheaval, etc. These risks are not usually impacted by adverse weather and climate.

among which is their rigidity and inability to succeed when the risk is covariate(Dercon, 2002).

In Africa, drought, wind storms, flood and extreme temperature are predominant in different parts of the continent(Boko, Niang, Nyong, Vogel, Githeko, Medany, Osman-Elasha, Tabo and Yanda, 2007). These have adverse effects on the peasant farmers resulting to low crop yields and increase in the level of poverty in the affected region (Gassner et al., 2019). This is because African economies are mainly agrarian and crop production is predominantly rain-fed. In developed countries and most of the developing countries with higher incomes, farmers subscribe to agricultural insurance policies to protect themselves from agricultural risks and shocks, particularly the weather risks that occur naturally and beyond the control of farmers (Raithatha & Priebe, 2020).

Weather index-based crop insurance is an innovative type of insurance introduced as a loss mitigating financial strategy. It has been adopted in most of the developed and some of the developing countries in Asia, Europe and Africa, to protect farmers in case of any weather related peril(Fonta, Sanfo, Kedir, & Thiam, 2018). It has been introduced in pilot or experimental form in many developing countries at the individual or institutional level as well(see for example Assah, Iturrioz, & Stutley, 2011). Some of the developing countries that adopted and implemented weather index based crop insurance at the individual level include; Brazil in 2001, Mexico in 2003 and Colombia in 2005, India, Malawi, Ethiopia and Thailand since 2007, then, Kenya, Rwanda and Tanzania in 2009(Carter, De Janvry, Sadoulet, & Sarris, 2014).

In Nigeria, weather related perils are also prevalent in the economy. As an agrarian society, agriculture is the major economic activity in the country, and is practiced mainly at the subsistence level by the peasant farmers in the region. In Katsina State<sup>2</sup>, weather related risks are also pervasive and the peasant farmers are vulnerable to these risks. When any of such risks occurred, it results in low yields or complete loss of farm output in some cases(Azare, Abdullahi, Adebayo, Dantata, & Duala, 2020). Smallholder farmers employ informal mitigating strategies to cope with the adverse effect, such as holding back investment on high risk but high return ventures, intercropping, seeking for credit and diversifying the economic activities(Umar & Musa, 2015). These strategies employed have limitation of being

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<sup>2</sup> An agrarian State, Located in the Northwest part of Nigeria

idiosyncratic, whereby a coping strategy could involve more cost (Dercon, 2002). Despite the traditional, cultural and religious believe against insurance policies particularly in some rural areas (Mills, 2004), there is an urgent need for an effective adaptation of policy measure that could mitigate the negative impact of climate change on the most vulnerable segments of the society. Weather Index Based Crop Insurance (WIBCI) is a formal weather risks management strategy introduced to protect small holder farmers from weather related risks and encourage them to invest more in risky production environments (Dick & Stoppa, 2011).

Despite the promise of these innovations however, there are knowledge gaps as to whether peasant farmers struggling to feed their families would be willing to pay for the insurance products when introduced. Since Nigeria is gradually introducing weather index-based insurance, this paper tries to examine the willingness of farmers to pay for Weather Index Crop Insurance (WICI), using Daura and Mai'adua local government areas of Katsina state as case study. The paper is structured into five sections. Immediately following the introductory section in section one, is section two which contain the review of relevant literature. Section three and four contains the research methodology and data analysis sections respectively, while section five contains the conclusion and recommendations.

## **2.0 Literature Review**

Weather Index Crop Insurance is an attractive approach to managing weather and climate related risk, because it uses a weather index, such as historical temperature or rainfall measurement to determine payouts. Under this scheme, payouts can be made more quickly and with less controversy than is typical for conventional agricultural insurance (CGIAR, 2013). A weather index crop insurance product uses an underlying index to estimate crop losses due to climate variability and change. Unlike traditional insurance that looks at actual observed losses to indemnify the policy holder, the weather index acts as a proxy for losses. In this case, the index is based on weather data and the damage associated with weather is estimated from the index's deviation from historical weather patterns (CGIAR, 2013).

Although, weather index crop insurance is a key function of the global financial system particularly in developed economies, there is no adequate understanding of how insurance provision causally influences real economic behaviour and risk-taking in African continent (Cole, Giné, & Vickery, 2017). A first step in exploring causality, however, is analyzing the willingness to pay for such financial services.

To this end, several studies have conducted research on the willingness to pay for weather index insurance, especially in sub Saharan Africa. For example, Abugri, Amikuzuno, & Daadi (2017) examined the willingness of smallholder farmers to pay for drought-index crop insurance premium in the Northern Region of Ghana. It was found that farmers were willing to subscribe the insurance policy and pay a premium of GHS175.25/ha (USD39/ha). Also, Abebe & Bogale (2014) examined the willingness to pay for Rainfall based Insurance by Smallholder Farmers in Central Rift Valley of Ethiopia. They found that maize farmers were willing to subscribe to the insurance product and pay a premium ranging within 129.98 and 183.41 birr per hectare of farmland. Similarly, (Aidoo, Mensah, Wie, & Awunyovitor, 2014) assessed the willingness of 120 farmers in Ghana to adopt weather index crop insurance. The results revealed that majority (76%) of these farmers were willing to adopt crop insurance. Another study by Hill, Hoddinott and Kumar (2013) found that educated, wealthier individuals are more likely to purchase insurance and risk aversion is associated with low insurance take-up, suggesting that models of technology adoption can inform the purchase and spread of weather index insurance. Other recent research conducted include Thompson (2017), Adjabui, Tozer and Gray (2019), Abugri et al. (2017), Ellis (2017), Sibiko, Veetil, & Qaim (2018), Fonta et al. (2018), and Anamsigiya Nyaaba, Nkrumah-Ennin, & Tetteh Anang, (2019).

Although many studies have been conducted on willingness to pay for weather index based crop insurance in Africa, no study was identified found from the study region. Thus, this paper aims at eliciting information on the willingness to pay for weather index crop insurance products in Katsina state Nigeria, using Daura and Mai'adua as case studies. The paper also highlights the extent of climate variability, its effect on crop production and evaluates the hypothetical willingness to pay for weather index based crop insurance by the peasant farmers.

### **3.0 Methodology**

The paper adopt the prospect theory of risk as the theoretical framework. The rationale for adopting this theory lays in the fact that the theory discusses the behavioural preference in probabilistic alternative that involve risk, where the probability of possible outcomes are known. The theory states that people make decisions based on the potential value of losses and gains rather than the final outcome, and that people evaluate these losses and gains using certain experiences. Furthermore, the theory identified two stages in decision making process

(Kahneman & Tversky, 1979). The first stage in the theory is the ordering the possible outcomes according to certain heuristics and consider lesser outcomes as losses and greater ones as gains. The second stage is based on expected utility on the potential outcomes taking into account their respective probability. Thus, the choice is based on equation 1 below:

$$\text{Expected Utility}^3 = \sum_{i=1}^n \pi(p_i)v(x_i) \dots\dots\dots 1$$

The theory posits that the decision of farmers to participate in a new intervention (WICI) depends on the level of the utility expected to derive from that participation ( $U_p$ ). Therefore, farmers will only participate in weather index insurance WII scheme, if the expected utility of participation ( $U_p$ ) is equal to or greater than the expected utility of non-participation ( $U_n$ ). Thus, expected utility ( $EU$ ) maximizing agent will choose risky option ( $R$ ) over the safe option ( $S$ ) if:

$$E[U(R)] \geq E[U(S)] \dots\dots\dots 2$$

**Sample Size**

In determining the sample size, it is important to state the confidence level to be use which is normally 95% ( $Z=1.96$ ). The proportion of the target population which is the peasant farmers ( $X$ ) is unknown. Therefore, the study used  $X = 0.5$  which assumes maximum heterogeneity (i.e. a 50/50 split). The degree of precision ( $E$ ) is the margin of error that is acceptable. Setting  $E= 0.07$ , for example, would give a margin of error of plus or minus 7%. Based on this information, the sample size is calculated using the Bartlett, Kotrlík, & Higgins (2001) formula:

$$n = S^2 \frac{(X)(Y)}{E^2} \dots\dots\dots 4$$

Where  $n$  = sample size

$S$  = confidence level 95% (1.96)

$X$  = proportion of the total population that are farmers (0.5)

$Y$  = proportion of the total population that are not farmers ( $1-X=0.5$ )

$E$  = margin of error (7%)

$$n = (1.96)^2(0.5)(0.5) / 0.07 = 196$$

196 respondents is the minimum sample size needed, but for the purpose of this study 204 respondents were questioned so as to improve the response rate and also reduce the sampling error.

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<sup>3</sup>The variables are defined in the theoretical literature(see Daniel and Tversky, 1979).

Based on a survey design method, the target population of this study is small landholder farmers. Simple random sampling technique was adopted in selecting five farming communities in Daura and Mai'adua local government area of Katsina State. Primary data were collected from 204 respondents among the ten selected farming communities.

#### **4.0 Data Presentation and Analysis**

**Table 1: Demographic Characteristics of Respondents**

<b>Variables</b>	<b>Frequency</b>	<b>Percentage</b>
<b>Gender</b>		
Male	204	100.0
Female	0	0.0
<b>Total</b>	<b>204</b>	<b>100</b>
<b>Age</b>		
15-25	17	6.9
26-35	86	32.8
36-45	79	24.0
46-55	52	15.7
55 and above	66	20.6
<b>Total</b>	<b>204</b>	<b>100</b>
<b>Marital Status</b>		
Single	13	5.4
Married	283	94.6
Divorce	1	0.0
Widowed	3	0.0
<b>Total</b>	<b>204</b>	<b>100</b>
<b>Household Size</b>		
1-5	86	35.8
6-10	87	28.9
11-15	66	20.1
16-20	32	8.3
21 and above	29	6.9
<b>Total</b>	<b>204</b>	<b>100</b>
<b>Educational Status</b>		
Non-formal	144	46.1
Primary	71	18.1
Secondary	53	26.5
Tertiary	32	9.3

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<b>Total</b>	<b>204</b>	<b>100</b>
<b>Major Crop Grown</b>		
<b>Millet</b>	188	84.3
<b>Sorghum</b>	61	14.7
<b>Maize</b>	49	1.0
<b>Rice</b>	2	0.0
<b>Total</b>	<b>204</b>	<b>100</b>

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Source: Field Survey, 2018

Table 1 presents the socio demographic characteristics of the respondents. These included sex, age, marital status, level of education, and household size.

All the farmers interviewed were male. This is because only the household heads were interviewed and most of the households were headed by male member of the family. Also crop production is mainly done by the male, while the female members of the household take care of the domestic activities at home. About 32.8% and 24% of the farmers were within the range of 26-35years and 36-45years respectively, while 15.7% and 20.6% were within the range of 46-55years and 56years and above respectively. Only 6.9% were within the range of 15-25years. This implies that most of the farmers were within the active working population. On marital statuses about 94.6% of the respondents were married, while just 5.4% were not married. This suggests that crop production is a major means of catering for the family in the study area.

In terms of the household size, the frequency distribution result shows that 35.8%, 28.9% and 20.1% have a family size within the range of 1-5, 6-10 and 11-15 respectively. Also, 8.3% and 6.9% of the respondents have a family size within the range of 16-20 and 21 and above respectively. Family labour plays an important role in crop production among the peasant farmers. The peasant farmer first exhausts all sources of labour in his family before hiring labour in order to reduce the cost of production. Thus, this shows that there is much availability of labour for crop production.

The frequency distribution on the educational status of the respondents shows that a higher proportion of the respondents (46.1%) did not attend formal education. Only 9.3% attended tertiary education, while 26.5% and 18.1% attended secondary and primary education respectively. This shows that majority of the farmers in the study area have little formal education.



About 84.3% of the respondents produced millet in the study area, while 14.7% and 1.0% of the respondents produced sorghum and maize respectively. This implied that millet and sorghum were the major crops produced.

**Table2: Weather Risk, its Effect on Crop Production, self-adaptation measures taken and their Effectiveness**

<b>Variable</b>	<b>Frequency</b>	<b>Percentage</b>
<b>Major Weather Risk</b>		
Drought	198	97.1
Flood	1	0.5
Extreme Temperature	1	0.5
Windstorm	4	2.0
<b>Total</b>	<b>204</b>	<b>100</b>
<b>Loss Incurred</b>		
Yes	300	100
No	0	0
<b>Total</b>	<b>204</b>	<b>100</b>
<b>Magnitude of the Loss</b>		
Low	24	11.8
Moderate	102	50.0
Extreme	78	38.2
<b>Total</b>	<b>204</b>	<b>100</b>
<b>Government Support</b>		
Yes	0	0
No	300	100
<b>Total</b>	<b>204</b>	<b>100</b>
<b>Adopted Self-Adaptation Measures</b>		
Yes	196	96.1
No	8	3.9
<b>Total</b>	<b>204</b>	<b>100</b>
<b>Adaptation Measures</b>		
Adopted	117	57.3
Planting More than One Crop	57	27.9
Off-Farm Activities	30	14.8
<b>Total</b>	<b>204</b>	<b>100</b>
<b>Engage in Irrigation</b>		
<b>Total</b>		

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<b>Effectiveness of these Measures</b>		
<b>Ineffective</b>	27	13.2
<b>Somewhat</b>	148	72.5
<b>Effective</b>	29	14.3
<b>Total</b>	<b>204</b>	<b>100</b>

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Source: Field Survey, 2018

About 97.1% of the farmers were faced with drought risk, 2.0% were faced with windstorm, only 0.5% of the respondents faced extreme temperature and 0.5% suffered from flood risk in the past five years. Thus, the major risk faced by the farmers in Katsina state is drought that disturbed 97.1% of the respondents in crop production. Also windstorm, extreme temperature and flood are disturbing risks; all the respondents stated that the risks caused lot of damages to their crops, which result in significant reduction in total output.

With regard to the magnitude of losses incurred in crop production as a result of weather risk, this is captured from the difference between the expected and actual crop yield at the end of the season. About 38.2% of the respondents suffered extreme loss, while 50.0% respondents stated that the loss were moderate, and only 11.8% said the loss were low. This shows that weather risk caused a huge loss to crop farmers in Katsina state. Furthermore, all the respondents stated that they have never received any kind of relief from government or non-governmental organization.

On the adoption of self-adaptation measures to mitigate the risk or cope with the adverse effect of weather variability, it was observed that all the farmers plant more than one crop on their plots, which they consider a mitigating strategy. Furthermore, 96.1% of the respondents considered inter-cropping the only available way to cope with the adverse effects of weather risks. While, 2.9% stated that inter-cropping system of farming is not reliable, because drought affects all crops. However, 27.9% of the respondents engaged in other economic activities like trading, building, transportation business and other off-farm labour activities, while some were civil servants. Also 14.8% engaged in irrigation farming. The remaining 57.3% solely depend on planting more than one crop in their farm. This implied that majority of the respondents so much depend on rain fed crop farming, which means they are only employed during the raining season.

On the effectiveness of the available mitigating strategies, 72.5% of the respondents were not fully satisfied with the strategies they have been adopting, while 13.2% were completely not satisfied. Only 14.3% were able to cope with the adverse effect of weather risk. By implication the farmers need a formal financial strategy, like insurance, to support them in the event of crop failure caused by weather variability.

**Table 3: Awareness and Willingness to Pay for WII**

<b>Variables</b>	<b>Category</b>	<b>Frequency</b>	<b>Percentage</b>	
<b>Awareness</b>	Strongly Aware	0	0.0	
	Partially Aware	0	0.0	
	Fairly Aware	30	14.7	
	Not Aware	174	85.3	
	<b>Total</b>	<b>204</b>	<b>100</b>	
<b>Willingness to Key-in into WII</b>	No	43	21.1	
	Yes	161	78.9	
	<b>Total</b>	<b>204</b>	<b>100</b>	
<b>If no Why</b>	I can't Afford the Premium.	5	11.6	
	I can Cope on my own.	1	2.3	
	I don't have enough information and still in doubt.	27	62.8	
	I don't trust insurance.	3	7.0	
	Against my Faith/Culture.	7	16.3	
	<b>Total</b>	<b>43</b>	<b>100</b>	
	<b>If Yes (CVM)</b>	< N3500	9	5.6
		N3500	5	3.1
N4000		4	2.5	
N4500		1	0.6	
N5000		21	13.0	
N6000		22	13.7	
N7000		99	61.5	
<b>Total: N999,500.00</b>		<b>161</b>	<b>100</b>	
<b>AWTP: N 6,208.00</b>				

**Source: Field Survey, 2018**

Among the 204 respondents that filled the questionnaire, the result of the willingness to key-in and pay for the insurance policy shows that 78.9% of the

respondents were willing to key into the insurance policy and pay N6.208.00, as premium for the insurance product per annum. Furthermore, only 21.1% were not willing to take the insurance policy. The study supports the findings of Aidoo et al. (2014) and Simpson (2016) which revealed that 76% and 65% of the respondents were willing to subscribe the insurance policy respectively. Though, most of the respondents have never heard about the weather index insurance policy, but were willing to take it. This is due to the awareness creation done by the researcher on the product design and the important of the product as a risk management strategy in rain-fed crop production.

## **5. Conclusion and Recommendation**

Based on the empirical findings, the study concludes that farmers are willing to participate in the insurance policy if implemented. This is because of farmers' perception of the insurance scheme as an initiative to protect farmers' rain-fed crop production and secure livelihood. The major weather related risk faced by the farmers in the study area is drought, which causes lots of crop damage and lower yield. The study found that the available mitigating and coping strategies were not effective, thereby increase the level of poverty to the farmers, as lower crop yield results to insufficient food for the household consumption. Though, farmers in the study area were not aware of the proposed WII scheme, but majority were willing to take the insurance scheme and pay the required premium. The average amount farmers were willing and able to pay stood at N6, 160.00 per hectare of farmland. The study therefore strongly recommends that Weather Index Crop Insurance be implemented, if not fully, the pilot stage. Also, the study area should be used for the pilot experiment to test the applicability of the insurance policy.

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