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Rice Farmers' Willingness-to-Pay for Weather-Index Insurance in Kwali Area Council, Federal Capital Territory, Nigeria

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Abstract

Objectives: This study examined rice farmers' willingness to pay (WTP) for weather-indexed insurance in the Kwali Area Council, Federal Capital Territory, Nigeria. The research aimed to determine the drivers of insurance participation and the specific factors influencing the amount farmers are willing to invest to mitigate climate-related risks.

Method: A multistage sampling technique was employed to select 120 rice farmers from a population of 171 across five wards. Data were analysed using descriptive statistics and the Heckman Two-Stage Selection Model to correct for potential selection bias.

Result: Descriptive results indicated that a significant majority of respondents (70.8%) were willing to pay for weather-indexed insurance. The first stage of the Heckman model (participation) revealed that age ($p \leq 0.05$), lack of extension contacts ($p \leq 0.10$), farm income ($p \leq 0.01$), artisan income ($p \leq 0.10$), and non-rice farming ($p \leq 0.05$) significantly influenced the decision to participate. The second stage (WTP amount) showed that land ownership ($p \leq 0.01$), illiteracy ($p \leq 0.10$), rice farm size ($p \leq 0.10$), farm income ($p \leq 0.10$), and cooperative membership ($p \leq 0.10$) were the key determinants of WTP. Major barriers identified include limited awareness, inadequate government support, credit scarcity, and premium affordability.

Conclusion: Despite a high willingness to participate, adoption is hampered by significant institutional and knowledge-based constraints. The study recommends implementing targeted education programs to enhance financial literacy, alongside the provision of affordable credit and premium support mechanisms. Strengthening institutional and policy frameworks is essential to transition the high stated willingness into active participation in insurance schemes.

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Keywords: Farmers' participation, Heckman selection model, weather-indexed insurance, willingness to pay.

Introduction

Agriculture is fundamental to Nigeria's economy, accounting for over 21% of the country's GDP and providing employment opportunities for more than one-third of the labour force (National Bureau of Statistics, 2025). Nigeria's agricultural sector is characterised by a variety of commodities that underpin both local food consumption and export revenue. One of them is Rice production, which plays a pivotal role in the nation's agricultural framework and food security strategy, with Nigeria among Africa's foremost rice producers. Rice production has increased steadily over the years, with approximately 5.2 million metric tons of milled rice produced between 2010 and 2024. However, it still falls short of domestic demand (United States Department of Agriculture [USDA], 2023). One factor may be the weather-related risks to which rice farmers are susceptible. These weather risks may include unpredictable rainfall, prolonged droughts, flooding, and temperature extremes, all exacerbated by climate change (Usman & Haruna, 2024). Climate-induced shocks lead to significant crop losses, income instability, and food insecurity, jeopardising the farmers' livelihoods and threatening national rice self-sufficiency objectives. However, rice farmers have devised means to cope with varying extreme weather events, including crop diversification, forward contracting, and crop insurance. Regarding insurance, weather-indexed insurance has attracted global interest as a potential mechanism for managing agricultural weather risks, particularly for smallholder farmers in developing countries. One of its advantages over conventional insurance is the ability to begin payouts based on objective weather parameters recorded at specific weather stations, such as rainfall, temperature thresholds, or vegetation indices (Wodaju et al., 2025). Additionally, weather-indexed insurance reduces administrative expenses, minimises moral hazard and adverse selection, expedites claims resolution, and increases transparency (Jiba et al., 2024).

Farmers with insurance can automatically receive compensation to offset losses when rainfall falls below a predetermined threshold or exceeds critical limits during critical growing periods. This allows them to recover and replant without getting into debt traps. Weather-index-based crop insurance is increasingly valuable as a risk-reduction strategy that farmers can employ to mitigate the adverse effects of climatic shocks and natural disasters they may encounter in farming. However, the adoption of weather-indexed insurance remains surprisingly low across Africa, including Nigeria, despite its theoretical appeal and demonstrated advantages in many contexts. Therefore, designing a feasible, long-lasting insurance product that can scale significantly requires an understanding of farmers' willingness to pay (WTP) for weather-indexed insurance. WTP represents the highest amount farmers are willing to forgo to obtain insurance coverage. Influenced by risk perceptions, income levels, prior loss experiences, trust in insurance providers, product knowledge, and availability of alternative risk management tools (Ngango et al., 2022). Furthermore, Uncertainty in cash flows, as many banks and large microfinance institutions are very reluctant to finance agriculture through small microfinance institutions and cooperatives.

Poor understanding of farmers' risk perception in general, their willingness to pay, and the factors that influence their decision to pay, such as low trust in insurance providers. Against this backdrop,

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this study seeks to determine rice farmers' willingness to pay for weather-indexed insurance in the Kwali Area Council, Federal Capital Territory. The broad objective of the study was to assess rice farmers' willingness to pay for weather-indexed insurance in the Kwali Area Council, FCT. The specific objectives were to (i). Describe the socio-economic characteristics of the respondents in the study area, (ii) Describe the willingness of farmers to pay for weather-indexed insurance among rice farmers in the study area. (iii). analyse the factors influencing willingness-to-pay for weather-indexed insurance among rice farmers in the study area, and (iv) identify the constraints militating against insurance purchase among rice farmers in the study area. The study is significant because it will contribute to the growing literature on weather-indexed insurance in Nigeria and other developing countries, offering valuable insights for the Nigerian context and paving the way for more informed and effective interventions to support farmers in a changing climate.

Materials and Methods

This study was conducted in the Kwali Area Council, one of the six Area Councils that constitute the Federal Capital Territory (FCT) of Nigeria. Kwali Area Council is located in the southern part of the FCT and lies approximately between latitude 8°52'N and longitude 7°01'E. The Area Council covers 1,206 square kilometres and was established on October 1, 1996, during the military administration of General Sani Abacha (Kwali Area Council, 2024). Kwali is administratively subdivided into ten political wards: Kwali Central, Yebu, Yangoji, Pai, Ashara, Dafa, Kundu, Wako, Gumbo, and Kilankwa (Kwali Area Council, 2024).

According to the Nigerian Meteorological Agency [NiMet] (2021). Rainfall ranges from 1,200 to 1,500 mm, with the rainy season typically from April to October, peaking between July and September. The temperature ranges from 26°C to 28°C, with daily maximum temperatures often exceeding 35°C during the hot, dry season (March-April) and minimum temperatures dropping to around 18°C during the cool, dry season (December-January). Agriculture is the dominant economic activity in the Kwali Area Council, providing employment and livelihood for over 70% of the population. It is strategically important for food production in the FCT, supplying fresh produce, cereals, and livestock products to Abuja and surrounding urban centres.

For this study, a multistage sampling technique was employed to select respondents. The choice of the Kwali Area Council is due to the preponderance of rice farmers. In the first stage, four wards in the Kwali Area Council were purposively selected because they had available rainfall data, which helps confirm weather exposure patterns relevant to index insurance and facilitates accurate recall by farmers. The wards were Yebu, Pai, Kwali Central and Kilankwa. In the second stage, two farming communities from each ward were randomly selected. Ultimately, 120 rice farmers were randomly selected from a sample frame of 171, using Yamane's (1967) technique to determine the study's sample size. It is specified as follows:

$$n = \frac{N}{1 + N(\mathrm{e})^2}$$

Where; n = Sample size of rice farmers (Unit)
N = Sample Frame of rice farmers (Unit)

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e = Level of Precision (5%)

This study used primary sources for its data. Using interviews and a carefully designed questionnaire, the researcher and skilled enumerators gathered the data.

Model specification

Descriptive and inferential statistics were used to achieve the objectives of this study. Descriptive statistics were used to achieve objectives (i), (ii), and (iv). To analyse the factors influencing willingness to pay for weather-indexed insurance among rice farmers in the study area, the Heckman Two-Stage Selection Model was employed. The Heckman Two-Stage Selection Model is used to address potential sample selection bias that may arise when the decision to participate in a programme or adopt a practice is not random but is influenced by observable and unobservable factors (Heckman, 1979). In this research, it refers to the willingness to pay for weather-indexed insurance. Binary models were employed in some studies with willingness-to-pay as the dependent variable; for example, Otitoju, Fidelis, and Abah (2022) used a two-limit Tobit model. However, Otitoju, Olaifa, and Obasanya (2022) used the Heckman two-stage selection model to examine the determinants of farmers' willingness to accept seed production technology and their potential capacity for rice seed production. Here, the Heckman Selection model is appropriate to account for both the binary selection equation (whether the respondent is willing to pay for weather-indexed insurance) and the outcome equation (the amount the respondent is willing to pay).

Stage One: Selection Equation

In the first stage, a probit model was estimated to determine the probability that a rice farmer is willing to pay for weather-indexed insurance. The selection equation is specified as:

$$WTP_i^* = Z_i' {}_{\gamma} + ui$$

$$WTP_i = \begin{cases} 1 \; if \; WTP_i^* > 0 \\ 0 \; if \; WTP_i^* \leq 0 \end{cases}$$

Where:

WTP_i^* is the latent variable representing the ι-th rice farmer.

${}_{\gamma}$ is the parameter

Z_ι is a vector of explanatory variables for the ι-th farmer influencing the decision to participate.

ui ~N (0,1)

The first stage produces the inverse Mills ratio (IMR), which captures the effect of selection bias.

$IMR\iota$ = ϕ (WTP_i^*)/ Φ (WTP_i^*) for farmers with $WTP_\iota = 1$

$IMR\iota$ = - ϕ (WTP_i^*)/ [1- Φ (WTP_i^*)] for farmers with $WTP_\iota = 0$

Where ϕ and Φ are the probability density and cumulative functions of the standard normal distribution, respectively.

Stage Two: Outcome Equation

In the second stage, the outcome equation estimates the amount a rice farmer is willing to pay, using the subsample of the farmers who were willing to participate.

$Y\iota = X_\iota' \beta + \mathcal{E}\iota$

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Where:
Y_ι is the outcome of interest (only observed when WTP =1)
X_ι is a vector of explanatory variables
β are parameters
$\varepsilon_\iota \sim N(0, \sigma2)$
X_1= Sex of farmers (Dummy 1 = male, 0 = female)
X_2 = Household size (number of persons in the household)
X_3 = Age of farmers (years)
X_4 = Education level (Years of schooling)
X_5 = Membership of farmers' cooperative societies (Dummy 1 if yes, 0 otherwise)
X_6 = Extension contacts (Number of contacts in the cropping season)
X_7 = Farm income (Naira)
X_8 = non-farm income (Naira)
X_9 = Rice farm size (Hectares)
X_{10} = Rice production training (number)
X_{11} = Literacy ratio in the household (the ratio of the number of educated persons in the household to the total number of persons in the household)
X_{12} = Land ownership (Dummy 1 if owned land for rice cultivation, 0 otherwise)
X_{13} = non-rice farm income (Naira)

Results

Table 1a: Socioeconomic Characteristics of Rice Farmers in the Study Area

Variable	Frequency	Percentage	Mean
Age (Years)			
20-40	25	20.8	
41-60	76	63.3	**49.767**
61-80	18	15.0	
81-100	1	0.8	
Total	**120**	**100.00**	
Sex			
Male	71	59.2	
Female	49	40.8	
Total	**120**	**100.00**	
Education Level			
No formal education	33	27.5	
Primary education	34	28.3	
Secondary education	47	39.2	**7.167**
Tertiary education	6	5.0	
Total	**120**	**100.00**	
Marital Status			
Married	113	94.2	

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Variable	Frequency	Percentage	Mean
Single	1	8	
Divorced	5	4.2	
Separated	1	0.8	
Total	**120**	**100.00**	
Household Size			
1-5	52	43.3	
6-10	59	49.2	
11-15	6	5.0	**6.583**
16-20	3	2.5	
Total	**120**	**100.00**	
Maize Farm size			
Less than 1.0	77	64.2	
1.01 - 2.00	35	29.2	
2.01 - 3.00	7	5.8	
3.01 - 4.00	1	0.8	
Total	**120**	**100.00**	
Rice Farm Size (Hectare)			
Less than 1.10	33	27.5	
1.1 - 5.0	85	70.8	
5.01 - 10.0	1	0.8	**2.042**
10.01 - 15.0	1	0.8	
Total	**120**	**100.00**	
Rice Training			
Yes	78	65.0	
No	42	35.0	
Total	**120**	**100.00**	
Farm Income (Naira)			
Less than 10,001.00	2	1.7	
10,001 - 50,000.00	87	72.5	
50,001 - 100,000.00	16	13.3	**49733.33**
100,001.00 - 150,000.00	8	6.7	
150,001.00 - 200,000.00	5	4.2	
250,001.00 - 300,000.00	2	1.7	
Total	**120**	**100.00**	

Source: Computed from Field Data, 2024

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Table 1b: Socioeconomic Characteristics of Rice Farmers in the Study Area

Variable	Frequency	Percentage	Mean
Trade Income (Naira)			
Less than 10,001.00	57	47.5	
10,001.00-40,000.00	56	46.7	**15708.33**
40,001.00-80,000.00	3	2.5	
80,001.00-120,000.00	4	3.3	
Total	**120**	**100**	
Artisan Income (Naira)			
Less than 10,001.00	100	83.3	
10,001.00-50,000.00	8	6.7	
50,001.00-100,000.00	5	4.2	**9283.33**
100,001.00-150,000.00	2	1.7	
150,001.00-200,000.00	4	3.3	
200,001.00-250,000.00	1	8	
Total	**120**	**100.00**	
Other Income (Naira)			
Less than 10,001.00	110	91.7	
10,001.00-40,000.00	2	1.7	**7566.67**
40,001.00-80,000.00	6	5.0	
80,001.00-120,000.00	2	1.7	
Total	**120**	**100.00**	
Rice Farming Experience (Years)			
1 – 10	13	10.8	
11 – 20	42	35.0	
21 – 30	31	25.8	
31 – 40	22	18.3	**22.5**
41 – 50	8	6.7	
51 – 60	4	3.3	
Total	**120**	**100.00**	
General Farming Experience (Years)			
1 – 10	13	10.8	
11 – 20	42	35.0	
21 – 30	31	25.8	
31 – 40	22	18.3	**25.4**

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Variable	Frequency	Percentage	Mean
41 – 50	8	6.7	
51 – 60	4	3.3	
Total	**120**	**100.00**	
Extension Contact			
Access to extension contact	37	30.8	
Do not have access to extension contact	83	69.2	
Total	**120**	**100.00**	
Access to Credit			
Yes	36	30.0	
No	84	70.0	
Total	**120**	**100.00**	
Financial Literacy Training			
Access to literacy training	42	35.0	
Do not have access to literacy training	78	65.0	
Total	**120**	**100.00**	

Source: Computed from Field Data, 2024

From Table 1b regarding income distribution, the average monthly income of the rice farmers was around ₦49,733, with the majority (72.5%) earning between ₦10,001 and ₦50,000. The mean trade income was ₦15,708.33, while artisan income averaged ₦9,283.33, and other income averaged ₦7,566.67. In terms of farming experience, the average for rice farming was 23 years, while the average for general farming was 26 years. Regarding extension contact, the majority of farmers (68.4%) did not have access to extension services, while just 37 farmers (31.6%) did. Access to credit was reported by 30% of the respondents, while 70% had no access. Similarly, the findings indicate that only 35% of farmers had participated in financial literacy training, whilst 65% had not.

Table 2: Distribution of Farmers' Willingness to Pay for Weather-Indexed Insurance Among Rice Farmers in the Study Area

Variables	Frequency	Percentage
Willingness to Pay for Weather-Indexed Insurance		
Yes	85	70.8
No	35	29.2

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Variables	Frequency	Percentage
Total	**120**	**100.00**
Knowledge on Weather-Indexed Insurance		
Yes	3	2.5
No	117	97.5
Total	**120**	**100.00**
Membership of Farmers-Based Organisation (FBOs)		
Yes	25	20.8
No	95	79.2
Total	**120**	**100.00**
Access to Micro-finance Services		
Yes	25	20.8
No	95	79.2
Total	**120**	**100.00**
Micro-Loan		
Yes	10	8.3
No	110	91.7
Total	**120**	**100.00**
Micro-Saving		
Yes	16	13.3
No	104	86.7
Total	**120**	**100.00**
Micro-Insurance		
Yes	0	0.00

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Variables	**Frequency**	**Percentage**
No	120	100.00
Total	**120**	**100.00**
Micro-Training		
Yes	0	0
No	120	100.00
Total	**120**	**100.00**

Source: Computed from Field Data, 2024.

Table 2 shows that while 29.2% of rice farmers were hesitant to pay for weather-indexed insurance, a significant percentage (70.8%) were willing to do so. Only 2.5% of respondents knew about weather-indexed insurance, while 97.5% were unaware. Notably, it shows that 79.2% of respondents were not members of Farmer-Based Organisations (FBOs), whereas 20.8% were. Regarding access to microfinance services, only 20.8% of respondents had access; within this group, 8.3% obtained microloans, 13.3% engaged in microsavings, and none reported access to microinsurance or microtraining programmes.

Table 3: Factors Influencing Willingness-to-Pay for Weather-Indexed Insurance among Rice Farmers in the Study Area

Variable	**Coefficient**	**Std. Error**	**z-value**	**P>|z|**
Selection Equation: Participation Decision (Probit):				
Sex of farmer (dummy)	0.2354	0.3732	0.63	0.528
Household size (number)	0.0382	0.0848	0.45	0.652
Age of farmer (years)	-0.0571**	0.0227	-2.52	0.012
Education (years of schooling)	-0.0271	0.0352	-0.77	0.441
Cooperative membership (dummy)	0.2919	0.4539	0.64	0.520
Number of extension contacts	0.2247*	0.1237	1.82	0.069
Farm income (naira)	-0.0000153***	0.0000	-3.11	0.002

Variable	Coefficient	Std. Error	z-value	P>|z|
Artisan income (naira)	-0.0000128*	0.0000	-1.66	0.097
Rice farm size (hectares)	0.8978***	0.2346	3.83	0.000
Rice production training (number)	0.5280	0.3400	1.55	0.120
Literacy Ratio	0.0319	0.1132	0.28	0.778
Land ownership (dummy)	0.4036	0.3966	1.02	0.309
Non-rice farm income (naira)	0.0529**	0.0248	2.14	0.033
Constant	-0.2694	0.9163	-0.29	0.769
Outcome Equation: Willingness to Pay (WTP)				
Sex of farmer (dummy)	0.0128	0.0388	0.33	0.741
Household size (number)	-0.0111	0.0101	-1.10	0.269
Age of farmer (years)	0.0021	0.0023	0.91	0.363
Education (years of schooling)	-0.00000120	0.0041	-0.00	1.000
Cooperative membership (dummy)	-0.0800*	0.0482	-1.66	0.097
Number of extension contacts	0.0075	0.0148	0.51	0.611
Farm income (naira)	-0.00000131*	0.0000	-1.79	0.073
Artisan income (naira)	0.00000184	0.0000	1.38	0.166
Rice farm size (hectares)	0.0270*	0.0144	1.87	0.061
Rice production training (number)	0.0391	0.0386	1.01	0.310
Literacy Ratio	0.0222*	0.0121	1.83	0.067
Land ownership (dummy)	-0.1705***	0.0538	-3.17	0.002
Non-rice farm income (naira)	-0.0015	0.0027	-0.56	0.574
Constant	1.0700***	0.1153	9.28	0.000

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Variable	**Coefficient**	**Std. Error**	**z-value**	**P>|z|**
/athrho	-0.2402	0.2743	-0.88	0.381
/lnsigma	-1.9876***	0.0830	-23.94	0.000
rho (ρ)	-0.2357	0.2591	—	—
sigma (σ)	0.1370	0.0114	—	—
lambda (λ)	-0.0323	0.0364	—	—
Diagnostic statistics				
Selected (Participants):80				
Non-selected (non-participants):40				
Log likelihood: -5.1763				
Wald chi2(13) = 26.43				
Prob > chi2 = 0.0149				
Number of observations = 120				
LR test of indep. eqns. (rho = 0): chi2(1) = 0.77, Prob > chi2 = 0.3818				

*****is significant at 1% level, ** is significant at 5% level, and * is significant at the 10% level of significance.**

Source: Computed from Field Data, 2024.

Table 3 below presents the factors influencing willingness-to-pay for weather-indexed insurance among rice farmers in the study area. Using the Heckman selection model, potential sample selection bias arising from farmers' participation decision in the weather-indexed insurance scheme was corrected. The selection equation identifies the factors influencing farmers' participation decision, capturing barriers related to awareness, access, and initial willingness. Conversely, the outcome equation estimates the determinants of WTP, focusing on how much they are willing to pay, conditional on participation. The Wald chi-square score was 26.43 ($p = 0.0149$), indicating that the model has explanatory power and is statistically significant at the 5% level. Selection bias may not be severe in this sample, as indicated by the inverse Mills ratio ($\lambda = -0.0323$) and the likelihood ratio test for independence of equations ($\chi^2(1) = 0.77$, $p = 0.3818$).

The non-significant correlation between the error terms does not, however, rule out the theoretical possibility that unobservable factors like risk aversion, trust in institutions, and unmeasured social

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capital can simultaneously influence both the willingness to pay for insurance and the decision to participate, so the use of the Heckman model is still methodologically justified. The age of rice farmers in the study area was found to reduce the likelihood of participating in the insurance scheme by −0.057. Similarly, the farm size of rice farmers had a positive and significant effect, increasing the odds of participating in the insurance scheme by 0.898. In addition, being a non-rice farm income positively influenced participation, increasing the probability of enrolling in the insurance scheme by 0.05. Similarly, the farm size of rice farmers had a positive and significant effect, increasing the odds of participating in the insurance scheme by 0.898. Conversely, farm income was negatively associated with participation, decreasing the probability of enrolling in the insurance scheme by −0.0000153. Similarly, artisan income was negatively associated with participation (−0.0000128).

Table 4: Distribution of Constraints Militating against Insurance Purchase among Rice Farmers in the Study Area

Constraints	Very Serious	Serious	Less Serious	Not Serious	Mean
Limited awareness and understanding of weather-indexed insurance	80(66.7)	29(24.2)	6(5.0)	5(4.2)	3.5
Inability to afford the payment of weather-indexed insurance premiums	66(55.0)	35(29.2)	13(10.8)	6(5.0)	3.3
Low income from rice farming	47(39.2)	42(35.0)	20(16.7)	11(9.2)	3.0
High transaction costs	52(43.3)	45(35.0)	13(10.8	10(8.3)	3.2
Inadequate Government support for weather-indexed crop insurance	70(58.3)	36(30)	9(7.5)	5(4.2)	3.4
Limited access to credit	72(60.0)	29(24.2)	11(9.2)	8(6.7)	3.4
Cultural and social barriers to crop insurance	66(55.0)	26(21.7)	17(14.2)	11(9.2)	3.2
Inadequate access to weather data	49(40.8)	36(30.00)	17(14.2)	18(15.0)	3.0
Limited availability of insurance products	42(35.0)	35(29.2)	18(15.0)	17(14.2)	2.7
Possible variation in insurance premiums	49(40.8)	28(23.3)	18(15.0)	25(20.8)	2.8
High rate of premium	44(36.7)	28(23.3)	25(20.8)	23(19.2)	2.8

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Constraints	Very Serious	Serious	Less Serious	Not Serious	Mean
Low literacy level	56(46.7)	31(25.8)	14(11.7)	19(15.8)	3.0
Inadequate access to financial institutions by rice farmers	62(51.7)	23(19.2)	18(15.0)	17(14.2)	3.1
Complex procedures to get registered for crop insurance	59(49.2)	26(21.7)	23(19.2)	12(10.0)	3.1

Source: Computed from Field Data, 2024.

The findings in Table 4 highlight the constraints that rice farmers in the research area face when trying to get weather-indexed insurance (WII). The major constraints faced by the respondents in the study area are: limited awareness and understanding of weather-indexed insurance (mean = 3.5), Limited access to credit (mean = 3.4), Inadequate Government support for weather-indexed crop insurance (mean = 3.4), and Inability to afford the payment of weather-indexed insurance premiums (mean = 3.3).

Discussion

The study reveals that the majority of rice farmers are within their economically active years, a demographic profile that significantly influences decision-making and the adoption of enhanced agricultural technologies (Alabi & Anekwe, 2022). While women play a substantial role, the male dominance in rice cultivation in the Kwali Area Council likely stems from the labour-intensive nature of production (Olohungbebe et al., 2025). High literacy levels among these farmers are encouraging, as education is a crucial component for the adoption of new innovations (Alabi et al., 2020), while the prevalence of large, married households suggests a reliance on family labour and collaborative decision-making (Alabi et al., 2020).

Economically, most farmers earn low incomes from small-scale operations, leaving them exposed to instability from weather shocks. While many engage in off-farm activities such as artisan work to augment their earnings, agriculture remains their primary livelihood, highlighting the vital role non-farm income plays in sustaining living standards (Damenaa & Habteb, 2017). Despite their experience, poor access to agricultural extension services and credit remains a major barrier, supporting previous findings that a lack of institutional support often leaves critical knowledge gaps (Musa et al., 2023). Interestingly, while there is a high willingness to pay (WTP) for weather-indexed insurance to stabilise income (Ngango et al., 2022), a striking lack of technical knowledge suggests that this willingness is driven by a general need for financial security rather than a thorough comprehension of insurance procedures (Ibrahim, 2020). This gap is further exacerbated by the total lack of micro-insurance delivery systems and micro-training in the region (FAO, 2022; Ibrahim, 2020).

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The Heckman Selection model identified several significant variables affecting participation and WTP. Age negatively affected participation, suggesting that younger farmers are more inclined to embrace new risk management tools (Jiba et al., 2024). Paradoxically, farmers with no extension contact showed a 0.22 increase in participation probability, potentially due to the influence of private informal networks. Furthermore, larger farm sizes positively influenced WTP, as larger-scale farmers view insurance as a safeguard for their greater investments (Wang et al., 2022). While non-rice farm income encouraged participation through diversification, higher rice income and artisan earnings negatively influenced it, suggesting these farmers may self-insure (Usman & Haruna, 2024).

Regarding the outcome equation, land ownership negatively influenced WTP by approximately 0.17 units, likely because landowners perceive their assets as a form of security. Conversely, the literacy ratio positively influenced WTP by reducing information asymmetries and enabling more informed participation (Madaki et al., 2023). While rice farm size added 0.027 units per hectare to WTP due to economies of scale (Wodaju et al., 2025), cooperative membership was associated with a lower WTP, indicating that these groups may provide alternative internal risk-sharing mechanisms. Ultimately, adoption is hampered by limited awareness, inadequate government support, and the inability to afford premiums (Wang et al., 2022). These institutional shortcomings are mirrored by high transaction costs, complex registration procedures, and cultural barriers (Alabi & Anekwe, 2022). Technical constraints, such as inadequate access to localised weather data due to the distance of weather stations, further complicate the implementation of reliable insurance frameworks in the study area.

Conclusion and Recommendation

The study concludes that rice farmers in the Kwali Area Council demonstrate a strong, positive disposition toward weather-indexed insurance, signalling a robust demand for risk-management innovations amid increasing climate uncertainty. A significant finding is the "willingness-knowledge gap," where a high demand for financial stability exists despite minimal prior understanding of insurance mechanisms. Econometric analysis using the Heckman selection model confirmed that participation and willingness to pay (WTP) are significantly driven by socioeconomic factors, most notably age, farm income, farm size, and cooperative membership.

Despite this favourable attitude, adoption is currently hindered by critical constraints, including limited awareness, credit scarcity, and premium affordability. To bridge these gaps, it is recommended that stakeholders prioritise targeted sensitisation programs and implement institutional supports, such as premium subsidies and flexible payment structures. Strengthening these frameworks will be essential to fostering inclusive insurance policies, ultimately enhancing the resilience and economic sustainability of smallholder rice farmers in Nigeria.

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