Risk Attitudes of Rice Farmers Participating in IFAD-VCD Programme in Niger State of Nigeria

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Abstract

Weather vagaries, inconsistent government policies and market imperfections make things difficult for smallholder farmers to predict the future with certainty, thus, there is a need to understand their behavior towards risk. It is in the light of this that this study was conceptualized to determine risk attitudes of rice farmers participating in IFAD-VCD programme in Niger State of Nigeria. Cross-sectional data of 2018 cropping season was collected on a fortnightly basis from 110 IFAD rice farmers through a structured questionnaire complemented with an interview schedule and the collected data were analyzed using safety-first rule approach and Tobit regression model. The empirical evidence showed that most of the farmers were risk-averse owing to lack of complete market information in spite of the technical and input-output market support offered by IFAD programme in the study area. However, the major factors identified to be affecting farmers' preference for risk in rice production were the problem of glut which causes price dampening and high agro-input prices in the studied area. Therefore, the study recommends the need to strengthen the linkage between the farmers and off-takers, subsidizing farm inputs and also providing farmers with adequate market information in order to allay the fear of market imperfection in the studied area.

Keywords: Risk attitude, Safety-Approach model, IFAD, Farmers, Niger State

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Introduction

The fear of capital loss by small-scale farmers in Nigeria owing to lack of economic capital, and agricultural enterprise being bounded by uncertainty e.g. weather vagaries, the spread of pests and diseases etc., has been a serious threat to agricultural investment in the country. Amaefula *et al*. (2012) cited that small-scale farmers are naturally keen to avoid taking a risk which might threaten their livelihoods due to the potential negative outcomes of risk, thus they are willing to sacrifice their potential income to avoid risk or uncertainty. This behaviour influences the levels and types of farm inputs used by them and the aggregate levels of output they produce.The consequences of this risk and uncertainty phenomenon have kept productivity in agricultural enterprises low, despite all interventions aimed at ensuring food security. Therefore, due to this inherent risk associated with agricultural production, these farmers, especially the smallholder category, are not able to meet-up with their basic household needs. According to Mosley and Verschoor (2003), the vicious circle of poverty takes many forms but one key element in many versions of the spiral in many environments is risk aversion. If poor people are risk-averse to the extent that they are unwilling to invest in the acquisition of modern inputs because it involves risks, they will remain poor.

Picazo-Tadeo and Wall (2011) reported that agricultural production being subject to risk has a direct consequence on the farmers' attitudes towards risk as it influences their input choices owing to production risk. The time-lag characteristics associated with agricultural production activities inhibits accurate prediction of expected output and their prices, thus increasing the concern of risks and uncertainty (Amaefula *et al*., 2012).

Literature has shown strong evidence of resource-poor farmers being averse to risk (Moscardi and de Janvry, 1977; Binswanger, 1980; Antle, 1987) due to the associated impacts of risk and uncertainty on the households' production and consumption decision. Besides, Abayomi *et al*. (2013), reported that in recent years, risks have rivaled profitability as a measure of performance for producers. These general conclusions and observations have stimulated considerable research into the effects of risk on farmers' economic decisions. To add to the current literature, more needs to be done because research on the economics of risk in farming businesses has not been explored and documented in some places.

In Nigeria, particularly the study area, to the best of our literature review horizon, there is little or no documented empirical evidence on studies involving risk in crop farming business supported by International Fund for Agricultureal Devopment (IFAD) agricultural programme. Moreover, knowledge of how smallholder farmers make economic decisions under risk is important in determining the strategies and policies to be formulated for agricultural development. It is in view of this that the need to determine the risk attitudes of rice farmers participating in the IFAD programme in Niger State of Nigeria was conceptualized.

Objectives

The specific objectives were:

1.To determine the risk attitudes of the participating farmers and the

2. Factors influencing the risk attitudes of the farmers in the studied area.

Research Methodology

Niger state is located on latitudes 8°20'N and 11°30'N of the equator and longitudes 3°30'E and 7°20'E of the GMT. The agro-ecological zone of the state is northern guinea savannah with a fringe of southern guinea savannah in Mokwa Local Government Area (LGA). The major occupation of the inhabitants is farming and it is complemented with civil service jobs, artisanal, craftwork, *Ayurveda* medicines and petty trade. By using a structured questionnaire complemented with an interview schedule, field survey data of 2018 cropping season was elicited from a total of 111 rice farmers sampled through multi-stage sampling design. In the state, only five (5) Local Government Areas were chosen as the pilot phase for the programme with Agricultural Zone A (Bida) and C (Kontagora) having two LGAs each namely Bida and Katcha; and, Wushishi and Kontagora respectively, while Zone B has one participating LGA *viz.*Shiroro. In the first stage, for Agricultural Zone A, one LGA *viz.*Katcha LGA was randomly selected; for Zone B the only participating LGA *viz.*Shiroro LGA was automatically selected; while for Zone C, Wushishi LGA was purposively selected based on its comparative advantage as rice is produced throughout the year owing to the presence of Tungan Kawo irrigation dam. In the second stage, two villages were randomly selected from each of the chosen participating LGAs. Thereafter, two active co-operative associations from each of the selected villages were randomly selected. It is worth noting that Microsoft excel inbuilt random sampling mechanism was used for the random selection of the villages and the co-operative associations. In the last stage, using the sampling frame obtained from the International Fund for Agricultural Development - Value Chain Development (IFAD - VCD) office (Table 1), Cochran's formula was used to determine the representative sample size. Thus, a total of 111 active rice farmers formed the sample for the study. The collected data were analyzed using a multiple regression model (OLS) and safety-first rule approach in conjunction (first objective), and Tobit regression model (second objective). The Cochran's formula used is shown below:

$$n_a = \frac{n_r}{1 + \frac{(n_r - 1)}{N}} \quad \text{.......... (1)}$$

$$n_r = \frac{(1.96)^2 pq}{e^2} \quad \text{.......... (2)}$$

Where:

n_a = adjusted sample size for finite population

n_r = sample size for infinite population

N = population size

p = proportion of the population having a particular characteristic

q = 1 – p

e^2 = error gap (0.07)

Thus, p = 0.40 and q = 1 – 0.60 = 0.50

Table 1. Sampling Frame of Participating Farmers

LGAs	Villages	Co-operative Associations	SF	SS
Katcha	**Baddegi**	Managi Badeggi Farmers CMPS	24	10
		Aminci Ebanti Twaki CMPS Ltd	25	10
	Edostu	Edotsu Co-Operative Credit & Marketing CMPS	25	10
		Edotsu Jinjin WugakunYema CMPS	25	10
Shiroro	**Baha**	Baha Abmajezhin Cooperative Multi-Purpose Society Ltd	15	7
		Abwanubo Najeyi Development Association	18	8
	Paigado	Paigado Achajebwa Development Farmers Soc.	25	10
		Paigado Farmers Cooperative Society Ltd	25	10
Wushishi	**Bankogi**	Bankogi Alheri Farmers Coop. Multipurpose Soc Ltd	22	9
		Bankogi Gwari Nasara CMPS	16	7
	Kanko	Kanko Arewa Farmers	25	10
		Kanko Unguwar Ndakogi Cooperative Multipurpose Society Ltd	25	10
Total			270	111

Source: IFAD-VCDP farmers' database, 2018
Note: SF and SS mean sampling frame and sample size respectively.

Model Specification

The multiple regression model estimated by ordinary least square (OLS) is presented below:

Implicit form

$$Y = f(X_1, X_2, X_3, X_4 .... X_n) \quad (2)$$

Explicit form

$$Y_i = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 \dots\dots + \beta_n X_n + \varepsilon_i \quad (3)$$

Where;

Y = Output of rice (kg)

X_1= Farm size (ha)

X_2= Seeds (kg)

X_3= NPK fertilizer (kg)

X_4=Urea fertilizer (kg)

X_5= Herbicides (ltr)

X_6 = family labour

X_7 =Paid labour (manday)

X_8 = depreciation on capital items (₦)

β_0 = Intercept

β_{1-8} = Regression coefficients

ε_t = Stochastic

The functional forms fitted into the specified equation are as follow:

(a) Linear function

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 \ldots\ldots\ldots\ldots + \beta_n X_n + \varepsilon_t \ldots\ldots\ldots\ldots (4)$$

$MPP = \beta$

$Elasticity = \beta * \overline{X}/\overline{Y}$

(b) Semi–log function

$$Y = \beta_0 + \beta_1 logX_1 + \beta_2 logX_2 + \beta_3 logX_3 \ldots\ldots\ldots\ldots\ldots + \beta_n logX_n + \varepsilon_t \ldots\ldots\ldots (5)$$

$MPP = \beta/\overline{X}$

$Elasticity = \beta/\overline{Y}$

(c) The Cobb Douglas (double log) function

$$\log Y = \beta_0 + \beta_1 \log X_1 + \beta_2 \log X_2 + \beta_3 \log X_3 \ldots\ldots\ldots\ldots\ldots + \beta_n \log X_n + \varepsilon_t \ldots\ldots \quad (6)$$

MPP = $\beta * \overline{Y}/\overline{X}$

Elasticity = β

(d) Exponential function

$$\log Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 \ldots\ldots\ldots\ldots\ldots + \beta_n X_n + \varepsilon_t \ldots\ldots \quad (7)$$

MPP = $\beta * \overline{Y}$

Elasticity = $\beta * \overline{X}$

Safety-first Approach Method

Following Moscardi and deJanvry (1977), the safety-first approach used to generate risk aversion parameter (Ks) for each farmer is shown below:

$$K_s = \frac{1}{\theta}\left[1 - \frac{P_i W_i}{P_y \beta_i \quad \mu_y}\right] \ldots\ldots \quad (8)$$

Where; K_s is the risk index of i[th] farmer; θ is the variance parameter; P_i is the unit price of the chosen most influential input for i[th] farmer; W_i is the quantity of the chosen most influential input of the i[th] farmer; P_y is the unit price of the output of i[th] farmer; β_i is the elasticity coefficient of output with respect to the chosen input; and, μ_y is the mean of the output. The researchers did not adopt the classification developed by Moscardi and de Janvry as the mean and the standard deviation ($\bar{X} \pm 0.5 * SD$) of the risk aversion parameter K_s were used to classify the farmers in the studied area into three (3) distinct categories as presented below:

$0 < K_s < 2.286$ = Low risk aversion/ Risk-preference

$2.286 < K_s < 2.305$ = Intermediate risk aversion/ Risk-neutral

$2.305 < K_s < 2.329$ = High risk aversion/ Risk-averse

Tobit regression model

The Tobit model assumes:

$$Y_i^* = \alpha + X\beta + \varepsilon_i \quad \text{......} (9)$$

$$Y_i^* = \alpha + X_1\beta_1 + X_2\beta_2 + X_3\beta_3 + X_4\beta_4 + X_5\beta_5 + \cdots . + X_n\beta_n + \varepsilon_i \quad \text{..........} (10)$$

Where:

Y_i* = Risk Index valuefor ith household; X_1= Yield (kg); X_2= Marital status (married =1, otherwise = 0); X_3= Education (years); X_4= Sickness of household member (yes =1, otherwise =0); X_5= Extension visit (number); X_6= Access to credit (yes = 1, otherwise = 0); X_7= Seed variety (improved = 1, local =0); X_8= Gender (male =1, otherwise = 0); X_9= Age (year); X_{10}= Household size (number); X_{11}= Annual income (₦); X_{12}= Farming Experience (year); X_{13}= Non-farm income (yes =1, otherwise = 0); X_{14}= language spoken (number); X_{15}= Security threat (yes = 1, no = 0); X_{16} = Household commercial index (HCI); X_{17}= Seed cost (high =1, low =0); X_{18} = NPK fertilizer cost (high =1, low =0); X_{19} = Urea fertilizer cost (high =1, low =0); X_{20} = Herbicides cost (high =1, low =0); X_{21} = Human labour cost (high =1, low =0); X_{22} = Kcal consumption (recommended ($\geqslant$2250 *kcal*) =1, otherwise 0); X_{23} = Poverty depth (poor =1, otherwise =0); X_{24} = Food security status (secured =1, otherwise =0); β_0= Intercept; $\beta_{1\text{-}n}$ = vector of parameters to be estimated; and, ε_i = Error term.In partitioning the operating capital cost items this formula: $\bar{X} \pm 0.5 * SD$ was used, where the value $\geqslant \bar{X} \pm 0.5 * SD$ was considered high while the value $\leqslant \bar{X} \pm 0.5 * SD$ was considered low.

Results and Discussion

Risk Attitudes of the Participating Farmers

The linear functional form was chosen as the best fit among all the functional forms fitted into the specified equation as it satisfied the economic, statistical and econometric criteria of the method of estimation used i.e. ordinary least square (OLS) (Table 2). Furthermore, the estimated coefficient of farm size

Table 2. Production determinants of rice output among IFAD beneficiaries

Inputs	Ordinary least square (OLS)				Col. Test
	Linear (+)	Exponential	Semi-log	Double log	VIF (+)
Constant	106.127(380.503) [0.2789]^NS	7.584(0.0721) [105.2]***	−9553.19(3611.59) [2.645]**	6.188(0.617) [10.04]***	-
Farm size	1475.41(438.83) [3.362]***	0.292(0.0831) [3.516]***	2109.97(677.51) [3.11]***	0.435(0.116) [3.760]***	3.988
Seeds	3.98472(2.28357) [1.2134]^NS	0.00048(0.001) [0.481]^NS	331.64(321.99) [1.030]^NS	0.054(0.055) [0.978]^NS	2.817
NPK	6.0322(2.0268) [2.976]***	0.0011(0.00038) [2.927]***	1117.24(479.31) [2.33]**	0.214(0.082) [2.618]**	3.039
Urea	2.05026(1.9673) [1.045]^NS	0.00042(0.00075) [0.555]^NS	839.34(516.13) [1.62]^NS	0.120(0.088) [1.362]^NS	3.413
Herbicides	28.129(81.0175) [0.347]^NS	0.00818(0.0153) [0.533]^NS	582.72(473.85) [1.23]^NS	0.083(0.081) [1.020]^NS	2.526
Family labour	7.4674(2.8184) [2.649]***	0.00057(0.00053) [1.074]^NS	144.91(163.02) [0.89]^NS	0.018(0.028) [0.649]^NS	2.483
Paid labour	6.6226(3.588) [1.846]*	0.00069(0.00068) [1.016]^NS	105.21(156.26) [0.67]^NS	0.002(0.027) [0.074]^NS	1.266
Depreciation on capital items	−0.01606(0.0149) [1.142]^NS	−2.842E-6(1.31E-5) [0.216]^NS	96.48(288.22) [0.33]^NS	−0.0011(0.049) [0.022]^NS	2.288
$\sum \beta$	**0.98**				
R^2	**0.728**	**0.680**	**0.660**	**0.675**	
Adjusted R^2	**0.706**	**0.655**	**0.633**	**0.649**	
F-stat	**33.74*****	**26.80*****	**24.47*****	**26.20*****	
Heteroskedasticity (B-G)	**2.645{0.234}^NS**	**80.61{0.0006}*****	**77.53{1.5E-13}*****	**52.20{1.5E-8}*****	
Normality test	**13.16{0.0013}*****	**3.865{0.144}^NS**	**17.40{0.00016}*****	**3.07{0.214}^NS**	

Source: Field survey, 2018

Note: * ** *** ^NS significance at 1%, 5%, 10% and Non-significant respectively.

Values in ( ); [ ]; and { } are standard error, t-statistic and probability value, while Col. = Collinearity was found to be the *primus interpares* among the least-squares found to have a significant influence on the rice output, thus chosen as the factor to determine the risk attitude coefficient of the participating rice farmers in the studied area. The results showed that majority of the participating farmers were risk-averse (64.0%) owing to incomplete market information as the programme input supplier and off-taker linkages supports are not reliable given that they operate in the same environment that is subject to market imperfection (Table 3). However, 30.6 per cent identified to have a preference for risk is due to the confidence they have in the technical support, input and output linkages provided by the programme in the studied area.

Table 3. Risk attitudes of rice farmers

Category	Frequency	Percentage
Risk-preference (0 < 2.286)	34	30.6
Risk-neutral (2.286 << 2.305)	6	5.4
Risk-averse (2.305 2.329)	71	64.0
Total	**111**	**100**

Source: Field survey, 2018

Factors influencing Risk Attitudes of the Participating Farmers

The diagnostic test statistics *viz.* test for normality of the residual showed that the model failed the test of normality given that the error term is not normally distributed. However, this is not considered a serious case given that naturally in most scenario data are not normally distributed. In addition, the test for multicollinearity of the explanatory variables showed the absence of a collinear relationship between the variables as the explanatory variables variance inflation factors (VIF) were less than the value of 10.0. Furthermore, with the significance of the estimated Chi^2 value at less than 10 per cent degree of freedom, this indicates that the Tobit regression model is the best fit for the specified equation and the estimated parameters included in the model are different from zero i.e. they exert influence on the risk attitudes of the farmers in the studied area (Table 4).

A cursory review of the results showed that risk attitudes of the farmers were influenced by nutritional status, yield, educational status, access to credit, seed variety, commercialization index, language spoken, household size, cost of seeds, cost of NPK fertilizer, cost of urea fertilizer and cost of herbicides as indicated by their respective estimated coefficients which were different from zero at 10 per cent degree of freedom.

The negative significance of the nutritional status coefficient indicates that the farmers were nutritionally balanced i.e. those that meet the recommended kcal intake of 2250 kcal had a preference for risk. Therefore, the marginal and elasticity implications of a unit increase in the kcal intake of a farmer will make him reduce his aversion towards risk by 0.007 and 0.0004 per cent respectively. The negative significance of the coefficient for household member sickness showed how a case of non-ill health among the farm family of participating farmers encouraged them to have a preference for risk as his capital is not affected by medical expenditure coupled with no psychological trauma. Thus, the marginal and elasticity implications of a participating farmer with no case of ill-health among the farm family will lead to a decrease in risk aversion by 0.0019 and 0.00095 per cent respectively.

Farmers who used improved variety other than the local variety have a preference for risk due to the tendency of having a high yield which will translate to a high income if the prevailing market is remunerative as shown by the negative significance of the estimated coefficient for seeds variety. Thus, the marginal and elasticity implications of a farmer who used improved variety will make him reduce his risk aversion by 0.0076 and 0.0035 per cent respectively. The negative significance of the household size coefficient revealed that a large farm family composed of able-bodied people has a preference for risk due to multiple income streams which accrue to the household owing to income remittance by the household members. Therefore, the marginal and elasticity implications of a unit increase in the household size of a farmer will make him decrease his risk aversion by 0.00017 and 0.00063 per cent respectively.

The negative significance of the estimated coefficient of language spoken showed how communicating in more than one language enables a farmer to integrate into the global farming community *viz*. having adequate information about innovations and market information, thus making him have preference for risk as compared to his counterpart who will remain confined to his immediate farming environment if he speaks only one language. The marginal and elasticity implications of an additional language spoken by a farmer will make him decrease his risk aversion by 0.00098 and 0.0013 per cent respectively.

Farmers with a good market for their product have a preference for risk as indicated by the negative significance of the estimated coefficient for commercialization index. Therefore, the marginal and elasticity implications of a unit increase in a farmer's marketed surplus will make him reduce his aversion for risk by 0.0072 and 0.0021 per cent respectively. Low costs of operating capitals owing to subsidy encouraged the participating farmers to have a preference for risk as indicated by the negative significance of the estimated coefficients associated with the operating capitals. The marginal implication of low costs associated with seed cost, NPK fertilizer cost, urea fertilizer cost and herbicides cost will decrease the risk aversion attitude of a farmer by 3.59E-7, 3.398E-7, 6.74E-7 and 9.998E-7 respectively. In addition, the elasticity implication of low costs associated with seed cost, NPK fertilizer cost, urea fertilizer cost and herbicides cost will decrease the risk aversion attitude of a farmer by 0.0031 per cent, 0.0055 per cent, 0.0059 per cent and 0.0034 per cent respectively.

The positive significance of the yield coefficient showed how fear of glut in the market which dampens the market price makes farmers risk averse. Thus, the marginal and elasticity implication of a unit increase in the yield of the farmers will increase their risk aversion by 7.45E-06 and 0.0119 per cent respectively. The positive significance of the education coefficient revealed

Table 4. Factors influencing risk attitude of IFAD rice farmers

Variables	Coefficients	t-stat	Elasticity	VIF
Constant	2.34008 (0.01533)	152.6***		-
Yield	7.624E-6 (1.36E-6)	5.626***	0.0118944	1.703
Marital status	– 0.00083 (0.0044)	0.187NS	-0.0002941	1.743
Educational level	1.84E-5 (1.10E-5)	1.673*	0.0001246	1.433
Kcal consumption	– 0.00685 (0.00277)	2.478**	-0.0004988	1.827
Sickness	– 0.0019 (0.00077)	2.468**	-0.0009449	2.214
Extension visit	– 0.000195 (0.00031)	0.624	-0.0006487	1.558
Access to credit	0.00077 (0.00195)	0.395	0.0001499	1.627
Seed variety	– 0.0076 (0.0046)	1.668*	-0.0034502	1.266
Gender	– 0.0064 (0.00595)	1.081NS	-0.0027118	1.638
Age	– 9.39E-5 (0.00017)	0.551NS	-0.0016703	3.408
Household size	– 0.000169 (0.00005)	3.38***	-0.0006249	4.367
Annual income (₦)	– 7.07E-10 (2.61E-9)	0.270NS	-0.0001548	1.986
Farming experience	8.92E-5 (0.00019)	0.460NS	0.0009016	4.184
Non-farm income	0.00011 (0.0020)	0.053NS	0.000056	1.469
Language spoken	– 0.00098 (0.000177)	5.54***	-0.0013223	1.659
Security threat	– 0.0036 (0.0043)	0.834NS	-0.0000633	1.375
CI	– 0.0072 (0.00155)	4.645***	-0.0020922	1.604
Poverty depth	0.00312 (0.00251)	1.241NS	0.000305	2.084
Food security status	– 0.00345 (0.00225)	1.535NS	-0.0004708	1.937
Seed cost	– 3.59E-7 (1.24E-7)	2.885***	-0.0031	3.852
NPK cost	– 3.39E-7 (9.78E-8)	3.475***	-0.0054811	3.547
Urea cost	– 6.74E-7 (1.87E-7)	3.616***	-0.0059841	3.779
Herbicides cost	– 9.998E-7 (3.97E-7)	2.517**	-0.0033658	2.676
Hired labour cost	– 2.69E-8 (3.71E-8)	0.723NS	-0.0004084	1.698
Chi^2 test	535.62***			
Normality test	58.36 [2.1E-13]***			

Source: Field survey, 2018
Note: *** ** * & NS means significant at 1%, 5%, 10% and non-significant respectively.
The values in ( ) and [] are standard error and probability value respectively

how lack of complete market information owing to market imperfection made the educated farmers to be apprehensive of risk. Therefore, the marginal and elasticity implications of a unit increase in the educational level of a farmer will make him increase his/her risk aversion attitude by 1.84E-5 and 0.00013 per cent respectively. The positive significance of the credit estimated coefficient indicated how fear of loss of real capital due to default and delinquency by farmers with access to credit makes them averse to risk. Therefore, the marginal and elasticity implications of a farmer with access to credit will make him/her increase his aversion to risk in rice production by 0.00077 and 0.00015 per cent respectively.

Conclusion and Recommendations

It can be inferred that most of the participating farmers were apprehensive to risk in rice production owing to the problem of glut which causes price dampening and high cost of agro-inputs, and all are directly related to lack of complete market information in the studied area. Therefore, the study recommended the need to strengthen the linkage between the farmers and off-takers, provide input subsidies and adequate market information to the farmers in order to allay the fear of market imperfection among the farmers in the studied area.

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