Original Article

Assessment of risk attitudes of smallholder farmers in south-west, Nigeria

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A B S T R A C T

All production is subjected to risk and uncertainty, but the risks associated with agricultural production are particularly salient. Diffusion of new technologies by smallholder farmers as well as outcomes of rural development programmes depends largely on their attitudes towards risks. Understanding and quantifying farmers' risk attitudes is critical to market outcomes and policy designs. It is on this premises that, this study profile the risk attitudes of smallholder farmers in South-west, Nigeria. This study was conducted in South-west Nigeria. Four-stage random sampling technique was employed. First, was the selection of two States out of the six states in South-west, Nigeria. Second stage is the selection of two zones per state. Third, was the selection of two Local Governments per zone and fourth stage was the selection of 33 smallholder farmers per local governments. Data were collected through a well-structured questionnaire and were analyzed using descriptive statistics and Multinomial Logistics regression. Results of this study show that majority of the smallholder farmers are risk averse. An increase in years of experience, household size, and income diversification decreased the probability of a farmer inclining towards risk aversion while access to credit facilities and landownership increased the probability towards risk aversion (p-value<0.05).

Introduction

Agricultural activities entail extensive, direct and continuous contact with the forces of nature. These forces of nature exposes agricultural production to much risk: both weather shocks and unpredictable pest damages and in turn affect farm production. Agricultural activities are more susceptible to the physical and natural uncertainties than other enterprises (Kohn, 2014). Obviously, the reactions of farmers to unpredictable agricultural conditions are known as Farmers' Risk Attitudes. Farmers differ in their degree of acceptance, rejection and perception of risks. Some farmers perceived risk has desirable (risk lovers), undesirable (risk averse) while some are indifferent (risk neutrals). However, attitudes to risk are often related to the financial ability of the farmer to accept a small gain or loss (Kahan, 2013).

According to Taylor and Adelman (2003), farmers, particularly resource-poor farmers, are risk averse, as they frequently lack financial resources. They may maintain traditional production systems and practices even when market, environmental, and technological changes make them unsustainable. Resource-poor farmers are embedded with farm income uncertainty, fears on their ability to meet overhead costs, family needs, and also repay of any debt

(Nwosu *et al.,* 2010). The bulk of the peasant-poor farmers operates as smallholder farmers and is characterized by less efficient output. Even though, historically, very few of smallholder farmers collect all their income from only one source, hold all their wealth in the form of any single asset, or use their resources in just one activity. This situation in the rural areas has negative welfare implications and predisposes the rural populace to various risks, which threaten their livelihoods and their existence.

Similarly, there are numbers of risks and uncertainties that are associated with food production, which greatly impede the effort of smallholder farmers in terms of their agricultural production and productivity. Food and Agricultural Organization (2005) believed that operating costs would likely spike after a risk, because more resources are needed to recover pre-shock levels of production. It is believed that specific agricultural risks will increase in the coming decades due to exogenous shocks on supply and demand and the increased integration of agricultural products and markets within the financial world (Cordier, 2014). Not only does the frequent occurrence of these shocks impose high welfare costs in terms of food availability, food affordability, and malnutrition challenges for individual households, it also

adversely affects household incomes, the performance of the agricultural sector, the government's fiscal balance, and the growth of the economy (World Bank, 2013). Therefore, this study was carried out to specifically: (i) identify the risk preferences of smallholder farmers in the study area; and (ii) examine the factors affecting the risk preferences of smallholder farmers in the study area.

This study was conceptualized on the review and approaches of prospect and cumulative theory. The concept hangs on behavioral economics describing the choice of people between probabilistic alternatives whose outcome is unknown. The potential value of losses and gains influence people decisions rather than outcome. Prospect theory models real life choices as descriptive model compare to nominal models (Shafir and Leboeuf, 2002). The decision processes accompanying this concept has two stages: the initial stage (ordering of decision outcomes) and evaluation stage (computing the utility value). The equation for computing the utility value (evaluation stage) is:

$$V = \sum_{i=1}^{n} \pi(p_i)v(x_i) \qquad (1)$$

where

V is the overall or expected utility of the outcomes to the individual making the decision $x_1, x_2, ... x_n; p_1, p_2, ... p_n$ istheir respective probabilities;

v is a function that assigns a value to an outcome;

$\pi$is a probability weighting function;

Let $(x, p; y, q)$ denote a prospect with outcome x with probability p and outcome y with probability q and nothing with probability $1 - p - q$.

If $(x, p; y, q)$is a regular prospect (i.e., either $p + q < 1, or\ x \geq 0 \geq y, or\ x \leq 0 \leq y$), then:

$$V(x, p; y, q) = \pi(p)v(x) + \pi(q)v(y) \qquad (2)$$

However, if p+q=1 and either x>y>0 or x<y<0, then:

$$V(x, p; y, q) = p(y) + \pi(p)[v(x) - v(y)] \qquad (3)$$

If (x, p) is equivalent to (y, pq) then (x, pr) is not preferred to (y, pqr), but from the first equation it follows that;

$\pi(p)v(x) + \pi(pq)v(y) = \pi(pq)v(y)$, which leads to $\pi(pr)v(x) \leq \pi(pqr)v(y)$, therefore:

$$\frac{\pi pq}{\pi p} \leq \frac{\pi pqr}{\pi pr} \qquad (4)$$

Cumulative Prospect Approach modifies observations using expected utility theory by replacing final wealth with payoffs, replacing the utility function with a value function, and replacing cumulative probabilities with weighted cumulative probabilities. Therefore, the formula model for this study using the subjective utility of a risky outcome described by probability measureρ is:

$$u(p) := \int_{-\infty}^{0} v(x) \frac{d}{dx}\left(w(f(x))\right) dx + \int_{0}^{+\infty} v(x) \frac{d}{dx}\left(-w(1 - f(x))\right) dx, \qquad (5)$$

$u$is the subjective utility of farmers;

vis the value function;

w, is the weighting function

Material and Methods

The study was carried out in two states (Oyo and Osun) in South-west Nigeria. South–west Nigeria has six states (Lagos, Ogun, Oyo, Osun, Ondo, and Ekiti states). Four stages random sampling technique was adopted. The first stage was the ballot selection of two states out of the six states in South-west, Nigeria. The second stage was the selection of two zones (based on the ADP guidelines) per state, (Ogbomosho and Ibadan/Ibarapa zones in Oyo State while, Osogbo and Iwo zones in Osun State). The third stage was the selection of two local governments from each zone,

and the fourth stage is the selection of 33 smallholder farmers per local government to make 132 respondents per state. The total smallholder farmers interviewed for this study are 264 smallholder farmers. The data and variable collected for this study are: General farm information; Socio-economic and Risk preferences data.

The risk attitudes of the farmers were elicited through the individual utility using the Equally Likely Certainty Equivalent (ELCE). The ELCE method involves the subjection of farmers to series of risky outcomes that has equal probabilities of 0.5. The responses of farmers to the risky outcomes were tagged as certainty equivalent (CE). The utility values of 1 (the best outcome) to 0 (the worst outcome) were correlated with the CEs. Therefore, the lowest outcome that a farmer got from the lottery ticket was ₦0 and the highest was ₦100,000. So, $U(0) = 0$ and $U(100,000) = 1$.procedurally, smallholders' farmers were to choose between alternative I, a lottery ticket, and alternative II, a sure sum of money (Z). The lottery offered a chance to win either ₦100,000(Z_{max}) or ₦0 (Z_{min}) with a 50:50 probability.

The factors affecting risk attitudes of the farmers elicited through the ELCE was analyzed using the multinomial logistic regression of the form:

$$Y_{i=0,1,2} = b_0 + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + b_6X_6 + b_7X_7 + b_8X_8 + e_i \qquad (6)$$

Y = Risk attitudes (0 = Risk Averse, 1 Risk neutral and 2 = Risk lovers).

The independent variables are as follows:

b_0 =intercept of the equation;

$b_1 - b_9$= partial regression coefficient;

$X_1, $ = Gender (1 = male, 0 = female);

$X_2, $ = Experience in years;

$X_3, $ = Household size (No of persons living under the same roof);

$X_4, $ = Farm size (ha);

$X_5, $ = Income diversification (Have other source of income apart from farming = 1, no other source = 0)

X_6 = Access to Credit facilities (Access to credit =1, No access to credit = 0);

X_7 = Farm Income (the farm revenue from the specific farm activity ₦)

X_8 = Ownership of cultivated land (owner-self operated =1, otherwise = 0)

e_i= error term

Results and Discussions
3.1 Socio-economic characteristics

The statistics of the socioeconomic characteristics of the smallholder farming households in the study area was presented in Table 1.

The data in table 1 show that smallholder farming is not restricted to a particular gender; males and females are involved in the farming business based on accessibility to assets and resources. Although, factors such as; female position in the south-western Nigeria culture, gender inequality, beliefs, etc. usually hinder female participation in farming. Out of the 264 farmers interviewed for this study, majority are male. This is a result of the agrarian nature of the study area, where women have less advantage than men especially on land ownership, acquisition of wealth and fixed assets, either by inheritance or by possession. Therefore, the

Characteristics	Frequency	Percentage	Cumulative
Bank of Agriculture	25	9.46	9.47
Commercial Bank	7	2.65	12.12
Cooperative	85	32.20	44.32
Village Funds	3	1.14	45.46
Friends/Relatives	34	12.88	58.34
Personal Funds	110	41.66	100
Total	**264**	**100**	

Source: Field Survey, 2020

The context of marriage in south-west part of Nigeria lies predominantly on responsibility, among other things. The responsibility cut across decision making related to the wellbeing as well as risks that can make or mar the prospect of immediate family members or households. However, marriage in the rural areas of south-west part of Nigeria can be polygamous or monogamous, with polygamous households adjudged with high poverty incidence according to Anyanwu, (2013). The marital status of the respondents in the study area shows that married farmers dominated the study area, followed by single, with few percent in the divorced category. This is a pointer that commitment to responsibility will be high among the respondents and all things be equal should affect their disposition to risks.

The level of education is an important decision-making determinant (risk attitudes), as well as poverty determinant in Nigeria according to the Anyanwu, (2013). The level of acquired knowledge of a farmer through education determines the ability of such farmers to make profitable decisions on investment, reduction of production failures and prosperity of farming households. From the results obtained, the majority of the farmers have secondary education. This suggests that most of the respondents should have the necessary knowledge related to risk.

Also, farming experience indicates the ability to acquire skills and adopt innovations. Experience also enables an entrepreneur to set realistic targets. From the results obtained, a majority of the farmers have between 1-20 years of farming experience. This suggests that most of the respondents should have garner experience about risky decisions and mitigation viz-a-viz management of outcomes of risky games to cushion the effect on wealth and poverty.

On Household size, there are two opposing views as to the effect of household size on risk attitude and poverty. The larger the household size, the greater will be the total consumption needs of the farm family and thus, the less willing to bear risk and such will have a direct impact on the poverty status. However, a larger household size also helps to augments the total labour supply of the farm household and thereby enhances its income-generating potentials, right decision on risk attitude and reduction in poverty. Table 1 shows that majority of the respondents in the study area have household size between 6-10 persons, which is a pointer to enhance labour supply and reduction in cost associated with farm production.

study area is expected to have more households with mitigating measures against risk.

The age group distribution shows that smallholder farmers in the study area are in their middle age and farmers in their middle age are expected to be energetic and economically active. In other words, middle-aged farmers could drive agricultural productivity, if supported and given the needed incentives. This study revealed that the majority of the interview farmers are between the ages of 30-49. This indicates that more than average of the respondents can meet their labour requirement in the accomplishment of farm activities. The age distribution of this study agrees with the work of Adeola and Adetunbi (2015) conducted on perception of farmers in South western, Nigeria to sustainable agriculture. The authors reported that most of the farmers were still in the active age range of 31-40 years.

In terms of farm credit, investment fund is an integral part of smallholder farming in developing nation like the study area. From the study, 32% of the smallholder farming households borrowed from cooperative. Also, 42 % used their savings while a few percent of the respondents get loans from commercial banks. It shows that the accessibility of formal loans (Bank of Agriculture and Commercial Banks) by smallholder farmers is minimal in the study area.

Table 1. Socioeconomic Characteristics of smallholder farmers.

Characteristics	Frequency	Percentage	Cumulative
Gender			
Male	226	85.61	85.61
Female	38	14.39	100
Age			
≤30	83	31.44	31.44
30-39	93	25.33	66.67
40-49	63	23.86	90.53
50-59	16	6.06	96.59
≥60	9	3.41	100
Marital Status			
Single	12	4.55	4.55
Married	247	93.56	98.11
Divorce	5	1.89	100
Educational Level			
No education	28	10.60	10.60
Primary	52	19.70	30.30
Secondary	100	37.88	68.18
Vocational	24	9.09	77.27
Tertiary	46	17.42	94.69
Post Graduate	14	5.31	100
Total			

Source: Field survey, 2020

Table 1. Continued: Socio economic Characteristics of the Respondents.

Characteristics	Frequency	Percentage	Cumulative
Farming Experience			
≤10	5	1.89	1.89
11-20	102	38.63	40.52
21-30	74	28.05	68.57
31-40	32	12.12	80.69
41-50	32	12.12	92.81
>50	19	7.19	100
Household Size			
≤5	100	37.88	37.88
6-10	144	54.54	92.42
>10	20	7.58	100
Farm Finance			

3.2 Risk Attitudes of Smallholders' Farmers

Exploring the attitudes of farmers towards risk is important in understanding their managerial decisions as well as the exposure of farmers to risky events. The result of the Equally Likely Certainty Equivalent (ELCE) used to elicit the individual utility risk attitudes of smallholders' farmers.

Table 2. Risk Attitudes of smallholder farmers.

Risk Attitudes	Frequency	Percentage	Cumulative
Farming Experience			
Risk averse	179	67.80	67.80
Risk neutrals	64	24.24	92.05
Risk lovers	21	7.95	100
Total	**264**	**100**	

Source: Field Survey, 2020.

The risk attitudes of the respondents as shown in Table 2, reveals that majority of the smallholders' farmers' in the study area are risk averse. This aligns with the findings of Iyer*et al* (2020) that rural households are predominantly risk averse. Furthermore, there are more risk neutral farming households than risk loving households in the study area. The numbers of risk neutrals and risk lovers among smallholder farmers in the study area agree with the works of Bergho*et al.* (2018).

Table 2, reveals that 68 % of the smallholder farming households are risk averse which agrees with the work of Iyer*et al* (2020) where majority of respodents were found to display aversion towards risk tailored with respect to innovations. The authors believed that, the risk attitudes (risk aversion) of the farmers will hinder them from embracing innovations, thereby, affecting the goal of ensuring food security.

In the same vein, the percentage of risk lovers and risk neutral are 8% and 24% respectively for this study as shown in Table 2.

3.3 Multinomial Logistic Regression

The Multinomial logistic regression result of selected socioeconomic characteristics towards the Risk attitudes of smallholder farmers interviewed in the study area, as shown in Table 3, reveals that six variables and one variable out of the nine variables were significantly related to risk averse and risk neutral smallholder farming households in the study area respectively.

The income diversification as an independent variable was found to be negatively significant to both risk averse and risk neutral smallholder farming households in the study area. This is a pointer to the fact that, smallholder farming households with diversified income will have a decrease probability towards risk aversion and risk neutrality. Income diversification will guarantee the farmers the needed shocks

against risk peradventure a farming system fails. This stands to reason that, an additional; income to the farmer from non-farming sources will tend the farmer towards risk taking. Hence, all other things being equal, respondents with high income will be more willing to take risks than those with lesser income.

Furthermore, years of experience were also found to be significant at 5% and negatively associated with the risk aversion of interviewed farming households. It means, an increase in the years of experience of smallholder farming households, is equivalent to a decrease in their probability towards risk aversion as an attitude. This can be attributed to the actuality that the majority (67%) of the smallholder farmers have between 11-30 years of farming experience. This implies that farming experience garner over the years must have exposed the farmers to risky economic games and might be willing to take a higher level of risk. Also, this is in line with Iheke & Igbelina (2016) that a unit increase in the years of farming experience will lead to an increase in the reduction of risks. This conforms to Ogoke (2009) observation that farmers with longer years of farming experience should have acquired practical knowledge concerning risk.

The findings of this study showed that household size had a negative significant relationship with risk averse farming households. This is an indicator that, an increase in household size of smallholder farming household will decrease their probability toward risk aversion. Evidently, the size of the households is a huge relieve on the labour cost, thereby, enticing the households towards risk taking.

Poorer farmers are less risk takers than wealthy ones and as such avoid prospects in which the probability of failure looms large (Senapati, 2020). This agreed with the results of this study that signaled an inverse probability between the multidimensional poverty index of the smallholder farming households and their risk aversion attitude. That is, the poorer farmers (those whose censored score are greater than 0.33) shows a probability decrease towards risk aversion.

Access to credit facilities and landownership shows a positive correlation to risk aversion index of the smallholder farming households. It is a signal that, smallholder farming households that have access to credit and pays no money on land rent shows a probability increase of farming households towards risk aversion.

Table 3. Multinomial Logistic Estimates of Selected Socioeconomic Characteristics towards Risk Attitudes of Smallholder Farmers.

Variables	Coefficient	Std. Err.	z	P>|z|	ME
Risk lovers (Base)					
Risk Averse					
Gender	0.0690289	0.4923261	0.14	0.888	-0.065649
Years of experience	-0.0247932	.0124982	-1.98	0.047*	-0.003464
Household size	-0.1311566	.0598297	-2.19	0.028*	-0.030640
Farm size	0.6314319	.7733359	0.82	0.414	0.089185
Income diversification	-1.224348	.4558959	-2.69	0.007*	-0.111256
Access to credit	0.1790032	.0982142	1.82	0.054*	0.033121
Farm income	-0.0000621	0.0000764	-0.81	0.416	-1.430808
Land ownership	0.459562	0.2060485	2.23	0.026*	0.082207
Constant	0.7936471	1.63203	0.49	0.627	
Risk Neutral					
Gender	.7709584	0.6876785	1.12	0.262	0.009947
Years of experience	-0.0384344	0.0225814	-1.70	0.089	0.004641
Household size	0.0264859	0.0906786	0.29	0.770	0.020568
Farm size	1.065212	1.295219	0.82	0.411	-0.106507

Variables	Coefficient	Std. Err.	z	P>|z|	ME
Income diversification	-1.460964	0.7530461	-1.94	0.052*	0.153248
Access to credit	0.0443392	0.1586006	0.28	0.780	-0.026963
Farm income	0.0000618	0.0001183	0.52	0.601	1.224008
Land ownership	0.2725024	0.3326091	0.82	0.413	0.073269
Constant	-0.5217929	2.769204	-0.19	0.851	

Number of observations = 264   Log likelihood = -182.80388
LR chi2(30)   =   61.20   Pseudo R2   =   0.1434
Prob> chi2   =   0.0007

Conclusion

The study concluded that most of the smallholder farmers in the study area are risk averse and that their socioeconomic characteristics such as; income diversification, years of experience, access to credit, household size and landownership had significant effect on their risk attitudes.

Based on the findings of this study, these were the recommendation:

1. Smallholder farmers in the study area should be encouraged to embrace diversification of enterprise. Income diversification can gear them towards risk loving.
2. Since access to credit facilities was part of the significant variables towards risk attitudes, policies that will enhance smallholder farmers' accessibility towards credit facilities should be formulated.

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