RISK PREFERENCES AND RESOURCE ALLOCATION DIFFERENTIALS OF FOOD CROP FARMERS IN OSUN STATE, NIGERIA

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Abstract

Apprehension of risk induces certain behaviour into a farmer and this would grossly affect enterprise selection and consequently his resource use and allocation pattern. In this study, risk preferences of food crop farmers in Osun State were measured and efficient resource use and allocation patterns were modeled and suggested. Data from 165 farmers, obtained using a two-stage sampling procedure were used in the study. Analytical tools were descriptive statistics, Risk Behavioural Model (RBM) and Target Minimization of Total Absolute Deviation (T-MOTAD). Risk averse farmers were 144 representing 87.3 percent while the risk preferers were 21 representing 12.7 percent. However risk preference was higher among the males, farmers with larger farm sizes and smaller household sizes. Efficient utilization of labour and borrowed capital was discovered among the risk preferers than the risk averters; hence a significant difference existed in their returns (P< 0.01). It is recommended that farm management research and the extension packages should be channel to the farmers while considering the socio-economic environments that characterize their risk preferences.

Keywords: Risk Preferences, Food Crop, Resource allocation, Efficient Plan

1. Introduction

Actualizing the increased food production programme of the government has ever been attributed to small scale farmers who represent 95 percent of the total food crop farming units in the country and produce about 90 percent of the total food output (Okuneye and Okuneye, 1988; as cited by Adejobi, 2004). These farmers use two principal resources, land and labour (Dipeolu and Akintola 1999), others are owned and borrowed capital and purchased inputs; agro-chemical, fertilizer, etc and are often faced with severe price and yield variation (Isik 2002). Viewing that efficient use of these resources stands paramount; studies have extensively investigated the allocative efficiencies among farmers. While some results have shown that farmers were efficient (Holden and Shifraw, 1997; Amaza and Olayemi, 1999) others showed that they were inefficient (Fafchamps, 1998; Adejobi, 2004). It is the concern of this study that these results may be mis-specified if these small farmers make production decisions in the face of risk that characterized Nigerian agriculture. Apprehension of risk induces certain behaviour into a farmer and this would grossly affect enterprise selection and consequently his resource use and allocation pattern.

The rural poor are risk averse as they are always skeptical of losing the little resources that they have at their disposal and thus specialize on low risk – low return activities (Collier and Gunning, 1999).These farmers are therefore more of risk minimizers contrary to the neo-classical principle of profit maximization. In essence, the household tends to obey a safety – first principle that assumes the individual's objective is to minimize the probability of experiencing a short fall in income below a certain initial level (Sekar and Ramasamy, 2001). The practical implication is that fewer resources are devoted to risky or perceived risky activities given the fact that a single crop failure can threaten a household's livelihood. In line with this thought, the farmer should rightly be seen as trying to satisfice between goals rather than maximize particular economic magnitudes (Kooten *et al*, 1986). Satificing behaviour refers to a situation under which farmers allocate their available resources among competing production alternatives in such a way as to attain a satisfactory level of overall performance in terms of a defined set of aspiration levels of their pre-specified objectives of production (Aromolaran and Olayemi, 1997). The concern of this study becomes more important in that most predictions, projections and farm planning for small farmers are carried out without adequate consideration and incorporation of farmers perception of risk and uncertainties inherent in farming. Land area devoted to any crop varies from farmer to farmer depending on expectations and subjective probability attached to each crop success. The degree of risk manifested by individual farmer can thus be derived from the observed behaviour. Thus, for a farmer with given production resources, the way those resources are allocated among enterprises shows his perception of risk inherent in each enterprise (Berbel, 1990). Therefore ignoring production and or output price uncertainty or risk preferences of farmers would lead to misleading estimates of the effectiveness of policies set at improving agricultural development in the country. This study aimed at measuring farmer's risk preferences and as well develops a risk-efficient utilization plan for farmers. It is hypothesized that there are no farm returns difference between farm plans of risk averse and risk prefer farmers.

2. **Methodology**

2.1. ***Study area***

The study was carried out in Osun State, Nigeria. The state was chosen because of its location in the rainforest region and the availability of food crops farmers. Also, available studies suggesting efficient farm plan for food crop farmers in the study area have not been much established on the premise of their risk preferences. An attempt to fill this void further provides a basis for this study and Osun State as the study area. A two-stage sampling procedure was used in the collection of primary data in Osun State. The first stage involved a random selection of

30 village/farming communities from the three agro-ecological zones of the state's Agricultural Development Programme. The second stage involved a random selection of food crop farmers from each of the villages with probability proportionate to size of each village/farming communities. Data from 165 respondents were used for the analysis. Using structured questionnaires, data used included some socio-economic and demographic characteristics, resources employed and costs, food crop choices, yield and prices. Secondary data were also obtained from Central Bank of Nigeria and Food and Agriculture Organization.

2.2. *Analytical techniques*

Data were analyzed using Descriptive statistics, Risk Behavioural Model (RBM) and Target Minimization of Total Absolute Deviation (T-MOTAD). The descriptive statistics include tables, frequency counts and percentages. Summary statistics like mean and standard deviation were also employed.

In order to measure risk preferences of food crop farmers in the study area as stated in the first objective; a risk behavioural model was employed. The model is based on the principle of safety- first. In its framework, the principle assumes that the individual's objective is to minimize the probability of experiencing a shortfall in income below a certain initial level. The decision makers are therefore pre-occupied with maximizing their chances of survival.

The model, which was developed by Roy (1952), is expressed below following Shahabuddin *et al* (1986) and Sekar and Ramasamy (2001).

$$\Psi_i = (\partial_{i*} - \mu_i) / \sigma_r \qquad \text{---------- (1)}$$

Where Ψ_i = risk aversion Index

∂_{i*} = disaster level of income

μ_i = Expected income from the farm

σ_r = Standard deviation of household income

i = 1to n

n = number of farmers

The disaster level of income ∂i^*, represents the point below which the behaviour of the decision maker must change markedly, that is, the farm household must borrow or sell assets to avoid starvation. This level of income would also be determined by the situation of the decision-maker in a given socio –economic environment (Shahabuddin *et al*, 1986). The model is constructed following the utility function. The respective respondent is risk averse if $\Psi_i < 0$, if $\Psi_i = 0$, the farmer's attitude to risk is neutral and if $\Psi_i > 0$, the farmer is a risk seeker or preferer.

Linear programming is widely recognized as a method for determining a profit maximizing combination of farm enterprises that is feasible with respect to linear fixed farm constraints. The conventional deterministic model ignores uncertainty, however, and may lead to a farm plan that is unacceptable to a farm operator on the basis of previous experience (Hazell, 1971). This thus informs suggestion of allocation plan

for farmers while element of uncertainties are adequately taken care of. Alternative risk efficient resource allocation pattern is therefore predictable through the use of Target MOTAD (Minimization of Total Absolute Deviation) model. The model formulation becomes useful because decision makers often wish to maximize expected return but are concerned about net returns falling below a critical target. This approach is in accordance with safety- first principle. Mathematically, the model, which was modified by Tauer (1983) after Hazell (1971), is stated below:

$$Max\, E(Z) = \sum_{j=1}^{n} C_j X_j \qquad (2)$$

Subject to

$$\sum_{j=1}^{m} a_{ij} X_j \leq \qquad (3)$$

$$\sum_{j=1}^{n} C_{rj} X_j + y_r \geq T \qquad (4)$$

$$\sum_{j=r}^{n} P_r Y_r = \uparrow, (\uparrow = M.....0) \qquad (5)$$

R=1…..

X_j and $Y_r \geq 0$

Where E (Z) = Expected return of the plan or solution to the plan in naira
C_j = expected return of activity in Naira, (Mean return from each activity)
X_j = level of activity j
a_{ij} = technical requirement of activity j for resource i
b_i = level of resource i
T = target level of return in Naira (using the daily consumption requirement recommended by FAO)
Crj = return of activity j for state of nature or observation r in Naira
P_r = probability that state of nature or observation r will occur
$\uparrow$ = a constant parameterized from M to 0
m = number of constraints or resource equations
s = number of state of nature or observation
M = Large number (represents the maximum total negative deviation of return of the model)
n = number of activities, or resource, or observation and their levels
y_r = deviation below T for state of nature or observation r.

$$y_r = \sum_{j=1}^{n} (Cr_j - C_j) X_j \qquad \text{…….. (6)}$$

Equation (2) maximizes expected return of the solution set. Equation (3) fulfils the technical constraints; equation (4) measures the revenue of solution under state r. If that revenue is less than the Target T, the difference is transferred to equation (5) via variable y_r. Equation (6) sums the negative deviation after weighing them by their probability of occurring, P_r. In order to incorporate risk variable into the model, time series data on input level, yield and price are usually needed for each production activity (Hazell, 1971, Adubi, 1998, Oni, 2000 and Isik 2002). For the purpose of this study, prices and yield for only three (3) years 2002, 2003, and 2004 were considered due to constraint in the information/data availability. Average prices, costs and yield data for 2002 and 2003 were collected from ADP in the study area while the study relied on farmers' memory for similar data for year 2004. The gross margins estimates for the three-year period for the respective crop production activities were then adjusted to their 2003 price values, using the consumer price index (CPI). The model is superior to other programming models for farm planning under risk because it is computationally efficient and it generates solutions that are not in conflict with second degree stochastic dominance (SSD) (Berbel 1990). The model is a risk programming technique solved with a linear programme algorithm since it has a linear objective function and linear constraints. The safety first element was then formulated in the second step as a matrix of deflated gross margins and the sum of negative deviations from the expected returns for each state of nature. This served as risk measure while a target level of return, T (an average amount required to provide for households' minimum financial needs) was set as risk constraints. As the total absolute deviation (TAD) was parameterized, selection of a set of risk efficient farm plan from the available possible points on the frontier becomes possible through the comparison of the standard deviation, coefficient of variation (measures of associated level of risk) and returns of activities or enterprises and farm plans generated by the programme.

The programming technique was based on the following assumed objectives of the farmers:

i. to provide adequate food in order to ensure at least minimum household food requirement,
ii. to earn adequate monetary income so as to meet minimum household financial needs,
iii. to maximize the return to the allocated resources

3. Results and discussions

3.1 *Summary* of r*isk preferences of farmers*

Following the procedure outlined in the methodology; the farmers were categorized into risk averters and risk preferers (takers). Table 1 reveals that 144 farmers in the study area have negative risk coefficients and were therefore categorized as risk averters. This represents 87.3 percent of the sampled farmers. Twenty one farmers on the other hand have positive risk coefficients and were categorized as risk seekers. This represents 12.7 percent of the sampled farmers. However, none of the farmer respondents has zero risk coefficients; an indication of risk indifference, hence none of the farmers was risk indifferent or neutral. The result of the study is a confirmation of the general assumption in the world of agriculture that farmers are risk averse and it is in line with empirical results of various studies (Shahabuddin *et al* 1986; Adubi, 1998 and Sekar and Ramasamy, 2001). The categorization was further used to explain some characteristics of these farmers (Table 2).

Table 1
Distribution of Risk Preferences of Farmers

Category	*Frequency*	***Percentage***
Risk Aversion	144	87.27
Risk Indifference	0	0.00
Risk Preferences (seekers)	21	12.73
Total	165	100

3.2. *Categorization of farmers risk preferences*

The distribution of some household characteristics among these categories of farmers was compared and the result is shown in Table 2. The characteristics were age, sex, marital status, educational level, household size, membership of cooperative society or similar association and the farm size. The result shows that: The average age of the risk averse farmers was 47.7 years while it was 50.7 years for the risk seekers. This implies that an average risk averse farmer was younger than risk seekers. This age distributions may be unexpected; two possible reasons are considered to be responsible for this. First, younger farmers, due to little experience or resource base may be scared of risk occurrence than the older farmer who is expected to be more experienced and have more resource base. Secondly, attitude towards risk for a particular individual may not be the same for all options of life. While a younger farmer may be risk averse in agricultural production, they may tend to risk seekers in other aspects of life. The percentage of male among the risk seekers was 85.8 percent while it was 62.5 percent for the other group. This shows that more male were found among the risk referrers than the risk averse farmers. While 66.7 percent of the risk seekers had either no formal or

mere primary education, the risk averse farmers were only 60.4 percent in this category of education. This shows that a relatively higher percentage of the averters, was educated than the other group. The household size distribution shows that risk averters had an average of seven members per household while it was five for the risk seekers. This shows that risk averse farmers had larger household size. The distribution of farm size reveals that an average of 2.0 hectares of farm size was possessed by risk averse farmers while it was 3.1 hectares for the risk referrers. Tests of differences between means were used to compare the variables in the two categories. It is shown that household size and farm size among the risk averters differed significantly from that of risk referrers.

Table 2

Categorization of Farmers Attitudes to Risk Based on Some Household Characteristics

Household Characteristics	*Risk Averters*	*Risk Referrers*	*t-value*
Age (years)	47.72	50.74	0.98
Gender	62.50% Males	85.80% Males	
Marital Status	95.83% Married	95.24% Married	
Educational Level	60.42% (No formal or Primary Education)	66.67% (No Formal or primary Education)	
Household Size	7 members	5 members	1.22
Membership of Cooperative Society of similar group	64.50%	62.78% 3.11	2.96*
Farm Size (ha)	2.01		6.5*

* indicates significant at P < 0.01

3.3. *Efficient farm plans across different risk categories*

The farmers' existing plan (Plan I) in the study area, pooled risk minimized or efficient farm plan (Plan II), efficient farm plan for the risk averters (Plan III) and the efficient farm plan for the risk referrers (Plan IV) are as shown in Table 3. Plan IV has the highest return of ₦51, 323.94 and allowed the cultivation of five enterprise combinations. However, the existing resource allocation pattern as obtained in the study area (Plan I) has the lowest returns ₦31, 959.81 from 13 different enterprises cultivated by the farmers. Thus the farmers are assumed not to be efficient. The efficient plans II, which represents the recommendation for the pooled farmers (i.e. both risk averters and referrers taken together) has a close level of returns of ₦36, 776.05 and six enterprises when compared with plan III (that is, efficient farm plan for the risk averters) which has ₦35, 812.14 and five enterprises. This closeness is justified in that an average farmer in African countries is risk averse (Bar-Shira et al, 1997 and Bard and Barry, 2001). The enterprises are as shown in Table 3. From the table, the average farmer should allocate his resources in such a way that the five enterprises in Plan III are produced according to their hectrage

Table 3:

Risk minimized (Efficient) farm plan for risk averters and risk preferers

	Farmers' plan (Pooled: Plan I)	*Risk minimized farm plans (Pooled: Plan II)*	*Risk minimized farm plans (Risk Averters: PlanIII)*	*Risk minimized farm plans (Risk Preferers:PlanIV)*
Returns in Naira per/ha	31,959.81	36,776.05	35,812.14	51,323.94
Maize	0.048 (2.21)			
Cassava	0.133 (6.20)			
Sorghum	0.04 (1.87)	0.018 (0.84)	0.25 (12.43)	0.45 (14.50)
Yam	0.168 (7.80)	0.52 (24.18)		0.70 (22.51)
Cowpea	0.005 (0.26)			
Maize/ Cassava	0.774 (35.90)	1.00 (46.51)	0.98 (48.75)	1.71 (54.98)
Maize/ Yam	0.107 (5.00)	0.20 (9.30)	0.47 (23.38)	
Yam/ Vegetable	0.011 (0.52)			
Maize/ Vegetable	0.131 (6.09)	0.26 (12.09)	0.15 (7.50)	0.80 (25.72)
Cassava/ vegetable	0.134 (6.24)			
Maize/Cassava/yam	0.318 (14.77)			
Cowpea/cocoyam	0.154 (7.14)		0.16 (7.96)	
Maize/cowpea/cocoyam	0.130 (6.02)	0.15 (7.00)		0.45 (14.50)
Total Cropped Area	2.15 (100)	2.15 (100)	2.01 (100)	3.11 (100)
Percentage sole Cropping	18.34	25.02	12.44	36.98
Percentage Cropped Mixtures	81.68	74.90	87.56	63.02

Figures in Parentheses are the percentage cropped area

Farm plan differentials exist between risk averse and risk prefer farmers (t-value = 5.89 significant at P < 0.01)

allocations. The recommended allocation pattern depicts the most important enterprises as maize/cassava (0.98ha), maize/yam (0.47ha),

sorghum (0.25ha), cowpea/cocoyam (0.16ha) and maize/vegetable (0.15ha). In plan IV, the recommended allocation pattern is maize/cassava (1.71ha), maize/vegetable (0.80ha), yam (0.7ha), sorghum (0.45ha), and maize/cowpea/cocoyam (0.45ha). It could be observed that maize/cassava enterprise had the highest land allocation in the three risk minimized plans II, III and IV (46.51percent and 48.75percent and 54.98 percent respectively). While sorghum had the least land allocation (0.84 percent) in plan II, maize/vegetable was the least (7.50 percent) in plan III and sorghum (14.50 percent) and maize/cowpea/cocoyam (14.50 percent) were the least in plan IV. Except in the plan IV, percentage crop mixtures were above 70 percent implying a mitigation strategy towards reducing the possible risk among the enterprises. The major similarity is that the available land in the two categories was fully utilized while maize/cassava enterprise had the highest land allocation in the two efficient sets. However, sole cropping was 12.94 percent for the risk averse farmers while it was 36.98 percent for the risk referrers. This probably shows that the extent of crop diversification is higher for the risk averse farmers as a way of reducing the probability of loss. However, despite five enterprises being recommended in plan IV, the return (₦51, 323.94) was still more than that of plan III with a return of (₦35, 812.54) from five recommended enterprises also. This difference could easily be traced to larger farm size allocations to the enterprises and consequently, the analysis shows that there exists a significant difference between the returns from the risk averse farmers and the risk referrers ($P < 0.01$) as shown in Table 3.This result is similar to the findings of Ceyhan and Cinemre (2003).

3.4. *Resource allocation differentials among farmers*

The resource use status across the plans is presented in Table 4. A striking feature in the result is that land and cash on material inputs (fertilizers, agrochemicals, seeds and cuttings etc) were fully utilized in all the plans implying additional returns to the farmers (as given by the shadow prices) as more units of these resources are utilized. It would also be observed that on a general note; the labour resource was not fully utilized in the plans. This implies an excessive use of family and hired labour (as shown by the slack variables).This invariably would have increased the production cost. The efficient plan for the risk referrers however has an outstanding feature that distinguishes it from the other plans. There are two observations in this respect; first is the efficient utilization of labour resource and second is the effective utilization of borrowed capital in comparison with risk minimized plan for the risk averters. Though it has been shown that labour resource is a major resource in crop production (Dipeolu and Akintola, 1999), however; this cost could be reduced using agrochemical options for operations like

Table 4
Resource Allocation Differentials among Farmers

Resource	Farmers Plan	Risk Minimized Plans (Pooled)			Risk Minimized Plans (Risk Averters)			Risk Minimized Plans (Risk Preferers)		
		Resource Use Status	Slack	Shadow Price	Resource Use Status	Slack	Shadow Price	Resource Use Status	Slack	Shadow Price
Land (hectare)	2.15	Fully utilized	-	9899.13	Fully utilized	-	2994.46	Fully utilized	-	1182.34
Family Labour [1]	102	Not Fully utilized	12.30	-	Fully utilized	-	44.6	Not Fully utilized	11.39	-
Hired Labour [1]	148	Not Fully utilized	6.50	-	Not Fully utilized	8.00	-	Not Fully utilized	22.24	-
Family Labour [2]	102	Not Fully utilized	21.22	-	Not Fully utilized	11.8	-	Fully utilized	-	44.60
Hired Labour [2]	148	Not Fully utilized	30.53	-	Not Fully utilized	43.9	-	Fully utilized	-	56.7
Cash on Material (₦)	32,690.95	Fully utilized	-	19.0	Fully utilized	-	20.0	Fully utilized	-	4.1
Borrowed Capital (₦)	25,988.75	Not Fully utilized	8,618.09	-	Not Fully utilized	5,112.30	-	Fully utilized	-	456.2

[1] Labour required in wet season (mandays)
[2] Labour required in dry season (mandays)

weeding and an increased yield through fertilizer options as suggested in the plans.

4. Conclusions

The study concludes that most of the farmers in the study area were risk averse and cultivated smaller farm sizes as compared with risk preferers among the farmers. Efficient utilization of labour, borrowed capital and cash on material input was discovered among the risk preferers than the risk averters; hence a significant difference existed in their returns ($P< 0.01$).This therefore poses an important policy implication for strategies towards increase food production in the country and farmers welfare. The sustainability of the farmers in this respect lies in resource availability. Farm management research and smallholder development programmes initiations through extension education on efficient allocation of resources by the government should be built. The extension packages should also be channel to the farmers while considering the socio-economic environments that characterize their risk preferences.

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