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Application of safety-first approach to measure risk behaviour of yam farmers in Benue state, Nigeria

Sadiq MS[1&2☼], Singh IP[1], Singh NK[1], Lawal M[3], Ahmad MM[4], Eije OC[2]

1.Department of Agricultural Economics, SKRAU, Bikaner, India
2.Department of Agricultural Economics, FUT, Minna, Nigeria
3.Department of Agricultural Education, Federal College of Education, Katsina, Nigeria
4.Department of Agricultural Economics and Extension, Bayero University, Kano, Nigeria

☼**Author correspondence address:**
Sadiq, Mohammed Sanusi,
Department of Agricultural Economics,
SKRAU, Bikaner,
India
Email: sadiqsanusi30@gmail.com

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ABSTRACT

The present research empirically measured the risk attitudes of yam farmers in Benue State of Nigeria. Multi-stage sampling design was used to draw a sample size of 120 respondents and ex-post 2016 production data were tacitly elicited from the respondents using structured questionnaire complemented with an interview schedule. The collected data were analyzed using both descriptive and inferential statistics. The yam sett was found to be the most important input in the production process, as such used to measure the farmers risk behavior. Evidence showed that all the respondents were risk aversive and the identified factor which propelled farmers' risk apprehension was paucity of economic capital. Therefore, in order to shift the paradigm from risk aversion to risk preference, yam farmers in the studied area should be given access to formal credit facilities.

Keywords: Risk attitude; Yam crop; Benue state; Nigeria

1. INTRODUCTION

Actions are taken in anticipation of future benefits that may not be achieved due to uncertainty and almost total absence of perfect and complete information which characterized the environmental decision of most business operations. From little or none knowledge of how the weather vagaries will be like at present, to wondering if market prices will increase or decrease in the next moment; and, even to not knowing whether pests and diseases will ravage their various promising crops and livestock enterprises tomorrow.

In lieu of these, farmers are forced to make decisions based on imperfect information and knowledge; born out of this uncertainty is the possibility of agricultural injury or loss.

According to Dadzie and Acquah (2012), risk and uncertainty affects households' production and consumption decisions. They further stated that previous studies (Moscardi and de Janvry, 1977; Dillion and Scandizzo, 1978; Binswanger, 1980; Antle, 1987) have shown strong evidence of poor farming households been aversive to risk. Since then, numerous researches into the effects of risk on farmers' economic decisions have been stimulated due to the above generalization. Literature review showed significant progresses made by researchers (e.g. Ghadhim *et al*., 2005; Székely and Pálinkás, 2009; Olarinde *et al*., 2007; Nto *et al*., 2011; Fakayode *et al*., 2012; Teweldemedhin and YKapimbim 2012; Salimonu and Falusi, 2009; OECD, 2013; Soham and Vikas, 2013; World Bank, 2013; Nto *et al*., 2014; Jean-Paul and Guanming, 2015; and, Hatz, 2016) in understanding the concept of risk and risk management strategies at various farm levels.

Considering the fact that the economics of risk in farming businesses at some places has not been researched and documented, more work is required to enrich the already existing literature. To the best of our knowledge, literature showed no empirical evidence of study which used the safety-first behavioural econometric approach adopted by Moscardi and deJanvry (1977) in determining the risk attitudes of any agriculture and allied enterprises in the studied area. Moreover, knowledge of how subsistence farm households make economic decisions under risk would be of importance to policy makers in determining strategies and formulating agricultural development policies. In view of the above, the present research tends to determine farmers attitude towards risk in yam cultivation in the study area. The choice of yam crop was premised on the fact that Benue State been the second largest producer of yam crop after Niger State in Nigeria can earn substantial foreign revenue, as the crop has assumed the position of cash crop due to the current ongoing export expansion of yam crop to Europe and USA.

The broad objective of this research was to determine yam farmers' attitudes towards risk in the studied area, while the specific objectives were to describe the socio-economic profile of the farmers; to estimate costs and incomes of yam production; and, to determine the risk attitudes and the factors determining farmers' responsiveness to risk.

2. RESEARCH METHODOLOGY

Benue state of Nigeria which is the study area is located between latitude 6°25'N and 8°8'N and longitude 7°47'E and 10° 0' E Greenwich meridian. The state has an estimated landmass of 5.09 million hectares, representing 5.4% of the national landmass and about 3.8 million hectares is arable. The vegetation of the state is characterized by southern guinea savannah having an annual rainfall of about 1723mm and an average temperature of 27.2 degree Celsius. Agriculture is the major occupation of the natives with over 70% of the populace engaged mostly in arable crop farming while others engaged in occupations such as fishing, cloth weaving, white collar jobs, businesses, arts and crafts, Ayurvedic medicine among others.

Multi-stage sampling design was used to collect cross-sectional data from 120 selected active yam farmers in the studied area. The first stage involved convenient selection of Otukpo Local Government Area in Benue State due to cost and time constraint of the researchers, as yam crop is produced in all the agricultural zones of the state. The second stage involved random selection of four (4) villages *viz.* Upu-Entekpa, Otada, Okpanehe and Ogodumu villages. The last stage involved random selection of thirty (30) active yam producers from each of the selected villages, thus giving a total sampling size of one hundred and twenty (120) farmers.

Well structured questionnaire complemented with interview schedule were the instrument used for data collection. The content validity of the questionnaire was pre-tested in a pilot survey composed of 20 farmers and the result of the reliability tested gave a Cronbach' Alpha coefficient higher than 0.60 cut-off suggested by Churchill (1979) to be appropriate for exploratory research. With the aid of block extension agents, ex-post data for 2016 yam cropping season were collected during the years 2016/2017. The first, second and the third objectives were achieved using descriptive statistics; cost concepts and income measures technique; and multiple regression model (OLS), safety-first behavioural approach and censored regression model respectively.

Empirical model

1. ***Cost concepts and Income measures***

The cost concepts and income measures used by Subba *et al*.,(2004; 2016) are specified below:

a. ***Cost Concepts***: Costs related to paddy rice production are split up into various cost concepts such as A_1, A_2, B, C and D

Opportunity/Implicit cost: costs of self-owned and self-employed resource i.e. imputed cost

Accounting/Explicit cost: costs for purchasing and hiring of inputs and input services i.e. paid out costs/cash costs/ nominal/money cost

Economic cost: Opportunity cost + Accounting cost

Cost A_1: The following items are included in Cost A_1

Wages of hired labour
Charges of hired machinery
Market rate of fertilizers
Market rate of seeds
Market value of biocides
Land revenue, cess and other tax
Depreciation of farm implements
Interest on working capital
Miscellaneous expenses

Cost A_2: Cost A_1 + rent paid for leased in land

Cost B: Cost A_1 or A_2 + interest on fixed capital excluding land + rental value of owned land

Cost C: Cost B + imputed value of family labour

Cost D: Cost C + 10% of TCV as management cost (Sidharth and Pankaj, 2012)

b. ***Income Measures***

These are the returns over different cost concepts. Different income measures are derived using the cost concepts. These measures are given below:

Farm business income = Gross income – Cost A_1 or A_2 .... (1)

Family labour income = Gross income – Cost B .... (2)

Net income = Gross income – Cost D .... (3)

Farm investment income = Farm business income – Imputed value of family labour – Imputed management cost (OR) Net income + Imputed rental value of owned land

Return on Naira invested (ROI) = $\frac{\text{Gross margin}}{\text{Total variable cost}}$ .... (4)

Rate of return on capital invested (RORCI) = $\frac{Net\ farm\ income}{Total\ cost}$ .... (5)

2. ***Multiple regression model***

The implicit form is as follow:

Y = f$(X_1, X_2, X_3, X_4, X_5)$ .... (6)

While, the explicit form is:

$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \varepsilon_t$ ...... (7)

Where:

Y = Yam output (kg)
X_1 = Fertilizer (kg)
X_2 = Herbicides (litre)

X_3 = Yam setts (kg)
X_4 = Depreciation on capital items (₦)
X_5 = Human labour (manhour)
β_0 = Intercept
β_{1-5} = Regression coefficients
ε_t = Noise

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

(a) Linear function

$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 \ldots\ldots\ldots\ldots\ldots + \beta_n X_n + \varepsilon_t$ .... (8)

MPP = β

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

(b) Semi–log function

$Y = \beta_0 + \beta_1 \, logX_1 + \beta_2 \, logX_2 + \beta_3 \, logX_3 \ldots\ldots\ldots\ldots\ldots + \beta_n \, logX_n + \varepsilon_t$ .... (9)

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

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

(c) The Cobb Douglas (double log) function

$logY = \beta_0 + \beta_1 \, logX_1 + \beta_2 \, logX_2 + \beta_3 \, logX_3 \ldots\ldots\ldots\ldots\ldots + \beta_n \, logX_n + \varepsilon_t$ .... (10)

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

Elasticity = β

(d) Exponential function

$logY = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 \ldots\ldots\ldots\ldots\ldots + \beta_n X_n + \varepsilon_t$ .... (11)

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

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

Determining technical efficiency of resource use

The elasticity of production was used to estimate the rate of return to scale which is a measure of a firm's success in producing maximum output from a set of variable inputs.

EP = MPP/APP .... (12)

Where:
EP = elasticity of production
MPP = marginal physical product
APP = average physical product
If
EP =1: constant return to scale
EP < 1: decreasing return to scale
EP > 1: increasing return to scale

Marginal rate of technical substitution (MRTS)

Following Dawson and Lingard (1982); and, Hussain (2013), the MRTS approach adopted is given below:

$MRTS_{L/C} = \beta_L/\beta_C \times CL^{-1}$ .... (13)

Where $MRTS_{L/C}$ represents marginal rate of substitution of input L for C, β_L is the ouput elasticity of L and β_C is the output elasticity of C.

Determining the allocative efficiency of resource-use

The following ratio was used to estimate the relative efficiency of resource use (r)

$AEI = MVP/MFC$ .... (14)

Where:

MFC or P_x = unit cost of a particular resource

MVP = value added to poultry output due to the use of an additional unit of input, calculated by multiplying the MPP by the price of output i.e. $MPP_{xi} * P_y$

Rule of Thumb

If r = 1, resource is efficiently utilized

If r > 1, resource is underutilized

If r < 1, resource is over utilized

Economic optimum takes place where *MVP = MFC*. If *AEI* is not equal to *1*, it suggests that resources are not efficiently utilized. Adjustments could be therefore be made in the quantity of inputs used and costs in the production process to restore *r = 1* and the model is given as follows:

Divergence percentage (D %) = $1/r_i \ (1 - \ 1/r_i) \times 100$ *or* $(r_i - 1/r_i) \ \times 100$ .... (15)

Safety-first behavioral approach

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

$$K_s = \frac{1}{\theta}\left[1 - \frac{P_i W_i}{P_y \beta_i \mu_y}\right] \text{ .... (16)}$$

Where; K_s is the risk index of i^{th} farmer, θ is variance parameter; P_i is the unit price of the chosen most influential input for i^{th} farmer; W_i is 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. Following Moscardi and deJanvry (1977), the risk aversion parameter K_s was used to classify farmers into three (3) distinct categories as shown below:

$0 < K_s < 0.4$ = Low risk aversion/ Risk preference

$0.4 < K_s < 1.2$ = Intermediate/moderate risk aversion/ Risk neutral

$1.2 < K_s < 2.0$ = High risk aversion/ Risk aversion

Tobit model

The original Tobit model developed by James Tobin a Nobel laureate economist (Tobin, 1958) was adopted for this study and it is given below:

$$Y_i^* = \alpha + X\beta + \varepsilon_i \text{ .... (17)}$$

Where Y_i^* is censored variable. Now,

$Y_i = 0$ *if* $Y_i^* \leq 0$

$= Y_i^*$ *if* $Y_i^* > 0$

$$Y_i^* = \alpha_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 \ldots\ldots\ldots\ldots\ldots\ldots.. + \beta_n X_n + \varepsilon_t \text{ .... (18)}$$

Where:

Y_i^* = Risk index of i^{th} farmer

X_1 = Age (year)

X_2 = Gender (male =1, female = 0)
X_3 = Marital status (married =1, otherwise = 0)
X_4 = Educational level (year)
X_5 = Household size (number)
X_6 = Farming Experience (year)
X_7 = Yam sett variety (improved variety = 1, otherwise = 0)
X_8 = Non-farm activity (yes =1, otherwise = 0)
X_9 = Co-operative membership (yes = 1, otherwise = 0)
X_{10} = Access to credit (yes =1, otherwise = 0)
X_{11} = Extension contact (yes = 1, otherwise = 0)
X_{12} = Land ownership (yes =1, otherwise = 0)
X_{13} = Inoutput (kg)
X_{14} = Inherbicides (litre)
X_{15} = Infertilizer (kg)
X_{16} = Inyam-setts (kg)
X_{17} = Inlabour (manhour)
α = Intercept
β_{1-n} = Parameter estimates
ε_i = Error term

3. RESULTS AND DISCUSSION

Socio-Economic Profiles of Yam Farmers in the Studied Area

The socio-economic profiles of yam farmers in the studied area are presented in Table 2. A perusal of the table depicted an active, economic and productive yam farming population as evident from the mean age of 50 years coupled with the standard deviation value of 13.44. The implication of having an economic viable farming population would be sustainable increase in yam production in the study area. This farmers' category are expected to be more responsive to new agricultural technologies. The male farmers' population outweighs that of their female counterparts in yam farming in the studied area. This may be connected with the laborious nature of yam production which most females cannot contend with. The energy demanding activities involved in the production of yam require men who are naturally endowed with enough strength needed for such jobs.

Table 2 Socio-economic profile of yam farmers

Variables	Frequency	Variables	Frequency	Variables	Frequency
Age		**Total**	**120 (100)**	**Non-farm activity**	
≤ 29	9 (7.5)	**Farming experience**		Yes	77 (64.2)
30-39	14 (11.7)	≤ 3	10 (8.3)	No	43 (35.8)
40-49	37 (30.8)	4-6	13 (10.8)	**Total**	**120 (100)**
50-59	34 (28.3)	7-9	6 (5.0)	$\bar{x}$ ± **SD and Chi^2**	$\{9.63^{***}\}$
≥ 60	26 (21.7)	≥ 10	91 (75.8)	**Sett variety**	
Total	**120 (100)**	**Total**	**120 (100)**	Hybrid	- (-)
$\bar{x}$ ± **SD and Chi^2**	**[50 ± 13.4]** $\{24.9^{***}\}$	$\bar{x}$ ± **SD and Chi^2**	**[21 ± 14.01]** $\{166^{***}\}$	Improved	97 (80.8)
Gender		**Land acquisition**		Local	23 (19.2)
Male	38 (31.7)	Inheritance	84 (70.0)	**Total**	**120 (100)**
Female	82 (68.3)	Purchase	1 (0.8)	$\bar{x}$ ± **SD and Chi^2**	$\{45.63^{***}\}$
Total	**120 (100)**	Borrowed	3 (2.5)	**Agriculture holding**	
$\bar{x}$ ± **SD and Chi^2**	$\{16.1^{***}\}$	Rent	2 (1.7)	Small scale (< 2)	4 (3.3)
Marital status		Communal land	1 (0.8)	Medium scale (< 4)	32 (26.7)
Married	93 (8.3)	Multiple source	29 (24.2)	Large scale (≥ 4)	84 (70.0)
Single	10 (77.5)	**Total**	**120 (100)**	**Total**	**120 (100)**

Widower	17 (14.2)	$\bar{x}$ ± SD and Chi²	$\{606^{***}\}$	$\bar{x}$ ± SD and Chi²	**[7.05 ± 5.53]** $\{82^{***}\}$
Total	**120 (100)**	**Extension contact**		**Operational holding**	
$\bar{x}$ **± SD and Chi²**	$\{105.95^{***}\}$	Yes	- (-)	Small scale (< 2)	49 (40.8)
Education		No	120 (100)	Medium scale (< 4)	49 (40.8)
Informal	17 (14.2)	**Total**	**120 (100)**	Large scale (≥ 4)	22 (18.3)
Primary	42 (20.0)	$\bar{x}$ **± SD and Chi²**		**Total**	**120 (100)**
Secondary	37 (35.0)	**Co-operative mem.**		$\bar{x}$ **± SD and Chi²**	**[2.37 ± 1.82]** $\{12^{***}\}$
Tertiary	17 (30.8)	Yes	15 (12.5)	**Labour source**	
Total	**120 (100)**	No	105 (87.5)	Family labour	22 (18.3)
$\bar{x}$ **± SD and Chi²**	$\{13.27^{***}\}$	**Total**	**120 (100)**	Hired labour	19 (15.8)
Household size		$\bar{x}$ **± SD and Chi²**	$\{67.50^{***}\}$	Family & hired labour	72 (60.0)
≤ 3	2 (1.7)	**Access to credit**		Family and communal	6 (5.0)
4-6	23 (19.2)	Yes	1 (0.8)	Hired and communal	1 (0.8)
7-9	56 (46.7)	No	119 (99.2)	**Total**	**120 (100)**
≥ 10	39 (32.5)	**Total**	**120 (100)** $\{116^{***}\}$	$\bar{x}$ **± SD and Chi²**	$\{132.75^{***}\}$

Source: Field survey, 2017 Note: values in ( ) [ ] and { } are percentage, mean ± standard deviation and Chi²

Married farmers dominated yam farming; an indication of the importance of marital status in agricultural production especially when farm labour supply is limited. In addition married farmers are at liberty to benefit from the twin economic and social capitals with respect to financial resource pooling and tacit decision making on allocation of farm resources. High literacy level as evidenced by the majority of the farmers' who attained one form of formal education or the other, thus, there will be an increase in the productivity due to responsiveness of the farming community to new agricultural technologies. Education tends to have effect on the speed with which new technologies are been diffused and accepted by the farmers. The mean household size of 9 persons depict that most of the farmers had large household size, thus, an access to family labour. Large household size is important to yam farmers because it is the main source of unpaid family labour services as yam production is highly labour intensive. Large household size is an asset if most of its members are able bodied people, otherwise a liability if majority of the members are weak people.

Most of the farmers in the study area had adequate experience which should enable them to utilize their resources efficiently. The predominant mode of land acquisition in the studied area was through inheritance. The implication is that as household size increases there will be more pressure on land as every adult member of the family would want to have a share of the land. This would lead to fragmentation of land and will discourage large scale farming, cultivation of cash crops and farm mechanization which will result in low productivity, thus, threatening the yam food security in the study area. It was observed that none of the yam farmer in the studied area received or had any extension contact during the study period i.e the last cropping season. The implication is that the yam farmers in the studied area during the last cropping season had no access to recent technologies on the best yam practices and this will greatly affect their output level. This is not a good omen given that effective extension contact is an essential tool for the adoption of modern technologies and effective communication system that encourages increase productivity of any agricultural venture. However, a greater percentage of the farmers (87.5%) did not belong to any co-operative association. The implication is that most of the yam farmers in the studied area do not enjoy benefits of having access to credit, market outlets, marketing information and information about new technologies that accrued to co-operatives association by collective pooling of their social capital together for a better expansion, efficiency and effective management of resources for profit maximization. Majority (99.2%) of the yam farmers did not have access to credit, an indication of likely profit constraint due to paucity of capital.

Most of the yam farmers (64.5%) partake in both farming and non-farming activities, an indication that yam farming is not the major source of income generation among the respondents in the studied area. Results showed that most of the farmers (97%) in the studied area cultivated improved variety, depicting that the farmers preferred improved variety over the local variety. However, the case of hybrid cultivation in the studied area was not observed during the study period. The preference could be as result of the respondents past experience with both varieties. Majority of the yam farmers in the studied area had large size of agricultural holding as evident from the mean farm size of 7.06 hectares, but produced yam on a small scale based on operational holding. This showed that the farmers in the studied area engaged in farm diversification as a coping strategy against risk and uncertainty. The operational holding mean farm size of 2.37 hectares, implying that majority of the farmers in the studied area were small and medium scale farmers due to problems such as land ownership, capital and absence of extension agents, thus, affecting their yield. Majority of the farmers combined family and hired labour (60%) and this could be that most of the farmers' family members were vulnerable and could not carry out most of the farm operations due to its rigorous nature. The Chi^2 values for each of the socio-economic profiles considered were different from zero at 10% risk level, indicating differences in the proportion of distribution of each variable considered.

Cost concepts and income measures per hectare of yam in the studied area

Yam farming may not be for the purpose of only satisfying the household food need or subsistence, the farmers may be interested in selling their output to raise income. Thus, the farmers, like any other entrepreneurs, would be interested in the profitability of the farm enterprise. For this reason, efforts were made to estimate the cost associated with yam farming and the revenue that accrued to the farmers' efforts.

Shown in Table 3 are the cost concepts and income measures per hectare of yam production in the studied area. A perusal of the table showed the total economic and accounting costs of cultivation to be ₦112669.60 and ₦64562.30 respectively. The decomposition analysis showed the share contribution of total economic variable cost (TEVC) and total economic fixed cost (TEFC) in economic cost of cultivation to be 83.85% and 16.15% respectively; while the share contribution of total accounting variable cost (TAVC) and total accounting fixed cost (TAFC) in accounting cost of cultivation were 91.10 and 8.90% respectively. For the return structure, the economic and accounting revenue per hectare were ₦129750.00 and ₦108912.30 respectively.

Table 3 Cost concepts and income measures per hectare of yam farm

Items	Quantity	Unit price	Amount (₦)	Items	Amount (₦)
Variable costs				Total variable accounting cost	58814.65
Family labour	143.31manhours	200	28661.75	Total fixed accounting cost	5747.65
Hired labour	104.35manhours	200	20870.18	Total accounting cost	64562.30
Seeds	121.25 kg	15	1818.68	Total variable economic cost	94474.52
Fertilizer	45.61 kg	145	6614.04	Total fixed economic cost	18195.10
Manure	1666.67 kg	14.50	24166.67	Total economic cost	112669.60
Herbicides	2.01 litres	1350	2709.47	Cost A_1	68560.41
Transportation			1238.62	Cost A_2	71560.41
IV Interest on working capital	8% of 87476.41		6998.11	Cost B	74560.41
Total variable cost			**94474.52**	Cost C	103222.20
Fixed costs				Cost D	112699.60
Depreciation on capital items	20%		2747.65	**Income measures**	
Contract rent (lease-in)	-		3000	Implicit revenue	20837.70
Imputed contract rent (owned land)			3000	Explicit revenue	108912.30
Imputed managerial cost	10% of TVC		9447.45	Economic revenue	129750.00
Total fixed cost			**18195.1**	Accounting gross margin	50097.65
Total cost (TC)			**112669.6**	Accounting net farm income	44350.00
Returns				AROI	0.85
Quantity sold	1629.42 kg	65	105912.30	ARORCI	0.69
Quantity consumed	225.03 kg	65	14626.95	Account cost of production	39.62
Quantity gifted	95.55 kg	65	6210.75	Farm business income	58189.59
Total output quantity	1950 kg	65	126750	Family labour income	55189.59
Lease-out			3000	Economic gross margin	35275.48

Total revenue			**129750**	Economic net farm income	17080.38
Cost concepts				Farm investment income	20080.38
Total variable opportunity cost			35659.86	EROI	0.37
Total fixed opportunity cost			12442.47	ERORCI	0.15
Total opportunity cost			48107.32	Economic cost of production	57.78

Source: Field survey, 2017

Furthermore, the profitability decomposition results showed the economic gross margin cum net farm income to be ₦35275.48 and ₦17080.38 respectively, while the accounting gross margin cum net farm income were ₦50097.65 and ₦44350.00 respectively. Therefore, at farm level, it can be concluded that yam production was a profitable venture in the studied area. The economic and accounting ROIs were 0.37 and 0.85 respectively, implying that for every ₦1 invested in the enterprise, an economic and accounting profit of 37kobos and 85kobos respectively, were gained. This profit margin should stimulate financing from the lending institutions, because if yam farmers in the studied area are funded with ₦87476.41 at an interest rate of 8%, the farmer will return the principal of ₦87476.41, interest of ₦6998.11 and retain ₦35275.48 as profit. The implication of this result is that there is a considerable level of profit in yam farming in the studied area. The rate of return per unit of capital invested (RORCI) indicates what is earned by the business through capital outlay. The results revealed that the economic and accounting RORCIs of 15 and 69% respectively were greater than the prevailing bank lending rate of 8%, thus, further justifying the profitability of yam farming in the studied area. Therefore, if a farmer takes a loan from the bank to finance yam farming, in respect of economic and accounting status he/her will be 7 and 61% respectively better off on every one naira spent after paying the loan at the prevailing interest rate.

Technical and Allocative efficiencies of yam farmers in the studied area

The empirical results of the Pearson correlation matrix showed farm size to have high correlation with yam setts, fertilizer and herbicides inputs (Table 4a), and to avoid the problem of multicollinearity, the farm level observations were converted to per farm hectare observations as recommended by Acharya and Madnani (1988). The OLS results showed the exponential functional form to be the most appropriate when compared to the linear, double logarithm and semi-logarithm functional forms fitted into the specified equation but the sum of the residual square was not constant i.e. there exist heteroscedasticity (Table 4b). However, the most appropriate functional form was corrected using Heteroscedasticity-corrected estimation technique and the least square estimates were found to satisfy the economic theory (sign and size of the estimates), statistical criterion (standard error and R^2) and econometric criterion (Gauss-Markov assumptions and theorem), thus, the best fit. In addition, the diagnostic test *viz.* multicollinearity indicates the absence of collinear relationship among the predictor variables as evident from the respective variable variance inflation factors (VIF) which were less than the 10.00 VIF benchmark. Thereafter, the test of normality of the residuals showed non-normality in the distribution of the error term as indicated by the test statistic which is different from zero at 10% probability level (Table 4a). However, non-normality is not considered a serious problem as in most cases data are found not to be normally distributed. The estimated R^2 value of 0.362 indicated that 36.2% of the variation in the obtained output per hectare was explained by the predictor variables captured in the model while the outstanding percentage is accounted by those variables outside the farmers' control. It is worth to note that the low-moderate R^2 is okay as the estimation was carried out on per hectare basis. Furthermore, all the variables captured in the model had significant positive influence on the output level as their respective degree of freedom were different from zero at 10% probability level.

Table 4a Pearson correlation matrix

Variables	Fertilizer	Herbicides	Yam setts	Depreciation	Farm size	Human labour
Fertilizer	1	0.791	0.877	0.775	0.875	0.699
Herbicides		1	0.850	0.653	0.845	0.678
Yam setts			1	0.652	0.997	0.819
Depreciation				1	0.656	0.520
Farm size					1	0.820
Human labour						1

Source: Field survey, 2017

Table 4b Production determinants of yam output

Inputs	Ordinary least square (OLS)				HC	Colin. Test
	Linear	Exponential (+)	Semi-log	Double log	Exponential (+)	VIF (WLS +)
Constant	-1735.15 (845.71)	5.435 (0.465)	-14455.1 (4589.08)	-1.564 (2.516)	5.605 (0.444)	-
	[2.052]**	[11.68]***	[3.15]***	[0.621]^{NS}	[12.63]***	
Fertilizer	9.291 (2.889)	0.0040 (0.0016)	427.15 (150.61)	0.199 (0.082)	0.0046 (0.0018)	1.156
	[3.216]***	[2.517]**	[2.84]***	[2.408]**	[2.574]**	
Herbicides	199.99 (77.34)	0.117 (0.043)	484.10 (179.36)	0.283 (0.098)	0.107 (0.043)	1.308
	[2.327]**	[2.749]***	[2.70]***	[2.873]***	[2.484]**	
Yam setts	17.12 (7.355)	0.0092 (0.004)	2598.95 (966.24)	1.350 (0.530)	0.0073 (0.0037)	1.283
	[2.327]**	[2.265]**	[2.69]***	[2.547]***	[2.002]**	
Depreciation	0.0345 (0.030)	2.96E-05 (1.64E-05)	132.78 (91.50)	0.1020 (0.050)	3.004E-05 (1.405E-05)	1.219
	[1.159]^{NS}	[1.807]*	[1.45]^{NS}	[2.033]**	[2.138]**	
Human Labour	0.371 (0.378)	0.0004 (0.00021)	71.21 (121.94)	0.094 (0.067)	0.00055 (0.00017)	1.276
	[0.981]NS	[1.899]*	[0.584]	[1.407]^{NS}	[3.159]***	
$\sum \beta$	-	-	-	-	**0.1195 (0.0424)**	
	-	-	-	-	**[2.818]*** **	
R^2	**0.324**	**0.351**	**0.319**	**0.350**	**0.362**	-
Adjusted R^2	**0.295**	**0.323**	**0.289**	**0.321**	**0.334**	-
F-stat	**10.94*** **	**12.33*** **	**10.66*** **	**12.27*** **	**12.93*** **	-
Heteroskedasticity (B-G)	-	**[20.82] {0.0009}**	-	-	-	-
Normality test	-	**[6.71] {0.035}**	-	-	**[6.71] {0.035}**	-

Source: Field survey, 2017

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

All the elasticity of the parameter estimates *viz*. yam setts, fertilizer, labour, herbicides and capital depreciation were inelastic and directly related to output of yam, and the implication of a unit increase in the aforementioned variables would lead to an increase in yam output by 0.897%, 0.218%, 0.176% and 0.097% respectively. The VPS value of 1.614 implied that the farmers are experiencing increasing return to scale i.e. an increase in all the inputs joint together while holding the farm size constant (1 hectare) would result in more than proportional increase in the output level. The significance of the parameter estimate of the sum of the elasticity at 1% probability level set aside the null hypothesis of constant return to scale and uphold the increasing return to scale indicated by VPS. Therefore, farmers in the studied area should increase the use of their input mix if they want to be economically viable in yam production i.e. if their objective is profit maximization.

The marginal implication of additional increase of 1kg of yam setts and fertilizer; 1 manhour, 1 litre of herbicides and ₦1 in capital item would increase the yam output per hectare by 10.67kg and 6.72kg; 0.804kg, 156.39kg and 0.044kg, respectively (Table 4c). Relying on these results, it can be inferred that yam farmers in the studied area were more technical efficient in the use of herbicides and technical inefficient in the use of human labour and capital item resources. In other words, the marginal physical product (MPP) results showed that the farmers were more efficient in the use of herbicides as it has the highest (156.39 kg) additional contribution to yam output for an extra unit of herbicides, and, were least efficient in the utilization of human labour and capital item depreciation as their contribution to output were 0.804kg and 0.044kg respectively, for any extra unit of input used. The inefficiency in the utilization of human labour can be attributed to free availability of family labour coupled with the cheap cost of hired labour due to limited white collar job opportunities in the cities which are responsible for the rural-urban migration of able bodied people.

The results of the marginal rate of technical substitution (MRTS) showed that 1 kg of fertilizer in pair can be substituted for 0.043 litre of herbicides, 0.63kg of yam setts, ₦154.14 of capital inputs and 6.77 manhours of human labour while still maintaining the same level of output. 1 litre of herbicides in pair can be substituted for 23.27kg of fertilizer, 14.68kg of yam setts, ₦3586.50 of capital inputs and 195.16 manhours of human labour while still maintaining the same output level. 1 kg of yam setts in pair can be substituted for 1.59kg of fertilizer, 0.068 litre of herbicides, ₦244.39 of capital inputs and 13.30 manhours of human labour while still producing the same output level. For depreciation on capital, ₦1.08 capital input in pair can be substituted for 0.0064kg of fertilizer, 0.0003litre of herbicides, 0.0041kg of yam setts and 0.054 manhours of human labour while still maintaining the same output level. Lastly, 1 manhour of labour can be substituted for 0.12kg of fertilizer, 0.005 litre of herbicides, 0.075kg of yam setts and ₦18.38 of capital inputs while still maintaining the same output level (Table 4d). Therefore, it can be inferred that for the farmers to be technical efficient they should reduce the human labour effort committed to yam production, as aside of mound making and staking, farmers mostly substitute human labour requirements with the use of biocides. Also, decrease in the cost of capital inputs will also increase the technical efficiency of the farmers, though, capital items in Sub-Saharan African agrarian small scale farming are mostly considered negligible (sunk cost) as the implements mostly used are crude implements e.g. hoes, cutlass, axes etc.

The empirical results of the allocative efficiency showed that the farmers were not efficient in the cost of cultivation of yam in the studied area (Table 4c). The decomposition figures showed that with the exception of human labour which was over-utilized all the remaining inputs were under-utilized in the production of yam per hectare. The inputs with highest and least forward adjustment requirements towards the optimum allocation frontier were yam setts (97.84%) and capital depreciation (62.26%) respectively; while human labour is the only input that requires backward adjustment towards the efficient allocative frontier. The under-utilization might be tied to high cost of these farm inputs, and owing to the poor economic capital of these farmers, efficient utilization is inhibited. However, the over-utilization can be attributed to availability of cheap family labour coupled with cheap hired labour in the studied area due to limited white collar job opportunities in the cities been the major driver of rural-urban migration of able bodied people, thus, affecting agricultural labour force in the rural area.

Table 4c Technical and Allocative efficiencies of yam farmers

Inputs	**Mean**	**APP**	**MPP**	**EP**	**MPV**	**MFC**	**AEI (D%)**	**Decision**
Fertilizer	47.36	30.86	6.72	0.218	436.8	145	3.01 (66.78)	**UU**
Herbicides	2.11	692.70	156.39	0.226	10165.35	1350	7.53 (86.72)	**UU**
Yam setts	122.90	11.89	10.67	0.897	693.55	15	46.24 (97.84)	**UU**
Depreciation	3248.20	0.45	0.044	0.097	2.86	1.08	2.26 (62.26)	**UU**
H. Labour	320.69	4.558	0.804	0.176	52.26	200	0.26 (-284.62)	**OV**

Source: Field survey, 2017

Note: UU = Under-utilization; OU = Over-utilization

VPTS = 1.614; Output $\overline{Y}$ = 1461.6; P_y/kg = ₦65

Table 4d MRTS of inputs used

Inputs	**Fertilizer ↑**	**Herbicides ↓**	**Yam setts ↓**	**Depreciation ↓**	**H. Labour ↓**
Fertilizer ↑	1	23.267	1.586	0.0065	0.115
Herbicides ↑	0.0430	1	0.068	0.00028	0.005
Yam setts ↑	0.6307	14.675	1	0.0041	0.075
Depreciation ↑	154.14	3586.50	244.39	1	18.38
H. Labour ↑	8.3879	195.16	13.299	0.054	1

Note: ↓, ↑ means increase and decrease respectively

Measuring risk attitude of yam farmers in the studied area

The most influential input identified in the best fit functional form in the production of yam is yam setts and thereafter, it was used to measure risk attitudes of yam farmers in the studied area (Table 5a). A cursory review of the results showed that all the respondents were risk aversive as their respective risk attitude scores ranged between > 1.2 to < 2.0. Based on this outcome, it can be inferred that the goal of the farmers is not only profit maximization as they might be interested in the food security of the farming household.

Table 5a Risk attitude categorization of farmers

Category	Frequency	Percentage
Risk preference (0 < K_s < 0.4)	-	-
Risk neutral (0.4 < K_s< 1.2)	-	-
Risk averse (1.2 < K_s < 2.0)	120	100
Total	**120**	**100**

Source: Field survey, 2017

Table 5b Factors determining risk attitudes of yam farmers in the studied area

Variables	Coefficients (MPP)	Standard error	Elasticity	t-stat	VIF
Constant	1.267	0.00587	-	215.5***	-
Age	-3.195E-06	1.952E-05	-0.00013	0.164^{NS}	6.276
Gender	0.0004	0.000288	0.000234	1.395^{NS}	1.461
Marital status	1.489E-06	0.000398	8.17E-06	0.0038^{NS}	1.321
Education	-4.916E-05	3.685E-05	-0.00043	1.334^{NS}	3.626
Household size	1.150E-05	2.3084E-05	0.000087	0.498^{NS}	1.451
Experience	1.640E-05	2.0142E-05	0.000282	0.814^{NS}	5.717
Variety	0.00049	0.000375	0.00034	1.298^{NS}	1.212
Non-farm income	0.00067	0.000318	0.00036	2.096**	2.477
Co-operative mem.	-0.00047	0.000302	-0.0000496	1.558^{NS}	1.225
Access to credit	0.00114	0.000403	0.000137	2.827***	1.160
Extension contact	0.00012	0.00034	0.0000135	0.340^{NS}	1.113
Lnoutput	-0.00084	0.000364	-0.004795	2.301**	4.254
Lnherbicides	-0.00039	0.00022	-0.00286	1.771*	2.671
Lnfertilizer	-0.00024	0.00017	-0.00188	1.392^{NS}	2.773
Lnyam setts	-0.0044	0.00047	-0.04288	9.193***	8.228
Lnlabour	-0.00178	0.000596	-0.01780	2.981***	2.490
LR Chi^2	**811.61*** **				
Normality test				**17.74*** **	

Source: Field survey, 2017

The MLE estimates of the factors determining risk attitude of the yam farmers in the studied area are shown in Table 5b. The significance of the LR chi^2 at 1% risk level indicates that the parameter estimates in the model were different from zero at 10% degree of freedom and also the model best fit the specified equation. The test of multicollinearity showed non-presence of collinear relation between predictor variables as evidenced by the respective variables variance inflation factors (VIF) which were less than the 10.0 VIF benchmark. However, the residual variable failed the test of normality as evidenced by the test statistic which is different from 10% risk level. Though, non-normality in the distribution of residual variable is not considered a serious problem as data in most circumstances are not normally distributed. A cursory review showed that only the parameter estimates of the predictor variables *viz.* non-farm income, access to credit, quantity of yam output, cost of herbicides, cost of yam setts and cost of human labour have significant influence on the farmers' attitude towards risk as indicated by their respective t-statistics which were different from zero at 10% risk level.

The marginal and elasticity implications of earning non-farm income and having access to credit would increase farmers' risk apprehension by 0.00067 and 0.0036%; and, 0.00113 and 0.00014%, respectively. This showed the extent of risk apprehension of farmers who earn non-farm income towards fear of lose of their diversified meager fund invested in yam production. Credit is a catalyst for sustainable and enhanced production, but the fear of default or delinquency as a result of uncertainty, production and marketing risks dissuade farmers with credit facilities from having preference for risk in yam production in the studied area.

Increase in yam output coupled with readily available markets as evidenced by the present export promotion of yam product to international market makes the farmer in the studied area to have preference for risk. The marginal and elasticity implication of a unit increase in the yam output would increase farmers' preference for risk by 0.00084 and 0.0048% respectively.

The marginal and elasticity implications of a unit increase in the costs of operational capitals *viz.* herbicides, yam setts and human labour would increase farmers' preference for risk by 0.00039 and 0.0029%; 0.0044 and 0.043%; and, 0.0018 and 0.018%, respectively. The farmers' urge for risk preference is likely aimed towards defraying the operational costs *via* profit optimization.

4. CONCLUSIONS AND RECOMMENDATIONS

A perusal of the results showed that the farmers were fairly technical efficient but inefficient in the allocation of their productive resources. This implied that the farmers were aware of the yam production techniques but the paucity of economic capital is affecting their rationality in the mix of their productive resources. Furthermore, all the farmers were apprehensive of taking risk i.e. risk aversive with the factors causing this scenario been non-farm income and access to credit facilities as the constraint of the duo will impact negatively on the farmers access to working capital. In view of the above, the following recommendations were made:

- The government should re-visit its policy of subsidy removal for operational inputs or preferable should set in place private public partnership to help yam farmers in the studied area have access to operational inputs at reasonable prices that will make their returns remunerative.
- All agricultural credit should be covered by insurance irrespective of its source as far as it is formal and the farmers should be enlightened on the benefit of premium paid for insurance.
- Also, government and farmers should be cautious of temptation for yam market abroad which rears its effect in the result (increase in output), as it has the tendencies of threatening the yam food security and also endangering the biodiversity of the studied area.

REFERENCE

1. Acharya SS, Madnani. *Applied Econometrics for Agricultural Economists*. Himanshu Publications, Udaipur, India, 1988
2. Antle JM. Econometric estimation of producer's risk attitudes. *American Journal of Agricultural Economics*, 1987, 69
3. Churchill GA. A Paradigm for Developing Better Measures of Marketing Constructs. *Journal of Marketing Research*, 1979, 16(1), 64-73
4. Dadzie SKN, Acquah HD. Attitudes toward risk and coping responses: the case of food crop farmers at Agona Duakwa in Agona East District of Ghana. *International Journal of Agriculture and Forestry*, 2012, 2(2), 29-37
5. Dawson PJ, Lingard J. Management bias and returns to scale in a Cobb-Douglas production function for agriculture. *European Review Agricultural Economics*, 1982, 9(1), 7-24
6. Dillon JL, Scandizzo PL. Risk attitudes of subsistence farmers in Northeast Brazil: A sampling approach. *American Journal of Agricultural Economics,* 1978, 60
7. Fakayode SA, Rahji MAY, Adeniyi ST. Economic analysis of risks in fruit and vegetable farming in Osun State, Nigeria. *Bangladesh Journal of Agriculture Research*, 2012, 37(3), 473-491
8. Gadhim I, Nyikal ERA, Kosura WA. Attitudes toward risk among peasants: An econometric approach. *American Journal of Agricultural Economics*, 2005, 59, 710-16
9. Hatz N. Successfully managing agricultural credit risk regardless of agricultural market conditions. Federal Reserve Bank of Minneapolis–Helena Branch, *Supervision and Regulation letter,* 2016, 11-14
10. Hussain A. Economic analysis of rice crop cultivation in District SWAT. *Journal of Agricultural Research*, 2013, 51(2), 175-188
11. Jean-Paul C, Guanming S. An economic analysis of risk, management and agricultural technology. *Journal of Agricultural and Resource Economics*, 2015, 40(1), 63–79

12. Moscardi E, deJanvry A. Attitude toward risk among peasants: An econometric application approach. *American Journal of Agricultural Economics,* 1977, 59, 710- 721
13. Nto POO, Mbanasor JA, Nwaru JC. Analysis of risk among agribusiness enterprises investment in Abia State, Nigeria. *Journal of Economics and International Finance*, 2011, 3(3), 187-194.
14. Nto POO, Mbanasor JA, Nto CPO, Osuala AE. Evaluation of risk management practices in rice production in Abia State. *American Journal of Experimental Agriculture*, 2014, 4(3), 263-274
15. Olarinde LE, Manyong VM, Akintola O. Attitudes towards risk among maize farmers in the dry savanna zone of Nigeria: Some prospective policies for improving food production. *African Journal of Agricultural Research*, 2007, 2(8), 399-408
16. Organisation for Economic Co-operation and Development (OECD).Managing risk in agriculture: A holistic approach. *OECD Publishing*, Paris. 2013, 1-43
17. Salimonu KK, Falusi AO. Sources of risk and management strategies among food crop farmers in Osun State, Nigeria. *African Journal of Food, Agriculture, Nutrition and Development*, 2009, 9(7), 1592-1605
18. Sidhart B, Pankaj KS. *Agricultural economics at glance*. Sharma publisher and distributors, New Delhi, India, 2012
19. Soham S, Vikas C. ICT applications for agricultural risk management: economic and sector work. *World Bank Project*, 2013
20. Subba RS, Raghu RP, Neelakanta STA, Bhavani DI. *Agricultural Economics First Edition*. Oxford and IBH publishing company PVT. Limited, New Delhi, India, 2004
21. Subba RS, Raghu RP, Neelakanta STA, Bhavani DI. *Agricultural Economics Second Edition*. Oxford and IBH publishing company PVT. Limited, New Delhi, India, 2016
22. Székely C, Pálinkás P. Agricultural risk management in the European Union and in the USA. *Studies in Agricultural Economics*, 2009, 109, 55-72
23. Teweldemedhin MY, YKapimbi Y. Factors influencing enterprise diversification as a risk strategy management in Namibia: A case study of communal farmers from the Kunene region. *International Journal of Agricultural Science*, 2012, 2(9), 845-853
24. Tobin J. Estimation relationship for limited dependent variables. *Econometrica*, 1958, 26, 24-36
25. World Bank. Dynamic risk management and the poor: developing a social protection strategy for Africa. *Africa Region Human Development Series*, 2013, Washington DC, USA