

ANALYSIS OF RISK FACTORS IN YAM PRODUCTION, EBONYI STATE, NIGERIA

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ABSTRACT

This study was conducted to analyze risk factors in yam production in Ebonyi State, Nigeria. Specifically, it categorized attitude of yam farmers to risk issues; ranked farmer's perception on major sources of risk in yam farming and described farmer's coping strategies at managing risks associated with yam farming. Purposive and multi-stage random sampling techniques were used to select two hundred and twenty seven (227) yam farmers. Data were collected using well structured questionnaire and analyzed using descriptive statistics, multiple regression, discriminant analysis and Kruskal-Wallis ranking analytical tools. A very good proportion (50.22%) of the yam farmers were risk neutral(indifferent to risk), 25.11% of them were risk averse while 26.67% of them were risk takers).Ten (10) discriminating variables found significant at 10.0% probability level were used to categorize attitude of yam farmers to risk issues in the study area. They were; gender, years of farming experience, mean household expenditure, education, household size, proportion farm income to total income, availability of storage facility and membership of cooperative society. The Kruskal-Wallis one Way Analysis of Variance result for major sources of production risks as perceived by yam farmers included expensive seed yam, lack of technical knowledge and weather dependency/flooding/erosion. The yam farmers' coping strategies in managing risks associated with yam farming were: selling within the locality (84.14% of the farmers), crop diversification (78.85%), time management (78.85%) and farmers that adopted new farming technologies (48.46%). Therefore, the socioeconomic variables used to distinguish the farmers into risk groups should be considered in any policy design that can make the farmers accept and adopt innovation geared towards increased yam production and minimize occurrence of the major preventable risk factors in yam production.

Keywords: Risk ,Yam production, discriminant, Kruskal-Wallis

INTRODUCTION

Yam (*Dioscorea spp.*) is one of the annual tuber and monocotyledonous crops commonly grown in Nigeria. Interestingly, Ebonyi State produces more of white,yellow and water(D.rotundata, D.cayensis, .alata respectively) yams(Amusa, 2010). It is a preferred food and a food security crop in some Sub-Saharan African countries (IITA, 1998).In other words, Yams do not only serve as the main source of earnings and food consumption, but also as major employer of farm labour in Nigeria. However, the country recorded the highest yam loss in 2006 with over 3.7 million metric tons due to inadequate preservation, storage and processing facilities, marketing and market access to yam products in the country. Arguably, this partly discourages rural smallholder yam farmers from fully taking part in the cultivation(Verter and Bečvařova, 2014; FAO STAT, 2016).

There are risks and uncertainties associated with food production, which greatly strain efforts of

farmers in terms of what they produce. Risk is defined as the product of hazard and vulnerability. In other words, it relates to the probability of a damaging event, such as drought, and the foreseeable consequences of such an event. On the other hand, uncertainty exists when these probability is not known.Riskin agriculture is regarded as the probability of losses resulting from incomplete control over the processes with which farmers are concerned (OECD, 2000). The sources of risks and uncertainties in food production include, incomplete control of, commercial, natural and technical aspects (Okereke,2012). The technical risks are those which comprise failure of farming methods, storage and processing, and also from imperfections in the transport systems. The natural risks occur as a result of losses caused by pests and diseases, decay of products and those due to adverse or harsh weather conditions. Commercial risks, relate to losses due to price fluctuations, which tend to increase with long gestation period of projects.

Carroll and Samwick (1995) and Okereke (2012) asserted that income risk faced by farmers happen when the future path of their expected income stream is not certain but their probability can be measured as deviation of future income stream from its expected path. Other circumstances that constitute risk to rural farmers are: highly erratic rainfall, commodity price fluctuations, poorly functioning or missing markets for inputs and outputs, unexpected changes in policies, unstable government and armed conflicts (Lire *et al.*, 2000). Farmers contend with these forces when they make decisions.

Generally, a system constitutes a risk when any factor tends to limit the capability of that system to maximize its intended objectives. According to Hyman (1997) and Okereke (2012) risk in business terms, is a measure of the extent of variation between an expected outcome and the actual outcome of a given management decision. The factors stated are risk factors that militate against attainment of food goals as a result of their negative impacts and in this case on yam production business.

Yam farmers as part of their farm management strategy may individually behave in various ways towards the risks in production. This strategy is embedded in what is known as the risk management planning process of the goals established for the operation, the risk bearing ability of the farm, and the attitude of the manager towards risk. Each one of these items differ for individual family members and each farm (Hardtaker *et al.*, 1997 and Kaan, 2000).

Despite the importance of yams to people, their attention to its risk of production still leaves much to be desired. Yam production faces a number of risks and constraints that significantly reduce its potential to support rural development and meet consumers' needs as an affordable nutritional product. (Verter and Bečvařova, 2014). A knowledge of the chances of occurrence of these risk factors would enable yam farmers take appropriate measures to minimize effects of such occurrences by adopting better management practices.

MATERIALS AND METHODS

The study was conducted in Ebonyi State which is one of the five Southeastern States of Nigeria. The state is made up of 13 local government areas with the capital at Abakaliki. It is located between latitudes $6^{\circ}15'N$ and $6^{\circ}25'N$ and longitudes $8^{\circ}05'E$ and $8^{\circ}08'E$ on the globe and total land area is $5,533\text{km}^2$ (Wikipedia, 2012). Purposive and Multi-stage sampling techniques were used to select 240 farmers that supplied the primary data needed in the study though only 227 were found useable for the study. Yam and yam-based enterprise farmers were purposively selected. The purposive technique was a selection of two (2) Local Government Areas (Ohaukwu and Ivo) selected from the thirteen (13) Local Government Areas of the State (NBS, 2012). Then the multi-stage sampling involved a first stage selection of 4

communities from each of the 2 chosen local government areas giving a total of 8 communities (Ndeguede, Iziya, Efiau and Ngbo from Ohaukwu LGA; Akaeze, Ishiagu, Okue and Ihie from Ivo LGA). Furthermore, 2 villages were randomly selected from each of the 8 communities giving a total of 16 villages (Amike and Amovia Udegude from Ndeguede; Umueze and Umuagara from Iziya; Enwezeaka and Nsurakpa from Efiau; Umuogudu Oshia Ngbo and Umuogu Akpu from Ngbo; Ogidi and iyioji from Akaeze; Obinagu and Amagu from Ishiagu; Nzerem and Ayaragu Ogor from Okue; Ezza ekembe and Ubegu Ihie from Ihie. Finally, 15 yam farmers were randomly selected from each of the 16 villages guided by the community and village heads.

Safety First rule model was initially applied following that Risk is put in an economic decision making model as a "safety-first" rule. A significant motivating force of the decision maker in managing the productive resources that he controls and, specifically, in choosing among technological options is the security of higher yield, large enough to cover subsistence needs. Whenever the satisfaction of basic needs may be at risk, safety-first rule criterion comes to play (Scandizzo and Dillon, 1976). The extent of risk aversion shown by an individual farmer can be deduced from an observed behavior, when the safety-first rule model holds. Given a production technology, the risk in production and market condition, the observed level of input use shows the underlying extent of risk aversion.

Two stages are involved here: first is the estimation of production functions in which the relationship between the direct input vectors (X) and yam yields (Y) is established. Ordinary least square method to obtain the regression coefficients, coefficients of multiple determination (R^2), etc. was used to analyse the collected data.

Implicitly, the function is expressed as follows:

$$Y = f(X_1, X_2, X_3, X_4, X_5, \dots, U_i) \dots \dots \dots (1)$$

Where:

Y = Quantity of yam tubers (kg)

X_1 = Quantity of yam setts (kg)

X_2 = Labor in (Man days)

X_3 = Quantity of fertilizer (Kg)

X_4 = Quantity of herbicides (Litres)

X_5 = Farm size (hectares)

$\beta_0 - \beta_5$ = Parameters estimated (Regression coefficients)

U_i = Composite error term defined as $V_i - U_i$

Error term was distributed with mean zero and constant variance and took care of all variables assumed constant.

The most significant variable was selected in the second stage. In relation to direct variables, the most significant of the yam yield was selected to determine the levels of farmers' risk aversion based on Moscardi and deJanvry (1977) econometric approach.

Assume: the randomness of net income that a farmer gets from yield uncertainty and that from the relationship between input vector (X) and yield (Y) as represented by (1) for the production function, the coefficient of variation (cv) of yield is:

$$\frac{\delta y}{\mu y} = h \dots \dots \dots (2)$$

Where h is the yield coefficient;

δy is the yield's standard deviation ;

μy is the yield mean; and

given input prices (P_i) and a given output price (P_y), the preference order can be increased with respect to input levels. The resulting first order conditions are:

$$P_y f_i \frac{\mu y}{X_i} = \frac{P_i}{1 - hK(s)} \dots \dots \dots (3)$$

Where P_i is the input price;

X_i , the input vector (most significant input);

P_y , the Output price;

f_i , the elasticity of production of the i -th input;

$K(s)$ is the risk aversion parameter, while h and μ are as explained in equation (2) above.

The value of the risk aversion parameter was deduced from observed levels of outputs and inputs by solving equation (3) as follows:

$$K(s) = \frac{1}{h} \left[1 - \frac{P_i X_i}{P_y f_i \mu y} \right] \dots \dots \dots (4)$$

Equation (4) gives an extent of risk aversion $K(s)$ that was gotten for each farmer from knowledge of production function, yield coefficient, output and input prices and observed levels of input use.

According to Moscardi and deJanvry (1977), the risk aversion parameter $K(s)$ was used to classify farmers into three (3) clear categories:

Risk preferers – low risk – ($0 < K(s) < 0.4$),

Risk neutral – intermediate risk – ($0.4 \leq K(s) < 1.2$)

Risk averse – high risk – ($1.2 \leq K(s) < 2.0$)

Following the grouping of farmers into various risk aversion categories, a discriminant analysis was done. Individual farmers may be classified into mutually exclusive and exhaustive groups based on a set of independent socio-economic variables using discriminant technique. On the whole, a risk behavior is assigned to one of a number of pre-determined groups based on observations made on the object (Teknomo, 2006). A nominal dependent variable and independent variables that could either be nominal, ordinal, interval or ratio are required in discriminant analysis (Klecka, 1980). The classification of farmers into clear groups and in line with their features were confirmed with discriminant analysis. It equally identified the variables that were significant in discrimination, and gave the probability of each individual that belonged to each group. The model as applied in the study made sure that separation among the three groups of farmers that would have earlier been identified was achieved.

The score on the linear combination of pX_s for the i -th member ($i = 1, 2, \dots, n$) of group g ($g = 1, 2, \dots, G$) and variables X ($X = 1, 2, \dots, P$) can be stated as

$$Z_{ig} = u_{i1}X_{i1g} + u_{i2}X_{i2g} + \dots + u_{ip}X_{ipg} \dots \dots \dots (5)$$

The mean of the random variable Z , that is the mean of the above linear combination, for the g th group, may be denoted by Z_g .

The variability among group means on the variable Z expressed the separation between the groups (Lindeman, Merenda *et al.*, 1980). This variability is expressed, as in the univariate analysis of variance, by the sum of square among group means. This can be represented as follows;

$$SSA = \sum_g (Z_g - \bar{Z})^2 \dots \dots \dots (6)$$

Where:

SSA is the Sum of squares among groups;

Z_g , the mean of the g th group;

\bar{Z} , the Grand mean based on $n = n_1 + n_2 + \dots + n_g$. Here, n_1, \dots, n_g are individuals in all groups combined. Because variability is due in part to variability among individuals, the discriminant criterion is defined as the ratio of variability among group means, SSA to that of within groups, SSw. Thus:

$$\lambda = \frac{SSA}{SSW} \dots \dots \dots (7)$$

Where

SSA is the sum of square among groups; SSw, the Sum of square within group.

The values of the U 's in equation (5) are chosen to maximize λ .

Farmers' categorical and behavioural attitudes were defined using their socio-economic and institutional characteristics in this research. Differential degree of risk aversion among the farmers can be explained from these characteristics. Discriminant analyses were then conducted and their functions estimated to explore quantitatively the relation between risk aversion and the farmers' socio-economic, institutional and farm characteristics that are listed below. This was done to capture which of these factors (characteristics) are actually important in determining farmers' risk attitudes in yam production. The independent variables which consists of socio-economic and farm characteristics are defined as follows:

X_1 – Experience (years)

X_2 – Education status (literate=1, illiterate=0)

X_3 – Household size (number)

X_4 – Total area of land cultivated (ha)

X_5 – Other sources of income (yes or no)

X_6 – Membership of association (yes or no)

X_7 – Total mean expenditure per month (Naira)

X_8 – Proportion of farm income to total income (Naira)

X_9 – Availability of storage facilities (yes or no)

X_{10} – Gender (female = 1, male = 0)

X_{11} – Age (years)

For the nominal dependent variables, farmers were classified into 3 groups as follows: Group 1 – Risk Averse - High

Group 2 – Risk Neutral- Medium

Group 3 – Risk Taker- Low

The listed socio-economic and farm characteristics (variables) are importantly titled “Risk factors” which may positively or negatively influence farmers’ risk averse behaviours. It is expected that the discriminant function estimates would assign the yam farmers to the same group as would have done the classification variables (parameter K).

Kruskal Wallis Ranking and Test

$$H = \frac{12}{(N+1)} \sum_{i=1}^{ni} \frac{1}{ni} \frac{[R_i - ni(N+1)/2]^2}{2} \dots\dots\dots(8)$$

Where R_i is the sum of the ranks assigned to observation in the i^{th} sample and

$ni \frac{(N+1)}{2}$ is the expected sum of ranks for the i^{th} treatment.

H is the test-statistic

- n_i is the number of observations in group

- Σ is summation sign
- N is the total number of observations across all groups

Method of ranking was by ranking all data from all groups together; i.e., ranking the data from 1 to N ignoring group membership. Assigning any tied values the average of the ranks they would have received had they not been tied. (Wayne,1990). In the presence of tied ranks, the test statistic is given in adjusted and unadjusted forms, (opinion varies concerning the handling of ties). The test statistic follows approximately a chi- square distribution with k-1 degrees of freedom; P values are derived from this. For small samples, one may wish to refer to tables of the Kruskal- Wallis test Statistics but the Chi-square approximation is highly satisfactory in most cases (Conover, 1999).

Results and Discussion

Table 1: Double Log Regression Estimates of Yam Production Parameters for yam farmers in the study area.

Variable	Coefficient	Std Errors	t-values
Constant	2.119927	0.243	(8.72)***
Qty of yam sett (kg)	0.5063271	0.106	(4.78)***
Labour used(mandays)	0.0375431	0.057	(2.520)**
Fertilizer used(Kg)	0.2654541	0.242	(1.10)
Herbicide used (Litres)	0.1106322	0.106	(1.04)
Farm size(Ha)	0.4434646	0.243	(2.242)**
R ²	0.8636		
Adjusted R ²	0.8580		
F-ratio	153.27***		

Source: Field survey, 2019

and * represent significant levels at 5% and 1% respectively

From Table 1, the double log production function was used to establish a direct relationship between input vectors and yield and the R² value revealed that the variables involved in the production process explained 86.3% of what happens in the overall production of yam in the study area. The significant coefficients of the variables were positive as expected. The positive coefficients of setts, labour, fertilizer, herbicides and farm size variables imply that increase in quantities used of these resources resulted

to increase in output of yam, ceteris paribus. However, the most significant of the variables was the coefficient of quantity of setts. The coefficient of quantity of setts(0.5063) was positive and conforms to *apriori* expectation and significant (p <0.01). This indicated that higher seed rate would result in high yam population and subsequently higher yield except where there is overcrowding leading to competition of available nutrients which will consequently lead to lower yield(Shehuet *al.*, 2010).

Table 2: Distribution of Yam Farmers in Ebonyi State by Risk Groups (based on the risk parameter, K)

Risk Groups	Frequency	Percentage
High (Risk Averse)	44	19.38
Medium(Neutral)	161	70.93
Low (Risk Taker)	22	9.69

Source: Field Survey, 2019

In categorizing attitude of yam farmers to risk issues, the linear discriminant function analysis was performed. The aim is to classify the yam farmers as either risk averse, risk neutral, or risk takers and to

evaluate the discriminatory powers of the independent variables involved. Based on the procedure of equation (4), a risk-aversion parameter, K(s) for each yam farmer was estimated and used to classify yam

farmers into their risk groups. The risk parameter was derived for each farmer from; knowledge of production function, the coefficient of yield and factor prices and observed levels of factor use as shown in Tables 1. Using the criterion, 44 farmers were found to be relatively risk averse, 161 farmers were risk

neutral while the remaining 22 farmers were relatively risk takers as presented in Table 2. The result formed a base for further analysis and so, was the classification of the yam farmers based on their risk rating before the discriminant function analysis.

Table 3: Classification Performance of the Estimated Discriminant Function

Group	True group	Predicted group membership		
	Number of cases	Risk averse	Risk neutral	Risk takers
High(risk averse)	44	17 (38.6%)	13 (29.5%)	14 (31.8%)
Medium(risk neutral)	161	40 (24.8%)	89 (55.3%)	32 (19.9%)
Low(risk takers)	22	3 (13.6%)	5 (22.7%)	14 (63.6%)
Total	227	60 (26.43%)	107(47.13%)	60 (26.43%)

Percentage of actual (original) grouped cases correctly classified=52.9

Source: Field Survey, 2019

Classification performance of the estimated discriminant function is shown in Table 3. The classification performance of the function was predicted using a sample of 227 yam farmers. Given that the power of the model lies in its capability to classify correctly, then the higher the rate, the better its predictive power of the function. Based on risk parameters, it was originally found that 44 farmers were relatively risk averse, 161 farmers were risk neutral while 22 farmers were relatively risk takers. Discriminant analysis using a set of 11 variables that were hypothesized to discriminate between the three groups of risk averse farmers and to validate the classification of farmers. On the application of the model, 60, 107 and 60 yam farmers were found to be relatively risk averse, risk neutral and risk takers respectively. This result is in conformity with Olarinde (2007) and Oluwatayo and Omowunmi (2015) who had different prediction of group membership after the application of the model. The result also shows that this typology was effective because 52.9% of farmers were correctly classified into their respective risk groups (Table 3). The classification performance of the function which is appreciable compares favourably with 59.2% realized by Oluwatayo and Omowunmi (2015) among catfish farmers in Oyo state and 60.2% obtained by Olarinde (2007) among maize farmers in the dry savanna zone

of Nigeria. In predicting group membership, misclassification error of 29.5%, 19.9% and 13.6% were made for risk averse, risk neutral and risk taking farmers respectively. The magnitude of the error (though not too high) may have implications in making policies that can help in reducing risk to an acceptable minimum or plans that can gear high risk averse farmers to accept innovations geared towards increased yam production.

The classification can be improved upon because the size of each group has changed with the predicted group membership of farmers according to the result. The number of low risk averse group(Risk takers) of yam farmers was increased from 22 to 60, that of medium group(risk neutral) reduced from 161 to 107, and the high risk averse group, increased from 44 to 60. As a result of the step-wise nature of the discriminant analysis, these grouping were considered as an improvement over the initial classification by the risk parameter, K. By implication, farmers are now better placed in their actual groups with higher probabilities of belonging to them. Given that the farmers are now classified appropriately, policies and interventions designed to help reduce risk to an acceptable minimum and help to accept innovations geared towards increased yam production by risk averse farmers are likely to be effective.

Table 4: Improvement in the typology of risk groups of yam farmers (based on level two discriminant analysis)

Group	True group	Predicted group membership		
	Number of cases	Risk averse	Risk neutral	Risk takers
High(risk averse)	60	54 (90.0%)	6 (10.%)	0 (0.0%)
Intermediate(risk neutral)	107	2 (1.9%)	104 (97.2%)	1 (0.9%)
Low(Risk takers)	60	1 (1.7%)	4 (6.7%)	55 (91.7%)
Total	227	57 (25.11%)	114(50.22%)	56(24.67%)

Percentage of farmers grouped cases correctly classified = 93.8

Source: Field Survey, 2019

A level two discriminant analysis showed an improvement in the classification of yam farmers to risk averse groups as shown in Table 4. An overall rate of 93.8% of farmers were correctly classified in their respective groups based on the level 2 discriminant analysis above, which is an improvement to the rate of 52.9% from the level 1 analysis. Further analysis did not yield any better result, which could not be of significant improvement over the second step wise discriminant analysis. Therefore, the result obtained in the level 2 discriminant analysis was taken as the authentic and valid risk averse farmer's groups. Also, the low misclassification error of 0.0%, 0.9 and 1.7% obtained for risk averse, risk neutral and risk taking farmers respectively all confirm the authenticity of the result of the level 2 discriminant analysis.

The result of the improvement in classification is shown in Table 4 which reveals that low risk yam farmers were 56 in number, intermediate risk yam farmers were 114 while those in the high risk group were 57. This implies that most (114) of the yam farmers in the study area are indecisive as to take risk and this depended on some yet to know factors or individual perceptions about the risk situation, while some of them are high risk averse. However, very few (56) of the yam farmers were willing to take risk whatever it entails. This result is tandem with Oluwatayo and Omowunmi (2015) whose findings show that most farmers in Oyo State exhibit neutral risk averse behavior. However this result seems to be at odds with previous findings in the literature that most farmers are risk averse (Olarinde, *et al.*, 2007; Ayinde, *et al.*, 2012 and Ayinde, 2016).

Table 5: Canonical Discriminant Function Coefficients of variables

Variables	Discriminant function coefficients
Constant	-12.085
Farming experience (years)	-0.146
Education (number years spent in school)	-0.035
Household size	0.157
Farm size (hectares)	0.500
Other sources of income (Naira)	1.069
Membership of association	0.471
Total mean expenditure per month (Naira)	0.000
Proportion of farm income to total income	-0.133
Availability of storage facilities	1.284
Gender	3.504
Age (years)	0.065
Group centroids:	
Risk averse	-0.939
Risk neutral	1.567
Risk Taker	-1.855

Source: computed from field survey data, 2019

The array of socio-economic characteristics involved in this study are farming experience, education, household size, farm size, other sources of income, membership of cooperative societies, mean expenditure, age, proportion of farm income to total income, availability of storage facilities, and gender. The discriminant function considering the socio-economic variables was fitted to the data of risk

averse, risk neutral, and risk taker. Table 5 showed that the estimated centroid for risk averse farmers, risk neutral, and risk takers were -0.939, 1.568 and -1.855 respectively. By implication, any variable score that is closer to -0.939 applies to risk averse farmers, while any score closer to 1.568 and -1.855 applies to risk neutral and risk seeking farmers respectively.

Table 6: Wilk's Lambda statistics and levels of significance of discriminating variables for level two discriminant analysis

Variable	Wilks' Lambda	Sig
Farming experience	0.938	0.001
Education	0.942	0.001
Household size	0.967	0.022
Farm size	0.992	0.416
Other sources of income	0.910	0.000
Membership of association	0.963	0.014
Total mean expenditure per month	0.863	0.000
Proportion of farm income to total income	0.974	0.050
Availability of storage facility	0.950	0.003
Gender	0.553	0.000
Age	0.977	0.077

Source: Field survey data 2019.

A test was conducted on the coefficient of variables for their statistical significance in line with Olarinde *et al.*, (2007) and Oluwatayo and Omowunmi (2015) to identify the minimum set of socio economic variables that are important for discrimination and extent of their importance. The Wilks' Lambda and the significance level of each variable are presented in Table 6. The scale ranges from 0 to 1, where 0 means total discrimination and 1 means no discrimination (Kanti *et al.*, 1979 and Olarinde *et al.*, 2007 and Fakayode *et al.*, 2012). The results indicate that out of eleven variables used, ten variables were statistically significant at a minimum of 10.0% level of probability. They were gender, years

of farming experience, mean household expenditure, education, household size, proportion of farm income to total income, age, other sources of income, availability of storage facility, membership of cooperative society,. The implication is that they stand out most important variables in categorizing attitude of yam farmers to risk issues in the study area. The variables used to distinguish the respondents into risk averse, risk neutral and risk taking yam farmers are also important in the design of any plan that can make the farmers accept and adopt any new innovations tailored towards increased yam production (Olarinde *et al.*, 2007). The importance of the significant variables above cannot be overemphasized.

Table 7 Summary of Kruskal-Wallis test for Major Sources of Production Risks

Sources of production risk	Mean	Rank
Traditional methods of farming	1366.87	1
Weak research and extension agents	1938.27	2
Damage by pest and diseases	5130.20	3
High cost of production	6412.75	4
Weather dependency/flooding and water erosion	12600.00	5
Expensive seed yam	12825.50	6
Lack of technical knowledge in production	12825.50	6
Chi-square	34.44	
X ² tab	18.5	
Degree of freedom		6
Asymp. Sig		0.0001

Ascending order of Ranks

Source: Field Survey, 2019

Table 7 showed the summary of Kruskal Wallis ranks and test for major sources of yam

Production risks. The table revealed that all the sources of production risk in yam production were

significant at 1.0% risk level and are statistically different from one another as the H / X² (34.44) depicts. The Table indicated that expensive seed yam (mean 12825.50), and lack of technical knowledge in production (mean 12825.50) were the highest ranked (6) sources of production risk as perceived by the yam farmers. Next was the dependency of yam production on weather/flooding and water erosion (mean 12600) ranked 5th, and perceived high cost of production (mean 6412.75) ranked 4th. The damage by pest and diseases as perceived by yam farmers (mean 5130) was ranked 3rd, while weak research and extension agency (mean 1938.27) was perceived and ranked lowly 2nd, and their use of traditional methods in yam

cultivation was least perceived and ranked lowest (1). It supports the findings of Fakayode *et al* (2012) that weather dependency (mean 514.05), traditional methods of farming (mean 467.93) and damage by pest and disease (mean 420.18) were perceived as the highest ranked sources of risk in production by vegetable respondents in Osun State. This suggests that the farmers had very high confidence in their age-long traditional method of cultivating yams. They perceived that their cultivation method posed least risk to outcome of their activities but may negatively implicate their technical efficiencies.

Table 8: Farmer's Coping Strategies in Managing the Risks associated with Yam Farming.

Strategies	*Frequency	Percentage
Crop diversification	179	78.85
Adoption of new farming technologies	110	48.46
Time management to suite weather	179	78.85
Sell within sites of production	191	84.14
Sell at low prices due to perishability	68	29.96
Maintain good relations with traders	46	20.26
Engage in non-farming businesses	174	76.65

Source: Field Survey, 2019* Multiple Responses recorded.

Farmer's coping strategies in managing the risks associated with yam farming is shown in Table 8. It showed that most (84.14%) of the yam farmers sell within the sites of production as an effective risk coping strategy. Crop diversification (78.85%) followed and time management to suit weather (78.86%). 48.46% of the farmers adopted new farming technologies while only few (20.26%) of the respondents maintain good relations with traders. This may imply lack of coordination among producers to increase bargaining power.

By implication, risk reducing strategies are often used in combination with one another, because no single strategy can cover all of the risk likely to be encountered. Farmers need to consider the risks simultaneously and to develop an integrated approach for better management (Kahan, 2008).

CONCLUSION

Yam farmers in the study area respond to risk differently and this is dependent on gender, years of farming experience, mean household expenditure, education, household size, proportion of farm income to total income, availability of storage facility and membership of cooperative society. Therefore, support programs like trainings and insurance by extension agents and government respectively would help yam farmers manage risk, accept and adopt innovation directed towards increased yam production.

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