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# Risk attitudes among catfish farmers in Oyo State, Nigeria


## Abstract

The risk attitudes of catfish farmers in Oyo State were examined. Primary data were collected from 130 catfish farmers in Oyo State with the aid of well-structured questionnaires. Respondents were selected using a multi-stage sampling technique and data were analyzed using descriptive statistics, Cobb-Douglas production function, discriminant analysis and ordinary least square regression model. Analysis of respondents' socioeconomic characteristics showed that majority (82.3 percent) were males between the ages of 25 and 50 years and married (80.8 percent). Respondents also had one form of formal education or the other and a sizeable number were engaged in farming as their primary occupation with the average monthly farm income standing at 32,380. The result of Cobb-Douglas production function revealed that the total number of stock of fishes was the most significant variable which was used to determine the risk attitude coefficient, K, for each respondent. The risk attitude coefficient/risk parameter, K, was used to classify respondents into different risk aversion groups which showed that 40.8 percent of them were in low-risk averse group, 46.9 percent were in intermediate-risk group while 12.3 percent were in the high-risk averse group. The classification of farmers based on risk attitude coefficient was further validated with the use of the stepwise discriminant analysis which correctly classified 59.2 percent of the respondents into their respective risk-averse groups. A further improvement was done which increased the size of the groups correctly classified them from 59.2 percent to 97.7 percent and the results indicated that 41.5 percent of the respondents were in low-risk averse group, 55.4 percent were in intermediate-risk group while 3.1 percent were in the high-risk averse group. The Wilk's Lambda test revealed that the important discriminating variables included age, number of years of education, primary occupation, years of experience in fish farming, proportion of fish farm size to total landed area, amount of capital, access to credit and proportion of farm income to total. The ordinary least square regression model showed that factors such as age and amount of capital had a positive impact on risk aversion level whereas household size had negative impact on the risk aversion level of the catfish farmers. The study therefore recommends the establishment of youth empowerment schemes to arouse the interest of youth and encourage them to venture into catfish farming. Also, sensitization on benefits of small family size and establishment of farm support groups for young entrants and provision of credit facilities will boost investment in catfish business.


**Keywords:** catfish farmers, production, risk attitude, Oyo State, Nigeria.
**JEL Classification:** D03, D24, D61, N57, Q12.

## Introduction

Nigeria is the most populous country in Africa, with the population estimated at over 170 million (Kuku-Shittu, 2013) and 250 ethnic groups (UNICEF, 2013). Agriculture was the main stay of the Nigerian economy as at independence in 1960 as it provided employment and income for over 90% of the indigenous population (FMAWR, 2008).

Farming is a business activity faced with risk factors such as drought, flood and other environmental factors. The attitudes of farmers towards this risky nature serves as an important issue in understanding the behavior and managerial decisions of farmers. For example, the more risk averse a farmer, the more likely he or she is to make managerial decisions that emphasize the goal of reducing variation in income rather than the goal of maximizing income (Harwood, J. et al., 1999; Turan et al., 2003).

As the population of a country increases, there's also a resultant increase in the demands for the basic necessities of life including water, food and shelter. The increase in human population and reports of large numbers of undernourished or starving people, especially in the developing countries, have made the need for food production a major worldwide issue of concern (Okechi, 2004). There is a high demand for protein rich food items of animal origin especially in order to meet the daily dietary requirement (Ugwumba and Chukwuji, 2010). The major animal protein sources in the country include cattle, goats, sheep, poultry and fish. Due to its accessibility and availability, fish and fish products constitute approximately 60 percent of total protein intakes in adults especially in the rural areas (Adekoya and Miller, 2004). Therefore, the importance of the fishing industry to the sustainability of animal protein supply in nutritional supplements in the country cannot be over-emphasized (Fakoya and Oloruntoba, 2002). This has led to the growth of fish farms worldwide to increase the quality and quantity of fish produced in order to meet a substantial part of the world's food requirement (Dagtekin and Emeksiz, 2007). Nigeria is one of the countries in Sub-Saharan Africa with great potential to attain sustainable fish production, via aquaculture considering extensive mangrove ecosystem available in the country (FAO, 2005).


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It is obvious that higher levels of development and improvement in technologies in an economy are accompanied with greater exposure of lives and properties to risks such as injuries, death and loss or destruction of properties. Thus, risk exposure is the quantified potential for loss that might occur as a result of some activities (Epetimehin, 2014).

Ajetomobi and Binuomote (2006) assert that there are different ways through which farmers react to risks such as forward pricing, production practices, insurance, holding liquid reserves, diversification, and liability management or their combination. However, in Nigeria farms are left with little or no opportunity for diversification and insurance. Their attitudes to risk are nevertheless major determinants of the rate of diffusion of new technologies among the farmers and of the outcome of rural development programs (Adejoro, 2000).

Aquaculture is a relatively new practice in Nigeria. For this reason it is important for potential and practicing fish farmers to know some basic necessities of its management and economics in order to boost the returns of their efforts. Like any economic activity in life, balancing investment cost and returns in favor of farmers are important in aquaculture. Considering the risks and uncertainties encountered in the investment venture is also a critical managerial operation. Therefore, it is always useful for fish farmers to know the profitability and risks involved in fish culture in order to guide their decision making.

## 1. Problem statement

Fish farming in Nigeria is constrained by many problems, principally: an inadequate supply of quality fish seed, extension support, and intensive management strategies, as well as lack of cost-effective feed and poor infrastructure. Others include limited opportunities for credit and the presence of technical inefficiency, which was identified by previous studies focusing on this sector as important for sustainable fish production in Nigeria (Awoyemi et al., 2003; Ajao et al., 2005; Fapohunda et al., 2005; Ojo et al., 2006a; Ojo et al., 2006b; Kareem et al., 2008; Ogundari and Ojo, 2009).

Short supply of resources needed to meet up with the needs of the increased population has raised the cost of animal protein especially beyond the reach of the low-income groups. This has led to considerate increase in demand for fish to supplement animal protein because of its availability and accessibility to the common man (Fregene and Ayodele, 2003). The fisheries subsector serves not only as a source for provision of food, but also for employment and foreign exchange for the populace. Fish farming provides important services including supporting nutritional well-being, providing feedstock for the industrial sector, making contributions to rural development, increasing export opportunities, more effective administration of natural resources and conservation of biological diversity (Dağtekin et al., 2007).

According to Mwangi (2007), aquaculture production goes beyond the biological processes of fish growth but it also encapsulates the managerial and financial aspects of the production higher profits can be obtained through efficient financial management of aquaculture due to proper managerial decisions. The level of risk aversion of an enterprise manager is explicit in the decisions made which affect such an enterprise. At the onset, aquaculture was poorly regarded as an economic acivity, thereby having negative effects on its commercialization as investors were not convinced that aquaculture could be a profitable enterprise (Gitonga et al., 2004). This decision taken by the investors is majorly ascertained because of the perception they have on the riskiness of the business. Lack of economic information on the risks faced and encountered in aquaculture has adverse effects. It affects decision making when evaluating possible investment options and accessibility to financing needed for investment (Pillay and Kutty, 2005). These factors will impact negatively on aquaculture investment and therefore development (Mwangi, 2007).

## 2. Objectives of the study

The main goal of this study is to examine the attitudes of catfish farmers to risks in Oyo State.

The specific objectives of this study are to:

1. identify the various forms of risks faced by catfish farmers in the study area;
2. estimate the farmers' risk attitude towards yield variability;
3. examine the risk status of respondents in the study area;
4. determine the relationship between their risk status and socio economic characteristics.

## 3. Theoretical models

Expected utility is the canonical theory of choice under risk and uncertainty in economics. Research into the concept of risk attitudes found reveals that the theme is based on a set of axioms which were proposed by Von Neumann and Morgenstern (1947). The axioms indicate that an individual's risk attitude can be inferred if the preference ordering and distributional properties of the risky prospects are known which also shows that behavior of farmers under risk can be studied using two approaches. According to Korir (2011) the first approach is an extension of the theory of consumer behavior. Consumers behave as if they have utility function and make choices that maximize it. This approach gives the expected utility model (EUM). In the second approach, risk is defined as the probability that income will fall below a predetermined disaster level. This gives rise to safety first models (SFM).

In the Expected Utility Model (EUM), farmers are assumed to prefer an activity that has a certain return, Y, than that which has a risky return r. The house hold is assumed to have a utility function. It strives to maximize the expected value of a Von Neumann-Morgenstern utility function subject to an income constraint.

$$U = U(y, c). \quad (1)$$

Where $y$ = net farm income and $c$ = consumption. The seminal works of Pratt (1964) and Arrow (1964) paid attention to one of the key elements of decision theory, i.e., the measure of risk aversion of the economic agents.

The safety-first model is an alternative modeling in which the decision maker is concerned with the probability of failing to achieve his income goals (Atwood et al., 1988). Roy's (1952) Safety-First criterion advocated the minimization of the probability for outcomes below a certain "disaster" level.

## 4. Empirical models

In estimating farmers' risk attitude towards yield variability using safety first rule, the study was based on two major assumptions namely the randomness of net income and the relationship between inputs (Vector $X$) and yield ($Y$) represented by a Cobb-Douglas production function as used in Olarinde et al. (2007) and Ajetomobi and Binuomote (2006).

The postulated relationship is:

$$Y = AXi^{bi}\mu^{e}.$$

Where $Y$ = total catfish output in kg, $i$ = 1, 2,...6, $A$ = intercept of the equation, $X_1$ = number of stock (fishes), $X_2$ = weight of feeds per respondents, $X_3$ = labor in man days, $X_4$= number of ponds, $X_5$ = cost of equipment (depreciation value), $b$'$s$ = partial regression coefficient, $\mu$ = error term.

For the estimation of the level of risk aversion of respondents, the risk aversion parameter was obtained using the formula below:

$$K(s) = 1/\alpha\left(\left(\frac{p_i x_i}{p_f \mu_y}\right)\right), \quad (2)$$

$\alpha$ = coefficient of variation of catfish output, $P_i$ = market price of fish, $X_i$ = Average number of fish stocked by for each respondent, $P$ = market price per kg of catfish output, $\mu_y$ = mean catfish output, $f$ = elasticity of production with respect to most significant input.

Following Moscardi and de Janvy (1977), Olarinde (2007), Olarinde et al. (2007), Ajetomobi and Binuomote (2006) and Amaefula et al. (2012), the risk aversion parameter *K(s)* was used to classify sampled catfish farmers into three (3) groups as: low risk cafish farmers ($O < K(s) < 0.4$), intermediate risk farmers ($0.4 \leq K(s) \leq 1.2$), high risk farmers ($1.2 < K(s) < 2.0$).

After grouping the farmers into various risk aversion categories, a discriminant analysis was carried out following Olarinde et al. (2007). This was done to improve on the classification of respondents according to their risk status. Discriminant analysis technique is used to classify individual farmers into two or more mutually exclusive and exhaustive groups based on a set of independent variables. Discriminant analysis requires interval independent variables and a nominal dependent variable. The usefulness of discriminant analysis in this study was found in its ability to validate the typology of farmers; that is their classification, given their characteristics, because of the existence of well-defined groups. It was also used to identify the minimum set of variables that will be important for discrimination, and to give the probability of each individual that belongs to each group.

The model ensured separation among the three groups of farmers that would have earlier been identified.

The score on the linear combination of $pXs$ for the $i$-the member ($i$ = 1, 2,…., $n$) of group $g$ ($g$ = 1, 2…..$G$) and variables $X$ ($X$ = 1, 2,….$P$) was written as:

$$Z = U_i X_{ilg} + U_2 X_{i2g} + U_p X_{ipg}. \quad (3)$$

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 $Zg$.

The separation between the groups is expressed in terms of the variability among group means on the variable $Z$ (Olarinde et al., 2008). This variability was expressed, as in the univariate analysis of variance, by the sum of square among group means. This was represented as follows:

$$SS_A = ng\,(Z_g - Z)^2. \quad (4)$$

Where $SS_A$ is the sum of squares among groups; $Zg$, the mean of the $g^{th}$ group; $Z$, the Grand mean based on $n = n_1 + n_2 + \ldots + n_g$. Here, $n_1 \ldots . n_g$ 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, $SS_A$ to that of within groups, $SS_w$. Thus:

$$\gamma = SS_A / SS_W, \quad (5)$$

where $SS_A$ is the sum of square among groups; $SS_w$, the sum of square within group. The values of the $U$'s in equation (3) are chosen to maximize γ.

The ordinary least squares regression method was used to estimate the linear, exponential, double log and power function of the model. This is done to determine the influence of socioeconomic characteristics on the level of risk aversion.

$$K_{(S)} = f(V_1, V_2, ...... V_{15}, \mu). \quad (6)$$

Where $K_{(s)}$ = risk aversion parameter (0, 1, 2,………) from equation 2, $V_1$ = Age in years, $V_2$ = Marital status, $V_3$ = Educational status (number of years of formal education), $V_4$ = Years of experience, $V_5$ = Household size, $V_6$ = Number of family members earning income, $V_7$ = Proportion of land used for catfish production, $V_8$ = Amount of capital, $V_9$ = Proportion of income from catfish to total income.

## 5. Results and discussion

Catfish farmers listed several risk types affecting maize production, which belong to four groups: natural, social economic and technical. The major types of coping strategies adopted by the respondents were the use of personal savings and restocking. Other coping strategies adopted either alone or in combination with two or more includes: insurance, reduced production, diversification into non-farm activities, roasting of dead fishes, informal borrowing, formal borrowing, sale of assets and trust in God.

## 6. Measurement of risk and categorization of risk averse farmers

The Safety-first principle was used in the determination of the risk attitude parameter of catfish farmers in the study area. This method involves first, the estimation of the Cobb-Douglas production function in which the direct relationship between input vector ($X$) and output ($Y$) is established as used by Olarinde (2007), Olarinde et al. (2008), Ajetomobi and Binuomote (2006) and Amaefula et al. (2012). From our results, the number of fishes with a coefficient of 0.865 appeared as the most significant input of the production process in the study area. The estimated function is shown in the table below.

Table 1. Result of the Cobb-Douglas production function

| Variables | Coefficients | *t*-ratios |
|---|---|---|
| Feeds(kg) | 0.072 | 2.291* |
| Total stock of fishes | 0.865 | 22.100** |
| Labor (man-hours) | 0.178 | 3.439** |
| Number of ponds | 0.031 | 0.686 |
| Capital inputs (equipment | -0.075 | -2.346* |
| Constant | -0.669 | -1.408 |

Note: ** Significant at 1%, * at 5%, Number of observation = 130, Prob > $F$ = 0.000, $R$-square = 0.933, Adjusted $R$-square = 0.930.

The elasticity of total stock of fishes, together with the coefficient of variation of output $\gamma$, the average price of product per kilogram and factor price per kilogram was used in determining the risk attitude coefficient ($K$), for each farmer.

Table 2. Frequency distribution of catfish farmers by risk groups (based on the risk parameter, $K$)

| Risk averse group | Frequency | Percentage |
|---|---|---|
| Low | 53 | 40.8 |
| Intermediate | 61 | 46.9 |
| High | 16 | 12.3 |
| Total | 130 | 100 |

Note: Overall mean risk attitude coefficient = 0.731.

## 7. Validation of categorization of the risk averse catfish farmers' group

The above classification of farmers in based on risk parameter was validated through the use of the stepwise discriminant analysis using a set of 12 variables that were hypothesized to discriminate between the three groups of risk averse farmers. Results in Table 3 show that this typology was effective because 59.2 percent of farmers were correctly classified into their respective risk-averse groups. The classification was improved upon using the predicted group membership of the catfish farmers which led to a change in the number of farmers in each risk group. In the low risk group, their number reduced from 53 to 51 persons; for the intermediate risk group, there was also an increase from 61 catfish farmers to 75 catfish farmers while there was a reduction from 16 to 4 catfish farmers in the high risk group. After the level two discriminant analysis, it was found that 97.7 percent of the groups were correctly classified. The farmers have now been placed in their actual groups with higher probabilities of belonging to them. Further analysis did not yield any better results, which could not be of significant improvement over the second discriminant analysis. The result obtained in the level two discriminant analysis was taken as the authentic and valid risk averse farmers' groups. The outcome of the improvement in classification is shown below in Table 4 which reveals that low risk catfish farmers are 54 in number, intermediate risk catfish farmers are 72 while those in the high risk group are 4.

Table 3. Validation of groups of catfish farmers (based on stepwise discriminant analysis level one)

| Actual group membership | | Predicted group membership | | |
|---|---|---|---|---|
| Group | Number of cases | Low risk | Intermediate risk | High risk |
| Low | 53 | 31 (58.5) | 22 (41.5) | 0 (0.0) |
| Intermediate | 61 | 17 (27.9) | 43 (70.5) | 1 (1.6) |
| High | 16 | 3 (18.8) | 10 (62.5) | 3 (18.8) |
| Total | 130 | 51 (39.2) | 75 (57.7) | 4 (3.1) |

Percentage of actual farmers correctly classified = 59.2%. Note: Read percentages in parentheses along the row.

Table 4. Improvement in the typology of groups of catfish farmers (level two discriminant analysis)

| Actual group membership | | Predicted group membership | | |
|---|---|---|---|---|
| Group | Number of cases | Low risk | Intermediate risk | High risk |
| Low | 51 | 51 (100.0) | 0(0.0) | 0 (0.0) |
| Intermediate | 75 | 3 (4.0) | 72 (96.0) | 0 (0.0) |
| High | 4 | 0 (0.0) | 0 (0.0) | 4 (100.0) |
| Total | 130 | 54 (41.5) | 72 (55.4) | 4 (3.1) |

Percentage of actual farmers correctly classified = 97.7%. Note: Read percentages in parentheses along the row.

## 8. Discriminating variables

A test was conducted on the coefficient of variables to infer their statistical significance so as to identify the set of variables that are important for discrimination, and in effect the extent of their significance in discriminating (Olarinde et al., 2007). The Wilk's Lambda and the significance level of each variable are presented in Table 5. The results indicate that out of 12 variables used, 9 variables are statistically significant at a minimum of 10% level of probability. They are age, number of years of education, primary occupation, years of experience in fish farming, proportion of fish farm size to total landed area, amount of capital, access to credit and proportion of farm income to total income.

Table 5. Wilk's Lambda statistics and levels of significance of discriminating variables (with 2 and 127 degree of freedom) for level two discriminant analysis

| Variable significance | Wilk's Lambda | *F* | Significance |
|---|---|---|---|
| Age | 0.883 | 8.432 | 0.000*** |
| Number of years of formal education | 0.990 | 0.635 | 0.532 |
| Primary occupation | 0.330 | 128.751 | 0.000** |
| Years of experience in catfish farming | 0.907 | 6.501 | 0.002** |
| Household size | 0.952 | 3.178 | 0.045 |
| Number of household members earning income | 0.965 | 2.333 | 0.101 |
| Proportion of fish farm to total landed area | 0.956 | 2.900 | 0.059 |
| Membership of cooperative society | 0.935 | 4.439 | 0.014* |
| Leadership position | 0.996 | 0.274 | 0.761 |
| Amount of capital | 0.328 | 130.210 | 0.000** |
| Access to credit | 0.964 | 2.397 | 0.095 |
| Proportion of fish farm income to total income | 0.921 | 5.498 | 0.005** |

Note: ** Significant at 1%, * at 5%.

From this study, it is shown that the variables used to distinguish the respondents into low, intermediate and high risk averse catfish farmers are also important in the design of any plan that can make the farmers accept and adopt any new innovations tailored towards increased catfish production.

## 9. Determinants of level of risk aversion

As depicted in Table 6, the coefficient of age of 2.804 was positively related to the level of risk aversion and significant at 1 percent. This positive relationship implies increasing risk aversion as the catfish farmer gets older. This study confirms *apriori* expectation that older farmers are more risk-averse as seen in Amaefula et al. (2012). This is also supported by the findings of Aye and Oji (2007) who found out that older people might be more willing to take risks at high levels than young people. This could be attributed to the fact that they would have dealt much more in risky economic games at high stakes in early years. Older farmers are more likely to have accumulated more wealth than younger farmers (Ghartey et al., 2014).

The coefficient of number of years of experience in catfish farming was negative and significant at 10 percent. Intuitively, it is expected that experienced farmers will have high level of risk aversion than less-experienced farmers but the result of the study is to the contrary. This could mean that the older catfish farmers have had some unfavorable experiences which they have not been able to overcome in the past. This result contradicts the findings of Amaefula (2012) and Nmadu et al., (2012) who expect that with growing experience in farming, the farmer is able to better understand the production technology and all associated challenges thereby proffering solutions to such challenges.

Table 6. Regression result on determinants of level of risk aversion

| Variables | Coefficients | $t$ |
|---|---|---|
| Age | 2.804 | 2.991** |
| Marital status | -0.376 | 0.885 |
| Number of years of formal education | -0.147 | 0.696 |
| Years of experience | -0.326 | -1.903 |
| Household size | -1.088 | -2.141* |
| Number of household members earning income | -0.359 | -1.357 |
| Proportion of fish farm to total farm area | 0.049 | 0.469 |
| Amount of capital | 0.495 | 4.596** |
| Proportion of fish farm income to total income | 0.369 | 1.286 |
| Constant | -13.665 | -4.912 |

Note: ** Significant at 1%, * at 5%, Dependent variable = $K_{(s)}$ (Risk parameter), Number of observation = 130, Prob > $F$ = 0.005, $R$-squared= 0.689, Adjusted $R$-square = 0.524, Root MSE = 1.084.

Again, the coefficient of household size of 1.088 was negatively related and significant at 5 percent. This indicates that a unit increase in household size will reduce the catfish farmer's level of risk consumption needs and given a fixed amount of land, the lower the willingness of the farmers, to assume risks. This result is in tandem with the findings of Amaefula et al. (2012) but contradicts Aye and Oji (2007) who assert that larger household size makes labor readily available, creating more income for the household thereby neutralizing the effect of the risk on the household. Also, the coefficient of amount of capital of 0.495 is significant at 1 percent and also has positive effect on the catfish farmer's level of risk aversion. This explains that risk aversion status among the respondents increases with available capital. What could be attributed to this is that it is likely that as capital increases they tend to channel their resources to other sources of income considered to be relatively stable as supported by Onyemauwa (2013).

However, the ordinary least square regression result indicated that age, household size and amount of capital were significant determinants of level of risk aversion of catfish farmers in the study area. While age and amount of capital had a positive impact on risk aversion level, factors such as household size had negative impact on the risk aversion level of the catfish farmers.

## Conclusion and policy recommendations

The knowledge of small-scale producer's attitudes to risk and their risk management strategies is important in determining strategies and formulating policies for agricultural development. This study has pointed out the relationship that exists between socio-economic characteristics and level of risk aversion of catfish farmers. The step-wise discriminant analyses in addition to the earlier regression criterion, used in estimating risk aversion levels and the consequent categorization of the sampled farmers, make us to conclude that farmers' risk attitudes are directly responsible for their levels of catfish production. The regression analysis revealed significant socio-economic variables such as age, household size and amount of capital which may indicate that there exists a part of level of risk aversion which is inherent in individuals resulting from their socio-economic characteristics. The risk aversion levels also substantiate the fact that sustainability of catfish production can be achieved by tailoring the design of the programme to the needs of small-holder farmers based on implications of these factors on the farmers' behaviors.

In this study, we have identified variables that ultimately define the behaviors of the three categories of risk averse maize farmers. Since risk cannot be totally eradicated because of its intrinsic component, the above can serve as a basis to define policies that can help in reducing risk to an acceptable minimum.

The government should therefore establish youth empowerment schemes to encourage the younger generation to venture into catfish farming at their early stages so as to be able to build social capital and networks to serve as a coping strategy when faced with risks. As years of farming experience were found to be negatively related to the level of risk aversion of respondents, support groups should be established in the various Fisheries Department in each Agricultural Development Zones. The government should intensify efforts in implementing programs such as family planning programs which would encourage smaller household size. Since the amount of capital was found to affect level of risk aversion positively, policies and programs that increase capital especially disposable asset should be encouraged. This can be enhanced by given agricultural entrepreneurs loans in form of agricultural inputs and assets rather than in liquid capital to ensure proper usage.

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