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An Analysis Of Risk Factors Among Urban Fish Famers In Kaduna, Kaduna State

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Abstract: *The risk factors associated with fish production were examined in Kaduna metropolis of Nigeria. A multi stage sampling method was used in sampling a total of 240 respondents with the aid of structured questionnaires which were administered to fish farmers. Data collected were analysed using descriptive statistics and Bayesian decision models. The result shows that farmers in the study area have an average age of about 37.8 years and an average household size of about 5 people. An average sampled fish farmer in the study area had a minimum of secondary education. The three major risk factors identified in the study area includes diseased/parasites, flooding resulting from excessive rain and pilfering with posterior probabilities of occurrence of 0.34, 0.46 and 0.20 respectively. it is recommended that farmers should stock disease resistant varieties ,put in place adequate disease preventive measures, arrange for prompt veterinary attention when ever there is outbreak of diseases and also ensure good security around their farms.*
Key words: *Risk factors, Fish farming, urban agriculture.*

I. Introduction

Urban fish farming amongst other urban farming system is relatively a new issue in Nigeria, following the evolution of fish farming in Nigeria since 1915; it has occupied a unique position in the agricultural sector of the Nigerian economy and has progressively contributed to the national and global fish production. Similarly, it is one of the several tools for making productive use of urban open spaces, saving or generating income, employment and managing fresh water resources more effectively. Urban centers in Nigeria are generally characterized by high rate of population growth and urbanization. A serious challenge associated with this is the inability to meet up with the food and nutrition (especially protein) demands of the teaming urban population. In recent times, urban agriculture seems to have gained importance in Nigeria because among other benefits, it has been discovered to be a viable intervention strategy for the urban poor to earn extra income. As a major component of the urban foods system it provides the diversity of food needed to ensure dietary quality as well as contributes to food security by increasing the amount of food available to people living in cities (*Smit, Nasir and Rattu*, 1996; Balogun, Agbomaka and Akinyemi, 2009).

In most parts of the world especially Bangladesh, Madagascar, Thailand, China and Indonesia, urban agriculture is highly practiced and urban fish output in these countries accounts for about 80% of World urban fish production (FAO, 2002; Ahmed, 2006). Since 1994, more than three million Chinese have found employment in urban aquaculture and earn generally higher income than other farmers (FAO, 2002).

In recent times, fish demand in Nigeria has continued to increase with an estimated 1.4 million metric tonnes compared to an an estimated fish production of about 500,000 metric tones supplied by artisan fisher-folk Adekoya, (2004, 1999). This statistics shows an estimated demand-supply gap of at least 0.7 million metric tones with import making up the short fall at an estimated cost of about 0.5 billion US dollars per year. Afolabi et al ( ) noted that there is considerable potential for achieving increased fish production especially in urban centers. Technically, morden innovations for fish culture can be easily adopted by urban dwellers if properly managed. Family-scale (backyard) aquaculture in peri-urban areas has been recommended in Nigeria (Egwui 1986; Fagbenro 1987; Anyanwu *et al*. 1989) as an economical method of producing fish where the homestead concrete tank has been developed as an alternative and suitable enclosure for backyard fish culture in urban centres. Family-scale (backyard) aquaculture in peri-urban areas has been recommended in Nigeria (Egwui 1986; Fagbenro 1987; Anyanwu *et al*. 1989) as an economical method of producing fish where the homestead concrete tank has been developed as an alternative and suitable enclosure for backyard fish culture in urban centres.

Although, Afolabi and Fagbenro (1998) had observed that two major constraints to establishment of fish culture enterprise (especially in urban centers) in Nigeria includes lack of initial capital input and acquisition and ownership of land. It is also important to note that apart from these constraints, urban agricultural production is inherently risky, which puts farmers at risk of not been able to meet even their basic subsistence needs Terrance, (2010). Many reasons have been adduced to why agriculture is inherently risky. Some school of thought believe that because agricultural production depends crucially on biotic and abiotic processes that are not completely understood (for example, why some crops or livestock's are less susceptible to drought than others) even when there is reasonable understanding of certain processes, there may still be little that can be done to control them (for example, rainfall and drought) Terrance, (2010).

Furthermore, uncertainties in weather and markets, as well as changing government policy characterized the environment of agricultural production making governments and the private sector often make decisions based on incomplete knowledge and a high degree of uncertainty. This leads to negative impact on social, environmental and economic consequences.

In recent years, risks have rivaled profitability as a measure of performance for producers. Risk analysis has wide applicability to different fields of agriculture including aquaculture. It has mainly been applied in assessing risks to society and the environment posed by hazards created by or associated with aquaculture development. These include the risks of environmental degradation; introduction and spread of pathogens, pests and invasive species; genetic impacts; unsafe foods; and negative social and economic impacts. Risk analysis can provide insights to decision making that will help to avoid or reduce negative impacts of risk factors on producers.

Significant literature explores the causes and consequences of risks faced by farmers. First, risks is commonly thought of as the chance of something “bad” happening; though it is also possible to give risk a more positive connotation by framing it as the chance of something good happening Terraccy, (2010). Regardless of how risk is framed, there are two common features to most characterizations. The first is the notion that the eventual outcome is a matter of chance. For example in deciding which crop to plant or which fish to rear, farmers may not know exactly how much rain will fall during the season or better still the extent of pest and disease infestation that may be associated with production. In developing counties, farmers have little or no control over rain fall, market prices and in the case of fish farming, the stock of improved fish varieties that will be available for the next farming season may be a mirage to the famers. This uncertainty contributes immensely to farmers' inability to make adequate decision concerning production and output plans.

Urban fish farming has its associated risks. This study therefore focuses on risk factors associated with fish production and forecast the probabilities of the occurrence of these risk factors. The study attempts to answer the following research questions. What are the socio-economic characteristics of fish farmers in the study area? What are the probabilities of occurrence of identified risk factors associated with fish production?

II. Conceptual Framework

The predominant theory in economics for explaining risky decision is the expected utility hypothesis. The theory asserts that an individual make choices to maximize expected utility. There are three components to expected utility. The possible outcome and the utility (or desirability) of possible outcomes. The likelihood of outcomes is characterized in terms of a probability distribution that is often conditioned on individual's choices. In most resent literatures, (for example Terrance (2010) possible outcomes are mostly conceptualized in terms of subjective perceptions of the likelihood of chance outcomes. (savage, 1954). The utility derived from a particular outcome serves as device for capturing individual attitudes towards risk.

Expected utility $Eu(x) = \int_{c}^{\bar{c}} U(c) f(c/_{x})\, dc$ 1

Where c is a continuous random variable bounded by c and $\bar{\bar{c}}$ that represent a set of mutually outcome and x is an individual's choice over alternative activities that affect the distribution of outcomes such as adoption choices of improved hybrids of fish. U(c) is the utility of outcome c, and f $(c/_{x})$ is an individual's subjective perceptions about the likelihood of outcome c given the choice x.

III. Methodology

Study area: The study was conducted in Kaduna metropolis, the entire state is located between latitudes 10^0N and 11^o 31' N and longitude 7^o 30'E and 9^oE of the Prime Meridian Omolehin, Adeniji; Mai- Anguwa and Oguntolu , *(*2007). The state is estimated to have a land area of about 48,473.2 sq kilometer and a population of about 6,066,652 (NPC, 2006). The climate varies from north to south of the state. Kaduna belongs to the guinea savannah vegetation belt with rainfall starting by April and ending in October in the southern part of the state while rain starts in May/June and ends in October in the northern part of the state. The major occupation of the people is agriculture.

Data Collection and sampling techniques: Random sampling method was used to select respondents for the research. Data was collected through the distributions of questionnaires to fish farmers within Kaduna metropolis. A total of 240 questionnaires were administered randomly to fish farmers within Kaduna metropolis. Data were collected on the socio-economic characteristics such as age, sex, and marital status, level of education, household size and membership of association. Information was also collected on types of fish reared, risk factors such as : number of fish lost to water poison, pest attack, disease and parasites, food poison, excessive rain/flood, water shortage and pilfering.

Method of data analysis: Data collected were analyzed using descriptive statistics (mean, standard deviation, frequency tables) and Bayesian decision model.

IV. Analytical Framework

Bayesian model: The Bayesian decision model is a quantitative technique developed to calculate probabilities of "causes" on observed "effect". It is used in the solution of problems involving decision making under uncertainty. It involves the use of posterior probabilities, which are obtained by combining the prior probabilities of occurrence of risk factors with their conditional probabilities. The Bayesian formula as defined by Hoel, Spiegel and SFMPG is given as:

$$P\left(\lambda_i / z_j\right) = p(\lambda_i)p(z_j / \ \lambda_i)\left[\sum_{i=1}^{n} p(\lambda_i)p\left(z_j / \lambda_i\right)\right]^{-1} \qquad 2$$

Where $P(\lambda_i)$= the prior probabilities of occurrence of the state of nature (events λ_i),$P(Z_j/\lambda_i)$= the conditional probabilities of event Z_j given event λ_i has occurred, (λ_i/Z_j)=the conditional probabilities of event λi given Zj have occurred (it is also called the posterior probabilities), P(Zj)=marginal probabilities and are arrived at using the formula:

$$p(Zj) = \sum_{k=1}^{n} p(\lambda i)p(Zj/\lambda i) \qquad 3$$

In most applications of the theorem to decision problems, the Zj represents events which precede the occurrence of the observed λi. For decision making, the posterior probability distribution P(λi/Zj) and the marginal probability distribution (PZj) are required . In order to determine these distributions, a prior probability P(λi) must be assigned and a simple likelihood (conditional) distribution $P(Z_j/ \lambda_i)$ must be known . Events Zj represent the decision of the poultry farmers as to what type of fish enterprises to produce while events λi represent the identified risk factors in the fish business. For this study, the fish enterprises involved include Z_1 = Catfish production, Z_2= Catfish/Tilapia production, Z_3= Catfish/Ornamental fish production, the identified risk factors include: λ_1 = water poison, λ_2 = pest attack, λ_3 = disease and parasites, λ_4 = food poison, λ_5= excessive rain/flood λ_6= water shortage λ_7= pilfering.

V. Result And Discussion

***Respondents Socio-Economic Characteristics*:** The empirical result of the analysed socioeconomic characteristics was presented in table 1 and 2. The findings indicated that the sampled farmers' age ranged between 20 an 59 years with a mean of about 37 years and a standard deviation of 8.08. This imply that the crop of fish farmers in the study area were relatively young people. The estimated mean age of the farmers' shows that they are at the most energetic stage of their life. The age distribution of the farmers shows that about 45% falls within the age bracket of 30-40 years while approximately 23% were less than 30years implying that a total of about 68% of the farmers were actually less than 40 years of age.

The household size of the respondents ranged between 2 and 12 members with a mean of about 5 persons and a standard deviation of 2.1. The distribution of the household size table (2) shows that about 30% of the farmers had household size less than 10 persons. This is typical of urban settings, as more urban elites tend to have fewer children than their rural counterparts. However, other factors such as labour requirements for the fish farm (ponds) and religious reason might have contributed to the few large families. The literacy level of an average respondent in the study area (14.2years) was reasonably high; the years of education ranged between 2 and 18 years, these findings indicated that, most of the fish farmers (45%) had tertiary education.

The output of the farmers ranged between 80kg and 9000kg with a mean of about 1354kg per production cycle for the area. Farming experience ranged between 3 months to 20 years with a mean of about (4years). This is fairly low showing that urban fish farming could as well be relatively new in the study area. Many factors such as access to quality fish farming techniques, awareness, availability of space within the metropolis, access to quality fingerlings among other reasons may be responsible for the relatively low years of experience in fish farming in Kaduna metropolis. Various types and sizes of ponds ranging from plastic tanks, earthen ponds to concrete ponds were recorded among the farmers. The pond sizes range between $5m^2$ to 170 m^2. The most commonly employed pond type in the study area was the earthen pond. About 78% of the farmers were married, while 22 were single.

Table 1. Descriptive statistics of some demographic variables

Item	Mean	Minimum	Maximum
Age	37.508	24.000	59.000
Household size	5.3051	2.0000	12.000
Educational level	14.203	2.0000	18.00
Pond size	47.017	4.8960	170.00
Mean Output (kg)	1354.0	80.000	9000.0
Years of farming experience	3.9534	0.25000	20.000

Source: Field survey 2010

Table 2. Distribution of socio-economic characteristics of fish farmers in Kaduna.

Age group	**Frequency**	**Percentage%**
20 – 30	56	23.33
31- 40	108	45.00
41- 50	64	26.67
51- 60	12	5.00
Sex		
Male	140	58.33
Female	100	41.67
Marital Status		
Singles	52	21.67
Married	188	78.33
House hold Size		
1-5	88	36.67
6-10	72	30.00
11-15	80	33.33
Farming experience		
< 1year	4	1.67
1-5years	196	81.67
6-10years	32	13.33
>11years	8	3.33
fish pond Type		
Plastic tank	20	8.33
Earthen pond	168	70.00
Concrete pond	52	21.67
Level of education		
Primary	8	3.33
Secondary	52	21.67
Tertiary	180	75.00

Source: Field survey 2010

Risk factor analysis: The computation of the prior probabilities from the number of fishes lost by each fish enterprise to each of the identified risk factor is presented in Table 3. A total of 12,972 fishes were lost to all the risk factors out of which 3,409 were lost to diseases and parasites alone, followed by a loss of 2,403 to feed, Excessive rain/ flood, Diseases/parasites and excessive rain/flood thus had the largest prior probabilities of occurrence.

Table 3. Computation of prior probabilities of occurrence of risk factors

Fish enterprise produced Z_j	Number of fishes lost to states of nature (Risk factors)λ_i							
	λ_1	λ_2	λ_3	λ_4	λ_5	λ_6	λ_7	Total
Catfish only Z_1	776	308	3305	1993	2238	1661	2034	12315
Tilapia/Catfish Z_2	105	-	104	80	90	80	123	582
Catfish / Ornamental fish Z_3	-	-	-	-	75	-	-	75
Total fish lost	881	308	3409	2073	2403	1741	2157	12972
Probabilities $P(\lambda_i)$	0.068	0.024	0.26	0.16	0.19	0.13	0.17	1.00

Source: Field survey 2010

The joint probabilities are presented in Tables 4 and 5. The conditional probabilities are derived by dividing the joint probabilities by the prior or marginal probabilities. The posterior probabilities, that is, probabilities of occurrence of the identified risk factors given the fish enterprise are presented in Table 6. The values of the posterior probabilities of disease and parasites was largest both in catfish only and in catfish and tilapia. The mean values of the posterior probabilities of disease and parasites were 0.34 and 0.46 for excessive rain /flood. Therefore, disease and parasites and excessive rain /flood were the two major risk factors in fish production in the study area. These risk factors are preventable with efficient management practices. Such management practices could include pay more attention to breeds and varieties of fish the farmer stock in his farm in other words farmers should be kin at selecting stocks from reputable sources, stocks should not be selected based only on rate of growth performance but also on resistance to diseases. Farmers should ensure that adequate disease and pest preventive measures are in place as well as seek prompt veterinary assistance in periods of outbreak. To reduce lost due to pilfering, farmers should be vigilant, employ adequate security around their ponds

Table 4. Computation of conditional probabilities of occurrence of risk factors $P(Z_j/\lambda_i)$

Fish enterprises Z_j	State of nature							
	λ_1	λ_2	λ_3	λ_4	λ_5	λ_6	λ_7	Total
Z_1	0.06	0.03	0.27	0.16	0.18	0.13	0.17	1.00
Z_2	0.18	-	0.18	0.14	[0.15	0.14	0.21	1.00
Z_3	-	-	-	-	1.00	-	-	1.00
Conditional Probabilities	0.068	0.024	0.26	0.16	0.19	0.13	0.17	1.00

Source: Field survey 2010

Table 5. Joint probabilities of occurrence of risk factors

Joint Probabilities	Value
$P(Z_1)$	0.18
$P(Z_2)$	0.16
$P(Z_3)$	0.19

Source: Field survey 2010

$$p(z_j) = \sum_{i=1}^{3} p(z_j/\lambda_i)\, p\,\lambda_i$$

Table 6. Computation of posterior probabilities of occurrence of risk factors

Fish enterprises	State of nature							
	λ_1	λ_2	λ_3	λ_4	λ_5	λ_6	λ_7	Total
Z_1	0.02	0.004	0.39	0.14	0.19	0.09	0.16	1.00
Z_2	0.08	-	0.29	0.14	0.18	0.11	0.22	1.00
Z_3	-	-	-	-	1.00	-	-	1.00
Posterior Probabilities	0.05	0.004	0.34	0.14	0.46	0.1	0.19	1.00

Source: Field survey 2010

VI. Conclusion

The three major risk factors identified in the study area includes diseased/parasites, flooding resulting from excessive rain and pilfering. It is recommended that farmers should stock disease resistant varieties ,put in place adequate disease preventive measures, arrange for prompt veterinary attention when ever there is outbreak of diseases and also ensure good security around their farms.

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