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Profitability of Selected Ventures in Catfish Aquaculture in Ondo State, Nigeria

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Abstract

The need to provide information to prospective investors on the decision to invest led to this study on profitability analysis of selected ventures in catfish aquaculture in Ondo State, Nigeria. A multi-stage sampling technique was used to select 144 fish farmers rearing fingerlings, juveniles and table size (full) fish in the study area. The results of the analysis of socio-economic characteristics showed that the mean age of the three groups of farmers was about 35.0 years, while about 88.0%was maleand about 83.0% was married.All the respondents had western education while about 88.0% of farmers had tertiary education. Fish farming was a secondary occupation for about 61.0% of farmers while the mean farming experience was 6.3 years. The result of Benefit-Cost Ratio (BCR) was 1.46 for fingerlings, 1.29 for juveniles and 1.26 for full fish. Profitability and efficiency ratio of 0.85 and 1.85, 0.71 and 1.71, and 0.55 and 1.55 were recorded for fingerlings, juveniles and full fish, respectively. Comparing these values indicated that fingerlings production is the most profitable catfish enterprise in the study area. It is recommended that governments at all levels explore the possibility of using the various ventures in catfish farming as a solution to the worrisome unemployment problem in Nigeria.

Keywords: Full fish; Fingerlings; Juveniles; Efficiency ratios; Profitability; Catfish aquaculture; Nigeria

Introduction

Fish is an important protein food for Nigerian households and is supplied to large urban markets of Nigeria [1]. At the national level, fisheries provide a significant part of the national income. The processed fish (mainly dried clariid catfish) is a highly valuable trade item (Central Bank of Nigeria) [2] and thousands of people are employed in the marketing chain (gear manufacturers, processors, transporters, merchants, etc). The importance of fisheries to the Nigerian economy is indicated by its contribution to theGross Domestic Product which stood at 4.4% in 2008 [3]. There have been empirical findings by Mafimisebi and Thompson that the fisheries sub-sector inherently contributes more to the Nigerian economy than is apparent in this paltry 4.4% [4].

The fisheries sub-sector of the agricultural sector in Nigeria is classified on the bases of type and structure (Federal Department of Fisheries (FDF) [5]. The industry is divided into three (3) sub-sectors; artisanal, industrial and aquaculture. In the last 3 decades, both production and consumption of fish have risen drastically and the national demand for fish also continues to increase [6].

Nigeria is a food deficit nation and it is obvious that protein intake is grossly inadequate in both qualitative and quantitative terms [7]. Although, fish is generally regarded as a cheap source of animal protein [8-10], the shortfall in domestic production due to the neglect of the sub-sector and environmental impact of crude oil exploration on fish production, has resulted in increased importation of fish in Nigeria [10,11]. However, because of its remarkable profitability, there is a growing aquaculture industry that has come to the rescue in an attempt to bridge the gap between supply and demand [12-15].

Therefore, this study is focussed on the profitability analysis of various ventures in catfish production in Ondo State, Nigeria. This is with the aim of providing informed guidance to prospective investors seeking to invest their funds in profitable fish farming enterprises. Comparing profitability across ventures will reveal the extent to which each of the various ventures is attractive. This will serve to encourage more investment in aquaculture business and ascertain the most profitable enterprises with regard to catfish aquaculture. Increased investment in aquaculture has become very important in boosting domestic fish production which will subsequently reduce the annual fish import bill in Nigeria. Also, this study hopes to provide prospective fish farmers with information on the various cost items and how best to invest their limited competitively utilizable resources in a bid to maximize profit.

Methodology

Study area

The study was carried out in Ondo State, Nigeria. The state is one of the six states in South-West of Nigeria. The state is bounded in the West by Osun and Ogun States and in the North by Ekiti and Kogi States. Ondo State also shares boundaries with Edo and Delta States in the East and in the South by the Atlantic Ocean [10]. The state is made up of 18 Local Government Areas (LGA) with a total population of about 3.4 million inhabitants (National Population Commission) [16]. Ondo State has three distinct ecological zones; the mangrove forest to the south, the rain forest in the middle and the guinea savannah to the north.

The state is well suited for the production of both permanent and arable crops and fishery products from both artisanal and aquaculture sub-sectors. Ondo State has about 180 km coastline which is the longest in the Nigeria. The coastline harbours Ilaje Local Government Area, which is inhabited by three ethnic nationalities which are Ilaje, Apoi and Arogbo Ijaws. The major occupation of these riverine or coastline ethnic groups is fishing either at the artisanal or motorized levels with minor occupations which are also related to fishing such as related lumbering and production of local gins [11,12]. The fact that Ondo State is one of the highest producers of fish in Southwest Nigeria justified the reason for selecting it as the study area [17].

Data collection

A multi-stage sampling technique was used to select respondents for the study. In the first stage, Ondo State was chosen based on the fact that the state is the highest producer of fish in South west Nigeria. In the second stage, two Local Government Areas (LGAs); Akure South and Akure North which accounted for 18.11% of the total population of the state Ondo State Ministry of Information [18] and 48% of the fish farms in the state (Ondo State Agricultural Development Programme (OSADP) [19] were purposively selected. In the third stage, random sampling technique was used to select the fish farmers. Seventy-Two (72) respondents divided into 24 each of fingerlings, juveniles and table size fish farmers, respectively) were randomly selected in each LGA. A set of 24 questionnaires was administered to each category of farmers in each of the two LGAs giving a total of 144 respondents. In the farms surveyed, data were collected with the aid of structured questionnaire.

Data analysis

Descriptive statistics comprising of frequency distribution, mean and percentage was used to summarize the socio-economic characteristics of fish farmers. The Benefit-Cost Ratio (BCR) analysis and ordinary least squares regression were also used to analyze the data. Benefit-Cost model is calculated as the NPV of benefits divided by the NPV of costs. It is shown as follows

$$BCR = \frac{\sum_{r=1}^{r} \frac{Bt}{(1+r)^t}}{\sum_{r=1}^{r} \frac{Ct}{(1+r)^t}}$$

Where Bt is the benefit in time t and Ct is the cost in time t. Where t is the first five years of which fish farmers has been running the fish farming business based on their records and r is 9% interest rate which is the prevailing rate at which agricultural loan is given to farmers by the financial institutions as directed by the Central Bank of Nigeria.

Therefore, if the BCR exceeds one, then the fish farming venture is considered profitable. The BCR was constructed to determine (and compare) the benefits and costs of producing fingerlings, juveniles and full size fish in the study area. Also, the profitability and efficiency ratios of each fish venture (fingerlings, juveniles and full fish) was calculated and compared.

Thus:

Profitability Ratio=NP/TC

Where NP=Net Profit

TC=Total Cost

Efficiency Ratio=TR/TC

Where:

TR =Total Revenue

TC =Total Cost

Furthermore, in estimating the parameters of socio–economic and operational characteristics postulated as explanatory variables, the explicit production function relating income realized from the sales of fingerlings, juveniles and full fish was estimated using OLS regression. Various functional forms of multiple linear regression models were fitted to data collected to reveal the best fit.

The explicit regression equation for fingerlings production is presented as follows:

$y=b_0 +b_1X_1 +b_2X_2+b_3X_3+b_4X_4+b_5X_5 +b_6X_6+b_7X_7+U_i$

Y=Gross revenue realized from fingerlings production (Naira)

X_1=Age of respondent (years)

X_2=Educational status (years of formal schooling)

X_3=Major occupation (1=fish farming, 0=otherwise)

X_4=Initial stock (number)

X_5=Cost of feeds (Naira)

X_6=Veterinary Cost (Naira)

X_7=pond size

U_i=Error term

Where b_0=Intercept or constant

b_1=Parameter estimates

For juvenile production, the explicit regression equation is as follows:

$Y=b_0 +b_1X_1 +b_2X_2+b_3X_3+b_4X_4+b_5X_5 +b_6X_6+b_7X_7+b_8X_8+b_9X_9+U_i$

Y=Gross revenue realized from juvenile production (Naira)

X_1= Age of fingerlings stocked (weeks)

X_2=Cost of fingerlings stocked (Naira)

X_3=Cost of feeds (Naira)

X_4=Veterinary cost (Naira)

X_5=Cost of equipment used (Naira)

X_6=Educational status of respondents (years of formal education)

X_7=Number of family members involved in production

X_8=Years of fish production experience (years)

X_9=Pond Size

U=Error term.

Where b_0 and b_i are as earlier defined.

For full fish production, the explicit regression equation is as written hereunder:

$Y=b_0 +b_1X_1 +b_2X_2+b_3X_3+b_4X_4+b_5X_5 +b_6X_6+b_7X_7+b_8X_8+b_9X_9+U_i$

Y=Gross revenue realized from table size fish production (Naira)

X_1=Age of juveniles stocked (weeks)

X_2=Cost of juveniles stocked (Naira)

X_3=Cost of feeds (Naira)

X_4=Veterinary cost (Naira)

X_5=Cost of equipment used (Naira)

X_6=Educational status of respondents (years of formal education)

X_7=Number of family members involved in fish production

X_8=Years of fish production experience (years)

X_9=Pond Size

U=Error term.

Where b_0 and b_i are as previously defined.

The estimated functional form that yielded the best fit for each farm category was selected using statistical, economic and econometric criteria.

Results and Discussion

Table 1 revealed that over 85% of the respondents were less than 40 years for all the categories of fish farmers (i.e. fingerlings, juveniles and full fish) with a mean age of 33.5 years, 38.7 years and 31.4 years, respectively. This is in line with the findings of Aderinola and Adeyemo that most fish farmers are in their active productive ages in the study area [13]. The sex distribution of the respondents' showed that majority of the respondents was male. The value recorded was about 88.0%, 85.0% and 90.0% for fingerlings, juveniles and full fish producers, respectively). Thus, more males were involved in fish production than females. This is also in line with the findings of Ajayi and Fagbenro who described fish farming as "a totem of masculinity" [20].

Again from Table 1, the marital statusof respondents revealed that majority (81.3%, 83.3% and 85.4% for fingerlings, juveniles and full fish producers, respectively) were married. Those that were single were less than 20% for all the categories of fish respondents. The farmers could therefore be expected to strive to make rational production decisions that will enhance returns from the business since they may be relying on the farm to provide for their family members [21]. Education is important for the adoption of new innovations according to Olarinde and Kuponiyi [22]. All the respondents had western education. Majority (89.6%) of the fingerlings farmers had tertiary education while 85.4% and 87.5% of juveniles and full fish farmers had tertiary education.

Socio-economic Characteristics	**Fingerlings Farmers**		**JuvenileFarmers**		**Table SizeFarmers**	
	Frequency	**Percentage**	**Frequency**	**Percentage**	**Frequency**	**Percentage**
Sex						
Male	42	87.5	41	85.4	43	89.6
Female	6	12.5	7	14.6	5	10.4
Total	**48**	**100**	**48**	**100**	**48**	**100**
Age in years						
20-29	15	31.2	8	29.3	23	47.9
30-39	27	56.3	21	58.3	19	39.6
40-49	2	4.2	10	6.2	4	8.3
50-59	4	8.3	9	6.2	2	4.2
Total	**48**	**100**	**48**	**100**	**48**	**100**
Fish Farming Experience in years						
9-Jan	44	91.7	43	89.6	38	79.2
19-Oct	4	8.3	5	10.4	10	20.8
Total	**48**	**100**	**48**	**100**	**48**	**100**
Marital Status						
Single	8	16.7	6	12.5	7	14.6
Married	39	81.3	40	83.3	41	85.4
Widowed	1	2	2	4.2	0	0
Total	**48**	**100**	**48**	**100**	**48**	**100**

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Solely Fish Farming Business	28	58.3	29	60.4	31	64.6
Self employed	9	18.8	7	14.6	7	14.6
Civil Servant	11	22.9	12	25	10	20.8
Total	**48**	**100**	**48**	**100**	**48**	**100**
Access To Credit	6	12.5	4	8.3	5	11.6
No Access To Credit	42	87.5	44	91.7	43	88.4
Total	**48**	**100**	**48**	**100**	**48**	**100**
Education Attained						
Completed Secondary School	5	10.4	7	14.6	6	12.5
Tertiary	43	89.6	41	85.4	42	87.5
Type of Ponds						
Concrete Pond	45	93.8	43	89.6	42	87.5
Earthen Pond	3	6.2	5	10.4	6	12.5
Total	**48**	**100**	**9**	**100**	**100**	**100**
Size of Pond						
100 - 250 m2	41	85.4	42	87.5	39	81.3
251 -999 m2	5	10.4	3	6.25	5	10.4
Above 1000m2	2	4.2	3	6.25	4	8.3
Total	**48**	**100**	**9**	**100**	**100**	**100**
Mean Age of Fish Farmers	**33.5 years**		**38.7**		**31.4 years**	
Mean Farming Experience	**5.8 years**		**6.0 years**		**7.0 years**	

Table 1: Socio-Economic Characteristics of Fish Farmers (i.e. Fingerlings, Juvenile and Table Size) in Ondo State. Source: Field Survey, 2012.

Furthermore, Table 1 shows that most (58.3%) of the fingerlings producers engaged in farming as a major occupation while the balance were civil servants who took to these ventures on part-time basis. Few (18.8%) of the fingerlings farmers were self-employed. About 60.4% of juvenile farmers were engaged in farming as the main occupation while some (25.0%) engaged in civil service. Some (14.6%) of juveniles farmers were self-employed. Also, 64.6% of the full fish farmers had farming as their major occupation, 20.8% was in the civil service and 14.6% was self-employed. This implies that engagement in a secondary income source is a very popular practice among fish farmers in the study area. Again, according to Table 1, over 87.0% of the respondents confirmed that they do not have access to credit for all the categories of fish farmers while less than 15% reported having access to credit through informal sources.

From Table 1, majority (91.7%, 89.6% and 79.2%) of fingerlings, juveniles and full fish farmers, respectively, had less than ten years of fish production experience while 8.3%, 10.4% and 20.8%, respectively, had over ten years of fish production. The mean farming experience of 5.8 years, 6.0 years and 7.0 years, respectively,also attested to their years of experience in the fish farming in the study area. On management practices, a greater proportion (93.8%) of fingerlings farmers made use of concrete ponds, while majority (89.6% and 87.5%) of both juveniles and full fish farmers also made use of concrete ponds. This might be due to the fact that concrete ponds are more secured and reliable than the earthen ponds as observed by Kudi et al. [23].

Furthermore, the average frequency distribution of ponds sizes in the sampled area as given in Table 1 shows that 84.7% of the ponds were small sized ponds of 100 to 250 m^2 and 9.0% was medium sized ponds of 251 to 999 m^2. Big ponds of size more than 1000 m^2 had the lowest percentage of 6.3%. Small-sized ponds of 100 to 250 m^2 may have be preponderant because of lack of skills and infrastructural facilities to accommodate large scale fish farming as well as limited data and information on research and development requirements for fish farming. Large ponds will require modern pond engineering techniques and advanced management methods about which little is known at present in the study area [10]. Hence, most of the farmers prefer to have relatively small ponds, which they can manage.

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Benefit-cost ratio to fish farming production per hectare of fish farm

	Fingerlings	Juvenile	Table Size
BCR Value	1.46	1.29	1.26

Note: The Benefit- Cost Ratio analysis was based on the average of five years of operation of the three fish farming enterprises.

Table 2 revealed that the fingerlings enterprise is the most profitable fish farming enterprise in the study area since its value of BCR is greater than that of juvenile (1.29) and full fish (1.26). However, from the field survey, it was discovered that the cost of juvenile and full fish enterprises was higher because they will require more ponds for sorting and also, more brood-stock. This may likely be the reason why the fingerlings enterprise is more profitable than the other two fishing enterprises.

	Fingerlings Amount (N m)	Juvenile Amount (N m)	Table Size Amount (N m)
A. Variable Cost: Cost of Stock Cost of Feeds Labour Veterinary Cost Total Variable Cost	1.15 1.38 1.20 0.20 3.93	10.00 2.56 1.45 0.25 14.26	18.00 126.32 42.15 0.35 186.82
B. Fixed Cost Depreciation Cost Total Fixed Cost Total Cost of Production	1.70 1.70 5.63	2.36 2.36 16.62	33.33 33.33 220.15
C. Total Revenue	10.00	18.00	350.00
D. Gross Margin	6.07	3.74	163.18
E. Net Profit	4.37	1.38	129.85
F. Profitability Ratio	0.78	0.08	0.59

Table 3: Average Cost and Returns in Fish Production per Hectare of Fish Farm per Annum. Source: Field Survey, 2012.

Table 3 showed that total production cost per fingerlings in the study area was N 5.63 k while the revenue was N 10.00 k per fingerling. The analysis also revealed that fingerlings farmers earned an average of N 4.37 k as net profit per fingerling. For juvenile production, the production cost per juvenile was N 16.62 k while the revenue per juvenile sold was N 18.00 k. Thus, farmers producing juveniles earned an average of N 1.38 k as net profit per juvenile. Also, for full fish, the production cost N 220.15 k while the revenue per full fish was N 350.00 k. The results indicated that full fish farmers earned an average of N 129.85 k as net profit per full fish sold. The profitability ratio analysis which measures the ratio of revenue to expense and which gives room for comparison between two or more firms [24] revealed that fingerlings production was more profitable than production of both juveniles and full fish in the study area.

Production function for fish farms

The R2 for the estimated regression implied that 89.0% of the variations in the revenue from sales of fingerlings are explained by the explanatory variables. It was found from the regression result that age, cost of feeding, veterinary cost and pond size were the major determinants of the gross revenue from fingerlings production in the study area.

Variables	Coefficient	T-Values
Constant	-	-
Age	0.101	4.21*
Cost of feeding	-0.312	2.514*
Veterinary cost	-0.021	3.016*
Pond size	0.055	5.215*

Table 4: Estimated Production Function for Fingerlings Farms. Source: Field Survey, 2012. R^2=0.89, F =6.14*, * Significant at 5% level.

Age had a positive and significant relationship meaning that the older the fingerlings farmers are, the higher their productivity is. This may be owing to the fact that older fingerlings farmers are more patience and thorough as a hindsight of experience. According to Shimang, fingerlings farming requires the quality of resilience because, it is a fragile farming venture. In a single day, a fingerlings farmer may lose half of his/her fingerlings [25].

Also, from Table 4, cost of feeds had a negative coefficient which meant that the higher the gross revenue (and hence output), the lower the cost of feeds in raising fingerlings. This may have been due to the possibility of bulk purchase of feeds directly from dealers which leads to reduced costs. This will be the case especially when the feeding is done according to prescription. Veterinary cost had negative coefficient, which implied that the average veterinary cost for larger fingerlings farms will be lower than average cost on smaller fingerlings farm. Pond size had a positively significant coefficient with the implication that the larger the size of the pond for the production of fingerlings, the higher the gross revenue especially in a situation in which mortality rate is highly reduced.

Variables	Coefficient	T-Values
Constant	-	-
Cost of feed	0.605	5.841*
Cost of equipment	-0.091	2.625*
Production experience	0.056	2.312*
Pond size	0.145	6.185*

Table 5: Estimated Production Function for Juveniles Farms. Source: Field Survey, 2012. Notes: R^2=0.86, F =8.61*, *Significant at 5% level.

From Table 5, it was shown that cost of feeds, cost of equipment, production experience and pond size were the major determinants of income from juvenile production. With an F- value of 8.61 which is significant at 5% level, it is shown that most of the postulated variables influenced the income from juvenile production. The R^2 for the estimated regression was 0.86 implying that about 86.0% of the variations in gross revenue from sales of juveniles are explained by the explanatory variables. Cost of feeds had positive and significant regression coefficient. This meant that the higher the quantity of feeds used, the higher the revenue from juveniles production.

Cost of equipment had a negative but significant relationship with gross revenue from juveniles production. This connotes that the higher the output and by implication, gross revenue, the lower the cost of equipment per juvenile. Production experience had a positively significant regression coefficient which is interpreted to mean that the more experienced the juvenile producer is, the higher the output and hence, gross revenue, other things being equal. From Table 5, pond size is a very crucial determinant of juvenile production in the study area. The results revealed that the larger the size of the pond, the more the output of juveniles. At juvenile production level, the size of the pond is very crucial to the output level. In juvenile production, the pond with larger dimension gives rise to more output compared with a smaller pond.

Variables	Coefficient	T-Values
Constant	-	-
Cost of feed	0.716	3.418*
Cost of equipment	-0.011	3.425*
Educational level	0.191	2.018*
Production experience	0.077	4.952*

Table 6: Estimated Production Function for Table Size Fish Farms. Source: Field Survey, 2012. R^2=0.84, F =8.91*, *Significant at 5%.

The R2 for the estimated regression implied that 84% of the variations in the revenue from sales of full fish is explained by the postulated explanatory variables. From the result of the regression model, it was observed that cost of feeds, cost of equipment, educational level, production experience and pond size were the major determinants of gross revenue from full fish production. Cost of feeds had positive and significant regression coefficient, which implies that the higher the cost of feeds, the higher the revenue from full fish production. The growth of the full fish is essentially determined by the quantity and quality feed [26].

Therefore, the more feed consumed, the more weight of full fish that will be produced. Also, the coefficient of the cost of equipment used in full fish production is significant and negative. It is understandable that fixed cost like cost of equipment will always be high if the quantity of fish produced is low. The study revealed that most of the full fish farmers in the study area were not into large scale production, and then the fixed cost like cost of equipment will be high as there exists an inverse relationship between the cost of equipment and gross revenue realized from full fish production.

Again, the educational level has a positive relationship with the gross revenues from full fish. Thus, the higher the level of education of full fish farmer, the higher the gross revenue. This corroborates the findings of Olarinde and Kuponiyi, that “education is an important factor that determines adoption of new innovations [22]. It provides readability consciousness and awareness, which enable decisions to be made. Therefore, the higher the level of farmer’s education, the better is his/her decision making ability, especially in the adoption of new technologies and innovation”. Such decision will enhance output.

Furthermore, the coefficient of production experience is positive and significant, because the farmer is able to make wise economic decisions in production by drawing on first hand farm experience which is better when compared with relying on theoretical knowledge [10]. The pond size coefficient is also positive because the size of the pond also determines the size of the full fish as it ensures enough space for growth without antagonism from other fishes in the same pond (reduced cannibalism).

Conclusion

The study revealed that the fish farmers were in the active working age bracket, they are well educated while the business of fish production is male dominated. Fish production was profitable in the study area but for the three farm ventures, fingerlings production was more profitable than production of juveniles and full fish. Since all ventures of catfish farming were discovered to be profitable in the study area, government at all levels can adopt them as an employment scheme to solve the pervasive and worrisome unemployment problem in the country by providing the enabling environment for school leavers to go into catfish production and exportation.Also, this step to encourage school leavers to go into aquaculture can also boost fish supply and subsequently bridge the demand-supply gap of fish in Nigeria.

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