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Economics of Fish Farming in Ibadan Metropolis

S.A Yusuf[1], Ashiru A.M.[1] and Adewuyi S.A.[2]

[1]*Department of Agricultural Economics, University of Ibadan, Ibadan.*
[2]*Department of Agricultural and Rural Productivity, National Productivity Centre, Abuja*

Target Audience: Fish Farmers, Fish Experts, Policy Makers, academics and the Public

Abstract

The study assesses the economics of fish farming in Ibadan Metropolis. The data for the study were collected from 50 fish farmers with the aid of structured questionnaires. The data were analyses using descriptive, gross margin and regression techniques.

The study revealed that most farmers had secondary education and above. Most farmers operate at small-scale level with an average of 3 ponds in this category. Fish farmers practiced poly culture fish farming. Clarias spp is the most raised fish species followed by Heteroclarias spp. The gross margin analysis revealed that medium scale farmers derived the highest return of ₦1.55 for every one naira expended. This is followed by large-scale farmers at ₦1.52 for every one naira compared with only ₦1.34 for every naira spent by small-scale farmers. Fixed inputs, labour, fertilizers, feeds and finger lings significantly affect the value of fish produced. Fish farmers under utilize both labour and fertilizers while feeds and finger lings are over utilized.

Key words: *Aquaculture, fish production, Profitability and efficiency.*

Description of Problem

The overall effect of food insecurity is not only inadequate food production but also imbalances even nutritionally. The nutritional value of food consumption by average Nigeria household is below the recommended standard especially with respect to animal protein intake (1,2). However, fish has been recognized to possess the potential to make up for the deficiency in dietary requirements. The estimated fish demand in Nigeria based on annual per caput fish consumption of 110kg regarded as adequate for normal healthy growth is projected to increase to 1,545,000 tonnes (3). Local fish production has been below consumption with imports accounting for about ₦192 million in 1994 (3). Local production in 1990 was 685000 metric tonnes against a national demand of 1,632,000 metric tones (4).

The benefits of fish as a valuable food item and a commodity of commerce made most developing countries particularly Nigeria to turn to food rich in fish sources. This perhaps supports the intensified efforts of Nigeria with the assistance of donor agencies (notably International Fund for Agricultural Development, IFAD) at developing and exploiting her fishery resources. However, (5) notes that since resources of the sea and other natural bodies of water are not unlimited and there is need for sustainable ecosystem, attention has to shift to aquaculture as a viable alternative for boosting fish production. Aquaculture is becoming established outside its traditional confines of Asia and Europe, although absolute growth is still faster in Asia than elsewhere. Fish farming has become popular for two reasons: it provides a source of income rather than simple subsistence and can be incorporated into local agricultural systems to diversify the production base. As a result, flexible integrated culture systems that in-

clude fish are being adopted in many regions (6). According to (7), a total of 17.663 metric tonnes of fresh water fish were produced by Nigeria's aquaculture. The major species of cultured fish are finfish (Tilapia, Catfish and Carp) while fresh water fish makes up to 80 percent of the total aquaculture. Despite the fact that fish hunting supplies over 80 percent of local fish in the country (7,8), the gap between demand and supply has continued to grow (4,9). Fish farming is believed to have the potential of bridging the gap. Further, the sudden decline in the poultry industry as a result of high cost of feeds and other basic inputs like cages has made Nigeria investors to explore new possibilities particularly animal husbandry and aquaculture (10). These coupled with the recent ban on importation of frozen livestock products have put pressure on local supply to meet up with local demand. Aquaculture in Nigeria, as in most sub- Sahara Africa is carried out by subsistence rural operators in small fresh water ponds as secondary activities to agriculture. Nonetheless fish farming is developing in Nigeria (7).

In view of the growing importance of aquaculture in the country as enunciated above, this study seeks to provide an economic analysis of fish production in Ibadan Metropolis. The following questions provide the basis for the study. First, what are the key features of the fish farms? Second, what is the cost-returns relationship and hence its profitability? Lastly, what major factors determine the value of fish produced?

The rest of the report is sectionalized into three. The next section discusses the materials and methods for the study while the third section provides results and discussion of the findings. The last section is on conclusion and application of the study.

Materials and Method

This study was carried out in Ibadan Metropolis comprising 5 local government areas namely: Ibadan southwest, Ibadan southeast, Ibadan north, Ibadan northeast and Ibadan northwest. The data for the study were obtained from primary source with the aid of structured questionnaire. The questionnaire was administered on sixty fish farms using simple random sampling. In this respect, fish farms were randomly selected and interviewed on the basis of the list obtained from the Oyo State Ministry of Agriculture and Natural Resources. However, only 50 questionnaires were completely answered and the analysis was based on these. The farms were categorized into small, medium and large-scale farms on the basis of the number of stocked ponds. Each fishpond averaged 0.24 hectares and has a depth of 1.5m to 2m. The distribution of the fish farms is given in table 1.

Table 1: Distribution of Sampled Fish Farms by Size

Range of ponds	Average number of ponds	Frequency	Percentage
1-5	3	31	62
6-10	7	14	28
Above 10	24	5	10

Source: Field Survey, 2001.

It is evident from the table that most fish farms are small sale in nature with only 10 percent large scale. This supports the submission by (3) that agriculture (including fish farming) is largely practiced on a small scale. Data were collected on management practices, costs and returns.

The data collected for the study were analysed using descriptive, budgetary, and regression techniques. The descriptive analysis involved the use of frequency distribution, percentages and tabulation of data. The budgetary and regression techniques are expatiated upon below.

The budgetary technique is used to examine the profitability of fish farming in Ibadan Metropolis. The technique proceeds as follows:

Gross Margin = Total Revenue - Total Variable Cost
Profit = Gross Margin – Total Fixed Cost

The Gross Margin of fish farming is the difference between the total value of production (total revenue) and the variable costs of production. The total revenue refers to the gross income accruing to fish farms as a result of the sales of table-sized fish. This is obtained by multiplying the unit price of average table- sized fish by the quantity sold. The variable costs are those costs that vary with the level of output. In this study, the relevant variable cost items are fish feed, labour,

fertilizer, lime, fingerlings, and transportation among others. The fixed costs are the costs incurred regardless of sales or level of production. The fixed cost items under fish farming are land, pond construction, hatchery construction, trucks and other equipment. The addition of the total variable cost and total fixed costs give the picture of the over all cost incurred in production. However, for the purpose of arriving at fixed cost of the fish farms for a given year, the straight line depreciation method was used taking into consideration, the expected life span of the different fixed cost items. The budgetary analysis was carried out by farm sizes.

The regression analysis was carried out to examine the factors affecting revenue from fish out put. On the basis of selection criteria viz a *priori* expectation in term of signs and magnitude of the coefficients, the economic rationale, the significance of the coefficients and the over all performance of the model (11, 12), the double log functional form was selected as our lead equation. This is because the functional form performed best out of the four functional forms (Viz: double log, semi log, linear and exponential) experimented with.

The least square regression model is as specified below:

$$\ln Y = f(\ln X_1, \ln X_2, \ln X_3, \ln X_4, \ln X_5, e_i)$$

Where ln represents natural logarithm.

Y = value of table fish produced by farm i in Naira

X_1 = Depreciated value of fixed inputs of farm i in Naira

X_2 = Value of fee used by farm i in Naira

X_3 = Value of lime and fertilizer used by farm i in Naira

X_4 = Value of labour used by farm i in Naira

X_5 = Value of finger lings purchased by farm i in Naira

e_i = Error term.

It is expected that the values of fixed input (x_1), feed (x_2), labour (x_4) and finger lings stocked (x_5) will be positively related to total value of out put. In other words, the more the amount expended on these variables the more the value of production ceteris paribus. On the other hand a negative relationship is expected between the value of fertilizer / lime and output.

In order to examine the efficiency of input usage, the relationship as indicated by (13) was used.

$$MVP = r$$

Where MVP is the marginal value product i.e. additional revenue generated as a result of a unit increases in input usage. The term 'r' represents the price per unit of input. For this purpose, since analysis was done using naira value, then the relevant identity is $dy/dx_i = 1$

Where dy/dx_i is now the MVP and N1 represents the value of input

Following from the above:

MVP = 1 implies efficient use of resources

MVP > 1 implies under utilization of resources

MVP < 1 implies over utilization of resources

Results and Discussion

This section presents the results and discussion emanating from the study. In subsequent subsections we present the characteristics of fish farmers, profit analysis of fish farming and factors affecting the performance of fish farming in Ibadan Metropolis.

Selected Characteristics of Fish Farmers:

The table below shows the summary of selected characteristics of fish farmers in Ibadan Metropolis.

From the table, it can be seen that about 96 percent of the respondents have secondary school and above. This is indicative of high literacy rate, which may be required for effective management of fish farms. In term of years of establishment, it can be seen that aquaculture is relatively a new phenomenon in Ibadan Metropolis. About three-quarters of the respondents commenced fish farming in not more than 8 years ago. The sources of finger lings revealed that only 14 percent rely on wild finger lings while about 86 percent obtained theirs from hatchery. The type of ponds in use ranges from earthen pond to tanks. However, the use of tanks is highly restricted with only 4 percent of the respondents using it. The most com-

Table 2: Summary of Selected Characteristics of Farmers

Variable	Category	Frequency	%
Educational Status	Primary	2	4
	Secondary	9	18
	Tertiary	39	78
		50	100
Year of Establishment	1990 - 1993	11	22
	1994 - 1997	16	32
	1998 - 2001	23	46
		50	100
Sources of Finger lings	Hatchery	43	86
	Wild	7	14
		50	100
Types of Ponds	Earthen	39	78
	Concrete	9	18
	Tanks	2	14
		50	100
Sources of Labour	Hired	38	76
	Family	5	10
	Self	7	10
		50	100

Source: Field Survey, 2001

Table 3: Distribution of Fish Farmers by Types of Fingerlings used

Types of finger lings	Frequency	Percentage
Clarias spp only	18	36
Heteroclarias only	10	20
Hetero branchus spp only	9	19
Cyprinos carpio (carps) only	4	8
Tilapia only	2	4
Clarias and Tilapia	4	8
Tilapia and Carp	1	2
Tilapia, Carp and Clarias	1	2
Carp and Heterotis	1	2
	50	100

Source: Field Survey, 2001.

Table 4: Profit Analysis of Fish Farms (₦/ farm)

	Large farm	Size Medium	Small
Total Revenue	2,750,000.00	1,400,000.00	707,250.00
Feed	429,786.40	204,549.00	196,270.00
Lime and Fertilizer	8,224.66	5,700.00	3,000.00
Labour	480,000.00	295,000.00	210,680.00
Finger lings	100,000.00	40,000.00	15,000.00
Transportation	40,000.00	30,000.00	18,000.00
Miscellaneous	80,000.00	50,000.00	35,000.00
Total Variable Cost	1,138,011.00	575,249.00	442,270.00
Gross Margin	1,611,989.00	824,751.00	264,980.00
Fixed Cost*	44,000.00	16,000.00	8018.75
Buildings			
Land	41,000.00	6,200.00	3031.25
Pond Construction	48,000.00	6,713.75	3752.50
Borehole/Well			
Water Tank	5,500.00	2,028.50	1262.50
Water Pump	3,00.00	1,500.00	786.00
Aerators	1,000.00	1,021.00	375.00
Fishing Gears	900.00	450.00	112.50
Shovel/Spade	5,000.00	2,400.00	1440.00
Whell Barrow	600.00	175.00	132.50
Vehicle	720.00	375.00	166.60
Total Fixed Cost	24,250.00	11,000.00	5,250.00
	173,970.00	47,863.25	24,326.55
Profit	1,438,019.00	776,887.75	240,653.45

*The fixed cost items were depreciated using straight-line method. Building, land, pond construction, borehole/well, water tank, water pump, aerators and vehicle were depreciated over twenty years while fishing gears, shovel/spade and wheel barrow were depreciated over 5 years. Total fish harvest for small, medium and large-scale farms are 2829 kg, 5600kg and 11,000 kg respectively. However, average fish harvest per pond is 943 kg, 800 kg and 458.3 kg for small, medium and large scale fish farms respectively.

Source: Field Survey, 2001.

mon type of pond is the earthen pond accounting for 78 percent of all the sampled farms. The reliance of most fish farmers on earthen pond can be linked with the fact that it is easier and relatively cheaper to construct when compared with other types of ponds. Fish farms rely more on hired labour with only 14 percent of the farmers being able to carry out day-today activities on the farm by themselves. The dependence on hired labour as a source of manpower can be traced to the size of the farms as well as the level of education of the farmers. In this instance, most fish farmers are engaged in other activities that prevent them from under taking full-time aquaculture.

The types of fish used by farmers range from Clarias spp to Cyprinos carpio. In general, farmers raise two types of fish namely Clarias spp and hetero clarias. The emphasis on these fish species

may be a function of the demand for them, which is relatively higher compared with what obtains for other species. Table 3 shows the types of fingerlings raised by farmers in Ibadan Metropolis.

From the table, it can be noted that only about 14 percent of the fish farmers combine two or more fish species on their farms. Tilapia remains the most combined with other fish species.

Profitability of Fish Farming in Ibadan Metropolis: The profitability of fish farming is given on table 4. In absolute terms, the large-scale farms earn 96.4 percent and 288.8 percent above what the medium scale and small-scale farms earn respectively. Across the farms, feed and labour constitute significant proportion of the total variable costs. For instance, an arrange large scale fish farmers spends about 37.8 percent of its variable costs on feed compared with 42.2 percent that is spent on labour. In line with this, the medium-scale fish farms spend about 35.6 percent and 51.3 percent of the total variable costs on feed and labour respectively. Also, the small-scale fish farms spend 44.4 percent and 47.6 percent of their total variable costs on feed and labour respectively. In sum, at least 80 percent of the total variable costs by fish farmers are on feed and labour. The fixed cost items constitute only 13.3 percent of total cost of fish farms by the large-scale producers. The fixed cost components of the total cost for small and medium scale farms are 5.2 percent and 7.7 percent respectively.

In absolute terms, an average large-scale fish farm makes a profit of ₦,1438, 019, which is 96.4 percent and 288.83 percent higher than the farm profit for medium and small-scale fish farms respectively. However, on per pond basis, the medium scale farmers earn ₦110,983.97 compare with ₦80,217.82 for small-scale farmers and ₦59,917.46 for large-scale farmers. In this instance, the medium scale fish farms earn more. The analysis of profit on per pond basis is presented in table 5.

From the table, it can be seen that total revenue and total variable cost per pond rise as the farm size declines. For a small-scale farmer, every naira expended on each pond generated an extra 34kobo while for a medium scale fish farmers, one naira expended gave additional returns of 55kobo. Large-scale farmers are able to generate additional 52kobo on every naira expended.

Table 5: Profit Analysis of Fish Farms (N/Pond)

	Large	Medium	Small
Total Revenue	114,583.33	200,000.00	235,750.00
Variable Cost	47,417.13	82,178.42	147,423.33
Gross Margin	67,166.21	117,821.57	88,326.67
Fixed Cost	7,248.75	6,831.61	8,108.85
Profit	59,917.46	110,983.97	80,217.82

Source: Field Survey, 2001.

Factors Affecting the Performance of Fish Farms:

As indicated in the methodology, the factors affecting the performance of fish farms are captured using regression analysis. The result of the analysis is as presented in equation 1.

$$\ln Y = \underset{(4.304)}{\ln 20.785} + \underset{(0.160)}{0.633\ln X_1}^{**} - \underset{(0.341)}{0.697\ln X_2}^{*} + \underset{(1.125)}{5.050\ln X_3}^{**} + \underset{(0.201)}{0.554\ln X_4}^{**} - \underset{(1.394)}{5.843\ln X_5}^{**} \quad \ldots\ldots\ldots(1)$$

$R^2 = 0.853$

$R^{-2} = 0.833$ $\qquad F = 49.911.$

Figures in parentheses are standard errors.
** Indicates the variables are significant at 1 percent level
* Indicates the variable is significant at 5 percent level
All the variables are as earlier defined.

The result above shows that about 85.3 percent of the variations in the value of fish output are jointly explained by value of fixed input (X_1), value of feeds (X_2), value of fertilizer/lime (X_3), value of labour (X_4) and value of fingerlings stocked (X_5). The F-value of 49.911 indicates that the overall equation is statistically significant at 1 percent level. From the results, it is evident that all the independent variables significantly explained the variations in the value of fish. Except for the value of feed, which becomes significant at 5 percent level, all other variables have significant influence on fish value at 1 percent level.

In consonance with the *a priori* expectation, the regression coefficients of the values of fixed input (X_1) and labour (X_3) are positive. This indicates that the more the amount expended on these inputs, the more the fish output and by extension, the revenue from fish.

Contrary to expectations, the regression coefficients of the value of feed used (X_2), the value of fertilizer and lime (X_3) and the value of finger lings stocked (X_5) have different signs. While the coefficient of X_3 is positively signed as against the negative expectations, both X_2 and X_5 that were supposed to be positively signed, have negative signs. Hence, the more the amount expended on fertilizer and lime (X_3), the more the amount realized from fish farms while the more the amount expended on feed (X_2) and finger lings (X_5), the lower the revenue derived.

The responsiveness of value of fish output to changes in the values of the inputs differs. For instance, a one percent increase in the values of fixed input (X_1), values of fertilizer and lime (X_3) and value of labour (X_4) respectively will lead to 0.63 percent, 5.5 percent and 0.55 percent increases in the value of fish output. On the other hand, a one percent increase in the value of feed (X_2) and value of finger lings stocked (X_5) respectively will lead to 0.69 percent and 5.84 percent decline in the value of fish out put. In this respect, while the value of fish output is inelastic in response to changes in the values of fixed input (X_1), value of labour (X_4) and the value of feed (X_2) the value of fish output is elastic in response to changes in the values of fertilizers and lime (X_3) and the values of finger lings stocked (X_5).

The marginal product obtained for the variable inputs are as indicated below.

Tables 6: Marginal Value Products of the Variable Inputs Used in Fish Farms (₦/unit)

Variable Input	Marginal Value Product (MVP)
Value of feeds (X_2)	-3.47
Value of fertilizer and lime (X_3)	1304.85
Value of labour (X_4)	2.35
Value of finger lings stocked (X_5)	-218.83

Source: Computed from Regression Results.

As shown in the methodology, it is evident that since the MVP values for fertilizer and lime (X_3) and the value of labour (X_4) are positive and greater than 1, there is under utilization of these resources. On the other hand, the MVP values for feeds (X_2) and finger lings stocked (X_5) are negative indicating that they are being over utilized. Following from this, it pays to increase the usage level of fertilizer and lime (X_3) and labour while reducing the feeds and stock rate will improve the efficiency of this input.

Conclusions and Applications

The key conclusions and applications emerging from this study include the following:

1 Fish farms on the basis of number of ponds per farm can be categorized into small, medium and large-scale farms. However most farmers operate on small-scale level with average of 3 ponds per farm.

2 Though, fish catch per farm increases with the size of the farm, the fish catch per pond decreases with farm size. While the small-scale farmers harvest 943kg of fish per pond, the medium scale farmers harvest only 800kg per pond. The corresponding figure for large-scale farmers is 458.3kg per pond. This situation can be traced to the number of fishponds per different farm categories.

3 In line with the above, the revenue and total variable cost per pond decrease with increase in farm size.

4 In absolute term, the profit accruing to fish farmers per pond is highest for medium scale farmers with large-scale farmers generating the lowest profit per pond. However, every naira expended yields ₦1.34, ₦1.55 and ₦1.52 for small, medium and large-scale farms respectively.

5 Feed and finger lings are over utilized as extra naira spent on them gives negative returns. On the other hand, labour and fertilizer/lime are under utilized as extra naira spent on them yields more than ₦1 return.

Following from the above, it is more rewarding to engage in medium scale fish farms. In addition, variable cost items may have to be used efficiently to facilitate better returns. In sum, aquaculture in whatever scale is profitable and will serve as a way of income augmentation especially for urban dwellers.

References

1. FAO (1995): Review of the State of World Fishery Resources. Aquaculture FAO Fish Circular No. 866 Rome.
2. Olayemi J.K. (1998): Food Security in Nigeria, Research Report No. 2 Development Policy Centre, Ibadan, Nigeria.
3. Tobor J.G. (1990): The Fishing Industry in Nigeria: Status and Potential for Self-Sufficiency in Fish Production. National Institute of Oceanography and Marine Research Technical Paper No. 55 23pp.
4. Tobor J.G. (1994): A Fisheries Policy for Nigeria. FISON Quarterly Lecture.
5. Faturoti E.O. (2000): Beneath the Ripples and Sustainable Production Inaugural Lecture, University of Ibadan. 14th December
6. FAO (1993): Inland Fishery Resources of Nigeria, CIFA Occasional Paper No. 20.
7. Bolarin J.D. (1985): Village Level Aquaculture Development in Africa. Proceedings of the Common Wealth Consultative Workshop in Village Level Aquaculture Development in Africa Freetown, Sierra Leone.
8. Ezenwa A.J. (1994): Status of Aquaculture. A Paper Submitted at an Aquaculture Seminar.
9. FDF (1997): Fisheries Statistics of Nigeria.
10. Olayemi J.K. (1998): Elements of Applied Econometrics. A Publication of the Department of Agricultural Economics University of Ibadan. Elshaddai Globa Ventures Limited, Ibadan, Nigeria.
11. Gujarati D.N. (1995): Basic Econometrics. McGraw-Hill International Edition. Economic Series Third Edition.
12. Olayide S.O. and Heady E.O. (1982): Introduction to Agricultural Production Economics, Ibadan University Press, University of Ibadan, Nigeria.