

Yield performance of commercialized upland fish farms in Ondo state of Nigeria

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Abstract

The study examined the socio-demographic characteristics of fish farmers, evaluated the profitability of upland fish farms in the study area and determined the key variables to which profitability is responsive. Empirical results showed that majority of the fish farms came into business less than ten years ago while 62.0% of the managers of the fish farms had formal education. The total farm size of the twenty-two fish farms surveyed was 229,112m² and the average size of a fish pond unit was 1,863m². Table fish production was preponderant over fingerlings production. About 70.0% of the fish farms practised monoculture, 23.33% used polycultural method and 6.67% employed both. The major fish species commonly cultured were Tilapia, Alestes, Heterotis and Catfish. The fixed cost per hectare of fish farm for the period studied was ₦517,591.48 while variable cost stood at ₦2,053,806.68. The most important components of fixed costs were labour (41.02%), bore-hole and water pumps (22.10%) and land and pond construction (14.50%). For variable cost, the most expensive items were fish feeds (51.44%), fish seeds (17.30%) and transportation and fuel (13.16%). The average net profit per hectare of fish farm was ₦960,037.57 per year. Various profitability ratios revealed that investment in upland fish farms is a worthwhile business but investors need to do something about the fluctuating trends of some of the indices since the desirable trend is either a consistent increase or decrease. A sensitivity analysis carried out showed that profitability is more responsive to the unit price of fish compared with cost of inputs. The NPV, B/C and IRR were ₦1,571,710.15, 1.53 and 52.4% respectively. The three indicators attest to the fact that fish culture is very profitable in the study area. It is recommended that the various governments make access to land and investible funds at affordable rates a priority in the study area. There is also the need for the establishment of a modern hatchery which will supply fingerlings to fish farmers at subsidized rate.

Keywords: Yield performance, fixed and variable costs, gross revenue, upland fish farms, Ondo State.

Introduction

In Nigeria in particular and Africa in general, nutritionists are extremely worried about the uncomfortably low level of readily available and affordable animal protein sources. This worry is justifiable because the per caput animal protein consumed per day in the continent falls

below the recommended quantity of 35.0 grammes. The level achieved in Africa, West Africa and Nigeria are respectively 12.82, 10.00 and 7.00 grammes (World Bank, 1996, Olayemi, 1996). The main sources of animal protein in Nigeria includes beef, chicken, goat meat, eggs, fish and recently rabbit. Of all these sources of

animal protein, fish has the highest level of easily metabolisable proteins. It is also reputed for its high quality calories, fat, vitamins, calcium, iron and essential amino acids (Olayide *et al.*, 1981, Tobor, 1990). A causal observation in the market shows that fish is the cheapest of all protein sources (Adewale, 1985, Geoff, and Bennet, 1995) and it is widely consumed across all income groups. The wide acceptability of fish may be owing to the fact that no religious taboos exist against its consumption in Nigeria.

Owing to its cheapness, high nutritional values and wide acceptability, fish has the potential to play an indispensable role in alleviating the pervasive protein malnutrition problem in Africa – a region where high carbohydrate diets are popular. If the seemingly formidable, hydra-headed problem of protein malnutrition with its adverse effects on health, mental capacity and work efficiency is to be surmounted, ways must be devised to meet the demand for fish which far outstrips the supply from 1981-85 period till present as shown in Table 1.

Table 1 Demand, supply, gaps, and fish imports in Nigeria (1970-2000)

('000 Metric Tonnes)				
Period	Domestic Production	Domestic Consumption	Surplus	Imports**
1970-1974	1769.65	1096.31	+673.34	94.98
1975-1980	2198.61	1353.22	+845.39	682.98
1981-1985	1403.86	1683.66	-279.80	1141.08
1986-1990	806.50	2019.37	-1212.87	2014.89
1991-1995	259.64	2263.84	-2004.20	N.A
1996-2000	599.83	2594.87	-1995.04	N.A
2000-2005*	1012.86	2816.28	-1803.42	
2006-2010*	1224.21	3016.67	-1882.46	

Source: Compiled from Annual Abstract of Statistics of the FOS (Various Issues)

*Indicates Projected Figures

**There is still importation in period of fish surplus because of the penchant of the high income class for elitist imported fish species.

The Table shows that while domestic fish production was declining, the deficit was widening and fish import increased considerably to make for the deficit. For instance, fish import, which was only 94.98 thousand metric tonnes in 1970-74 had risen to 2014.89 thousand metric tonnes by 1986-90 period. The implication of this is that a considerable proportion of our foreign exchange earnings is being allowed to drift to other countries of the world. Therefore, the need arises to explore all avenues to increase and sustain fish supply in Nigeria. A right step in this direction will necessitate raising fish under controlled environment where their feeding, growth, reproduction and health can be closely monitored. Such artificial fish rearing method called aquaculture is already gaining wide

popularity in Nigeria in general and Ondo State in particular (Mafimisebi, 1995) even though mostly at subsistence level. Only very few private commercial fish farms are at present found in Nigeria. However, for rapid production of cheap animal proteins, increased number of private commercial fish farms is a welcome development. This study therefore aims at determining the profitability or otherwise of private commercial fish ponds in the upland areas of the two riverine Local Government Areas (LGAs) in Ondo State. This is with the intention of drawing the attention of prospective investors to the potentials of aquaculture in the area. The specific research objectives includes an exploration of the operational and farm-specific characteristics of the sampled fish farms, a determination of the

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cost and returns to investors in fish farms with a view to obtaining measures of profitability and efficiency of the aquacultural business and to determine the sensitivity of profitability to some costs and returns items.

Materials and Methods

This study was carried out in two purposively selected LGAs in Ondo State. They are Ilaje and Ese-Odo LGAs. They were selected on the basis of being the earliest and largest fish production and marketing centres in the State. Twenty (20) private commercial upland fish farms were randomly selected from each of the two LGAs using as our sampling frame a list of private commercial fish farms in the area obtained from the Ondo State Agricultural Development Programme office.

A well-structured questionnaire was used to obtain information on the sampled fish farms and costs and returns of the production process for the production periods covering 1994-1998. The questionnaires were earlier pre-tested on the few private commercial fish farms in Irele LGA of Ondo State. Only twenty-two (22) questionnaires were correctly completed and thus used in the analysis. The fixed costs incurred in the production process were calculated as annual costs or rental values of such fixed items. The depreciated cost (obtained through the straight-line method) represents an annual lost in value of the facilities and or equipment as a result of wear and tear arising from use. The expected useful life (in years) of fixed items are as follows: Pond (20), Boat/canoe (8), Nets (5), Wheelbarrow (5), Bowls (5), Refrigerator / Deep Freezer (5), Generator (10), Outboard engine (8), Weighing scale (10), Farm building (25), Borehole and water pumps (8) Hatchery (10).

The data collected were analysed using descriptive statistics, which includes frequency counts, percentages and tables. The simple budget format analysis was used to determine profitability. The budget format analysis was first done for all the five years pooled together and then on a year by year basis. From the

result of the analysis, certain ratios of profitability and efficiency were obtained. They were:

1. Operating Ratio = $\frac{TVC}{GR}$
2. Return on Sales = $\frac{NP}{GR}$
3. Return on Assets = $\frac{GM}{TCA}$

where

TVC = Total Variable Cost

GR = Gross Revenue

NP = Net Profit

GM = Gross Margin

TCA = Total Cost of Assets

The sensitivity analysis was carried out to ascertain the factors to which profitability is more responsive. The following profitability indicators were also used to measure the extent of returns from the aquacultural business.

- (i) Benefit - Cost Ratio: This is the ratio of discounted costs to discounted revenue. Mathematically, it is stated as:

$$B/C = \frac{\sum_{t=1}^n \frac{B_t}{(1+r)^t}}{\sum_{t=1}^n \frac{C_t}{(1+r)^t}}$$

where B_t = benefit in each project year

C_t = cost in each project year

n = number of years

r = interest or discount rate

- (ii) Net Present Value (NPV): The value today of a surplus that a project makes over and above what it would make by investing at its marginal rate. It is the value today of all streams of income which a project is to make in future. NPV is given as:

$$NPV = \sum_{t=1}^n \frac{B_t - C_t}{(1+r)^t} \text{ where } B_t, C_t, n \text{ and } r \text{ are as defined above.}$$

- (iii) Internal Rate of Return (IRR): It is the rate of return that is being expected on

capital tied down after allowing for recoupment of the initial capital. It is also called the yield of an investment. It is given by:

$$\text{IRR} = \frac{\text{Lower discount rate} + \text{Difference between the two chosen discount rates}}{\left(\frac{\text{NPV of lower discount factor}}{\text{Absolute difference between the two NPVs}} \right)}$$

Results and Discussion

From the result, 77.3% of the upland farms have been in operation for less than ten years. The implication of this is that the managers or owners of the farms are still relatively new in the business and may not have gathered enough experience that can enhance productivity. The remaining 22.7% have operated for upwards of ten years. All the fish farms however started as subsistence concerns before expansion to

commercialized farms. About 63.6% of the managers of the fish farms have educational qualifications above primary six certificates while only 4.6% of them have certificates in agriculture, or related courses. None of the farm managers have a degree in fisheries. The implication of this is that the technicalities involved in artificial fish rearing may not be known to these managers. This would definitely affect the level of profitability of the fish farms. The total farm size of all the 22 fish farms was 229,112m² (area covered by fish farm) while the total land area was 637800m². The total number of fish pond units for the farms surveyed was 123. The average size of a fish pond unit for all farms surveyed was 1,863m². The modal fish pond size was 1901-2200m² and 35.78% of the observed farms fall within that range. The number of fish ponds with sizes lower than the average was 45 (36.59%) while 78 (63.41%) had sizes greater than the average for all farms (Table 2).

Table 2 Distribution of fish ponds by size (m²)

Size Range (X)	Class Midpoint	Number of Ponds (f)	fX
701-1000	850.50	12	10,206.00
1001-1300	1150.50	14	16,107.00
1301-1600	1450.50	09	13,054.50
1601-1900	1750.50	10	17,505.00
1901-2200	2050.50	44	92,272.00
2201-2500	2350.50	27	63,463.50
2501-2800	2650.50	07	15,903.00
		$\Sigma f = 123$	$\Sigma fX = 229,112$

Source: Author's calculation from survey data.

The number of fish pond units on the 22 farms surveyed varied from 1-10. Only two fish farms had one fish pond unit each while only one farm had 10 units of fish ponds. Majority (72.72%) of the fish farms managed between 4-8 fish

pond units. Except in a few cases, the smaller the number of fish pond units, the greater the total size of ponds on a farm and the greater the average size per fish pond (Table 3).

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Table 3 *Distribution of fish farms by total size and number of ponds owned*

Fish Farms	Total Size Of Ponds (m ²)	Number of Ponds	Average Size* (m ²)
1	2669.37	5	533.87
2	3003.04	6	500.51
3	855.45	1	855.45
4	19,186.09	8	2398.26
5	6006.08	3	2002.03
6	13,513.68	8	1689.21
7	12,846.34	8	1605.79
8	26,693.70	4	6673.42
9	12,512.67	6	2085.45
10	26,026.35	8	3253.29
11	1,334.68	2	667.34
12	2,068.76	1	2068.76
13	3,003.04	10	300.30
14	18,769.01	7	2681.29
15	30,030.41	4	7507.60
16	3,378.42	5	675.68
17	6,673.42	7	953.35
18	3,003.04	6	500.51
19	8,008.11	6	1334.69
20	8,758.87	8	1094.86
21	12,012.16	3	4004.05
22	8,758.87	7	1251.26
Total	229,112	123	

Source: Field Survey, 1998

*Computed by author

About 95.5% of the fish farms are involved in table fish production. Fingerlings production is still not popular in the study area probably owing to the heavy outlay and technicalities involved in running a hatchery. Majority of the

fish farms source their fingerlings from the wild despite acknowledging disease infestation and high mortality rates in such locally procured seedstocks (Table 4).

Table 4 *Distribution of upland fish farms by source of fingerlings*

Source of Fingerlings/Fries	Frequency	Percentage
From wild	16	72.73
From own local hatchery	1	4.55
From other private hatcheries	5	22.73
Total	22	100.00

Source: Survey data, 1998.

Their reasons were that locally procured fingerlings were cheaper, readily available and

timely supplied. Majority of the farms (68.2%) practise monoculture (i.e. rearing of one fish

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species in a pond unit). The managers of such farms believe that monoculture enhances fish growth rate due to absence of disturbance such as cannibalism and perking from other fish species. The managers of the farms using monoculture are also of the opinion that increased incidence of disease outbreak is more rampant in polyculture. About 23.0% of the farms use polyculture because of financial and land constraints. Some of the farmers practising polyculture argue that the system reduces outlay on pond construction and maximizes returns from a pond unit especially when compatible species are cultured together. Only 7.0% of the farms employ both mono-and polyculture methods.

The fish species commonly cultured in the upland parts of the study area are *Tilapia*, *Alestes*, *Heterotis* and *Catfish*. Not less than 40.9% of the twenty-two fish farmers rear these species on their farms. The other fish species which are reared but not so frequently are

Mudfish, *Heterobranchus*, *Ophiocephalus*, *Aeroplane* fish and *Mormyrus*. These species are reared by less than 27.3% of the sampled farms. The reasons given for preference for the first four species of fish were (1) ease of procurement and high survival rates of fingerlings and fry (2) easy culturing (3) fast growth and reproductive rates (4) high yield and (5) high demand and price in the study area.

Analysis of Costs and Returns on a One-Hectare Upland Commercial Fish Farm (1994-1998)

The depreciated average fixed cost per hectare of fish farm was ₦517,591.48 in the five years studied. The depreciated cost of pond construction and vehicles and boats carried 10.47 and 11.75% of fixed cost respectively. Labour was the single most expensive item of fixed cost as it stood at 41.02%. Table 5 shows the proportion of fixed cost accounted for by other components.

Table 5 Fixed and variable costs for a one-hectare upland fish farm (1994-1998)

Fixed Items	Cost (₦)	Percentage
Land	20,833.33	4.03
Pond construction	54,166.67	10.47
Farm buildings	23,257.33	4.49
Vehicles + Boats	60,825.00	11.75
Nets	11,395.83	2.20
Boreholes + Water pumps	114,366.67	22.10
Wheelbarrow + basins	5,999.67	1.16
Labour (permanent)	212,333.33	41.02
Generators + Deep Freezers	12,234.17	2.36
Local hatchery + Fencing materials	2,179.17	0.42
Sub-total	517,591.48	100.00
Fingerlings and Fry	355,240.00	17.30
Fish feeds	1,056,300.00	51.44
Fertilizers + other chemicals	54,266.67	2.64
Transportation and fuel	270,266.67	13.16
Repairs and maintenance	188,466.67	9.18
Casual labour	129,266.67	6.29
Total	2,053,806.68	100.00

Source: Survey data, 1998.

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The Table also reveals that seedstock constituted 17.30% of variable cost while fish feed (comprising fish pellets, spent grains, crayfish, some household left-overs, dried jumpers and bread) was the single most expensive item of variable cost accounting for 51.44% of total operating cost. Together, seedstock and fish feeds make up 68.74% of total variable cost. This finding is in accordance with that reported by Zadek (1984) and Inoni (1992) that the cost of feeds and seedstock accounted for more than 50.0% of total cost of production.

Gross revenue (GR)

Gross revenue is the amount realized from the sale of table fish, fingerlings and post-fingerlings (jumpers). However only table fish production is prominent in the study area (Table 6).

The GR per hectare reported for the years studied was ₦ 7,371,586.00.

Net Profit = Total Revenue (TR) – Total Cost (TC)

= ₦7,371,586.00 – ₦ (517,591.48 + 2,053,806.68)

= ₦7,371,586.00 – ₦2,571,398.16

= ₦4,800,187.84 per hectare for five years.

The ₦4,800,187.84 is the net revenue (NR) per hectare for the five years analysed. The average net profit per hectare per year is ₦960,037.57. Table 6 shows that *Heterotis* contributed the highest proportion of GR followed by *Gymnarchus*. *Alestes* ranked third. *Ophiocephalus*, *Heterobranchus*, Aeroplane fish and *Mormyrus* contributed about 1/15 of GR. It can thus be concluded that *Heterotis*, *Gymnarchus* and *Alestes* are the major commercial fish species cultured in the study area.

Table 6 Gross revenue on a one-hectare upland fish farm.

Fish Species	Gross Revenue Per Year ₦ ('000).					Total* 1994-1998
	1994	1995	1996	1997	1998	
<i>Heterotis</i>	398.081	367.130	398.882	463.554	554.089	2,181.736
<i>Gymnarchus</i>	351.607	327.633	314.169	378.929	471.222	1,843.560
<i>Alestes</i>	266.747	215.363	142.851	321.713	346.238	1,292.912
<i>Tilapia</i>	121.205	97.043	93.174	109.859	112.912	534.193
Catfish	107.316	76.690	86.397	129.463	144.366	544.232
<i>Heterobranchus</i>	99.110	62.258	69.587	106.828	135.846	473.629
Mudfish	27.200	21.001	15.685	34.000	30.000	127.886
<i>Ophiocephalus</i>	69.267	55.820	49.463	78.245	111.256	364.054
<i>Mormyrus</i>	0.048	0.037	0.027	0.058	0.089	259.
Total	1,442.310	1,224.225	1,171.280	1,625.064	1,908.707	7,371.586

Source: Survey data 1998.

*The total is actually unnecessary because of the problem of time value of money. However, they were given so that the budgetary analysis could be done.

Profitability Ratios

The year by year results of the budgetary analysis for a one-hectare fish farm is shown in Table 7.

Table 7 Summary of year by year budgetary analysis of one -hectare fish farm (1994-1998)

Year	Total Variable Cost (TVC) (N)	Gross Revenue (GR) (N)	Gross Margin (GM) (N)	Net Profit (NP) (N)
1994	326,311.76	1,442,310.00	1,115,998.24	1,012,479.94
1995	401,843.77	1,224,225.00	822,381.23	718,862.93
1996	452,761.09	1,171,280.00	718,518.91	615,000.61
1997	341,082.84	1,625,064.00	1,283,981.16	1,180,462.86
1998	531,787.21	1,908,707.00	1,376,919.79	1,165,883.19

Source: Author's Calculation from Survey Data

From the values given in the Table, profitability ratios were calculated and these enabled a conclusion to be made as to the efficiency of fish farms in the years studied. A decreasing

operating ratio over time is an indication of a good and efficient business. Table 8 shows the profitability ratio of one hectare fish farm by year.

Table 8 Profitability ratios of one-hectare fish farm by year (1994-1998)

Year	Operating Ratio	Return on Sales	Return on Assets
1994	0.226	0.702	2.156
1995	0.328	0.587	1.589
1996	0.387	0.525	1.388
1997	0.210	0.726	2.481
1998	0.279	0.611	2.660

Source: Author's calculation from survey data

A decreasing operating ratio in this study signifies either increasing TR or decreasing TVC. Operating ratio was 0.226 in 1994 but assumed an increasing trend to 0.328 and 0.387 respectively in 1995 and 1996. Operating ratio was lowest in 1997 at 0.210 followed by 0.279 in 1998. The fluctuating trend in operating ratio is not a desirable situation in the fish farms. The fish farmers must do all that is possible to achieve a consistently decreasing operating ratio. This can be achieved by preventing waste and over-feeding of fish beyond a stipulated marketable weight and exploring avenues for wider market outlets. Each of these scenarios will lead to either a decrease in TVC or an increase in TR which will bring down operating ratio.

An increasing return on sales over time indicates a stable, profitable and efficient business. Return on sales was highest in 1997 followed by 1994. Low values were achieved for this index

in 1995 and 1996 while the 1998 value of 0.611 falls below the 1997 value of 0.726. Fish farmers need to take more steps to make sure that return on sale is increasing or at least kept constant. The return on assets which was 2.156 in 1994 reduced to 1.589 and 1.388 in 1995 and 1996 respectively. The years with the best return on assets were 1998 and 1997 (in that order). An increasing return on asset indicates that assets are being more intensively utilized and so the farmers must seek to achieve this. One way of doing this is to lease out to other farms some fixed assets which are only useful at specific time of the year. This equipment leasing will lead to more intensive utilization of assets and increasing revenue which will result in increasing return on sales.

Judging by these three profitability and efficiency ratios, 1997 is the best year of performance by the fish farms followed by 1998 and 1994. The year 1996 recorded the poorest

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performance. Taking these ratios together however, the result of the study permits the conclusion that aquacultural business is a fairly stable and efficient venture in the study area.

Cash Flow and Sensitivity Analysis

The assumptions of the cash flow and sensitivity analyses are as follows:

1. The average bank-lending rate to agriculture in the twelve years covered by the sensitivity analysis is 25%.
2. A risk-discounted factor of 5% is added to the bank-lending rate. This means that a 30% discount factor is used.

3. There is a 20 and 10% projected yearly increase in variable cost and unit fish price between 1999-2010. This is in accordance with the farm management maxim, which says it is better to allow costs to rise faster than revenue in the estimation of future profitability of a venture (Adegeye and Dittoh, 1985).
4. Loan repayment was made in equal installment starting from the end of the first year of project life.

The result of the cash flow and sensitivity analysis is shown in Table 9.

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TABLE 9 Cash flow and sensitivity analysis for a one-hectare fish farm in Ondo state (1994-2010)

YEAR	COST	REVENUE	INCREMENTAL BENEFIT	DF		NPV		DISCOUNTED COST	DISCOUNTED REVENUE
				30%	50%	30%	50%		
1993	1,843,547.88	-----	-1,843,427.88	0.769	0.667	-	-	1,417,630.65	-
1994	325,311.76	1,442,310.00	1,115,998.24	0.592	0.444	1,417,630.65	1,229,596.41	193,176.56	853,847.52
1995	401,843.77	1,224,225.00	822,381.23	0.445	0.296	660,670.96	495,503.22	182,838.92	557,022.38
1996	452,761.09	1,171,280.00	718,518.91	0.350	0.198	374,183.46	243,424.84	158,466.38	409,948.00
1997	341,082.84	1,265,064.00	1,283,981.16	0.269	0.132	251,481.62	142,266.74	91,751.28	437,142.22
1998	531,787.21	1,908,707.00	1,376,919.79	0.207	0.088	345,390.93	169,485.51	110,079.95	395,102.35
1999	638,144.01	2,099,577.70	1,461,433.69	0.159	0.059	285,022.40	121,168.94	101,464.90	333,832.85
2000	765,772.94	2,309,535.47	1,543,762.53	0.123	0.039	232,367.96	86,224.59	94,190.07	284,072.86
2001	918,927.53	2,540,489.17	1,621,561.64	0.094	0.026	189,882.79	60,206.74	86,379.19	238,805.98
2002	1,102,713.04	2,794,538.72	1,692,825.68	0.073	0.017	152,426.79	42,160.60	80,498.05	204,001.33
2003	1,323,255.65	3,037,922.53	1,714,666.88	0.056	0.012	123,576.27	28,778.04	74,102.32	170,123.66
2004	1,587,906.78	3,381,391.78	1,793,485.00	0.043	0.008	96,021.35	20,576.00	68,279.99	145,399.85
2005	1,905,488.14	3,719,530.96	1,814,042.82	0.033	0.005	77,119.86	14,347.88	62,881.11	122,744.52
2006	2,286,585.77	4,091,840.06	1,805,254.29	0.025	0.003	59,863.41	9,070.21	57,164.64	102,296.00
2007	2,743,902.92	4,500,988.47	1,757,085.55	0.020	0.002	45,131.36	5,415.76	54,878.06	90,019.77
2008	3,292,683.51	4,951,087.32	1,658,403.81	0.015	0.002	35,141.71	3,514.17	49,390.25	74,266.31
2009	3,951,220.21	5,446,196.05	1,494,975.84	0.012	0.001	24,876.06	3,316.81	47,414.64	65,354.35
2010	4,741,464.25	5,990,815.65	1,249,351.40	0.009	0.001	17,939.71	1,494.98	42,673.18	53,917.34
				11,244.16			1,249.35		
				1,571,710.15			218,607.97	2,973,260.14	4,537,897.29

Source: Author's calculation from field data and projected figures.

- Notes:
- (1) 1993 is the investment year, so there is no revenue.
 - (2) Costs and revenues for 1994-1998 are actual flows recorded by fish farms.
 - (3) Cost and revenues for 1999-2010 are projected values.

DF means Discount Factor. IRR = 52.43% B/C = 1.53
 NPV at 30% = ₦ 1,571,710.15

The sensitivity analysis carried out indicates profitability of the aquacultural venture despite increases in prices of key production inputs. For instance, the NPV was ₦1,571,710.15 while the B/C stood at 1.53 and IRR was 52.43%. The IRR is commendable because at the bank lending rate of 25%, the investor gets ₦27.43 on every ₦100 invested as returns to management. The results also indicate that profitability is more responsive to changes in unit price of fish. This information is critical for the sustainability of the business in the long run.

Opportunity Cost of Invested Capital

The earnings which the invested capital should have made if simply lodged in a bank was compared with the profit made from investment in upland aquaculture. The total amount invested per hectare for the years analysed was ₦2,571,398.16. The net returns after the fifth year was ₦4,800,187.84. This amounts to a 187.4% returns to capital invested. If the investor had lodged the money in savings account with the assumption that the interest accruing is being withdrawn for spending at the end of every year, then, at the average bank interest rate of 25% between 1994-1998, the total interest accruing to the investor would be ₦1,613,680.84 at the end of the fifth year. This amounts to a 63% returns on capital. This simple analysis shows that it is far more profitable to invest in aquaculture than to lodge money in a bank.

Constraints to Upland Fish Farming

The problems commonly encountered in upland fish farming in the study area were ranked in terms of number of farms experiencing that problem out of the 22 farms surveyed. The problems are (1) Financial constraints (95.5%), (2) high running cost (86.4%), drying up of ponds due to seepage of water through dykes (63.6%), mass loss of fish due to use of polluted or high temperature water (63.6%), scarcity of seedstocks (59.1%) and incidence of pests and thieves (45.5%). The most frequent problems are therefore financial constraints which arise after meeting the high outlay on fixed cost and

running cost of the enterprise. Other problems are also important even though they appear less frequent than the first two. For example, thieves can harvest a fish pond at night except security is tight around the fish farm. This has resulted into a huge loss of investment by some farms.

Conclusion and Recommendations

The study has made attempt to explore the socio-economic and operational characteristics of upland fish farms, estimated the profitability of investment in fish farming and determined the production variables to which profitability is more sensitive. In addition, the study has also examined the constraints to fish production in the area studied.

From the study, *Heterotis niloticus*, *Gymnarchus niloticus* and *Alestes barmose* contributed the greatest proportion to gross revenue. They are therefore the commercial fish species cultured in the upland parts of the study area. The fixed cost per hectare of fish farm for the period studied was ₦517,591.48 while variable cost stood at ₦2,053,806.68. The most important items of fixed cost were labour (41.02%), borehole and water pump (22.10%), land and pond construction (14.50%). In variable cost, the most important components are fish feeds (51.44%), seedstock (17.30%), and transportation and fuel (13.16%).

Various profitability ratios showed that upland aquaculture is a worthwhile business in the area studied. However, there is the need for farmers to be concerned about the trend of efficiency and profitability of the aquacultural business as indicated by the ratios. A sensitivity analysis carried out revealed that profitability is more responsive to the price of output compared with the cost of inputs. The ability of the investors to sustain the returns from the aquacultural business will then be dependent on the relative prices of inputs and output. The results demonstrate that fish farming is a very profitable business even at an interest rate of 30% in the area. The study shows that there is a 37.48% yearly returns to capital invested in aquaculture

compared with a 21.0% yearly alternative returns to capital if money is lodged in a savings accounts.

It is recommended that the government makes access to land and investible funds (at bearable interest rates) to fish farmers a priority in the study area. The cost of feeds should also be subsidized. The Ondo State Agricultural Development Programme (ADP) or the Federal Department of Fisheries should help establish a modern hatchery in the study area where seedstocks can be produced and sold to practising fish farmers. If the government agencies play these roles suggested, then, the fish farmers in the study area would definitely become and remain partners in progress with the federal government in her quest for increased, readily available and affordable animal proteins in Nigeria.

References

- Adegeye, A. J. and Dittoh, J. S.** 1985. *Essentials of Agricultural Economics*. Impact Publishers Nigeria Limited, Ibadan.
- Adewale, A.S.** 1985. Production, Marketing and the Consumption of Fish in Oyo State, Nigeria. Unpublished B.Sc project, Department of Agricultural Economics, University of Ibadan.
- Geoff, A., and Bennet, C.J.** 1995. Fish Mammies and Tuna Conglomerates; Private Sector Fish Processing and Marketing in Ghana. In *Marketing Africa's High - Value Foods* (eds) Steven, J. and John, M. Pg 375-416.
- Inoni, O.E.** 1992. Financial Analysis of Fish Farming in Delta State of Nigeria. Unpublished M.Sc thesis, University of Ibadan.
- Mafimisebi, T.E.** 1995. Yield Performance of Selected Fish Ponds in Ilaje Esc-Odo LGA of Ondo State. Unpublished M.Sc thesis, University of Ibadan.
- Olayemi, J.K.** 1996. Food Security in Nigeria. The Report of a Research Study Sponsored by Development Policy Centre, Ibadan, Nigeria.
- Olayide, S.O; O. Ogunfowora, S.M. Essang and F.S. Idachaba.** 1981. *Elements of Rural Economics*, Pg 130.
- Sadek, S.** 1984. Development de l' aquaculture en Egypt. *Reference a' la ferme de Reswa (Port Said - et proposition d'une politique nationale equicole*. Institute National Polytechnique de Toulouse, Ph.D thesis, Pg 151.
- Tobor, J.G.** 1990. The Fishing Industry in Nigeria: Status and Potentials for Self - Sufficiency in Fish Production. *NIOAR Technical Paper* No. 54, pg 1 - 23.
- World Bank.** 1996. Nigeria, Poverty in the Midst of Plenty. The Challenge of Growth with Inclusion. *A World Bank Poverty Assessment Report* No. 14733 - UNI May 31.

(Received 2 February 2002; Accepted 26 September 2002)