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Economic analysis of aquaculture practices in some Local Government areas of Ogun State

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Abstract

The primary aim of the study was to ascertain the profitability and assess resource use efficiency as well as compare same between the two systems of aquaculture (Concrete pond and Dug-out pond Systems) in Ijebu-North and Ijebu North-East Local Government Areas of Ogun State. To accomplish this objective, the 65 fish farmers (30 Dug-out pond and 35 concrete pond) whose fish had reached market size were interviewed in the study areas during 2001/2002production season. Sets of structured questionnaire, personally administered were used to collect the required data. Descriptive, budgetary and regression techniques were employed in the analyses of the data. The mean sizes of the concrete ponds and dug-out ponds were 64.57 M^2 and 2392.43 M^2 respectively. The budgetary analyses of the two systems showed that fish production was profitable in the area. The concrete pond system (C P S) was however found to be more profitable than the dug-out pond system (D P S). The result of the regression analysis showed that the number of fingerlings stocked per square metre, man days of human labour used, months of production season and quantity of fertilizer and lime used had much more significant influence on yield (harvest) from the C P S than from the D P S. The comparison of the technical efficiency of inputs in both systems showed that inputs were more efficiently utilized in the C P S than in D P S. The result of the Chow test showed that the resource use in the C P S differed significantly at 5 percent level, from that of D P S. Following the findings, it was recommended that fish farmers in the study area should increase their stocking rate and reduce the amount of hired labour as well as use appropriate good quality feed in order to improve their productivity levels.

Key Words: Economic analysis, aquaculture practices.

Introduction

There is an obvious gap between demand and supply of animal protein to the Nigerian populace. This has necessitated the augmentation of animal protein supply with protein from fish, which is known to compare favourably and perhaps better than protein from other animals According to FAO (1991) fish accounts for about 20 percent of the world total supply of animal protein and this was projected to be on the increase. Indeed, Taiwo and Odunaiya (2004) observed the FAO (2002) report that in developing countries (Nigeria inclusive) fish provides as much as half of the animal protein required and that this is mainly got from the small scale fisheries.

Mabawonku (1989) had pointed out that artisanal fish production accounted for a very high percentage (about 98 percent) of the total domestic fish production. But the catch from artisanal sector has also been found to be declining in recent times. The situation has created a widening gap between supply and demand for fish thus necessitating further development of aquaculture (fish farming) to augment the artisanal catch.

In Ogun State modern aquaculture according to Adekoya (1997) started about 1954 with the establishment of some government fish farms while the private sector came on stream about 1965. Since then, there have been gradual increase in private sector participation in aquaculture business. A number of programmes have also been launched to encourage more individuals to embark on fish production. One of such was the "operation grow your own fish" programme launched in the Western Nigeria in the early 1970s (Adekoya, 1997). This has yielded positive results as many inland waters, streams and riverine are now being developed for fish production (Oreagba, 2002). The approach is capable of reducing fish importation and subsequently reduce the drain which food importation brings on the nation's foreign reserve. The importance of this step becomes more appreciated when it is realised that the projected demand for fish according to Tobor (1990) will continue to increase. For instance, the projected fish consumption in Nigeria is expected to increase from 1.2829 million metric tonnes in year 2000 to 1.5627 million metric tonnes in year 2010 (over 21 percent increase in just about 10years).

When compared with other livestock, fish requires less space, time, and capital per unit but at the same time has higher feed conversion rates. As a way of cutting down the cost of its feeds. Adekunmisi *et al* (2004) reported that poultry offal meal (a relatively cheaper ingredient) can completely replace fish meal in the diet of a particular specie of fish, *Clarias gariepinus*. This is a welcome development in a bid to maximize profit in fish production.

There are two popular systems (methods) of aquaculture in Nigeria, namely; dugout (earthen) pond and concrete tank pond. Each of these types has its cost and economic implications. It is therefore, of essence to carry out a comparative economic analysis of operating the ponds to establish the profitability of each as a guide to selecting a better method for improved production. This derives from the need for optimal utilization of the scarce resources available to the farmers.

Research Problem and Objectives

Animal protein intake among Nigerian households is still very low. Out of the 35 grams of animal protein per day per person recommended by FAO, less than 7grams was being consumed on the average (FAO, 1991). There is no evidence of significant improvement of the situation even now. Aromolaran and Igharo (1998) in what appears to be a confirmation of this situation still described the animal protein consumption of Nigerians as very poor and on the decline. This opinion is also supported by Adekunmisi *et al* (2004). This perhaps is borne out of the report of Agunbiade *et al* (2001) that *per caput* protein intake in Nigeria stands at 3.8g day. This has serious implications on the health and productivity of the people as undernourished people cannot achieve their full potentials.

Unfortunately most of the economic analyses attempted at addressing the problem had focused more on poultry, pig, cattle and other ruminants. It is against this background and the potentials of fish production at addressing the problem of malnutrition that this research was undertaken with the following research questions that face prospective fish farmers with respect to choosing the most appropriate method (concrete pond system, CPS or the Dug-out pond system DPS) of production.

(1) What is the cost – returns relationship in fish farming using the CPS or the DPS.?

(2) What method of fish production system is better, based on resources use pattern and efficiency?

The general objective of the study was therefore, to appraise and compare the financial returns to the two fish pond systems (Concrete tank and Dug-out) on the bases of their profitability and resource use pattern and efficiency.

Specific objectives were to:

(a) determine the profitability of each fish production system;

(b) compare the performances of the systems based on their profit levels; and

(c) determine the pattern of resources use and efficiency in the two fish production systems.

Hypothesis of the study

Ho: There is no significant difference in resource use efficiency in the concrete pond and dug-out pond fish production systems.

Ha: There is significant difference in resource use efficiency in the concrete pond and dug-out pond fish production systems.

Materials and Methods

Area of study

The study was conducted in Ijebu-North and Ijebu-North East Local government Areas (LGAs) of Ogun State in the South-Western part of Nigeria. Ogun State lies between 6^0N and 8^0N latitudes and longitudes $2^1/_2{}^0$E and 5^0E. The State has a land area of about 16, 409.25 square kilometers and an estimated 1991 population of 2,338,570 people (FOS, 1998).

The area of study was chosen for it richness in agricultural activities, especially livestock and fish production (Oreagba, 2002). The area is bounded by Oyo State to the North, Ikenne and Remo North LGAs to the West and Ijebu East LGA to the East while Ijebu-Ode and Odogbolu LGAs bound the area to the South.

Sample and Sampling

The sampling frame was compiled from sources that include the Ijebu-Ode Zonal office of Ogun State Agricultural Development Programme (OGADEP), L.G.A Agriculture Department, farmers and notable indigenes. A complete enumeration of all the fish farmers whose fish had reached market size during 2001/2002 production season was done to give equal chance to all the farmers with matured fish. Information from all the 65 fish farmers (30 DPS and 35 CPS) in the frame were analysed.

Analytical methods

Budgetary and Regression techniques were employed to analyse the data. The equality between the functions of the two systems of production, Dug-out pond (DPS), and concrete tank pond (CPS) was investigated through Chow Test. Straight line depreciation method was used to estimate the depreciation value of some fixed items used during the production season.

The Net farm income (π) was estimated as:

$$\pi = GM - FC. \qquad (1)$$

Where: GM = gross margin (TR - TVC)
TR = Total revenue (income)
TVC = Total variable cost.
FC = Fixed cost.

The two systems of production (CPS and DPS) were compared on the basis of their GM and π. The GM of an enterprise, according to Aihonsu (2002) can generally be determined by comparing the variable or operating costs of production and the returns from the products. Comparative economic ratios employed to measure the economic performances and economic worth of the two production systems are: Rate of return on investment (R O I), Operating ratio (O R), Fixed Asset Turn-Over (FAT) and Total Asset Turn-Over (TAT).

(a). Rate of return on investment (ROI) indicates the amount gained on every unit of money (₦) invested. It is measured as

$$ROI = \frac{E}{C} \times \frac{100}{1} \quad \text{..............(2)}$$

where E represents profit before tax and C represents Total cost.

(b) $$OR = \frac{\text{Total operating Expenses (TVC)}}{\text{Net sales (₦)}} \quad \text{............... (3)}$$

(c) $$FAT = \frac{\text{Total Sales (₦)}}{\text{Fixed assets (₦)}}; \quad \text{........(4)}$$

and

(d) $$TAT = \frac{\text{Total Sales (₦)}}{\text{Total assets (₦)}} \quad \text{..............(5)}$$

The relationship between the variables (factors) involved in the production was investigated with the use of regression analysis technique. Three functional forms, namely linear, semi-logarithmic and Double logarithmic (Cobb-Douglas) were tried.

The double log (C – D) functional form was selected as the lead equation on the bases of number of significant regression coefficients, magnitude of coefficient of multiple determination, R^2 and conformity with a-priori expectation, as well as desirable properties for economic interpretations for further explanation of the performance of the systems.

The model is expressed as:

$$\ln Y_j = \ln b_o + b_1 l_n X_{1j} + ... + b_7 l_n X_{7j} + e_j; \quad (6)$$

where, bs are respective regression coefficients;

- Y represents yield (quantity of harvest) of fish (kg)
- X_1 represents pond size (M^2)
- X_2 represents number of fingerlings stocked per M^2
- X_3 represents cost of fixed inputs used (₦)
- X_4 represents human labour (man days)
- X_5 represents length of production season (months)
- X_6 represents quantity of fertilizer and lime used.(kg)
- X_7 represents dummy variable for feeding stuff; D_1 for dummy variable which takes on the value of :
  1, for non-conventional feed (i.e maggots + offals, + other wastes
  0, otherwise (conventional manufactured pelleted feeds
- e_1 represents stochastic error term.

Measure of Efficiency

Production efficiency is achieved when no additional output can be obtained by increasing cost or units of an input. It can be achieved through efficient resource allocation (Taiwo, 1979). Thus allocative efficiency is achieved when it becomes impossible to improve or increase total output of an enterprise through increasing the volume of an input use or re-arrangement of the factors of production. The point of allocative efficiency is also described as the point where marginal value product of a factor (MVP) is equal to the marginal factor cost (MFC) otherwise referred to as factor price (P). That is

MVP_{xi} = Pxi (Onyenweaku *et al*, 2000). Hence if there is optimal allocation of resources xi, the efficiency principle requires that the condition: $\frac{MVPxi}{Pxi}$ or $\frac{MVPxi}{MFCxi}$ = 1 be satisfied for the enterprise in question; and

MVPxi = MPPxi . Py; where MPPxi is marginal physical product of xi and Py is unit price of product Y.

A ratio less than 1 implies excessive used of the input xi whereas a ratio greater than 1 suggests inadequate use of the input. For the Cobb-Douglass form of production function selected as the lead equation, the MPPxi is calculated as bi $\frac{Y}{Xi}$ where;

bi is the regression coefficient;
Y is the mean output level; and
Xi is the mean input Xi use level.

The Average Physical Product (APP) measures the technical efficiency of inputs. It is simply the amount of product obtained per unit of input at a particular level of production or level of input use. Following Olayide and Heady (1982) the Average Physical Product of input X (APPx) in Cobb Douglas functional form is estimated as the ratio of the volume of the input to the regression coefficient. i,e APP_x = xi/bi

Results and Discussion

Budgetary Analysis

The average size of dug-out ponds is 2,392m² although about 63 percent of the ponds are less than 200m². On the other hand, the concrete ponds averaged about 65m² in size. Table 1 presents cost composition on the two systems of farming. The evidence from the table also shows that both the gross margin and profit per

Table 1: Composition of costs of production on Dug-out pond and concrete pond fish farms

SN	ITEM	Average amount (₦) per Respondent (farm)			
		Dug-out System (2,392.43m²)		Concrete System (64.57m²)	
1.	Revenue from farm sales of fish (Total revenue)		667,364.67		261,748.00
2.	Variable Costs		Composition of TVC (%)		Composition of TVC (%)
	(i) Cost of fingerlings	73,783.33	25.27	22,105.71	21.19
	(ii) Cost of feeds	151,701.40	51.95	52,983.43	50.78
	(iii) Cost of labour	15,900.00	5.44	11,211.43	10.75
	(iv) Cost of water	24,896.67	8.53	16,514.29	15.83
	(v) Cost of fertilizer & lime	833.33	0.29	171.43	0.16
	(vi) Transportation Cost	24,866.67	8.52	1,342.86	1.29
3.	Total variable Cost (TVC)	291,981.40	100.00	104,329.15	100.00
4.	Gross Margin (GM) = (TR – TVC)	375,383.27		157,418.85	
5.	Fixed (Capital) Cost :				
	(i) Depreciation on fixed inputs	3,390.11		913.75	
	(ii) Taxes	5,807.67		438.29	
6.	Total Capital Cost (TCC)	9,197.78		1,352.04	
7	TC (TVC + TCC)	301,179.18		105,681.19	
8.	Net Income (NI) = GM – TCC	366,185.49		156,066.81	

Source: Field Survey, 2002

Table 2. Average (per square metre) parameter estimates of budgetary analysis of dug-out and concrete pond systems of fish farming

Parameters	Pond Types	
	Dug – Out Pond	Concrete-Tank Pond
Sample size (number of respondents)	30	35
Average pond size (M^2)	2,392.43	64.57
Total revenue (N)=	278.95	4,053.71
Total variable cost (~~N~~) =	122.04	1,615.75
Fixed cost (N)=	3.84	20.94
Gross margin (N)=	156.90	2,437.96
Net farm income (N) =	153.06	2,417.02

Source: field survey, 2002, data analysis.

farm were much higher in dug-out pond system than in concrete pond system apparently due to the much larger average size of dug-out ponds than concrete ponds.

Comparison of the two systems on the same platform (Metre square M^2 basis) is reflected in Table 2. It shows that the concrete pond farms had the highest total revenue per square metre. Both the gross margin and Net farm incomes are equally higher for concrete pond system than dug-out pond system. A comparison of the two systems, on per metre basis therefore, suggests that the concrete pond fish farmers were more efficient in space utilization than the dug-out pond farmers. But high cost and the shortage of 'finished' conventional feeds for fish in aquaculture ventures have been identified by Akegbejo-Samsons and Ojini (2004) to place constraint on the successful operation of intensive aquaculture business in Nigeria. In such circumstance therefore, extensive cultural practices in dug-out ponds may stand a better chance of survival.

On the average, TVC constitutes about 97% of the TC in DPS system while it constitutes about 99% of TC in CPS. Furthermore, feed is the highest cost item constituting about 52% of TVC in DPS and 51% of TVC in CPS. This agrees with the findings of Ogunmoroti (1990). Following feed in magnitude of proportion of TVC are fingerlings, water and transportation before labour in DPS. In the CPS however the order of magnitude is of fingerlings, water and labour before transportation. This perhaps is due to the bulkiness of most of the feed (dead animals) used in DPS and larger number of travels needed to obtain them as opposed to conventional manufactured feed used in CPS. Most of the profitability ratios also support the finding. The values of the various economic ratios are shown in Table 3.

Table 3: Economic Ratios of the two Systems

Ratio	Dug-out Pond system	Concrete Pond system
ROI	32.80	56.90
OR	1.76	1.10
FAT	3.16	4.18
TAT	1.33	1.57

Source: **Field survey, 2002 Data Analysis**

The economic ratios in Table 3 compare the performances of the two systems of fish production. From the table, it can be seen that the concrete pond farmers had higher return on investment (ROI) than dug-out pond farmers. While the concrete pond farmers recorded ₦56.90 return on a Naira invested, the dug-out pond farmers had ₦32.80 in return for a Naira invested.

The trend is similar for fixed asset turn over (FAT) and total asset turn-over (TAT). It is only in the case of operating ratio (OR) that the dug-out pond farmers recorded a higher value. This however equally indicates that the concrete pond farmers were able to control their operating costs better than dug-out pond farmers.

On the other hand, more fixed assets and total assets were used up in the production under the CPS than DPS. Overall, the results in strict sense, suggest that the concrete pond system is more profitable than dug-out pond system in the study area. Perhaps this is due to the fact that a better control can be exercised over the CPS than DPS to reduce loss to predators and pilferers. It could also be suggestive of the use of better quality of feed in the CPS system. The higher intensive nature of rearing fish in the CPS system also makes room for better utilization of feed borne out of reduction in feed wastage that could result out of a much more extensive rearing.

Regression Result.

Three functional forms namely, linear, semi-logarithmic and double logarithmic (Cobb – Douglas) were tried using the ordinary least square (OLS) technique and the best functional form was chosen based on the considerations of the value of adjusted coefficient of multiple

Table 4: Production function estimates for the fish farms

Functional form		b_0	b_1	b_2	b_3	b_4	b_5	b_6	b_7	R^2
Linear	DPS	-537.063	-0.018	0.305	-0.05	-0.352	42.242	-3.316	214.869	0.99
		(-1.302)	(0.312)	(18.090)*	(-0.467)	(-0.312)	(1.149)	(-0.686)	(0.635)	
	CPS	-43.381	-1.716	0.251	0.082	1.114	52.615	6.360	-491.025	0.92
		(-1.290)	(-1.212)	(10.090)*	(0.593)	(1.805)	(1.253)	(1.280)	(-2.084)*	
Semi - log	DPS	-21,536.30	-2,740.80	3,205.393	685.584	54.940	-1,207.240	3,177.50	-168.544	0.69
		(2.852)	(-1.782)	(2.459)	(0.697)	(0.384)	(-0.496)	(-1.338)	(-0.128)*	
	CPS	-8,350.44	-315.57	1,097.236	172.438	-9.242	559.88	92.323	-495.545	0.64
		(-4.37)*	(-1.009)	(4.596)*	(0.247)	(-0.759)	(0.844)	(0.844)	(-1.053)	
Double - log (Cobb Douglas)	DPS	-0.605	-0.169	0.843	0.398	0.067	-0.496	0.053	0.163	0.98
		(-0.817)	(-1.096)	(6.459)*	(4.039)*	(3.864)*	(-2.034)	(0.224)	(1.234)	
	CPS	-0.861	-0.180	0.958	0.087	0.072	0.678	0.145	-0.612	0.86
		(-0.886)	(-0.687)	(6.597)*	(0.806)	(1.233)	(1.909)	(0.648)	(-2.700)*	

Sources: Field survey, 2002 analysis.

determination, R^2, number of significant variables, and conformation with a priori expectations in relation to economic theory. The estimates of the three forms are shown in Table 4.

Figures in parentheses are values of t – ratio.

*indicates that the coefficient is significant at 5 percent level.

The lead equations of the regression analyses of the data for the two systems are Cobb – Douglas functional form specified as follows:

Dug-out Pond System (DPS):

$$\ln Y = -0.605 - 0.169 \ln X_1 + 0.843 \ln X + 0.398 \ln X_3 + 0.066 \ln X_4$$

(-0.817) (-1.096) (6.459)* (4.039)* (3.864)* -

$$0.496 \ln X_5 + 0.053 \ln X_6 + 0.163 D + e;$$

(-2.034) (0.224) (1.234) (8)

R^2 = 0.980

F = 178.578*

Concrete Pond System (CPS):

$$\ln Y\ -0.861 - 0.180 \ln X_1 + 0.958 \ln X_2 + 0.087 \ln X + 0.072 \ln X_4 + 0.678 \ln X_5$$

(-0.886) (-0.687) (6.597)* (0.806) (1.233) (1.909)

$$+ 0.115 \ln X_6 - 0.612 D + e;$$

(0.648) (-2.700)* (7)

R^2 = 0.856

F = 23.420*

Figures in parentheses are t-values

* Significant at 5% level.

There was goodness of fit of the production functions for the data analysed as revealed by F-values. While about 86% of the variation in yield (output) in the CPS was explained by the independent variables in the equation, about 98% of the same was explained by the variables included in the equation for the DPS.

The regression coefficients represent elasticity of production, which is the degree of response in output to a unit change in the use of input. Hence, it can be inferred that there is more than proportionate change in the output to a unit change in the number of fingerlings stocked per m^2 (X_2), and use or non-use of non-conventional feed to supplement the conventional manufactured feed (X_7). Hence these variables are critical in increasing the output in CPS. Similarly, the number of fingerlings stocked per m^2 (X_2), cost of fixed inputs (X_1), and labour (X_4) are found critical in increasing output in DPS. In the DPS, the coefficient D for X_7 is positive indicating that the use of the non conventional feed brings about increase in the yield of fish in dug-out pond system.

The negative value of coefficient for length of production season (X_5) in DPS suggests decrease in yield for increase in length of rearing (after maturity (or market size) has been attained). This could be due to the action of predators or due to pilferage. The reverse is the case in CPS. This implies that the DPS is more susceptible to decrease in output over time, resulting from greater exposure to theft/pilferage which could be warranted by the absence of security enclosures around the fields where dug-out ponds are often located or sited.

On the other hand, unlike the case in DPS the coefficient for use of non -conventional feeding stuffs (X_7) is negative for CPS. This could be due to pollution which is more likely to occur in CPS than DPS. This runs parallel with the findings of Okaema (1990) that the use of some unguided feeding stuffs could lead to water toxicity, unfavorable conditions for fish growth and fish mortality, among others. It was also observed during the survey that CPS farmers who fed their fishes with manufactured conventional feeds only had higher yield. This further suggests a higher probability of unconducive water environment for the fish in CPS if unconventional feeds are used. But feeding of non-conventional feed including maggots was beneficial in DPS. This again agrees with Ita (1989)'s report that National Institute of Fresh Water Fisheries Research (NFFRI) New Bussa Nigeria identified maggot as one of the cheap local feeding materials in fish farming. Similarly, Adekunmisi et al (2004) established the possibility of complete replacement of fish meal with poultry offal meal in aquaculture.

Pattern of Resource use and efficiency

A comparison of APP and MPP of resources used in the two systems indicate that technical efficiency as measured by average physical productivity in the use of inputs was higher in the CPS. The values for some inputs are shown in Table 5.

The results tend to suggest that inputs in CPS were more efficiently utilized than in the DPS. To ascertain this, allocative efficiencies were investigated by examining the ratios of the values of marginal products (VMPs) to input prices. The result is shown in Table 6.

Table 5 Average physical product (APP) and Marginal physical product (MPP) of some inputs on sampled farms.

Variable	MPP		APP	
	CPS	DPS	CPS	DPS
Pond size (m^2)	-1.54	-0.24	15.24	1.45
Number of fingerlings stocked/m^2	0.23	0.20	0.31	0.24
Labour (mandays)	1.69	1.35	27.03	20.62
Quantity of fertilizers and lime (kg)	4.35	1.45	29.98	27.21

Source: Field Survey 2002 data analysis.

Table 6: Values of Marginal Product (VMP) on Sampled farms

Variable	DPS*	CPS*	Input Price (₦)
Pond size (m^2)	-63.62	-400.79	600
	(-0.11)	(-0.67)	
Number of fingerlings stocked/m^2	52.16	60.11	5
	(10.43)	(12.02)	
Labour (mandays)	351.29	440.99	480
	(0.73)	(0.91)	
Quantity of fertilizers and lime (kg)	376.97	1,130.12	25
	(15.08)	(45.20)	

* Figures in parentheses are ratios of VMP to input price (i.e. Allocative efficiencies)
Source: Field Survey, 2002

A comparison of the VMPs and the input prices indicates that the farmers under-stocked their ponds but used too much labour. Ponds in the area were also under-fertilized. This could be responsible for the relatively lower yield, resulting in smaller returns and the values of marginal product (VMP). The negative values of MPP for the pond size suggests the inability of the farmers to efficiently manage large ponds most especially the concrete tanks. This could be due to poor capability in the use of other resources in the ponds, thus resulting in failure to optimize returns. Over all in both systems, the farmers were inefficient in the management of the various sizes of ponds vis – a – vis the inputs use. The result of the Chow test shows that the production functions of the two systems, (DPS and CPS) differ significantly. From the pooled production function generated from the two samples (DPS and CPS) an analytical model was stated as:

$$\ln y^* = \ln b_0^* + b_1^* \ln X_{1j} + \ldots + b_7^* \ln X_{7j} + \ln \lambda \ldots\ldots \quad (9)$$

A hypothesis of no difference between the production function of the two samples (DPS and CPS) was formulated and tested at 5% significance level with the aid of F-ratio statistic. The calculated F (F*) = 3.392 while the tabulated F ($F_{0.05}$) = 2.08.

Since $F^* > F_{0.05}$ the null hypothesis was rejected in favour of the alternative that there was significant difference between the two samples. It can, therefore, be inferred that there is significant difference in the resource use pattern between the two systems of fish farming in the area.

Summary and Conclusion

The average concrete pond operated was 65m^2 in size while that of dug-out was about 2.392m^2. The fish species reared included *Clarias* spp, *Tilapia spp, Heterotis spp* and *Gymarchus spp.* Feed items used included manufactured conventional feed and non-conventional feeds composed of, maggots and dead animals among others. Incidentally, feed remains the single highest cost item in fish production in the area.

The regression analysis revealed that the stocking rate (number of fingerlings stocked per m^2), capital cost on fixed inputs as well as labour are factors that had significant positive influence on the output. The use of non-conventional items as feeding stuffs also had significant influence on the variations in the output in concrete pond system. The assessment of the resource use pattern and efficiency showed that the fish farmers under-utilized the ponds and fertilizer while too much of labour was used. Resource use in the two systems was confirmed significantly different from each other as revealed by the Chow test.

In conclusion, fish production in the area may be said to be generally profitable using either of the two systems (CPS and DPS). But comparatively, concrete pond system may be preferred to dug-out pond system, having been found to be more profitable as revealed by the budgetary analysis. Also allocative efficiency in the use of pond space (stocking rate of fingerlings) was much higher in CPS than in DPS. It is therefore, suggested that the farmers should harness the profit potentials more, by increasing their stocking rate, and improve proper water fertilization while working to reduce their labour force appropriately. To ensure sustainability of any achievement in this direction, however serious efforts should be made to combat some major problems that may be facing the fish farmers in the area. Feed as a production input should be given the greatest attention to ensure profitability in the fish production business.

References

Adekoya, B.B (1997) "Aquaculture in Ogun State: Status Review". Paper presented at the First Fish Veterinary workshop organized by the Department of Veterinary Services, Ogun State Ministry of Agriculture, Ita-Eko, Abeokuta. Tuesday 11 November.

Adekunmisi, A.A., Awojobi, H.A., Mulero, M.A.S. and M.A. Onigemo, (2004) Performance of *Clarias gariepinus* fed poultry offal meal as a replacement for fish meal. *Nig. J. of Anim. Prod. 31 (2) : 286 - 290*

Agunbiade, J.A, Akeula, I.O. and H.A, Awojobi, (2001) An assessment of pig production systems: A case study of Lagos and Ogun States, Nigeria. *The Ogun Journal of Agricultural Sciences. 1: 108 – 120*

Aihonsu, J.O.Y (2002) Comparative Economic Analysis of Upland and Swamp Rice Production Systems in Ogun State, Nigeria. Ph.D Thesis, Faculty of Agriculture, Obafemi Awolowo University, Ile-Ife, Nigeria. Pp. 206

Akegbejo-Samsons, Y and J.N. Ojini, (2004) Use of the African locust bean, *Parkia biglobosa* waste slurry as energy feedstuff in practical diets for Tilapia, *Oreochromis niloticus* L. *Nig. J. Anim. Prod. 31 (1&2): 279 - 285*

Aromolaran, A.B. and , J.A. Igharo (1998) "Analysis of household consumption pattern in animal production in South Western Nigeria". In Oduguwa, O.O. Fanimo, O.A. and Osinowo, O.A. (eds.). Proceedings of the NSAP Silver, Anniversary Conference, 21 – 26 March, 1998, Gateway Hotels, Abeokuta, Nigeria.

Federal Office of Statistics (FOS) (1998) – *Annual Abstract of Statistics* 1998 Edition,
Abuja, Nigeria.

Food and Agriculture Organization, F A O (1991) *Fish for Food and Development* F A O, Rome. P. 120 – 132

Food and Agriculture Organization (2002). Promoting the Contribution of the Sustainable Livelihoods Approach and the Code of Conduct for Responsible Fisheries in Poverty Alleviation. Report of the Sustainable Fisheries Livelihoods Programme (GCP/INT/735/UK) and FAO Advisory Committee on Fisheries Research Joint working paper on Poverty in Small-scale Fisheries. FAO Fisheries Report No 678 Rome, FAO 2002. 22 p.

Ita E.O. (1989) " Acquaculture in Nigeria". A paper presented to students Association of Fresh water Fisheries School, Lagos.

Mabawonku, F.A. (1989). A Structural Analysis of the Nigerian Fisheries Industry. "*Nigerian Journal of Agricultural Sciences* 4 (2) : 116 – 122.

Ogunmoroti T. (1990) "Economics of fish farming systems in Nigeria. An example of 0.5ha Earthen pond. A paper delivered at the Second Fish Farmers Workshop 5th – 6th November, 1990. Nigeria Institute of

Oceanography and Marine Research, Lagos, Nigeria.

Okaeme, A.N. (1990) "Prospect and Problems of Fresh Water Fish Pond Fertilization using Animal Droppings in Subsistence Fish Farming "*Nig. J Agric. Ext.*, 5 (1 & 2) : 58 – 63

Olayide, S. O. and E. O. Heady (1982) *Introduction to Agricultural Production Economics.* Ibadan University Press. Nigeria. P.31 – 36.

Oreagba, O.F (2002) Comparative Analysis of Systems of Fish Farming in Ijebu North and Ijebu North-East Local Government Areas of Ogun State, Nigeria. B. Agric Research Project Report. Departments of Agricultural Economics/ Agribusiness and Farm Management. Olabisi Onabanjo University. Ago-Iwoye. Pp. 54

Onyenwaku, C.E, Agu, S.E. and F.C. Obase (2000) Economics of small – holder rice farming under different production systems in South – Eastern Nigeria. *Nig. J. Agric and Rural Dev.*. 1 (1): 1 – 11

Taiwo, O. O. (1979) A comparison of resources use efficiency in maize production between group farmers and industrial farmers in Oyo, Iseyin division of Oyo State. *Journal of Economics and Social Studies.* 1 (1): 88 – 92

Taiwo, I.O. and O. Odunaiya, (2004) Sex ratio and fecundity of *Chrysichthys nigrodigitatus* (family claroteidae) from Asejire lake. Nigeria. *Nig. J. Anim. Prod. 31(1) : 135 – 143.*

Tobor, J.G (1990) The Fishing Industry in Nigeria: Status and Potential for Self-sufficiency in Fish Production. N I O M R. Technical paper no 54 p. 11- 13.

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