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COMPARATIVE ANALYSIS OF TECHNICAL EFFICIENCY OF FISH FARMERS USING CONCRETE AND EARTHEN POND SYSTEMS IN MAKURDI METRO POLIS OF BENUE STATE, NIGERIA

F.O. Ogebe, [1]D.A. Idoko, [2] and D.P. Ani[1]

1. Department of Agricultural Economics, Federal University of Agriculture, PMB 2373 Makurdi, Benue State Nigeria.

2. Department of Agricultural Education, College of Education, Oju, Benue State, Nigeria.

ABSTRACT

The study compares the technical efficiency of fish farmers using concrete and earthen pond systems in Makurdi Metropolis of Benue State, Nigeria. Primarydata were collected with the use of structured questionnaires randomly administered to 40 respondents. The stochastic production analysis was applied to estimate and compare the technical efficiency among fish farmers using concrete and earthen pond systems in the study area. The results of the return to naira invested showed that earthen pond system yieldedN0.50 while concrete pond system yielded N0.30. The mean gross margin for concrete pond wasN357, 800 and N378, 445 for earthen pond. Similarly, return to investment (profit) for concrete and earth pond systems wereN166, 600 and N221, 535 respectively. The stochastic frontier production function models revealed that number of fingerlings and quantity of feeds used were found to be significant factors that contributed to the technical efficiency of concrete pond systems while number of labor used and fingerlings were significant factors in earthen pond type. The results further, revealed that years of experience, age, household size and annual income were the significant factors in the inefficiency sources model while only age was the significant factor in the earthen pond system in the inefficiency model. On the basis of these findings, the study concluded that fish production in the study area is economically rewarding and profitable. It is capable of creating employment, augmenting income and improving the standard of living of the people. Therefore, it is recommended that government provides a conducive environment for the establishment of more earthen and concrete ponds in a bid to alleviate poverty status and unemployment in the State.

Keyword: Economically profitable and rewarding, Capable of creating employment, augmenting income and improving the standard of living of the people.

INTRODUCTION

One of the greatest problems confronting millions of Nigerians today is lack of adequate protein intake. This inadequacy results in problem of malnutrition. The resultant effect of serious deficiency in the amount of protein intake is that people's health adversely affected, particularly the mental capacity working productivity and eventually, the overall national economic growth (Okoruwa and Olakanmi, 1999).

At present, there is a significant in-balance between food production and expanding population and this has resulted in an ever-increasing demand for fish consumption. This concern has prompted about the efficient performance of fish-farming production systems. Over the years, several people including government have always emphasized the need to increase fish production as priority without due consideration to the particular type of production environment in which to invest on with particular reference to economic analysis of the common concrete and earthen pond methods. One of the basic requirements of an investment decision is to get acquainted with the best system, which can give maximum profit to resource use.

Nigeria is believed to be the largest consumer of fish and fish products in Africa, reflecting its population size, economic status and dietary habits of the populace (Oderinde, 1998). Therefore, fish being one of the water resources is being targeted as a way of improving the protein intake of the Nigerian populace as well as improving the economic base of the country. In spite of the great potentials of fish, household fish production level had declined since the structural adjustment programme (CBN, 1998). This was a result of policy measures adopted under SAP, which had brought about an increase in cost of inputs.

Food production in Nigeria is still lagging against an escalating human population (Onucheyo 1999). This is evident in the deficiency of animal protein in the diet of average Nigerians. If aquacultures to play a vital role in ensuring fish availability for food security and nutrition in the country, this sectorhas to develop and expand in an economically viable and environmentally sustainable manner. There are strong opinions in scientific and agricultural business communities as to where this increase in aquaculture will come from: indoor or outdoor culture systems. In any case, the speed at which this industry will grow to meet the ever-increasing need for fish and fish products in future is paramount.

Among many factors, increasing efficiency of resource use and productivity at farm level is one of the prerequisites for sustainable aquaculture (FAO, 1997). Most recent studieshave failed to critically examine the importance of the different pond systems with a view to ascertaining the most economically viable method. It is against this background that the study compares the technical efficiency of fish farmers using concrete and earthen pond systems in Makurdi Metropolis of Benue State, Nigeria.

The specific objectives are to:

1. determine the technical efficiency of fish farmers using concrete and earthen pond systems;
2. determine the profitability of fish farming enterprise using concrete and earthen pond systems in the study area; and
3. compare the gross margin of fish farmers using concrete and earthen pond systems in the study area.

MATERIALS AND METHODS

The study was carried out in Makurdi Local Government Area of Benue State, Nigeria. The choice of this local government for this study stemmed from the fact that Makurdi is a business area where various agricultural and non-agricultural activities are carried out.Makurdi Local Government Area lies between Latitude 7^0 43’50N and Longitude 8^0 32’10E with estimated population of 500,797 people (NPC, 2006). The State is predominantly an agriculture catchment area specializing in human capital and material resources.

The data for this study were obtained from primary and secondary sources. The primary data were generated by the use of well-structured questionnaires randomly administered to 40 fish farmers. The respondents were selected by means of simple random sampling technique using the list of fish farmers association of Benue State and the National Population Commission list of households as sample frame. From the eleven council wards in Makurdi LGA, Eight council wards were purposively selected. Five respondents were selected from each of the eight council wards. A total of 40 respondents comprising 20 each that use concrete and earthen pond systems were interviewed. Descriptive statistics, profitability/gross margin analysis and stochastic frontier analysis were used to analyze the data.

Model specification

Stochastic frontier model

Technical efficiency is derived analytically and defined as follows:

$\text{Log } Y_1 = B_0 + B_1 \log X_1 + B_2 \text{ Log } X_2 + B_3 \text{ Log } X_3 \ldots Bn \text{ Log } Xn + (V_1 - U_1)$

Where:

Y_1 = Total output of the ith farmer (kg);

X_1 = Quantity of lime (kg)

X_2 = Quantity of feed (kg)

X_3 =Quantity of Fingerlings (kg)

X_4 =Labour (Man-days)

X_5 = Area of pond materials (ha)

X_6 = Cost of other materials (N)

B = Coefficient

V_1 = Random error that assumed to be normally distributed with zero and constant variance (d_2V_1) and

U_1 = Technical inefficiency effects independent of V_1 and have half normal distribution with mean zero and constant variance ((d_2V_1).

Inefficiency model

Following BatteseandCoeli (1995) model, the mean of farm specific technical inefficiency (U_l) was defined as$Ui = d_2 + d_1 Z_1 + d_2 Z_2 + d_3 + Z_3 + d_4 Z_4 \ldots d_n Z_n$

Where:

U_1 = Inefficiency effects

Z_1 =Age of respondent (years)

Z_2 = Faming experience (years)

Z_3 = Number of extension contact

Z_4 = Annual income (₦)

Z_5 = Family/household size

Z_6 = Constant term

$d_1 - d_7$ = Coefficient

RESULTS AND DISCUSSION

Table 1 shows the costs and returns analysis of fish farmers using concrete and earthen pond systems. The results showed that variable cost constituted 66.9% of the total cost of concrete pond system while fixed cost accounted for 33.1% of the total cost of production. Similarly, total variable cost constituted 62% of the total cost in the earthen pond system while fixed cost accounted for 38% of the total cost of production.

Results in Table 2 also showed the profitability analysis of fish farmers using ratio analysis. The analysis shows that monthly returns for concrete pond system were ₦7, 766.7. The analysis shows that fish production under concrete pond system had a mean turnover of 0.30. This indicated that for everyone naira invested in the concrete pond system, there was a return of 30 kobo to the farmer. Similarly, the monthly return for earthen pond system was ₦36, 922.5 with a return to investment of 0.50 all indicating the profitability of the enterprise in the study area.Similarly, the result of the profitability shows that the gross farm income was significantly higher ($P \leq 005$) then total variable cost in the two pond systems.

Estimates of Cobb-DouglasFrontier Production

The results in Table 3 showed the estimates of the technical efficiency of both concrete and earthen pond systems in the study area. Number of fingerlings and quantity of feeds used were found to be significant factors that were associated with technical efficiency of concrete pond systems while the number of labor and fingerlings were the significant factors in earthenpond type. In the concrete pond system, the mean technical efficiency was 0.570.The maximum was 0.999.Similarly, earthen pondsystems have a mean technical efficiency of 0.576. The results suggested that, technical efficiency in fish production in the study area could be increased by 43% and 42% to attain maximum output in concrete and earthen pond systems respectively.

In addition, the magnitude of variable ratio gamma (γ) was found to be at 0.999; suggesting that the systematic influencesthat were unexplained by the production function were the dominant sources of error. This means that 99% of the variations in output of fish farmerswere explained by the model. The estimate of sigma square was also significant at 1%.

Results of Inefficiency Model

The results of the inefficiency model Table 3 showed that the estimated coefficient of age (-0.483), farming experience (0.337) and householdsize (0.227) were significant in the concrete pond system. The result therefore suggested that technical inefficiency effects in concrete pond fish production in the study area increase with increase in farming experience. This means that farming experience, household size and age were the critical determinants of technical efficiency in concrete fish pond production. In other words, decrease in age, increase in farming experience and large household size increases technical efficiency of farmers. The implication of this is that farming experience, household size and age were very important in reducing inefficiency in utilization of inputs in concrete pond fish production.

In earthen pond system, only age and household size were found to be significant. The implication is that policies that would encourage young farmers with long farming experience in fish production would ensure efficiency use of resources in production. This would also improve profitability of fish production in the study area, as the efficient use of available resources would lead to maximization of profit.

CONCLUSION AND RECOMMENDATIONS

The study showed that fish production was profitable in the study area with average monthly revenue of ₦7, 766.7 and ₦36, 922.5 for concrete and earthen pond systems respectively. Also a mean gross margin of about ₦357, 800 and ₦378, 445 with returns to Naira invested of ₦0.3 and ₦0.5 for concrete and earthen pond systems respectively. The findings further revealed that earthen pond system is more technically efficient than concrete pond system. Thus, it is more advisable for fish farmers and other investors in fish farming business in the study area to adopt earthen pond system with a view to making more profit and to be more technically efficient in their investment decision.
The results of the resource use showed that number fingerlings and quantity of feeds were critical determinants of technical and efficiency in the concrete pond fish production while number of labor and fingerling were the significant factors in the earthen pond system. The attainment of average technical efficiencies of 57% and 58%indicated that the technical efficiency of the farmers could be increased by 43% and 42% through efficient efficiency use of inputs in concrete and earthen pond systems respectively.
The results suggested that fish farmers could increase output through more efficient use of inputs given the current state of technology. The major determinants of technical efficiency on fish production in the study area were household size, age and farming experience in the concrete pond system while age and household size were the significant factors in the earthen pond system. Thus, young farmers with high education and long farming experience should be motivated through sustained and adequate system that would provide financial supports to fish farmers to enable them increase production in the study area. On the basis of the findings, the study suggested that government of Benue State, Nigeria should provide a conducive environment for the establishment of more earthen pond systems, encourage more citizenry, mostly youth to set up earthen pond system in a bid to alleviate poverty status and unemployment in the state and the country at large.

Table no1: Average Total Cost Structure of Fish Farmers Using Concrete and Earthen Pond Systems.

Pond Type	Costs	Values (₦)	Percent of ATC
1.Concrete	Total Fixed cost	191,200	33.1
	Total Variable Cost	387,100	66.9
	Total	578,300	
2.Earthen	Total Fixed cost	156,910	38.0
	Total variable cost	285,805	62.0
	Total	442,715	100.0

Source;Field survey, 2018.

Table no2: Costs and Return Analysis of an Average Fish Farmer using Concrete and Earthen pond System

Items	**Concrete pond**	**Value**	**Earthen Pond**	**Value (₦)/Season**	
	Value (₦)/Season	**₦/ Season**	Value (₦)/Season		
A. Revenue (Output x Price)					
• Clarias	372450.0		332,125.00		
• Tilapia	279337.5		249,093.75		
• Others	93112.5		83,031.25		
	744,900		664,250.00		
B. Variable Cost					
Family labor	15,300		21,700		
Hired labor	12,300		10,850		
Feeds	121,750		66,200		
Lime	11,270		11,160		
Water	11,500		12,810		
Stock	156,300		109,000		
Fertilizer	12,580		14,190		
Transport	13,660		17,450		
Treatment	11,120		11,340		
Other costs	21,320		20,105		
	387,100		285,805		
C. Total Variable Cost (A-B)		357,800		378,445	
D. Depreciated fixed cost items/season	136,700		100,600		
Pond construction	31,375		34,550		
Pumping Machine	8,750		8,950		
Wheel Barrow	4,225		3,455		
Shovel	5,200		3,575		
Harvesting Materials	4,950		5,780		
Water Basin					
E. Total Fixed Cost	191,200		156,910		
F. Returns to investment A (B+C)		166600		221,535	
Returns to Naira Invested F(C+E)		₦0.30		₦ 0.20	

Source: Field survey, 2018.

Table no3: Results of Maximum Likelihood Estimate of the Cobb – Douglas Frontier Production functions for Technical Efficiency (Concrete and earthen pond systems).

Variable (Kg)\ Parameter estimate	Concrete pond type Coefficients(t-values)	Earthen pond type Coefficients(t-values)
Constant β_0	0.551(2.63**)	0.130(7.51***)
Ln Lime β1	0.320 (0.156)	0.374(0.292)
Ln Feeds β_2	0.775(2.56**)	0.860(-0.37)
Ln Fingerlings β_3	0.545(3.28***)	0.316(5.40***)
Ln Laborβ_4	0.336(1.317)	-0.524(3.49***)
Ln Pond β_5	0.292(1.70*)	0.852(0,35)
Ln Other materials β_6	0.159(1.26*)	0.634(1.10)
Inefficiency model		
Constant	-1.635(2.45**)	23.59(2.62**)
Age (years) Z_1	-0.483(3.8***)	0.902(2.088**)
Experience (years) Z_2	0.337(-4.74***)	-0.838(-1.30)
Extension contact Z_3	-0.714(-0.747)	0.431(0.425)
Annual Income Z_4	0.207(0.625)	-0.715(-0.259)
Household size Z_5	- 0.227(-2,16**)	-0.525(-2.34**)
Sigma – Square	0.691(13.047***)	0.251(2.31**)
Gamma	0.999(1835.38***)	0.999(7518553.86***)
Mean Technical Efficiency	0.570	0.576

Source: Field Survey, 2018*** Significant at (P<0.01), ** Significant at (P<0.05), * Significant at (P<0.10)

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