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COMPARATIVE EVALUATION OF ECONOMIC BENEFITS OF EARTHEN FISH PONDS AND CONCRETE TANKS IN AQUACULTURE ENTERPRISES IN OYO STATE, NIGERIA

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ABSTRACT

The study focused on the comparative evaluation of economic benefits of earthen fish ponds and concrete tanks in aquaculture enterprises in Ibadan, Oyo state. Primary data were collected with the aid of structured interview schedule, administered through personal interviews and observations to elicit information from 100 fish farmers using purposive and convenience sampling procedure. Data collected were analyzed using descriptive, budgetary and inferential statistics. The study revealed that the mean age, male, married, household size, educated and fish farming experience were 41 years, 83.0%, 87.0%, 5 persons, 96.0% and 8 years, respectively. Earthen fish ponds users earned mean revenue of ₦3,322,189.85 with gross margin of ₦2,188,397.89 while concrete tank users earned ₦2,412,271.08 with gross margin of ₦1,413,299.46. The results showed profitability indices (0.61 and 0.47), Variable Cost ratio (0.35 and 0.30), Benefit Cost Ratio (2.55 and 1.89), Gross ratio (0.40 and 0.54) and Expenses structure ratio (0.13 and 0.23) for both the earthen ponds and concrete fish tanks, respectively. There were significant differences ($t = 42.53$, $p \leq 0.05$) between the profit level of earthen fish ponds and concrete tanks. Major constraints affecting economic status of the respondents were high cost of quality feed, insufficient funds, poaching and poor marketing channel. In conclusion, aquaculture is a more profitable and viable business regardless of the culture system. Government should assist the fish farmers by subsidizing feeds cost, granting and monitoring of loan.

INTRODUCTION

Aquaculture is the husbandry of aquatic food; the need arose from the decrease in supply from ocean fisheries as a result of over-fishing and pollution (Olaoye, 2010). One of the ways to bridge the gap between the reduced fish supply and increased world food fish demand is through aquaculture (Omotayo et al., 2006). Aquaculture is the rearing of aquatic organism in enclosed water bodies such as ponds, dams, cages, raceways, tanks, reservoirs under human management. Nigeria has a population of about 150 million people (NPC, 2006). The national requirement for fish is about two million metric tons per annum, but Nigeria is currently producing about 500,000 metric tons per annum derived from aquaculture and catfish farming (FDF, 2009). Thus, there is a lot of potential in aquaculture because the industrial and artisanal catches are declining. So, the new direction is towards aquaculture and this is a global trend. Aquaculture has the same objective as agriculture, that is, to increase the production of food above the level that would be produced naturally. Since the mid-1990s, aquaculture has been the engine driving growth in total fish production as global capture production has levelled off. Its contribution to world total fish production climbed steadily from 20.9 percent in 1995 to 32.4 percent in 2005 and 40.3 percent in 2010. Its contribution to world food fish production for human consumption was 47 percent in 2010 compared with only 9 percent in 1980 (FAO, 2012). One of the priorities of

aquaculture is the increase in the production and the growth rate of fish that will meet the demand of the increasing population. Nigeria, like many other developing countries of the world is faced with the task of meeting the protein demands of its ever-increasing human population (Tijani, 2004).

Fish farming is expanding rapidly throughout the world and has a high potential for the provision of valuable protein in less developed countries (Little, 2003). Due to global population expansion, demand for high quality animal protein, especially from aquatic sources, is rising. Increasing the aquaculture production is clearly needed to meet this demand in the third millennium, especially as the capture fisheries resources are declining, due to over-fishing, habitat destruction and pollution (Dunham et al., 2001, Olaoye, 2010, Olaoye et al., 2012). The significant imbalance between food production and the expanding population has resulted in an ever increasing demand for fish consumption. This concern has been prompted big 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, with particular reference to economic analysis of the common concrete and earthen pond methods.

Aquaculture is a relatively new practice in Nigeria. For this reason, it is important for potential and practising fish farmers to know some basic necessities of its management and economics in order to boost the returns of their efforts. Like any economic activity in life, balancing investment costs and returns in favour of farmers is important in aquaculture. It is always useful for farmers to know the profitability of fish culture in order to guide their decision making (Olaoye and Odebiyi, 2011; Olaoye et al., 2012).

Fish farming is a part of aquaculture but sometimes the two are used interchangeably because majority of output from aquacultural production comes from fish farming. Fish farming/culture is the growing of fish in a controlled environment (concrete or earthen ponds), vats (wooden or fibre glass) and plastics. Fish farming is an enterprise, thereby proper management and economics must be put in place. This study reports the production system out of concrete tanks and earthen ponds that has the highest return on investment. It also determines whether there is any significant difference between the profit level of concrete and earthen fish pond owners/farmers, and examines the statistical relationship between the socio-economic characteristics of the fish farmers, as well as the profit levels of earthen ponds and concrete fish tanks in aquaculture enterprise.

Problem statement

Historically, fish production in ponds was the beginning of man's efforts to culture his desired fish species in a controlled environment and this forms the basis of modern aquacultural practices (Akegbejo-Samsons, 1997). In spite of the ambitious hope for fish production from the country's reservoirs, dams, perennial river and saline mangrove swamps, fish as an affordable protein source still eludes the greater part of production. Nigeria has consistently fallen below the FAO's recommendation for daily minimum protein intake of 70 grams, of which 35 grams should come from animal sources. It is expected that fish would supply part of this protein needed from the use of earthen ponds and concrete tanks. Lately, concrete tanks have gained a lot of prominence among fish pond operators. This is a way of raising fish closer to home because it requires less space and can be practiced within the home profitably.

Fish farming is an enterprise that aims at profit maximization. To attain this, every element of production must be put together. To choose the type of production system to culture in, its demerit must be minimal. The research questions to be addressed in this study are as follows:

i. What are the socio-economic characteristics of the respondents?
ii. What is the type of fish farming practices and characteristics of fish farmers in the study area?
iii. How profitable are the enclosures in the study area?
iv. What are the factors affecting aquaculture development in the study area?

Objectives of the study

The broad objective of the research is to make comparative evaluation of economic benefits of earthen fish ponds and concrete tanks in aquaculture enterprises in Oyo state, Nigeria. Specifically to:

i. describe the socio-economic characteristics of fish farmers who produce fish in concrete tanks and earthen ponds in the study area;
ii. determine the type of fish farming practices and characteristics of fish farmers in the study area;
iii. estimate the costs and returns of earthen ponds and concrete tanks in aquaculture enterprises and hence compare their profitability; and
iv. investigate the determinants of yield performance in small scale fish farming.

Justification for the study

Fish farming/culture is the growing of fish in a controlled environment (concrete or earthen ponds), vats (wooden or fibre glass) and plastics (Osawe, 2007, Nwokoye et al., 2007). Fish farming is an enterprise, thereby proper management and economics must be put in place. This study reports the production system out of concrete tanks and earthen ponds that has the highest return on investment. This study also allows the fish farmers who use earthen fish ponds and concrete tanks, especially farmers that are new in this enterprise, to have a good understanding of the benefits of the

two production systems, as well as the researchers who are trying to compare the two enclosures economically.

Fish farming is expanding rapidly throughout the world and has a high potential for the provision of valuable protein in less developed countries (Little, 2003). Due to global population expansion, demand for high quality animal protein, especially from aquatic sources, is rising. Increasing the aquaculture production is clearly needed to meet this demand in the third millennium, especially as the capture fisheries resources are declining due to over-fishing, habitat destruction and pollution (Dunham et al., Olaoye, 2010; Olaoye et al., 2012). The significant imbalance between food production and the expanding population has resulted in an ever increasing demand for fish consumption. This concern has been prompted by 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, 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 the maximum profit to resource use. One of the greatest problems confronting millions of Nigerians today is lack of adequate protein intake both in quality to feed the nation's ever-growing population. This inadequacy results in the problem of malnutrition. The resultant effect of serious deficiency in the amount of protein intake is that people's health is adversely affected, particularly mental capability, working productivity and eventually the overall national economic growth (Okoruwa and Olakanmi, 1999).

It follows therefore that the study assures comparison and evaluates the economic benefits of earthen ponds and concrete tanks in aquaculture enterprises. Given the importance of fish in our socio-economic life, coupled with the fact that pond fish production is increasingly becoming relevant as a production technique in fish farming, increasing its profitability is a test that needs considerable attention. Moreover, effort towards this must not be limited to its biological aspect alone, but the economical aspect must be looked at on the input-output level with a view to assessing resource use and profitability, as well as determining which production techniques of pond fish production are more profitable and proffer useful recommendations for private investment sector.

METHODOLOGY

Study area

This study was conducted in Oyo State where agriculture is the main traditional occupation. Oyo State covers approximately an area of 28,454 square kilometres and is ranked 14th by size. Ibadan is the capital which is known to be the largest indigenous city in Africa. It is bounded in the north by Kwara state, in the east by Osun state, in the south by Ogun state and in the west partly by Ogun state and partly by the Republic of Benin (Figure 1). The total population in 2006 was 5,591,589 (N.P.C., 2006) and the estimate for 2007 was 6,617,720. The density of the state is 196.5/km^2 (509/sq mi). The state Agricultural Development Programme established in 1989 was divided into four agricultural extension zones (Ogbomoso, Oyo, Saki and Ibadan) for effective agricultural coverage. The state consists of thirty-three Local Government Areas (LGAs).

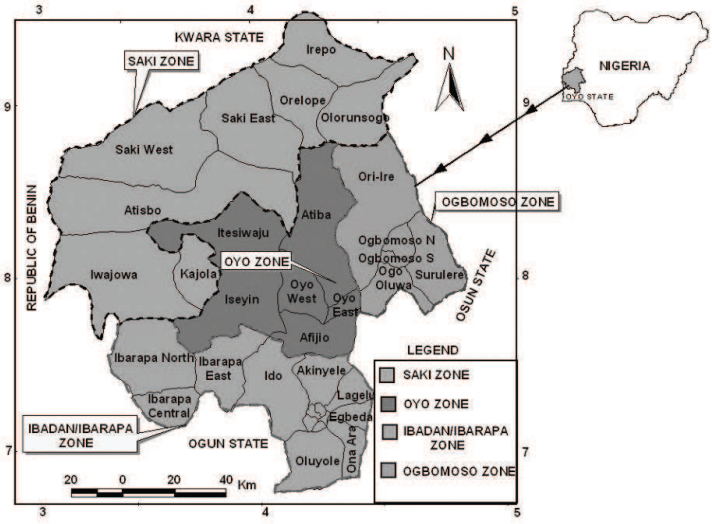

Fig 1. Map of Oyo state showing study locations

Data collection and sampling techniques

The primary data were collected with the aid of structured interview schedule, administered through personal interviews and observations to elicit information from 100 fish farmers using purposive and convenience sampling procedure in Ibadan, Oyo State, Nigeria.

Method of data analysis

Data collected were analyzed using descriptive statistics, budgetary technique and inferential statistics. Descriptive techniques such as tables, frequencies and percentages were used to describe the socio-economic characteristics, determine the type of fish farming practice and characteristics of the respondents, source of information for aquaculture development in the study area, as well as factors affecting aquaculture development in the study area. The budgetary technique (economic indicators) was used to determine the costs, returns and profitability indices of fish farming in earthen ponds and concrete tanks. Models used in estimating the costs, returns and profitability indices according to Olaoye and Odebiyi, 2011, Adegeye and Dittoh,

1985, Olukosi and Ehabor, 1988, Olaoye et al., 2013 are as presented below:

$GMI = \sum TR - \sum TVC$ ..... (i)
$TR = P_y \cdot Y_i$ ..... (ii)
$TVC = Px_i \cdot X$ ..... (iii)
$TC = TVC + TFC$ ..... (iv)
$NFI = GM - TFC$ ..... (v)
$PI = NFI/TR$ ..... (vi)
$RRI = NFI/TC.100$ ..... (vii)
$RVC = (TR - TFC)/TVC.100$ ..... (viii)
$VCR = TVC/TR$ ..... (ix)
$BCR = TR/TC$ ..... (x)
$ESR = TFC/TC$ ..... (xi)
$GR = TR/TFC$ ..... (xii)
$NM = TR/TFC$ ..... (xii)

NOTE: Investment and cost are used interchangeably in the analysis.

Where:
GMI = Gross Margin Income (₦)
TR = Total Revenue (₦)
TVC = Total Variable Cost (₦)
TFC = Total Fixed Cost (₦)
TC =Total Cost (₦)
NFI = Net Farm Income (₦)
P_y = Unit Price of Output Produced (₦)
Y = Quantity of Output (kg)
Px_i = Unit Price of Variable inputs i used (₦)
$X_{i=}$ Quantity of Variable Inputs i (kg)
PI = Profitability Index (Net Profit Margin)
NFI = Net Farm Income, (₦)
RRI = Rate of Return on investment, (%)
RVC = Rate of Return on Variable Cost

Depreciation

Depreciation values of fixed items of fish enclosures were used for calculation. For this analysis, Straight Line Method (SLM), which assumed salvage value of zero, was used. The formula is specified as:

$DS = (OC - SV)/L$

Where:
DS = Annual depreciation
OC = Original Cost
SV = Salvage Value
L = Expected or Useful Life Span (year)

RESULTS AND DISCUSSION

Socio-economic characteristics of the respondents

Socio-economic characteristics of the respondents in Oyo state were presented in Table 1. Table 1 shows that 38.0% of the fish farmers were in the age group of 41 – 50 years, while 6.0% of the fish farmers were above 60 years, the mean age was 44.5 years while standard error was 1.0. This indicates that most of the respondents were within the economically active population and therefore constitute a good labour force for fish farming industry (Olawunmi et al., 2010); an age in which they are considered highly productive and active to undertake strenuous task associated with farm work. This indicates that very few young and old people are involved in fish farming. Also, past studies revealed that older farmers often tend to be more conservative or traditional and were afraid of taking risk, which the adoption of new farm technology entails (Olomola, 1988).

The percentages of the male and female respondents were 83.0% and 17.0%, respectively. It is evident that male are more represented in the production of fish in both earthen fish ponds and concrete tanks (i.e. the farmers are gender biased). This result can be justified by the assertion of Brummett et al. (2010) that fishery activities are mostly dominated by men. However, aquaculture practices are not limited to a particular gender. Both male and female farmers are engaged in fish farming to increase fish production, improve food security, reduce hunger and also to increase their incomes.

Most (87.0%) of the fish farmers were married. The reason is in the fact that most of them are in their 30s and 40s, when people are usually married. Education is an important factor which can influence farm productivity and determines farmers' access to loans. Level of education, according to the study, showed that most (96.0%) of the fish farmers are learned which is expected to facilitate higher output and efficiency in fish production. This means that fish farming is dominated by the educated class . This is so because fish farming requires a lot of technical and scientific knowledge to be successfully undertaken. The information on the innovations of fish farming is somehow complex and these need some higher level of education for implementation. This emphasized that there are differences between agricultural farmers and fish farmers: the later are better educated (Ozor, 1998 and Okwoche et al., 1998).

Based on the survey results, one can also infer that Christianity was more (69.0%) practiced than any other religion. The average household size in the locality was found to be 5 persons. The relatively small size of the households may be attributed to their belief, since, for instance, religious tenets such as Christianity teach monogamous type of family. The implication is that the relative small household size may increase the hired labour needs in line with findings of Adegbite and Oluwalana (2004); large family means lower need for hired labour.

Farming experience plays prominent role in any farming enterprise (Olaoye, 2010). As a result, the respondents with the highest number of years of experience should have good skills and better approaches to fish farming business. Many (43.0%) of the surveyed fish farmers had a fish farming experience of 1 – 5 years, while 1.0% of the

Table 1. Percentage distribution of the socio-economic characteristics of fish farmers in Oyo state (N = 100)

VARIABLES	Frequency	Percentage	Mean ($\overline{X}$)	Std	S.E
Age (years)					
Below 20	0	0.0			
20 – 30	9	9.0			
31 – 40	29	29.0	44.5	10.06	1.0
41 – 50	38	38.0			
51 – 60	18	18.0			
Above 60	6	6.0			
Sex					
Male	83	83.0	-	-	-
Female	17	17.0			
Marital Status					
Single	12	12.0			
Married	87	87.0	-	-	-
Divorced	1	1.0			
Educational status					
No formal education	4	4.0			
Primary school uncompleted	2	2.0			
Secondary school completed	16	16.0	-	-	-
Secondary school uncompleted	7	7.0			
Tertiary school completed	70	70.0			
Tertiary school uncompleted	1	1.0			
Religion					
Christianity	69	69.0			
Islam	30	30.0	-	-	-
Traditional	1	1.0			
Household Size (Persons)					
1 – 3	9	9.0			
4 – 6	75	75.0	5.1	1.84	0.18
7 – 10	16	16.0			
Fish Farming Experience (Years)					
1 – 5	43	43.0			
6 – 10	37	37.0			
11 – 15	8	8.0	8.1	6.22	0.62
21 – 25	1	1.0			
Above 25	3	3.0			
Occupation					
Business					
Civil Servant	30	30.0			
Farming	25	20.0			
Mechanic	43	43.0	-	-	-
Tailor	1	1.0			
Mode of land acquisition	1	1.0			
Inheritance	16	16.0			
Gift	1	1.0	-	-	-
Lease/Rent	14	14.0			
Purchase	69	69.0			

Source: Field survey, 2012

fish farmers had a fish farming experience of 21 – 25 years. Occupation remains valid in our society as people have one or two things they are engaged in, which gives them sense of satisfaction and belonging to the society. Fish farming as the major occupation is a function of importance attached to it as a source of livelihood; 43.0% had farming as their major occupation and thus are likely to commit more number of hours, efforts and loans towards the success of the farm enterprise. It was shown that majority (69.0%) of the fish farmers got their land through purchase, while 17.0% of the respondents got their land as gift or inherited it.

Farming practice and characteristics of the respondents

Table 2 shows that majority (73.0%) of the fish farmers went into fish farming in order to make profit, while (20.0% and 1.0%) went into fish farming to augment income and for household consumption, respectively. Source and quantity of water available were some of the most important factors to be considered when selecting a site for aquaculture practice. Somewhat less than fifty per cent (48.0%) of the fish farmers depend on deep well, while 22.0% of the fish farmers depend directly on rivers or stream as sources of water. In the terms of fish enclosure structure, 38.0% of the fish farmers used concrete tanks only, 37.0% of the fish farmers used earthen ponds only, 19.0% of the fish farmers used both concrete and earthen ponds, while 6.0% used recirculatory systems. Fifty-one percent (51.0%) of the fish farmers prefer concrete tanks against 49.0% of earthen fish ponds. This concurs with the findings of Olaoye et al., 2007 and Olaoye, 2010 that convenience or adoption rate of culture in concrete tanks was mainly to more prominent features of urban and peri-urban fish farming, more cost-effective feed conversion, greater survival records, unit size reductions, higher fish stocking densities, more intensive grow-out management and art of backyard farming. Fish farmers in the study area preferred monoculture to polyculture system. Most (81.0%) of the fish farmers adopt monoculture of African Catfish (*Clarias gariepinus*). This may be as a result of poor market price for Tilapia due to too much bones. In terms of the type of fish cultured, the study showed that 70.0% of the fish farmers cultured *Clarias* sp. more than any other fish species. The reasons being that the species has a high market value and it can attain the market size under a few months of rearing. This supports the study of Olaoye et al., 2007 and Olaoye, 2010 that adoption rate of monoculture of *Clarias* sp. had replaced polyculture due to better market prices, greater demand preference, cultural preferences of most customers, hardiness of fish stock convenient for culture, presentation of fish live at sales point and relatively superior/timely growth performance. Slightly above fifty per cent (58.0%) of the fish farmers got their fish seed from private fish hatchery, while 9.0% of the fish farmers depend on government farms for fish seeds (Ministry of Agriculture). The fact was that the fingerlings sourced from fish farms were more likely to be healthier and well breed. Regarding the culturing period, many (41.0%) of the fish farmers cultured their fish for six months, 29.0% of the fish farmers cultured for five months, 16.0% of the fish farmers cultured for four months, while a very low percentage (2.0%) of the fish farmers cultured their fish for just two months.

Table 2. Percentage distribution of fish farmers' farming practice and characteristics

	FISH FARMERS	
VARIABLES	**Frequency**	**Pe (%)**
Reason for going into Fish Farming		
To make profit	73	73.0
Hobby	4	4.0
To augment income	20	20.0
For household consumption	1	1.0
Social status	0	0.0
To meet subsistence need	2	2.0
Source of Water		
Borehole	30	30.0
Deep well	48	48.0
Stream or river	22	22.0
Rearing Structure/Facilities		
Earthen ponds	37	37.0
Concrete tanks	38	38.0
Recirculatory system	6	6.0
Earthen and concrete	19	19.0
Types of culture		
Monoculture	81	81.0
Polyculture	19	19.0
Types of cultured species		
Tilapia spp.	13	13.0
Clarias spp.	85	85.0
Heterosis spp.	2	2.0
Source of fish seed		
Own fish hatchery	33	33.0
Commercial fish hatchery	58	58.0
Government fish farm	9	9.0
Culturing Period		
Two months	2	2.0
Four months	16	14.4
Five months	29	57.7
Six months	41	22.1
More than six months	12	5.9

Source: Field survey, 2012

Costs, returns and profitability analysis of fish production

The costs and returns analysis of earthen fish pond and concrete tank fish farming in Oyo state are shown in Table 3. The result of this study shows that the earthen fish pond users earned an average revenue of ₦3,322,189.85, while concrete tank users earned about ₦2,412,271.08 per cultured period of six months. It revealed that the costs of feed (₦975,516.91 and ₦839,845.32) for both the earthen pond and concrete fish tank production techniques respectively accounted for the highest proportion (0.86 and 0.84) of the costs of variable component in fish farming in the study area, followed by the cost of hired labour (₦75,996.00 and ₦59,165.19). This implies that a large amount of money was spent by the fish farmers in the study area for purchase of fish feeds and labour used. This finding was in agreement with Louise (1977) who said that the cost of feed was very high in catfish production. The fixed cost of production consists of land rent, pond construction, water pump, wheel barrow, pond equipment (such as net, weighing scale, generator etc.), which accounted for ₦171,408.14 and ₦290,788.54 of the total cost for both earthen fish pond users and concrete tank users, respectively. Equally, evident from the result is that an average total cost of ₦1,305,200.10 and ₦1,289,760.20 was incurred by the fish farmers in a cropping season for earthen fish ponds users and concrete tank users, while the gross margin (GM) was ₦2,188,397.89 and ₦1,413,299.46, respectively (Table 4). This indicates that fish farming in the study area was profitable. The results are consistent with the findings of Ashaolu et al. (2006) and Adewuyi et al. (2010) who observed that fish farming in Ogun State was profitable.

The costs and returns ratio analysis revealed that the benefit cost ratio (BCR) is greater than one emphasizing the profit-

Table 3. Economic analysis of the earthen and concrete fish tank usage by the respondents

ITEMS	EARTHEN			CONCRETE		
	Amount (₦)	Expected useful life (yrs)	Depreciation (₦)	Amount (₦)	Expected useful life (yrs)	Depreciation (₦)
FIXED COST						
Land purchase/rent	52,132.06	99	-	63,720.45	99	-
Water pump	23,609.81	5	4721.96	18,075.96	5	3615.19
Tanks	48,870.67	5	9774.13	55,765.09	5	1153.02
Deep well	-	-	-	90,876.90	20	-
Plumbing materials	18,742.09	15	1249.47	31,995.00	15	2133
Building/Shed	35,091.00	25	1403.64	40,009.98	25	1600.40
Generator	42,760.00	5	8552	35,000.90	5	7000.18
Dragnet, Weighing Scale/Cutlass	2,765.87	3	921.96	1,567.09	3	522.36
Wheel barrow/Shovel/Head pan/Bowls	2,054.90	3	684.97	1,110.76	3	370.25
TOTAL	**198,716.27**		**27,308.13**	**307,182.98**		**16,394.40**
TOTAL FIXED COST	**171,408.14**			**290,788.58**		
VARIABLES COST			Amount (₦)			Amount (₦)
Fish feed			975,516.91			839,845.32
Fish seed			31,001.09			28,909.00
Lime/Fertilizer			1,856.15			13,979.01
Labour			75,996.00			59,165.19
Transportation or handling charges			21,349.81			19,878.00
Others			28,072.00			37,195.10
TOTAL VARIABLE COST			**1,133,791.96**			**998,971.62**
TOTAL COST			**1,305,200.10**			**1,289,760.20**

Source: Field survey, 2012

ability and viability of fish farming in both types of fisheries enclosures in Oyo State (Table 4). The findings in this study concur favourably with that of Emokaro and Ekunwe (2009) who found the efficiency of resource-use among catfish farmers to be viable. The gross revenue ratio of 0.40 and 0.54 for earthen fish pond users and concrete tank users respectively indicates that for every naira of return to fish farm enterprise, 40kobo and 54kobo for earthen fish pond users and concrete tank users respectively were being spent. The result was also in line with the work of Raufu et al. (2009) and Okwu and Acheneje (2011).

Furthermore, profitability index, rate of return on investment, rate of return on variable cost and operating ratio for earthen fish ponds and concrete tanks were 0.61 and 0.47, 155.00 and 87.00, 278.00 and 240.00, and 0.35 and 0.30, respectively (Table 4). These imply that fish farming ventures were more profitable and viable if earthen fish ponds are used. The implication was that earthen ponds were found to be better than concrete fish tanks in terms of efficiency and profit.

Table 4. Comparison of economic/profitability indices between earthen ponds and concrete fish tanks

Measurement Indices	Earthen pond technique	Concrete fish tank technique
Total Revenue (TR)	₦ 3,322,189.85	₦ 2,412,271.08
Gross Margin (GM)	₦ 2,188,397.89	₦ 1,413,299.46
Net Farm Income(NFI)	₦ 2,016,989.75	₦ 1,122,510.88
Benefit Cost Ratio (BCR)	2.55	1.89
Gross Ratio (GR)	0.40	0.54
Expenses Structure Ratio (ES)R	0.13	0.23
Profitability Index (PI)	0.61	0.47
Rate of Return on – Investment (RRI)	1.55	0 .87
Rate of Return on – Variable Cost (ROR-VC)	2.78	2.40
Variable Cost Ratio (VCR)	0.35	0.30

Source: Field survey, 2012

Constraints militating fish farming

Various factors which affect fish farming in the study area were rated according to the degree of severity. The results show that most of the fish farmers identified high cost of quality feed (56%), inadequacy of sufficient fund (41%) and high cost of input (38%) as a very serious problem. Diseases and predators (57%), poaching (51%), high inflation rate in the economy (46%), poor marketing channel (46%), lack of technical know-how (39%) and poor quality fish seed (37%) were also considered as serious problems facing aquaculture development in the study area (Table 5).

Table 5. Distribution of constraints militating fish farming in Oyo State

	Very serious		Serious		Not a problem		I don't know	
	Freq	%	Freq	%	Freq	%	Freq	%
Lack of appropriate land or site	14	14.0	33	33.0	50	50.0	3	3.0
Old age	0	0.0	6	6.0	86	86.0	8	8.0
Inadequacy of sufficient fund	41	41.0	49	49.0	10	10.0	0	0.0
Poaching	18	18.0	51	51.0	25	25.0	6	6.0
Lack of technical know-how	17	17.0	39	39.0	44	44.0	0	0.0
Diseases and predator	17	17.0	57	57.0	25	25.0	1	1.0
High inflation rate in the economy	38	38.0	46	46.0	9	9.0	7	7.0
High cost of input	38	38.0	36	36.0	24	24.0	2	2.0
Poor marketing channel	28	18.0	46	46.0	34	34.0	2	2.0
Poor quality fish seed	11	11.0	37	37.0	48	48.0	4	4.0
High cost of quality feed	56	56.0	32	32.0	11	11.0	1	1.0
Harvesting cost	1	1.0	43	43.0	49	49.0	7	7.0

Source: Field survey, 2012

Hypotheses testing

This section shows the relationship/difference between some of the independent variables and dependent variables.

$H_{0\ 1}$: There is no significant difference between the profit

level of concrete and earthen fish pond owners/farmers.
Table 6 shows the test of difference in profit level (Net Farm Income) per six months culture periods of *Clarias gariepinus* in earthen fish ponds and concrete tanks. The average Net Farm Income (NFI) of earthen fish ponds was ₦2,016,989.75, while of concrete fish tanks it was ₦1,122,510.88, and the mean difference of ₦894,478.87 with t-value of 42.53 at 5% level is significant. This implies that earthen fish ponds were more efficient in terms of profit level.

Table 6. Test of difference in profit level (Net Farm Income) per six months culture periods of *Clarias gariepinus* in earthen fish ponds and concrete tanks

VARIABLES	Mean NFI/6 Months culture period	Df	Significant (p)	t – value	Decision
Earthen fish ponds	2,016,989.75	171	0.01	42.53	Significant Accept H_1
Concrete tanks	1,122,510.88	49	0.02		
Mean difference	894,478.87				

Source: Field survey, 2012

$H_{O\,2}$: There is no significant relationship between the socio-economic characteristics of the fish farmers and the profit level of earthen ponds and concrete tanks in aquaculture enterprise.
The linear correlation coefficient obtained from the statistical analysis in Table 7 shows that there is a significant relationship between the costs and returns, age ($r = 0.61$, $p < 0.05$), household size ($r = 0.53$, $p < 0.05$) and years of experience ($r = 0.31$, $p < 0.05$). This implies that there is a statistically valid analysis but moderate (in the first two cases) or almost weak (the third case) positive linear correlation between the variables.

Table 7. Correlation analysis of the respondents' socio-economic characteristics and the profit level

VARIABLES	R	P	DECISION
Age	0.61	0.01	S
Household size	0.53	0.03	S
Experience	0.31	0.00	S

Source: Field survey, 2012
NS = Not significant, S = Significant ($p < 0.05$)

The Chi–square analysis shows that there is no significant association between the profit level, sex ($\chi^2 = 0.01$, $p = 0.05$) and educational status ($\chi^2 = 4.31$, $p = 0.05$), while there is a significant difference between the costs and returns, marital status ($\chi^2 = 1.43$, $p = 0.05$) and religion ($\chi^2 = 2.14$, $p = 0.05$) (Table 8).

Table 8. Chi-square analysis of respondents' socio-economic characteristics and yield performance in small scale fish farming

VARIABLES	χ^2	Df	CC	DECISION
Sex	0.01	1	0.09	NS
Educational Status	4.31	6	0.10	NS
Marital Status	1.43	3	0.04	S
Religion	2.14	2	0.00	S

CONCLUSIONS

The study concludes that fish production is a profitable and viable business in Ibadan, Oyo state. Generally, there are lots of business opportunities in fish production using any production system and it promises a very good turnover subject to availability of initial capital and proper management. The earthen ponds, however, provide an option for those who are resource-poor because the fixed cost in this case is lower compared to the concrete tanks. Nevertheless, the earthen ponds are even more profitable than the concrete tanks. Based on these findings and the results showed, there was a significant difference between the profit level of earthen fish pond and concrete tank fish farmers in favour of the former.

Recommendations

Having in mind the results of the study, the following are recommended:

i. Variable cost accounted for the highest cost component in fish production; this is brought about chiefly through the high cost of fish feed. This study therefore recommends research into alternative feed sources that will improve the feed cost efficiency.
ii. The ownership structure revealed that most of the fish farms were owned by individuals who had little or no access to finance. One of the possible solutions is more proactive involvement of the government in the system of financing of small-scale fish farming in the area to boost the quantity of fish available for consumption.
iii. Fish farming in the area is male dominated. Females need to be encouraged to participate in fish farming in the area as a means of augmenting their income and improving their standard of living.
iv. Fish farmers should embark on using concrete tanks for fish rearing if wet land is not available to minimize animal protein deficiency and imbibe backyard farming.

Sažetak

USPOREDBA PROCJENE EKONOMSKE KORISTI ZEMLJANIH BAZENA RIBNJAKA I BETONSKIH SPREMNIKA U AKVAKULTURNOM PODUZETNIŠTVU DRŽAVE OYO U NIGERIJI

Temelj ovog istraživanja bila je usporedba procjene ekonomske koristi zemljanih bazena ribnjaka i betonskih spremnika u akvakulturnim poduzećima grada Ibadana u državi Oyo. U izboru 100 uzgajivača ribe korištena je kombinacija svrsishodnog i praktičnog uzorkovanja, a uzgajivači su bili podvrgnuti strukturiranom intervjuu radi prikupljanja primarnih podataka u svrhu deskriptivne statistike, proračunske tehnike i inferencijalne statistike. Istraživanje je rezultiralo sljedećim podacima: prosječna životna dob bila je 41 godina, muškaraca je bilo 83,0%, oženjenih 87,0%, u većini slučajeva bilo je 5 članova kućanstva, obrazovanih je bilo 96,0%, a iskustvo uzgoja riba kod ispitanika bilo je 8 godina. Korisnici zemljanih bazena ribnjaka imali su srednji prihod od ₦3,322,189.85 s bruto maržom od ₦2,188,397.89, dok su korisnici betonskih spremnika zaradili ₦2,412,271.08 s bruto maržom od ₦1,413,299.46. Indeks profitabilnosti bio je 0,61 i 0,47, varijabilni omjer troškova 0,35 i 0,30, omjer troškova i koristi 2,55 i 1,89, bruto omjer 0,40 i 0,54, a omjer strukture troškova bio je 0,13 i 0,23. Značajna je razlika između razine profita od zemljanih ribnjaka i betonskih spremnika ($t = 42,53$, $p \leq 0,05$). Glavne prepreke koje utječu na ekonomski status ispitanika bili su visoki troškovi kvalitetne prehrane, neadekvatnost fondova, krivolov i loš marketing. Zaključno, akvakultura je isplativo i održivo područje poduzetništva, bez obzira na kulturni sustav. Vlada bi trebala pomoći uzgajivačima ribe subvencioniranjem troškova prehrane, odobravanjem i praćenjem kredita.

Ključne riječi: usporedba procjene, ekonomske koristi, betonski spremnici, zemljani bazeni ribnjaka, Nigerija

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