Global Journal of Science Frontier Research
Volume 11 Issue 9 Version 1.0 December 2011
Type: Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals Inc. (USA)
Online ISSN : 2249-4626 & Print ISSN: 0975-5896

Comparative Technical Efficiency of Concrete and Earthen Fish Pond in Oyo State-Nigeria

By Ajao. A.O
Akintola University of Technology Ogbomoso

Abstract - The study analysed the technical efficiency of earthen and concrete ponds in Oyo State from a sample of 80 earthen fish farmers and 120 concrete fish farmers selected from two Agricultural zones in Oyo state given a grand total of 200 fish farmers using Data Envelopment Analysis (DEA) approach to analyse the technical efficiency of earthen and concrete ponds under the Constant Return to Scale (CRS) and Variable Return to Scale (VRS) specifications. In order to identify the derterminants of earthen and concrete ponds inefficeinecy, a tobit analysis was conducted on the efficiency indices and suspected correlates of inefficiency. The average overall technical efficiency estimates obtained under the CRS and VRS specifications for earthen pond fish farmers are respectively 0.91 and 0.94. The mean overall technical efficiency estimates obtained under the CRS and VRS specifications for concrete pond fish farmers are 0.93 and 0.97. The study concluded that substantial inefficiency in earthen and concrete ponds occurred in the area.

Keywords : *earthen pond; return to scale; efficiency.*

COMPARATIVE TECHNICAL EFFICIENCY OF CONCRETE AND EARTHEN FISH POND IN OYO STATE-NIGERIA

Strictly as per the compliance and regulations of :

© 2011. Ajao. A.O. This is a research/review paper, distributed under the terms of the Creative Commons Attribution-Noncommercial 3.0 Unported License http://creativecommons.org/licenses/by-nc/3.0/), permitting all non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

Comparative Technical Efficiency of Concrete and Earthen Fish Pond in Oyo State - Nigeria

Ajao. A.O

Abstract - The study analysed the technical efficiency of earthen and concrete ponds in Oyo State from a sample of 80 earthen fish farmers and 120 concrete fish farmers selected from two Agricultural zones in Oyo state given a grand total of 200 fish farmers using Data Envelopment Analysis (DEA) approach to analyse the technical efficiency of earthen and concrete ponds under the Constant Return to Scale (CRS) and Variable Return to Scale (VRS) specifications. In order to identify the derterminants of earthen and concrete ponds inefficeinecy, a tobit analysis was conducted on the efficiency indices and suspected correlates of inefficiency. The average overall technical efficiency estimates obtained under the CRS and VRS specifications for earthen pond fish farmers are respectively 0.91 and 0.94. The mean overall technical efficiency estimates obtained under the CRS and VRS specifications for concrete pond fish farmers are 0.93 and 0.97. The study concluded that substantial inefficiency in earthen and concrete ponds occurred in the area.

Keywords : earthen pond; return to scale; efficiency .

I. Introduction

In Nigeria the production of fish is about 0.7 million metric tons annually which results in shortfall of about 1.0 million metric tons annually. Only 5% of this 0.7million metric tons produced locally is from aquaculture while the remaining 95% is from the captured fisheries which is dominated by the artisanal fish farmers. (Aliu and Abolagba, 1998). Production levels and trends for food fish from the baseline projections are shown in table 2, a snapshot of world fisheries in the late 1990s can be derived from the figures in the table. The developed countries accounted for 27 percent of the world food fish, with the remainder fairly evenly split between China and the rest of the developing world. Worldwide, the share of aquaculture in total food fish in 1996/98 was under 31 percent, but the share in China was over 58 percent, with other developing countries producing 17 percent of their food fish from aquaculture. Low value species accounted for about 48 percent of food fish worldwide but for only 19 percent in the developed countries. Thus capture fisheries in the late 1990s accounted for more than two-thirds of the world's food fish, China accounted for the large majority of aquaculture and low value species accounted for just under half the fish used as food.

Author : Agricultural Economics Department Ladoke Akintola University of Technology, Ogbomoso.
E-mail : oaajao57@lautech.edu.ng

Table 2 shows a projected growth in total food fish production to 2020 of 40 percent , equivalent to an annual rate of increase of 1.5 percent from 1996/98 onwards. Over two-thirds of this growth is projected to come from aquaculture. The table shows that aquaculture growth trends projected to 2020 are almost twice as high as for capture fisheries in most of the world. China is a notable exception; capture fisheries are projected to grow at 2 percent per annum through 2020 in China, partially in substitution of the fishing effort of other nations. It should be noted that capture fisheries projections are largely influenced by (conservative) assumptions about non-price factors driving capture fisheries, whereas aquaculture growth rates are more influenced by relative prices and thus have a higher endogenous component in the modeling. The picture that emerges of changes to 2020 on the production side for food fish can be summarized into three sets of points. First, the production share of the developing countries rises from 73 percent in 1996/98 to 79 percent in 2020, and about 5 of the 6 percent increase in share is accounted for by China. Second, the share of aquaculture worldwide is projected to increase from 31 to 41 percent in 2020. While China, share of food fish production from aquaculture increases from 59 to 66 percent, other developing countries. Share of production from aquaculture increases from 17 to 27 percent, a larger relative change. The share of aquaculture will increase worldwide, but especially in the developing countries, and not just in China. Third, the share of low value fish in total food fish is remarkably stable, at about 48 percent. The overall shares in total food fish production of high and low value finfish capture species fall (by 4 and 6 percent of total production, respectively), but the production shares of low value finfish and (high value) mollusks and crustaceans from aquaculture rise enough by 2020 to compensate for this.

Global Journal of Science Frontier Research Volume XI Issue IX Version I December 2011

© 2011 Global Journals Inc. (US)

Table 2 : Production of total food fish, 1997 (actual) and 2020 (projected)

Region	1997		2020		Annual % growth, 1997 -2020	
	(000 mt)	(% from aq.)	(000 mt)	(% from aq.)	(total)	(aquaculture)
China	33,339	58	53,074	66	2.0	2.6
Southeast Asia	12,632	8	17,521	29	1.4	3.6
India	4,768	40	7,985	55	2.3	3.7
Other South Asia	2,056	23	2,999	39	1.7	4.0
Latin America	6,380	10	8,807	16	1.4	3.5
WANA	2,248	9	2,776	16	0.9	3.6
SSA	3,738	1	6,015	2	2.1	5.8
United States	4,423	10	4,927	16	0.5	2.7
Japan	5,188	15	5,172	20	0.0	1.2
EU-15	5,926	21	6,716	29	0.5	2.1
E. Europe & former USSR	4,896	4	5,024	4	0.1	0.4
Other developed	4,761	12	5,779	20	0.8	2.9
Developing world	67,973	37	102,495	47	1.8	2.8
Developing world excl. China	34,634	17	49,421	27	1.6	3.6
Developed world	25,194	13	27,618	19	0.4	2.1
World	93,167	31	130,112	41	1.5	2.8

Sources : 1997 data are three year averages centered on 1997, calculated from FAOSTAT (2000). Projections for 2020 are from IFPRI.s IMPACT model (July 2002).

Notes : Growth rates are exponential growth rates compounded annually using three-year averages as endpoints

© 2011 Global Journals Inc. (US)

Fish plays a vital role in feeding the world's population and contributing significantly to the dietary intake of hundreds of millions of the populace. On a global scale, almost 16 percent of total average intake of animal protein was attributed to fish in 1998 (FAO, 1990). In the developing world, fish is a highly acceptable food that supplies as much as 40 percent of all animal protein available and also countries where fish is the main source of animal protein, 39 out of the top 40 are found in the developing world (FAO, 1990). Moreover, the poor spend proportionally more on fish than on meat or other sources of animal protein. Fish can be consumed in different forms by both man and animals and it can be preserved using different method such as drying, salting, canning, freezing, smoking etc. Fish is a vital source of food for people and it is man's most important single of high quality protein, providing 16% of the animal protein consumed by world's population according to the Food and Agriculture Organization (1997). Fish is widely accepted because of its high nutritive value being rich in vitamins, fat and other nutrients needed for human growth and health. It is also palatable and tender. Moreover, it is free from cultural and religions taboos, thus making it acceptable to people of all nations, tribes and religions.

Fisheries subsector which is composed of marine, brackish and freshwater plays some roles in the Nigeria economy which includes being a source of cheap animal protein, employment and foreign exchange earning for the nation. The fisheries sub-sector also gives an opportunity to generate income and production of fish processing offers the advantage of improved local nutrition since it provides ready source of high quality protein (Otubusin, 1999). Although their production is still below expectation but several attempts have been made over the years to boost their productivity through institution reforms and various fiscal and economic measures. Some of these measures involved tax exemption and input subsidy schemes for distribution of fishermen to stimulate increased production. (Olujimi, 2002).

In Nigeria, the prevailing economic situation has produced poverty and increased cases of malnutrition. The need to provide adequate food especially animal protein for the ever-growing population is on the increase. Over 90 percent of domestic fish supply emanates from fishing in natural waters. Many Nigerians depend on meat production for protein supply. In 1970's and 1980's the intermittent outbreak of rinderpest coupled with desert encroachment has drastically affected meat production which has forced many more Nigerians to continually depend upon fish supply as source of animal protein. (Dada and Gmnadoess, 1986). The cost of meat, which is beyond the reach of many Nigerian, has forced many individual to shift to fish supply, which has been relatively cheaper. Production from fish culture is still low as well as that from industrial fishing which comprises the commercial trawlers when compared to the artisanal. On the whole, fish production in Nigeria is still largely dependent on the small scale fisherman. The demand for fish in Nigeria today is certainly greater than the total production from her domestic sources, thus imports account for about 50% of fish consumption in the country (Federal Ministry of Agriculture and Rural Development, 2001). Fish farming as an industry is faced with some problems one of them is inadequate supply of food. Insufficient production of fingerlings of cultivable fish species and lack of sufficient least discourteously effective feed for fish culture, the better performance in quality and quantity of fish nutrient is responsible for its increase in demand and investment in fishery in Nigeria. However, the higher demand refused to meet with the supply of the product. A report from Oyo State Ministry of Agriculture and Natural Resource (Agricultural unit) had reported that existing fishpond on paper are quite more than ones in ground. This could cause a supply deficit, since the physically present fishpond cannot meet the demand for fish products. It therefore implies that most ground fishpond could not operate due some technical insufficiency. A research into the problem on nutrition reveals that many people in the developing countries of the world are under nourished at least one out of nine persons sampled (FAO, 1991). Despite all developmental programmes on food accessibility and availability carried out by the Nigerian government, hunger and malnutrition still exists in most part of the country. In a meeting of the African Regional Nutrition strategy in 1993, Nigeria was included as one of the countries having the lowest daily per capita supplies of between 70-90 percent of nutrition requirements. In view of this, It important to consider the comparative efficiency of earthen and concrete fish pond in relationship to productions and to suggest the measure that could promote improvements in both in order to foster more fish availability for consumption of the rapidly increasing Nigerian populace.

II. Materials and Method

Data Envelopment Analysis (DEA)

DEA is a linear programming based technique for measuring the relative performance of Decision Making Units (DMUs) where the presence of multiple inputs and outputs makes comparisons difficult. DEA is a relatively new approach for evaluating the performance of set of decision-making units (DMUs), which convert multiple outputs. The definition of a DMUs is generic and in recent years has been a great variety of applications of DEA in evaluating the performances of many different kinds engaged in many different activities in many countries.DEA provides a means of calculating apparent efficiency levels within a group of DMUs. The efficiency of a DMU is calculated relative to the group's observed best practice. When there are multiple inputs and multiple outputs, a common measure for relative efficiency is

© 2011 Global Journals Inc. (US)

$$\text{Efficiency} = \frac{\text{Weighted Sum of outputs}}{\text{Weighted Sum of inputs}}$$

Each DMU picks weights such that it maximize its own efficiency subject to constraints that ensure: (1) no unit can have an efficiency score greater than 1 and (2) every weight must be strictly greater than 0. Let us assume there are n DMUs, each DMU has t outputs and in inputs. Let us take DMU, as the example the linearised output oriented DEA model is:

$$\text{Maximise} \quad h = \sum^{t} u_r y_{r_1}$$

$$\text{Subject to:} \quad \sum_{i_t=1}^{m} v_i^{r=1} x_{i_1} = 1$$

$$\sum_{r=1} u_r y_{r_j} - \sum_{i=1}^{m} v_i x_{i_j} \leq 0 \qquad j = 1,2......n$$

$$u_r \geq \varepsilon, r = 1,2,...t$$

$$v_i \geq \varepsilon, i = 1,2,...m$$

Where U_r is the weight of output r v_i is the weight of input i, y_{rj} is the amount of output r of DMU_j (j =1, ….n), X_{ij} is the amount of input i DMU_j (j = 1, ….n) and ε is a small positive number. The result of the DEA is the determination of the hyperplanes that define an envelope surface or pareto frontier. DMUs that lie on the surface determine the envelope and are deemed efficient, whilst those that do not are deemed inefficient. A complete DEA solves n linear programs, one for each DMU. DEA has been applied to a variety of industrial and service landscapes banks, airports, hotels, hospitals. The aim here is to determine corporate or branch efficiency compared to a competitor or ideal. Often the main goal of measuring efficiency is to determine which companies to do business with Weber and Desal highlight DEA's ability to distinguish between material suppliers and then use this distinction as a bargaining tools for less efficient suppliers DEA is so often applied to the "bottom line" that is use in areas outside strict profitability. These DEA applications have various forms of evaluating the performance of entities such as hospitals, Air force wings, universities cities, court, firms and others including the performance of countries (Cooper, et al., 1999) As pointed out by Cooper, Seiford and Zhu (1999), DEA has been used to supply new insights into activities (and entities) previously been evaluated by other methods, for instance, benchmarking practices with DEA has identified numerous inefficiencies in some of the most profitable firms, firms served as benchmarks by reference profitability has provided a vehicle for identifying better benchmarks for many applied studies. DEA utilizes techniques such as mathematical programming, which can handle numbers of variables and relations (constraints) and this relaxes the requirements that are often encountered when one is limited to choosing only few inputs and outputs because the techniques employed will otherwise encounter difficulties. DEA provides dual collabaration between analyst and decision makers, which extend from collaboration in choice of the inputs and outputs to be used and includes choosing the type of "what-if" question to be addressed, such collaborations extend to bench marking of "what-if" behaviour of competitors and include identifying (new) competitors that may emerge for consideration in some of the scenarios that might be generated (Zhu and Sarkis, 2004),

Additional advantage of DEA where also noted in terms of (a) its ability to identify sources and amount of inefficiency in each input and each output for each entity (hospital, firm, store etc) and (b) its ability to identify the benchmark members of the efficient set used to effect these sources (and) amount of inefficiency. Data envelopment analysis is a non-parametric mathematical programming analysis model may be classified into two groups oriented model such as those of Charnels *et al.,* (1978) and additive model, such as that of Charnels (1985). An appropriate method for anlaysing technical efficiency is the Data Envelopment Aanalysis method (Banker et al., 1984). Banker states that "Using DEA the weighted input firms have considerable flexibility in determining combinations of inputs to produce different combinations of outputs according to their preferred weights". Therefore more than one firm can be technically efficient only a small percentage of agricultural frontier applications have used the DEA approach for frontier estimation. Given the popularity of mathematical programming method on other of agricultural economics research during the 1960s and 1970s. However, DEA has a very large percentage in other professions especially in the management output such as banking, health and telecommunications and electricity distribution (Cooper *et al.*, 1999). The envelopment solution to a DEA mind produces two useful by-products as follows one, it supplies information on the peers and two, it supplies information on the target of each inefficient firms in the sample. The peers of inefficient firms are to be model firms. They are efficient firms, which have similar input mixes with the inefficient firms. The targets are coordinates of the efficient projected point (for the inefficient firm) and now provide the input and output qualities that the inefficient firm should be able to achieve, if it were to operate on efficient frontier (Coelli, 1997) for instance, efficiency consideration which are central to the DEA evaluations of interest are introduced by using the familiar and every simple ratio definition of output divided by input. This ratio formulation is then extended to multiple outputs and multiple inputs in a manner that makes contact with more complex formulation. (Cooper *et al.,* 1999).

© 2011 Global Journals Inc. (US)

Kareem *et al*., (2008) analyzed the technical, allocative and economic efficiency of different pond systems in Ogun state, Nigeria. The study investigated the costs and returns analysis of the respondents and the stochastic frontiers production analysis was applied to estimate the technical, allocative and economic efficiency. The results of the returns to Naira invested shows that earthen pond system yielded than concrete pond system. The results of economic, allocative and technical efficiency revealed that earthen pond system is higher than concrete pond system. Stochastic frontier production models showed that pond area, quantity of lime used, and number of labour used were found to be the significant factors that contributed to the technical efficiency of concrete pond system. While pond, quantity of feed and labour are the significant factors in earthen pond system. The result therefore concluded that only years of experience is the significant factors in concrete pond system in the inefficiency sources model. On the basis of findings, the study suggested that government of Nigeria should provide a conducive environment for the establishment of both concrete & earthen pond system, encourage more citizenry, mostly youth to set up both pond systems in a bid to alleviate poverty status and un-employment rate in the state and the country at large.

Sharma and Leung (1998) examined the technical efficiency of carp production in Nepal. In Nepal, productivity in aquaculture is much lower compared to other countries in the region which suggests that there is potential for increased fish production through technological progress and improvement in farm level technical efficiency. However, no formal analysis has yet been conducted to assess the productive performance of Nepales aquaculture and its potential for future improvement. Against this background, it examines the technical efficiency and its determinants for a sample of fish pond farms from the Tarai region of the country using a stochastic production frontier involving a model for technical efficiency of intensive farms being more efficient that extensive farms. The adoption of regular fish, water, and feed management activities has a strong positive effect on technical efficiency.

Adeokun *et al.,* (2006) investigated children's involvement in fish production in waterside local Government Area, Ogun State, Nigeria. Multi-stage technique was used. The findings of the research showed that male children dominated fish catching and net making and mending while the female children were mainly involved in processing. All other activities in which the children were involved were water fetching, fish marketing, fish processing and fish storage among others gave no significant difference on gender basis. Based on the findings, it was recommended that government and non-governmental agencies should come up with special programmes and incentives for revering fishing village's that will ensure effective integration of children into national programmes for food itself sufficiency and poverty alleviation at household and national levels.

Anetekhai *et al.,* (2004) conducted a study on aquaculture development in Nigeria. The current production from aquaculture is about 26,000 metric tones which is less than 0.01% of the national capacity. The major constraints identified as being responsible for the low production from aquaculture are shortage of inputs (fingerlings and feed), lack of knowledge resulting in poor management, inadequate funding, theft and direct involvement of the government in production. The study recommends some measures to be taken for the development of aquaculture in Nigeria particularly the creation of a ministry of fisheries to co-ordinate all activities in the sector and provides an enabling environment for aquaculture.

Sampling Procedure and Sample Size

Multi-stage sampling procedure was used. Firstly, two agricultural zones were selected from all the agricultural zones in Oyo-State. These were Ogbomoso and Ibadan/Ibarapa zones. Ogbomoso Agricultural Zone and Ibadan - Ibarapa agricultural zone was selected due to the present of many aquaculture farmers in the area. Secondly, all Local Government Areas were sampled from Ogbomoso zone and Ibadan/Ibarapa zone. Thirdly, registered fish farmers were chosen and fourthly from these registered fish farmers, 80 earthen fish farmers and 120 concrete fish farmers were randomly selected. In all, 200 fish farmers were selected.

The data that was used in this study is essentially from primary sources namely the fish-farmers in the study area. Structured questionnaires were used to collect information needed from the sample of fish farmers. The structured questionnaires were used to draw out information on variables such as pond data, land data, stocking or pond number source of stocking material, feed, labour data, harvesting time data, marketing, loan inventory of asset data cost etc. These variables were identified within the framework of the study objectives.

For the purpose of this study the major variables that were considered are the following output and input.

Y = Fish output (kilogram)
X_1 represented the quantity of fingerlings (kg).
X_2 represented fish pond (m^2)
X_3 represented the quantity of feed that was used on the farm (kg of dry matter weight)
X_4 represented the quantity of supplementary feed like: (waste of animal by product) used to feed the animal in kilogram
X_5 represented the fertilizer used to culture the fish (kilogram)
X_6 represented labour. (man-day)

© 2011 Global Journals Inc. (US)

Analytical Technique

Multi-stage DEA was used to analysed the data obtained. In Multi-stage DEA, the outputs from one process can be the inputs for the next. However, it is sometimes possible to merely "line up" outputs with wherever they occur again as inputs, not necessarily in the next consecutive node. Unique features of multi-stage DEA make it useful. That is, data flow from stage to stage in the model just as work parts. There is evidence that DEA conducted in multiple stages yields more reliable data and also has been configured to place more emphasis on inputs which are within management control.

III. Results and Discussion

Overall efficiency estimates of earthen pond farmers

The frequency distribution of the earthen pond fish farmers technical efficiency under the constant Return to Scale and the Variable Return to Scale (CRS and VRS) efficiency estimates is given in table 2.

The average overall technical efficiencies are 0.91 and 0.94 for CRS and VRS respectively. Substantial inefficiencies occurred in the fish pond farming of the sampled earthen pond fish farmers in the study area. Under this current circumstances, about 5% and 13.8% of ponds were identified as fully technically efficient under the CRS and VRS specification respectively. The observed difference between the CRS and VRS measures further indicated that some of the earthen pond fish farmers did not operate at an efficient scale and improvement in the overall efficiencies could be achieved if the farmers adjusted their scales of operation. Under the CRS, the group with the highest frequency of technical efficiency is 0.90-0.94 amounting to 50% of the sampled earthen pond fish farmers. This was followed by group 0.85-0.89 with a percentage of 25% of the total respondents under earthen pond. Under the VRS, the group with the highest frequency of technical efficiency is also 0.90-0.94 amounting to 46.3% of the sampled earthen pond fish farmers, followed by the group 0.95-0.99 with 25%. The lowest technical efficiency scores fall within the 0.75-0.84 group under VRS specification. The mean of the distribution under CRS and VRS are 0.91 and0.94, the minimum are 0.812 and 0.83, maximum 1.00 and standard deviation are 0.044 and 0.0.041respectively.

Table 2 : Overall efficiency of earthen pond farmers.

	Constant return to scale		Variable return to scale	
Technical Efficiency	Frequency	Percentage	Frequency	Percentage
0.80-0.84	06	7.5	01	1.3
0.85-0.89	20	25.0	11	13.8
0.90-0.94	40	50.0	37	46.3
0.95-0.99	10	12.5	20	25
1.00	04	5	11	13.8
Total	80	100	80	100
Mean	0.913898		0.941013	
Minimum	0.812		0.83	
Maximum	1.0		1.0	
Standard dev.	0.043696		0.040873	

Source : Field survey, 2010.

Overall efficiency estimates of concrete pond farmers.

Table 3 gives the frequency distribution of the concrete pond CRS and VRS efficiency estimates. The average overall technical efficiency under CRS is 0.93 while the average technical efficiency under the VRS specification is respectively 0.97. This result also reveals that substantial resource use inefficiencies occurred in the fish pond farming of the sampled concrete pond fish farmers in the study area. Under the prevailing condition, the percentage of ponds that achieved full efficiency technically under the CRS is 5%, under the VRS, those that are technically efficiency is 39.2% respectively. The large difference between the technical efficiency under the CRS and VRS specification justifies further the need for the concrete pond fish farmers to adjust their scale of operation by optimizing the resources available to them at present like the other pond above, it is obvious that the technical efficiency measures under the VRS are higher than those under the CRS. The technical efficiency of 35% between CRS and VRS specifications revealed the weakness in the scale of operation more than the other pond. The result also adduced to the substantial inefficiency of the concrete pond fish farmers in the study area.

© 2011 Global Journals Inc. (US)

Table 3 : Overall efficiency of concrete pond farmers.

Constant return to scale			Variable return to scale	
Technical Efficiency	Frequency	Percentage	Frequency	Percentage
0.75-0.79	01	0.8	00	00
0.80-0.84	02	1.7	00	00
0.85-0.89	21	17.5	01	0.8
0.90-0.94	63	52.5	27	22.5
0.95-0.99	27	22.5	45	37.5
1.00	6	5.0	47	39.2
Total	120	100	120	100
Mean	0.931142		0.967117	
Minimum	0.796		0.876	
Maximum	1.0		0.9785	
Standard dev.	0.036918		0.053351	

Source : Field survey, 2010.

Earthen and concrete ponds scale efficiency

Table 4 shows that the average scale efficiency indices for earthen and concrete ponds are respectively 0.97 and 0.96. Earthen ponds demonstrating the lowest scale inefficiency and concrete pond operating at the highest scale inefficiency. However, the results show that there are substantial scale inefficiencies in both earthen and concrete ponds. This implies that most of the fish ponds should be larger than their present sizes in order to achieve higher production.

Table 4 : Summary of earthen and concrete ponds scale efficiency

	Earthen pond		Concrete pond	
Efficiency indices	No of ponds	Percentage of ponds	No of ponds	Percentage of ponds
0.80-0.84	01	1.3	02	1.7
0.85-0.89	03	3.8	07	5.8
0.90-0.94	13	16.3	31	25.8
0.95-0.99	49	6.1	69	57.5
1.00	14	17.5	11	9.2
Total	80	100	120	100
Mean	0.97175		0.959738	
Minimum	0.812		0.872	
Maximum	1		1	
Standard dev.	0.035089		0.035773	

Source : Field survey, 2010.

Optimal, sub optimal and super optimal output of the earthen and concrete ponds

Earthen and concrete ponds optimal, suboptimal and super optimal output are reported in table 5. In term of economics of scale, 14 ponds were characterized by constant return to scale, 48 ponds had increasing return to scale and 18 ponds was characterized by decreasing return to scale among earthen pond fish farmers. In concrete pond, 11 ponds operated under the constant return to scale. 106 ponds were characterized by increasing return to scale and only 3 ponds was characterized by decreasing return to scale. If all ponds using the same technology, then it would be expected that return to scale would increase for ponds with a relatively low outputs and decreasing return to scale ponds with a relatively high outputs. Constant return to scale would be expected for ponds with output level equals to the mean output. The mean output of the suboptimal scale is larger than the mean output of the optimal as well as super optimal scales for concrete ponds while that of earthen pond the mean outputs of the super-optimal scale are larger than the optimal and sub-optimal scales. The results indicates that the super optimal output levels overlap a substantial portion of the optimal and sub-optimal outputs, while for concrete pond, the sub-optimal output value overlaps that of optimal and super optimal value.

© 2011 Global Journals Inc. (US)

Table 5 : Distribution of earthen and concrete ponds optimal suboptimal and super optimal outputs

Earthen pond/scale	No of ponds	Percentage of ponds	Mean Output (kg)
Optimal	14	17.5	2250
Sub-optimal	48	60.0	1430
Super-optimal	18	22.5	2975
Concrete pond/scale	**No of ponds**	**Percentage of ponds**	**Mean Output (kg)**
Optimal	11	9.2	2150
Sub-optimal	106	88.3	3000
Super-optimal	03	2.5	1513

Source : Field survey, 2010.

Summary of ponds output slack

Table 6 shows the ponds summary of the output slack under the CRS DEA and VRS DEA specifications. Under the constant return to scale, the output slacks for the earthen ponds and concretes ponds was zero for each of them. This result indicates that, given the present scale of operation and the available resources, the fish farmers could not do anything to increase their output levels beyond the present values irrespective of the adjustment in their input levels because of the difficulty of resource fixity. In the case of the VRS specifications, the output for earthen ponds and concrete ponds are 151kg and 275kg respectively. This result indicates the amount by which the output levels could be increase without a corresponding increase in the amount input used.

Table 6 : Distribution of ponds output slack

Ponds	CRS	VRS
Earthen ponds	0	151
Concrete ponds	0	275

Source : Field survey 2010.

Summary of ponds VRS input slacks

Table 7 gives the summary of the input slacks under the VRS specification. The fingerlings slack is the amount of the excess quantity of the fingerlings used in fish culture. The output levels realized could still have been realized if the quantity of fingerlings used in culturing had been reduced by 2141. 845kg, the slacks for ponds, feed, fertilizer, labour are 4.205m^2, 17.849kg, 3.917kg, 263.575kg respectively. These values correspond to the excess input used in the farming operation.

Table 7 : Distribution of VRS input slacks

Input	Slacks
Fingerlings (kg)	2141. 8
Ponds (m^2)	4.2
Feeds (kg)	263.6
Fertilizer (kg)	3.9
Labour (man day)	17.9

Source: Field survey 2010

Summary of pond output target

Table 8 gives the summary of the output targets. The output target refers to the amount of output the decision making units should aims at producing given the available units inputs. For example in concrete ponds, the minimum output target that some of the DMU should aim at producing fell within the range of 8001- 10,000. Only 1 DMU amounting to 0.83% of the total DMU's in the pond is applicable. None of the DMU in earthen pond had such a low output target range. The same maximum output target range is 10,000 above. Only 5% of the concrete pond fish farmers should aim at producing at this level of output.

Table 8 : Distribution of ponds output target

Target	Earthen ponds Frequency	%	Concrete ponds Frequency	%
< 2000	9	11.3	3	2.5
2001-4000	27	33.8	58	48.3
4001– 6000	31	38.8	47	39.2
6001– 8000	7	8.8	5	4.2
8001-10,000	6	7.5	1	0.8
> 10,000	0	0	6	5.0
Total	80	100	120	100

Source : Field survey 2010

IV. Conclusion

The study was designed to familiarize fish farmers attention with an area in fish production where the use of efficiency is becoming increasingly important. The study concluded that substantial inefficiencies occurred among concrete and earthen ponds fish farmers in the study area but surprisingly more evidenced in earthen pond. Available evidence from this study has shown that only four farms were fully efficient under the Constant Return to Scale for the earthen pond

© 2011 Global Journals Inc. (US)

fish farmers. While only 11 were fully efficient under the Variable Return to scale from earthen pond fish farmers. Also under Constant Return to Scale for concrete pond fish farmers five farms were fully efficient while under Variable Return to Scale for concrete pond fish farmers 47 were fully efficient.

References Références Referencias

1. Adeokun, O.A., Adereti, F. O. and Akanni, K.A. (2006): "Children Involvement in Fish Production: A Strategy For Poverty Alleviation in Waterside Local Government Area,Ogun State" Research Jounal of Fishery and Hydrobiology, 1(1): 10-13
2. Aliu, B.S and O.J Abolagba, (1998): "Feed as an Essential input in Agricultural Production in Nigeria. In sustainable utilization of Aquatic Netland Resources. Eds: Otubusin S.O., G.N.O. Ezeri O.A Ugwumba, A.A.A. Ugwumba, selected papers from the 9th 10th Annual conference of Nigerian Association for Aquatic Sciences, 30th November-2nd December 1995 Pp. 155-159.
3. Anetekhai, M. A.,Akin-oriola, G.A, Aderinola and Akintola S.L.,(2004) "Steps Ahead for Aquaculture Development in Sub-Sahara Africa-the case of Nigeria. Faculty of Science Fishries, Lagos state University, Apapa-P.M.B 1087, Lagos, Nigeria.
4. Banker, R.D. Charnes, A. and W.W. Cooper (1984) "Some Models for Estimating Technical and scale inefficiencies in Data Envelopment Analysis" Management Science, 30, 1078-1092.
5. Charnes, A. Cooper, W.W. and Rhodes, E. (1978): "Measuring the Efficiency of Decision Making Units". European Journal of Operational Research, 2(6): 429-444.
6. Charnels, J.G. (1985): A review of the fishing industry in worlds and status of fish preservation methods and future growth pre-requisite to cope with anticipated increase in production, NIOMR Tech paper No. 17.
7. Cooper, W.W., Seiford, L.M. and Zhu (1999): Data Envelopment Analysis Model and Interpretation Pp. 1-39; Handbook Envelopment Analysis.
8. Coelli, T.J (1997): A multistage Methodology for the Solution of Oriented DEA Models, Mimeo, centre for Analysis, University of New England , Armidale.
9. Dada, B.F. and B.D.S Gmnadoess, (1986): Nigerian fisheries Development: challenges and opportunities of the 1980's FISH, Maiduguri, Nigeria. Pp. 14-22.
10. FAO (1990): Commodity Review and outlook (1990-1991).
11. FAO (1991): Fish For Food and Development . FAO Annual Publication, Rome.
12. FAO (1997): Review of the state of World Aquaculture FAO fisheries circular No 886, Rev. 1 Rome, Italy Pp 10.
13. Federal Ministry of Agriculture and Rural Development (2001): A publication on opportunities business in Nigeria's agriculture sector Pp.4.
14. Kareem, R.O, Dipeolu, A.O, Aromolaran, A. B and Akegbejo-Samson.(2008) "Analysis of Technical Allocative and Economic Efficiency of Different Pond System in Ogun State, Nigeria" African Jounal of Agricultural Research,Vol.3(4),Pp.246-254.
15. Olujimi O. Jinadu (2000): Economic Efficiency in the coastal small scale fisheries in Lagos State, Nigeria Federal College of Fisheries and marine technology wilmot point, Victoria island Pp 1-6.
16. Otubusin, S.O. (1999). Fish for thought COLERM Seminar Series No. 4 University of Agriculture Abeokuta. Pp. 15.
17. Sharma, K.R and Leung, P. (1998), "Technical efficiency of carp production Nepal: An Application of stochastic Frontier production function Approach". Aquaculture Economics and management vol. 2, Iss 3, Pp. 23-35
18. Zhu.O. and J. Sarkis (2004): "Relationships between operational practices and performance among early adopters of green supply chain management practices in Chinese manufacturing enterprises" Journal of Operations Management, volume 22, No. 3 Pp 265-289.

© 2011 Global Journals Inc. (US)

This page is intentionally left blank

© 2011 Global Journals Inc. (US)