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Growth and Economic Performances of African Catfish, *Clarias gariepinus* Reared under Different Culture Facilities

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Abstract

This study determined the growth and economic performances of African Catfish, *Clarias gariepinus* reared in plastic tanks, sandcrete tanks and earthen ponds for 185 days. Nine hundred *C. gariepinus* fingerlings (mean weight 7.38 ± 0.02g) were acclimatized for 24 hours, out of which one hundred fingerlings were randomly selected and distributed into the three prepared culture facilities (plastic tanks, sandcrete tanks and earthen ponds) of the same size (3.0m X 2.8m X 1.0m), labelled as T1, T2 and T3 respectively. Each treatment was in triplicates; the culture facilities were filled with water up to 3/4 in all the treatment. The fingerlings were fed with formulated standard diet of 40% crude protein at 5% body weight. Fish were fed twice daily at 09:00 and 16:00 hours for 185 days. At final harvest, the total yield of fish was significantly greater (P<0.05) in earthen pond, 3.8kg than those in sandcrete tank, 2.4kg and plastic tank 2.12kg. There were significant differences (P<0.05) in final weight gain, feed conversion ratio, mean daily weight gain between *C. gariepinus* fingerlings stocked in plastic tank, sandcrete tank and earthen pond. Fish in earthen pond had the highest weight gain (1061.2g), specific growth rate (2.68%) than sandcrete tank (835.9g, 2.56%) and plastic tank (772.9g, 2.52%), while survival percentage of *C. gariepinus* from plastic tanks, sandcrete tanks and earthen ponds were: 90.00%, 87.3% and 76.7% respectively. Net profit obtained was ₦26,072 (earthen pond), ₦19,294.67 (sandcrete tank) and ₦18,286.67 (plastic tank). The benefit cost ratio was higher in earthen pond (2.130) than the sandcrete tank (1.773) and plastic tank (1.763). The study considered earthen pond enclosure system to be more productive and the most ideal culture facility for growth optimization in *C. gariepinus.*

Keywords: Growth performance, Economic performance, Culture facilities, *Clarias gariepinus*.

Introduction

Fish, a major product of aquaculture, is an important source of protein for the teeming population in developing nations (FAO, 2018). Fish and fishery products play a critical role in global food security and the nutritional needs of human health (FAO, 2018). Aquaculture is one of the fastest growing food-producing sectors in aquatic field and is set to play a key role in meeting the rising demand for fishery products due to increase in human population and decline in natural fisheries resources (FAO, 2018). One of the priorities of aquaculture is the increase in the production 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). World Fish Centre (2003) observed that total catches of fish from the wild reached a plateau in the early 1990s. Capture fishery production for both food and non-food utilization has levelled off. FAO (2010) also reported that the maximum wild capture fisheries potential from the world's oceans has probably been reached. Capture fishery production is relatively static since the late 1980's (FAO, 2016). Meeting the ever-growing demand for fish as food due to world population growth, health and economic factors is challenging. There is need for the expansion of aquaculture and improvement in aquaculture output. The objective of the study was to increase culture fish production. Ponds are the most widely used structures for aquaculture production. In Africa, especially in Nigeria, the species mostly cultured are *Clarias gariepinus*, *Heterobranchus sp*. and their hybrids (Adewolu *et al*., 2008). The culture of fish in plastic and concrete tanks is now a common practice in the country. Homestead fish farmers operate in concrete tanks whose sizes and shape vary from location to location depending on individual taste, availability of space and financial resources (Omitoyin, 2007).

The African catfish, *Clarias gariepinus*, (Family Clariidae) is an economically important food fish; the most cultured fish species in the country, because of its fast growth rate, tolerance to poor water quality and ability to withstand high stocking densities (Saad *et al.,* 2009). They live in freshwater and widely tolerate extreme environmental conditions with pH range of 6.5-8.0 and depth of 0.8m as well as human made places such as oxidation ponds or even urban sewer system (Skelton, 1993).

They possess elongated body, large head and depressed body with small eyes. Narrow and angular occipital process; gills opening wide; air breathing labyrinth organ arising from gill arches; first gill arch with 24-110 gill rakers; cleithrum pointed, narrow with longitudinal ridges and with sharpness (Benech *et al.,* 1993).

There are various enclosures used to raise fishes such as unused canoes, plastic and depressions that can hold water, tanks and earthen ponds (Angahar, 2017). 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 profitability and economic analysis of the concrete, plastic and earthen pond methods. A basic requirement of an investment decision is to be acquainted with the best system which can give the maximum profit to resource use.

Therefore, this study determined the best production system for fish production with good operating strategy to optimize fish farm profitability and productivity.

Materials and Methods

Experimental Procedure

This study was conducted at the Teaching and Research Farm of The Department of Fisheries and Aquaculture Technology, Federal University of Technology, Akure, Ondo State, for a period of six months.

Nine hundred *C. gariepinus* fingerlings (mean weight 7.38 ± 0.02g) were purchased from a reputable fish farm in Ondo State, Akure and was transported in 50 litre plastic kegs to the Teaching and Research Farm of the Department of Fisheries and Aquaculture Technology, Federal University of Technology, Akure, Ondo State.

The fishes were acclamatized for 24hrs prior to commencement of the study to allow for digestion of food already eaten and prepare the stomach for the formulated feed. One hundred fingerlings (mean weight 7.38 ± 0.02g) were randomly selected and stocked in three prepared different culture facilities: Plastic tanks, Sandcrete tanks and Earthen ponds of the same size (3.0M X 2.8m X 1.0m) labelled as T1, T2 and T3 respectively. Each treatment was in triplicates. The fingerlings were fed with formulated standard diet as reviewed by Fagbenro and Adebayo (2005). Feeding was carried out at 09:00 and 16:00 hours for 185 days. Changing of water in plastic and sandcrete tanks culture facilities was done on a weekly basis.

Water quality parameters (Temperature, pH, Dissolved Oxygen, nitrates and nitrites) were determined on a weekly basis during the experimental period. Temperature readings were taken weekly on the farm using Mecury-in-glass thermometer, pH and Do_2 were determined using pH meter (MODEL, Mettler Toledo 320) and dissolved oxygen meter (DO Model, 9071), nitrates and nitrites were determined by using Analytical Profile Index (API) test kits.

Table 1: Gross composition of the formulated standard diet

Ingredients	**Quality (g/kg) Catfish feed (40% protein)**
Fish Meal (65% cp)	250
Soybean meal (45% cp)	350
Maize	150
Blood Meal (85 percent cp)	100
Fish Oil	60
Vegetable oil	40
Vitamin/mineral premix	30
Binder	20

Source: Fagbenro and Adebayo (2005)

Data collected on growth performance were determined using the following parameters:

- Initial mean weight (g/fish) = $\dfrac{\textit{Initial weight of fish (g)}}{\textit{Number of fish stocked}}$

- Final mean weight (g/fish) = $\dfrac{\textit{Final weight of fish harvested (g)}}{\textit{Number of fish harvested}}$

- Mean Daily weight Gain (mg/day) = $\dfrac{\textit{Final mean body weight (g) - Initial mean body weight(g)}}{\textit{Duration of rearing period (day)}}$

- Weight gain = Final weight – Initial weight

- Food Conversion Ratio = $\dfrac{\textit{Total weight of Feed}}{\textit{Total Weight of fish produce}}$

- Specific Growth Rate SGR = $\dfrac{\text{loge w2} - \text{loge w1}}{t} \times \dfrac{100}{1}$

(Jobling, 1994; Cui and Xie, 2000; Alanara *et al.,* 2001)

- Survival (%) = $\dfrac{\text{No. of survived fishes after culture period (N1)}}{\text{No of fishes stocked (No)}} \times \dfrac{100}{1}$

(Alatise and Otubusin, 2006)

- Fish yield (kg/m^2) $= \frac{\text{Total weight of fish}}{\text{Area of tank}}$

(Jobling, 1994; Cui and Xie 2000; Alanara *et al.,* 2001)

The economic evaluations of the fish were calculated by the following methods:

1. Profit Index $= \frac{\text{Total value of fish (N)}}{\text{Cost of feeding type}}$

2. Net Production Value (NPV)
   NPV = Mean Weight gain of fish (g) X Total survival (n) X Cost per kg (N)

3. Investment Cost Analysis (ICA)
   ICA = Cost of feeding (N)+ Cost of fry Stocked (N)

4. Gross Profit (GP)
   GP = NPV (N)- ICA (N)

5. Incidence of Cost (N/kg) $= \frac{\text{Cost of feeding type (N)}}{\text{Kg weight of fish produces}}$

6. Benefit Cost Ratio (BCR) $= \frac{\text{Net Production Value}}{\text{Investment Cost Analysis}}$

(New, 1989; Aderolu and Oyedokun, 2008)

The data collected were analysed using one way analysis of Variance (ANOVA) at 95% confidence level as described by Steel and Torrie (1980). Comparisons among means were separated using Duncan Multiple Range Test (DMRT) at $P<0.05$, using SPSS version 17.

Results

Considering the water parameters, it was found that the means and range values of pH, dissolved oxygen (mg/l), temperature ^{0}C, nitrite (mg/l) and nitrate (mg/l) levels were considered for the three culture facilities. It was observed that the parameters were similar for the three culture facilities. This might be because the experiment was conducted in the same environment with the same source of water and also by changing the water on a weekly basis. This implies that changes in the yield and profit could not be attributed to water parameter. This is shown in Table 2. The water quality parameters measured in the three enclosure systems (plastic tank, sandcrete tank and earthen pond) during the experimental period varied as follows: temperature (26.4– 27.1, 26.3-27.3 and 26.8-27.6), dissolved oxygen (6.27–6.70, 6.29-6.74 and 6.27-6.80), pH (7.06 –7.28, 7.03–7.25 and 7.06-7.29), Nitrite (0.23–0.24, 0.22-0.24 and 0.21-0.24), Nitrate (31.8–37.2, 32.1-37.3 and 31.6-37.9) respectively.

Table 2: Water quality parameters of the three enclosure system

Water Quality Parameter	Sampling Month	Plastic Tank	Sandcrete Tank	Earthen Pond
	April	7.06 ± 0.05[a]	7.03 ± 0.01[a]	7.06 ± 0.07[a]
	May	7.14 ± 0.01[a]	7.12 ± 0.01[a]	7.17 ± 0.01[a]
pH	June	7.08± 0.03[a]	7.09 ± 0.02[a]	7.06 ± 0.04[a]
	July	7.28 ± 0.18[a]	7.25 ± 0.03[a]	7.29 ± 0.07[a]
	August	7.15 ± 0.05[a]	7.17 ± 0.03[a]	7.15 ± 0.01[a]
	September	7.10 ± 0.02[a]	7.11 ± 0.02[a]	7.08 ±0.07[a]
	April	6.37 ± 0.27[a]	6.34 ± 0.04[a]	6.36 ± 0.21[a]
	May	6.57 ± 0.23[a]	6.53 ± 0.17[a]	6.63 ± 0.03[a]
Dissolved Oxygen(mg/l)	June	6.63 ± 0.22[a]	6.61 ± 0.18a	6.70 ± 0.06[a]
	July	6.27 ± 0.12[a]	6.29 ± 0.15[a]	6.27 ± 0.19[a]
	August	6.70 ± 0.15[a]	6.74 ± 0.17[a]	6.80 ± 0.27[a]
	September	6.57 ± 0.12[a]	6.50 ± 0.09[a]	6.53 ± 0.15[a]
	April	26.4 ± 0.18[a]	26.3 ± 0.15[a]	26.8 ± 0.12[a]
	May	26.7 ± 0.28[a]	26.4 ± 0.21[a]	27.4 ± 0.06[a]
Temperature ^{0}C	June	27.0 ± 0.03[b]	26.8 ± 0.12a	27.1 ± 0.15[a]
	July	26.6 ± 0.23[ab]	26.5 ± 0.26[a]	26.8 ± 0.09[a]
	August	26.5 ± 0.27[ab]	26.8 ± 0.06[a]	27.0 ± 0.24[a]
	September	27.1 ± 0.06[a]	27.3 ± 0.15[a]	27.6 ± 0.22[a]
	April	0.24 ± 0.00[a]	0.23 ± 0.01[a]	0.24± 0.01[a]
	May	0.23 ± 0.07[a]	0.23 ±0.01[a]	0.23 ± 0.01[a]
	June	0.23 ± 0.07[a]	0.22 ± 0.01[a]	0.22 ± 0.66[a]
Nitrite (mg/l)	July	0.23 ± 0.01[a]	0.24 ± 0.01[a]	0.21 ± 0.07[a]
	August	0.24 ± 0.01[a]	0.23 ± 0.07[a]	0.23 ± 0.01[a]
	September	0.23 ± 0.01[a]	0.24 ± 0.01[a]	0.22 ± 0.01[a]
	April	36.4 ± 0.77[b]	36.8 ± 0.20[a]	36.5 ± 0.88[a]
	May	37.2 ± 0.58[b]	37.3 ± 0.87[a]	37.9 ± 0.83[a]
Nitrate (mg/l)	June	33.3 ± 1.16[a]	33.1 ± 1.42[a]	32.5 ± 0.06[a]
	July	31.8 ± 0.42[a]	32.1 ± 0.50[a]	31.6 ± 0.39[a]
	August	32.5 ± 0.86[a]	33.0 ± 1.14[a]	32.2 ± 0.27[a]
	September	32.6 ± 0.76[a]	33.4 ± 0.75[a]	32.1 ± 0.28[a]

Means in the same row with different superscripts, are significantly different at (P<0.05)

Table 3 shows the summary of the results obtained from the growth performance and fish yield of *C. gariepinus* reared in plastic tank, sandcrete tank and earthen pond. The result showed significant differences (P<0.05) in the final mean weight, mean daily weight gain, specific growth rate (SGR), weight gain (WG), and feed conversion ratio in the three enclosure system. The growth of *C. gariepinus* reared in earthen pond had the highest final weight gain, mean daily weight gain and specific growth rate respectively (1068.7±0.10, 5.73±0.03 and 2.68±0.00).

The value obtained from the weight gain of *C. gariepinus* reared in plastic tank, concrete tank and earthen pond is presented in Figure 1.

In sandcrete and plastic tank, observed growth parameter had the following values; 843.3± 18.6 and 780.9 ±11.3, 4.52±0.10 and 4.18±0.06, 2.56±0.01 and 2.52+0.01, 835.9±18.6 and 772.9±11.3 respectively.

The feed conversion ratio of the three enclosures were significantly different (P<0.05). However, the best feed conversion ratio (FCR) was recorded in earthen pond (1.36±0.01), followed by sandcrete tank (1.52±0.01) and 1.61±0.01 for plastic tank.

There were no significant differences (P>0.05) in survival rate and feed intake of T1 (Plastic) and T2 (Sandcrete) enclosure. Culture organism in earthen pond had lower survival percent of 76.7±0.67 than that of sandcrete and plastic. 87.3±2.91 and 90.0±2.31 respectively.

The result obtained from the fish yield of *C. gariepinus* reared in the three enclosure system showed significant difference (P<0.05) in the yield of *C.gariepinus* reared in the three enclosure systems. However, *C. gariepinus* reared in earthen pond had the highest yield value of 3.81, while sandcrete tank had 2.40 and plastic tank had the lowest value of 2.12.

Table 4 shows the summary of profitability investment analysis of *C. gariepinus* from the three enclosure systems, T1 (Plastic) T2 (Sandcrete) and T3 (Earthen pond). The total expenditure, gross income and profit margin from plastic and sandcrete enclosure systems are not significantly different (P>0.05) from each other.

However, there was significant difference (P<0.05) between earthen pond and sandcrete/plastic tank for total expenditure, gross income and profit margin with earthen pond having the lowest total expenditure of N 22,333.33.

The value recorded for the profit margin of *C. gariepinus* reared in plastic tank, concrete tank and earthen pond is presented in figure 2.
The result also showed that earthen pond had the highest profit margin of N26,072 compared to sandcrete and plastic tank that had the lowest value of N19,294 and N 18,286 respectively.

Table 3: Growth performance and fish yield of *Clarias gariepinus* reared in plastic tank, sandcrete tank and earthen pond

Parameters	Plastic	Sandcrete	Earthen
Initial mean weight(g)	7.38 ± 0.02^a	7.45 ± 0.04^a	7.47 ± 0.06^a
Final mean Weight(g)	780.3 ± 11.3^a	843.3 ± 18.6^b	1068.7 ± 6.96^c
Weight Gain(g)	772.9 ± 11.3^a	835.9 ± 18.6^b	1061.2 ± 6.94^c
Mean Daily Weight gain(g)	4.18 ± 0.06^a	4.52 ± 0.10^b	5.73 ± 0.00^c
SGR (%/day)	2.52 ± 0.01^a	2.56 ± 0.01^b	2.68 ± 0.00^c
Feed Intake	1245.8 ± 22.6^a	1271.8 ± 37.2^a	1440.0 ± 7.94^b
FCR	1.61 ± 0.01^c	1.52 ± 0.07^b	1.36 ± 0.01^a
Survival (%)	90.00 ± 2.31^b	87.3 ± 2.91^b	76.7 ± 0.67^a
Fish yield (kg/m^2)	2.12 ± 0.77^a	2.40 ± 0.14^b	3.81 ± 0.11^c

Means in the same row with different superscripts, are significantly different at (P<0.05)

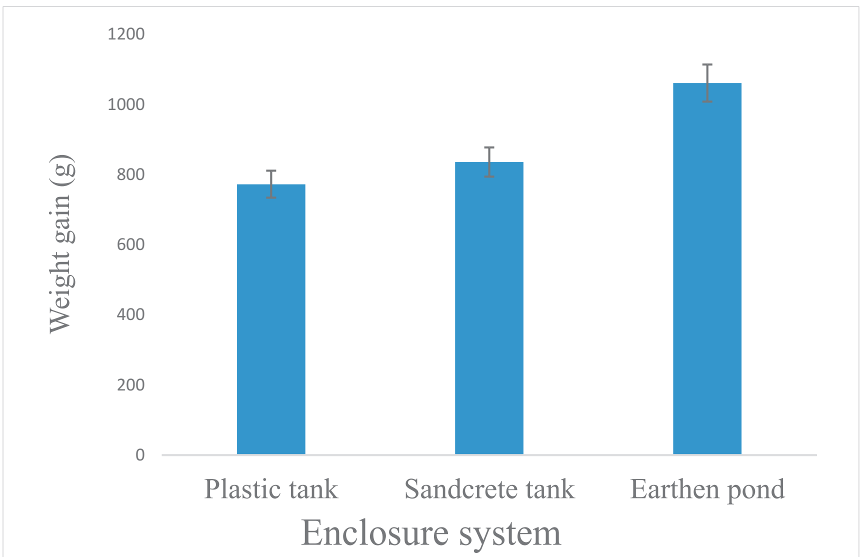

Figure 1: Weight gain of *Clarias gariepinus* reared in three enclosure systems (plastic tank, sandcrete tank and earthen pond)

Table 4: Profit analysis of *Clarias gariepinus* reared in three enclosure system (plastic tank, sandcrete tank and earthen pond)

Parameters	Plastic	Concrete	Earthen
Cost of fingerlings at ₦20.00 each	2000.00 ± 0.000^{a}	2000.100 ± 0.00^{a}	2000.00 ± 0.00^{a}
Number of Fish stocked	100.00 ± 0.00^{a}	100.00 ± 0.00^{a}	100.00 ± 000^{a}
Cost of locally made feed at ₦3,500/bag(15kg/bag)	17500.00 ± 0.00^{a}	17500.00 ± 0.00^{a}	16333.33 ± 583.33^{a}
Cost of Labour (₦)	1000.00 ± 0.00^{a}	2000.00 ± 0.00^{b}	4666.67 ± 3.33^{c}
Cost of changing water (₦)	3333.33 ± 3.333^{b}	33333.33 ± 3.33^{b}	0.00 ± 0.00^{a}
Number of fish harvested	90.00 ± 2.31^{b}	87.33 ±2.91^{b}	76.67 ± 0.67^{a}
Average weight of fish at harvest	0.780 ± 0.07^{a}	0.843 ± 2.91^{a}	1.0667 ± 8.82^{b}
Total weight of fish cropped (kg)	70.20 ± 1.57^{a}	73.54 ± 0.98^{a}	81.79 ± 1.30^{b}
Mortality recorded	10.00 ± 2.31^{a}	12.67 ± 2.91^{a}	23.33± 0.67^{b}
Number of bags of feed consumed(15kg/bag)	5.00 ± 0.00^{a}	5.00 ± 0.00^{a}	4.67 ± 0.17^{a}
Kilogram of Feed fed (₦)	75.00 ± 0.00^{b}	75.00 ± 0.00^{b}	70.00 ± 2.50^{a}
Total Expenditure (₦)	23,833.33 ± 3.33^{ab}	24833.33 ± 3.33^{b}	22,333.33 ± 81.72^{b}
Gross Income (₦)	42,120.00 ± 939.69^{a}	44128.00 ± 588.10^{a}	49,072.00 ± 781.67^{b}
Profit margin (Gross margin)	18,286.67 ± 943.07^{a}	19294.67 ± 588.97^{b}	26,072.00 ± 1054.80^{c}

Means in the same row with different superscripts are significantly different at (P<0.05)

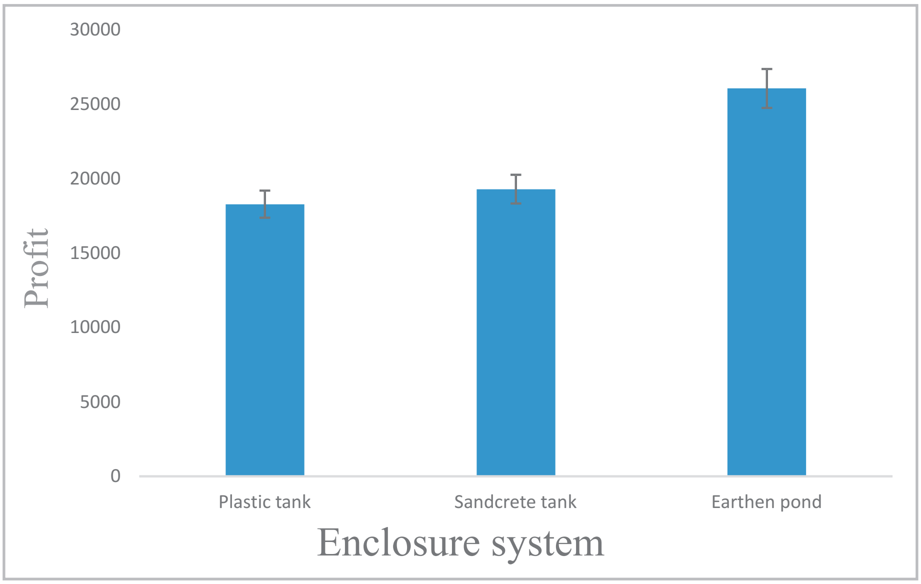

Figure 2: Profit margin of *Clarias gariepinus* reared in three enclosure systems (plastic tank, sandcrete tank and earthen pond)

Table 5 shows the summary of the economic performance parameters (Profit Index, Net Production Values, Investment Cost Analysis, Gross Profit, Incidence of Cost and Benefit Cost Ratio) of *C. gariepinus* reared in the three enclosure systems T1 (Plastic), T2 (Sandcrete) and T3 (Earthen pond). The result revealed that profit index of earthen pond had the highest ratio of 3.01 N/kg, while sandcrete had 2.51N/kg and plastic tank had the lowest ratio of 2.40N/kg. There was no significant difference between the benefit cost ratio of sandcrete and plastic (1.77 and 1.76).

However, that of earthen pond enclosure had the highest benefit cost ratio of (2.13). The result also revealed that earthen pond had the lowest incidence of cost (199.7), sandcrete and plastic tank had the highest incidence of cost value (237.97 and 249.47) respectively.

Table 5: Economic performance of *Clarias gariepinus* reared in three enclosure systems (plastic tank, sandcrete tank and earthen pond)

Parameters	Plastic Tank	Sandcrete Tank	Earthen Tank
Profit Index	2.400 ± 0.055[a]	2.577 ± 0.032[a]	3.010 ± 0.119[b]
Net Production Value (₦)	42,120.00 ± 939.69[a]	44,128.00± 588.10[a]	49,072.00 ± 781.67[ba]
Investment Cost Analysis (₦)	23,833.33 ± 3.333	24,833.33 ± 3.333[c]	22,333.333 ± 81.72[a]
Gross Profit (₦)	18,286.67 ± 943.01[a]	19,294.67 ± 588.97[a]	26072.00 ± 1054.80[b]
Incidence of Cost	249.47 ± 5.68[c]	237.97 ± 3.15[b]	199.77 ± 8.23[a]
Benefit Cost Ratio	1.763 ± 0.047[a]	1.773 ± 0.024[a]	2.130 ± 0.069[b]

Means in the same row with different superscripts are significantly different at ($P<0.05$)

Discussion

The adequate performance of any production system, evaluating the growth and economic viability is expected to be done at the end of such production. It will become clear if such a production system is profitable or not (Ross and Waten, 1995). At the end of the experiment, the weight gain of *C. gariepinus* in earthen pond was higher (1061.2g) than *C. gariepinus* in plastic and sandcrete tanks (835.9g, 772.9g) respectively. The higher weight gain recorded for *C. gariepinus* reared in earthen pond was in accordance with the observation recorded by Angahar, (2017) on comparative studies on growth performance of *Heterobrancus bidorsalis* and Keremah and Esquire (2014) on comparative studies on growth performance of *Heterobrancus bidorsalis* fingerlings. This could be due to the availability of natural food (plankton) induced by decomposed and degraded uneaten artificial feed given to *C. gariepinus* in earthen pond to consume. In the tank facilities, the fish relied solely on artificial feed as the only food source. Despite the higher fish weight gain noticed in earthen pond, the percentage survival rate was lower than that of plastic and sandcrete tanks facilities. At the end of the experiment, 76.7% survival rate was recorded in the earthen pond as against 90% and 87.3% for plastic and sandcrete tank facilities. The mortality recorded in the three culture facilities was attributed to cannibalistic tendency of the fish as no death of fish was recorded during the rearing period.

Adebayo and Adesoji (2008) reported that *C. gariepinus* reared in earthen pond and concrete tank facilities of same size, $10X10X1.5m^2$ gave a profit of ₦73,000 and ₦52,000 for pond and tank respectively. In this experimental study, realizing higher profit in earthen pond than plastic and sandcrete tank facilities corroborated the observations of Adebayo and Adesoji (2008). However, the profit margin and index recorded for *C. gariepinus* reared in earthen pond was higher despite its higher mortality rate (23.33%). This was attributed to the fact that, *C. gariepinus* reared in earthen pond were bigger in size and consumed lesser feeds. The earthen pond structure, though a confined enclosure as the plastic and sandcrete tank facilities, and mimic nature may be responsible for its high yield in terms of fish size.

The quantity of fish caught in plastic and sandcrete tank was higher (90%, 87.3%), but the smaller size and more feed consumed, negatively affected the profit margin and index. This study has also shown that the type of culture medium used and its management could have a significant influence on fish profitability as similarly reported by Ross and Waten (1995). The plastic and sandcrete tanks had lower values of benefit cost ratio probably due to high cost of changing water and high feed consumed when compared to earthen pond condition as observed in this study.

The values of temperature, pH, Do, nitrite and nitrate monitored during the experimental period (185 days) were within acceptable ranges for fish culture practice in this study (Boyd, 1982). This factor probably enhanced the observed good growth and condition of the test fish throughout the experimental period.

Conclusion

The results from this study show that the impact of fish rearing enclosure system cannot be underestimated on the overall performance result of fish production. The plastic tank, sandcrete tank and earthen pond are suitable for *C. gariepinus* production. The study did not discourage the use of such facilities for *C. gariepinus* culture. Nevertheless, earthen pond is the best and the most ideal culture facility for optimum yield in *C. gariepinus* culture. Profitability from the production of fish is a function of the final weight gain and the fish survival rate which in turn is dependent on knowledge in fish production and the application of the technical management practices acquired by the farmer/investor.

References

Adebayo, I.A and Adesoji, S.A. (2008). Comparative assessment of profit margin of catfish reared in concrete tank and earthen pond. *African Journal of Agriculture Research.* 3(10): 677-680.

Adekoya B.B. and Miller J.W. (2004). Fish cage culture potential in Nigeria- An overview National cultures. *Agricultural Focus,* 1(5): 10.

Aderolu, A.Z. and Oyedokun, G.T. (2008). Comparative utilization of biodegraded rice husk in the diets of *Clarias gariepinus*, *Journal of Fisheries and Aquatic Science,* 3(5): 312-319.

Adewolu, M.A., Ogunsanmi, A.O. and Yunusa, A. (2008). Studies on growth performance and feed utilization of two clariid catfish and their hybrid reared under different culture systems. *European Journal of Science Research*. 23(2): 252-260.

Ajani, E. K., Orisasona O. and Jenyo-Oni A. (2015). Growth and economic performance of *Clarias gariepinus* fry reared at various stocking densities. *Journal of Fisheries Livestock Production*, 3:136 - 141.

Alanara, A., Kaaris, S., Paspatis M. (2001). Feeding management. In: Hoalihan D, Jobling M, Boujard, T. Feed intake in Fish. Oxford, UK: Black well Science, pp 332-353.

Alatise, S.P. and Otubusin, S.O. (2006). Effect of different stocking densities on production of catfish (*Clarias gariepinus*) in Bamboo-net cage system. Conference of FISON at Port Harcourt, pp 24-29.

Angahar, L.T. (2017). Comparative studies on growth performance of *Heterobrancus bidorsalis* (Geoffroy Saint-Hilaire, 1809) in Different Culture Facilities. Turkish *Journal of Agriculture Food Science and Technology*, 5(3): 247-250.

Benech, V., Teugels G.G. and Gourene, G. (1993). Criterepractiquepor distinguisher deuxpoisson-chats africains, *Clarias anguillaris, C. gariepinus* (siluriforme: claridae). *Journal of Fisheries and Aquatic Science,* 17(1): 83-85.

Boyd, C.E. (1982). Water quality management for pond fish culture/ Elsevier Scientific Publication company. New York, 318p.

Cui, Y., and Xie S. (2000). Modeling growth in fish. In: Theodorou, M.K and France, J (Eds). Feeding systems and feed evaluation models. *CAB International*. pp 413-434.

Fagbenro, O.A. and Adebayo, O.T. (2005). A review of the animal and aqua feed industries in Nigeria. In: A synthesis of the formulated animal and industry in sub-Saharan Africa (John Moehl and Mathias Halwart, eds.) FAO/CIFA Occasional Fisheries Technical Paper, No.26, FAO, Rome. pp 25 – 36.

FAO, (2013). Fish Trade and Human Nutrition. Rome. Food and Agriculture Organization of the United Nation Press. p 49.

FAO, (2018). State of world Fisheries and Aquaculture Report. 2018 Edition, Food and Agriculture Organization of the United Nations, Rome, Italy. p 14.

Jobling, M., (1994). Biotic factors and growth performances. In: Fish Bioenergetics, Fish and Fisheries series 13. Chapman and Hall. pp. 169-194.

Keremah R.I. and Esquire J. (2014). Comparative studies on growth performance of *Heterobrancus bidorsalis* fingerlings in ponds and tanks. *Greener Journal of Agriculture Sciences* 4 (2): 034-038.

New, M.B. (1989). Formulated aquaculture feeds in Asia: Some thoughts on Comparative Economics, Industrial Potential, Problems and Research Need in Relation to Small-Scale Farmer. In Report of the Work-shop on Shrimps and Fin Fish Feed Development, J.E. Bahru, (Ed.) ASEAN/SF/89/GGEN/11. pp 112-115.

Olaoye, O., Adegbite, D., Elizabeth, O., Vaugh, I., Odebiyi, C. and Adediji, A. (2014). Comparative evaluation of economic benefits of earthen fish and concrete ponds in aquaculture enterprises in Oyo State, Nigeria. *Croatian Journal of fisheries*, 72 (3):107-119.

Ross, R.M. and Waten, B.J. (1995). Importance of rearing – unit design and stocking density to the behaviour, growth and metabolism of lake trout (*salvelinus namaysuch*) *Aquaculture Engineering*. pp. 40-45.

Saad, Y. M., Shaden Hanafi, M., Essa, M.A., Guerges, A.A. and Fawzia Ali, S. (2009). Genetics signatures of some Egyptian *Clarias gariepinus* populations. *Global Veterinaria,* 3(6): 503-508.

Skelton, P. (1993). A complete guide to the fishes of southern Africa. Southern Book Publishers, Harare, Zimbabwe. pp 91.

Tijani, A. (2004). Comparative analysis of profitability and technical efficiency of fish farming using different rearing techniques in Nigeria. *Asian Journal of Agricultural Extension, Economics and Sociology*, 3(5):405-418.

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