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Comparative Assessment of Growth Performance and Economics of Production of *Clarias gariepinus* Fingerlings in Ponds and Tanks

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ABSTRACT

An experiment was conducted to compare the growth and economics of producing *Clarias gariepinus* in ponds (6.4x5.4x1.5m^3) and tanks (2.5x1.1x1.2m^3) for 56days. Fingerlings of *Clarias gariepinus* (mean weight, 1.80g and body length, 4.40cm) were stocked at 250 and 50 fish separately into each pond and tank in duplicates. Fish were fed a commercial feed containing 45% crude protein at 5% body weight. It was divided into two halves and fed at 1000 and 1600hours daily. At final harvest, the total yield of fish was significantly greater (P<0.05) in pond, 3.0kg than those in tank, 1.81kg. There was no significant difference (P>0.05) in mean weight gain (13.75+0.95g, 13.44±0.95g), condition factor (0.92±0.03, 0.91±0.03) and feed conversion ratio (0.56±0.01, 0.51±0.01) between fingerlings stocked in pond and tank. Fish in pond had higher percentage weight gain and specific growth rate while survival rate ranged 74.11±0.54-88.80±0.54% in the culture media. Net profits obtained were ₦4300 (pond) and ₦2250 (tank). The benefit: cost ratio was higher for tank (1.38) than for pond (1.19). The pond environment appeared more productive while the tank was more economical with higher benefit in this study.

INTRODUCTION

Fish farming in Nigeria has progressed steadily over the years. The size of operation varies between 0.02-0.20ha for small-scale earthen ponds, 25-40m^2 for homestead concrete tanks and 3ha and above for commercial farms (FDF, 1990). Production estimate was put at 1ton/hectare/year for small-scale ponds. These productions were achieved by using low input semi-intensive culture level in homestead ponds and commercial fish farms in Nigeria (FDF, 1996). 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 reasons for their culture are based on their fast growth rate, disease resistance, high stocking density, aerial respiration, high feed conversion efficiency among others (Adewolu et al., 2008). Adebayo and Adesoji (2008) also reported that *Clarias gariepinus* cultured in earthen pond had a high yield.

The culture of fish in concrete tanks is now a common practice in Nigeria. Homestead fish farmers operate in concrete tanks whose sizes and shapes vary from location to location depending on individual taste, availability of space and financial resources (Omitoyin, 2007). Intensive tank culture can produce very high yields on small parcels of land. Species like Tilapia that grow well in high densities in confinement of tanks are preferred. However, Dambo and Rana (1992) suggested a low stocking rate of 2, 5 and 10 fish/m^3 for the hybrid catfish (*Heteroclarias*) in 2x2x1m^3 concrete tanks to improve survival rate and production efficiency.

The importance of *Clarias gariepinus* as a choice fish and as an inexpensive protein source in rural communities is shown by the geographical distribution, economic potential, availability and as fish food in Nigeria (Ayinla, 1985). This fish is ideal for culture because of its tolerance to low dissolved oxygen, rapid growth rate and acceptability of a variety of food items (Bard et al., 1976), resistance to handling stress and is well appreciated in a wide number of African countries (Hogendoorn, 1979).

Recent investments in Agriculture in Nigeria have been targeted on Catfish farming (Abdullah, 2007). Currently about 90% of farmed fish in Nigeria is Catfish which is now a major attraction to private sector investors (Kamthorn and Miller, 2006). Atanda (2007) reported that live catfish attracted premium price in Nigeria with a high return on investment ranging between 40-60% in some successful enterprises. Investment in catfish is still growing especially with the renewed awareness being created by the government of Nigeria through the Presidential Initiative on Fisheries and Aquaculture (Miller and Atanda, 2004).

The type of culture medium used and their management have a significant influence on fish profitability (Ross and Waten, 1995). According to Hankins et al. (1995), fish culture medium and their accessories add up to a large portion of farm capital. The need therefore arises to choose the best production system with a good operating strategy to optimize fish farm profitability. Therefore the aim of this study was to evaluate the growth performance, survival and the economics of producing *Clarias gariepinus* in earthen pond and concrete tank culture environments.

MATERIALS AND METHODS

Experimental Procedure

A total of 650 *Clarias gariepinus* fingerlings (mean weight, 1.80g and total length, 4.40cm) were obtained from a Fish Farm in Delta State, Nigeria. They were acclimatized and maintained with a commercial feed (Coppens) containing 45% protein for 7days prior to use for the experiment. Thereafter, the fish were randomly stocked at 250 each into earthen ponds with dimension, 6.4m x 5.4m x 1.5m and 50fish into each concrete tank, 2.5m x 1.1m x 1.2m in duplicates. The stocked fish were fed with the Coppens feed at 5% body weight. Daily rations were divided into two halves and fed at 1000 and 1600hours. At bi-weekly intervals, the fish in each culture facility were weighed and the amount of feed adjusted accordingly.

Water quality parameters were determined on a weekly basis during the experimental period. Water temperature record was taken daily with a laboratory mercury thermometer (0-100^{o}C). Dissolved oxygen (DO), pH, ammonia and total hardness were determined using Hach's Aquaculture Test Kit (Model FF-2). Length and weight measurements of the fingerlings were made at the start of experiment and weekly intervals using a metal metre rule and triple beam balance (Model MB-2610). Daily mortalities of fish in ponds and tanks were also recorded. This experiment was conducted for 8weeks from March to May, 2011 at the Fish Farm site of Department of Fisheries and Livestock Production Technology, Niger Delta University in Bayelsa State, Nigeria. Uneaten feed and waste products were siphoned off from the tanks with a rubber tube and water was allowed to flow through them throughout the study period.

Biological performance of test fish were evaluated as follows: mean weight gain (MWG) = W_2-W_1 (Okoye et al., 2001) where W_1 and W_2 are initial and final body weights of fish (g). Percentage weight gain (PWG), % = W_t-W_ox100/W_o (Adewolu et al., 2008) where W_t = final weight (g) at end of experiment, W_o = fish weight (g) at start of experiment. Specific growth rate (SGR), %day^{-1} = $l_n w_2$-$l_n w_1$x100/t_2-t_1 (Brown, 1957) where w_2 = final weight of fish, w_1 = initial weight of fish (g), t_2 and t_1 = mean of end of growth period and at time 0 in days and l_n = natural logarithm. Condition factor (K) = 100w/l^3 (Bagenal and Tesch, 1978) where w and l are the observed total weight (g) and total

length (cm) of a fish. Feed conversion ratio (FCR) = Feed intake (g)/weight gain (g), Utne (1979) and Survival of fish (S) = N_i x 100/N_o (Alatise and Otubusin, 2006) where N_o and N_i are number of fish at start and end (alive) of experiment. For economic evaluation, the profit index and incidence of cost were according to Mazid et al. (1997) with profit index = number of fish produced/cost of feed (₦), incidence of cost (R) = cost of feed (₦)/mass of fish produced (kg), net profit = sales–expenditure and Benefit : Cost ratio = total sales/total expenditure.

Data Analysis

Data obtained from this study were subjected to analysis of variance (Wahua, 1999). Duncan's multiple range test (Duncan, 1955) was used to compare differences among treatment means. Treatment were considered significant at $P<0.05$.

RESULTS

Table 1 shows the summary of the results obtained for growth responses of *Clarias gariepinus* fingerlings raised in pond and concrete tank environments. There was a general increase in weight and length in all fish during the experimental period. The mean weight of fish in pond was 13.75±0.95g and tank, 13.44±0.95g but similar in SGR for both pond (1.03±0.0%day^{-1}) and tank (1.00±0.0%day^{-1}). Condition factor of 0.92±0.03 and 0.91±0.03 were observed for pond and tank. However, fish survival varied between 74.11±0.54-88.80±0.54% for tank and pond. Feed conversion ratio was fairly the same for fish in both pond (0.56±0.01) and tank (0.51±0.01) culture facilities. Total fish yield and percentage weight gain were higher in pond than values obtained for fish in the tank situation.

The incidence of cost was 0.67±0.0 for pond and 1.67±0.01 for tank. The profit index varied between 0.02±0.0 and 0.45±0.01 for tank and pond while the Benefit: Cost ratio was 1.19 for pond and 1.38 for tank.

Table 1: growth, feed utilization and Economics of *Clarias gariepinus* fingerlings raised in different culture facilities for 56 days

Parameter	Pond	Tank
No. of fish stocked	250	50
Initial weight of fish (g)	1.80	1.80
Initial length of fish (cm)	4.40	4.40
Final length of fish (cm)	20.0	16.0
Weight gain (g)	13.75±0.95	13.44±0.95
Weight gain (%)	848.80±20.29	771.80±20.29
Specific growth rate (% day^{-1})	1.03±0.0	1.00±0.0
Condition factor (K)	0.92±0.03	0.91±0.03
Feed conversion ratio	0.56±0.01	0.51±0.01
Survival (%)	88.80±0.54	74.11±0.54
Total fish yield (Kg)	3.0	1.81
Incidence of cost	0.67±0.0	1.67±0.01
Profit index	0.45±0.0	0.02±0.0
Net profit (₦)	4,300	2,250
Benefit: cost ratio (B:Cr)	1.19	1.38

Values with different letter for a given parameter in the same horizontal row are significantly different ($P<0.05$).

Tank 2: Means and range values of water quality parameters for *Clarias gariepinus* fingerlings reared in different culture facilities for 56 days

Parameter	Pond	Cage
Temperature (^{0}C)	25.05±0.07^b (24.25-26.05)	26.20±0.07^a (26.00-26.60)
Dissolved oxygen (mg/l)	6.00±0.14^a (5.25-7.00)	5.25±0.14 (5.00-6.25)
pH	8.20±0.17^a (6.50-9.70)	7.50±0.17^b (6.95-8.20)
Ammonia (NH_3-N), mg/l	0.40±0.04^a (0.30-0.52)	0.30±0.04^a (0.24-0.48)
Total hardness (mg/l)	60.00±0.92^a (58.65-62.01)	55.00±0.92^b (53.00-57.01)

Values with different letter for a given parameter in the same horizontal row are significantly different ($p<0.05$), values in bracket represent range values for the parameters.

The values of the physico-chemical parameters monitored during the rearing period are shown in Table 2. Mean water temperature was 25.05±0.07^{o}C for pond and 26.20±0.07^{o}C for tank. Dissolved oxygen varied between 5.25±0.14mg/l for tank and 6.00±0.14mg/l for pond. Mean pH in tank was 7.50±0.17 while pond had 8.20±0.17. Ammonia values ranged 0.30±0.04mg/l-0.40±0.04mg/l for tank and pond culture environments. The mean total hardness in pond was higher (60.0±0.92mg/l) than in the tank (55.0±0.92mg/l).

DISCUSSION

The growth, feed utilization and cost benefits depended on the culture facility for the fish raised. At the end of study period, the mean weight gain in pond was slightly better than fish in the tank. However, fish in tank was more uniform in size than those in pond. The fish in the pond were larger in size (20.0cm) when compared to fish reared in tank facility. This could be due to the availability of natural food (plankton) induced by decomposed and degraded uneaten artificial feed for fish in the pond to consume. In the tank, the fish relied solely on artificial feed as the only food source.

Adebayo and Adesoji (2008) reported that *Clarias gariepinus* reared in earthen pond and concrete tank facilities of same size, 10x10x1.5m^3 gave a profit of ₦73, 000 and ₦52, 000 for pond and tank respectively. In this study, realizing higher profit in pond culture than tank corroborated the observations of Adebayo and Adesoji (2008). The present 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 concrete tank had a better Benefit : Cost ratio probably due to low cost in construction, good fish condition and growth, cheaper practice and the farmer being in full control when compared to the pond condition as observed in this study. For larger operations, the pond might be considered while in smaller practices the tank could be of choice. The net profit of N4, 300 recorded in pond and tank (N2, 250) showed that fish culture practice in the pond could be more profitable and appears to be a favourable financial potential for commercial production of *Clarias gariepinus*.

The values of temperature, DO and other observed water quality parameters monitored for 56days 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

Clarias gariepinus is an economically important fish and its culture should be encouraged because it attracts premium price and is accepted by consumers. The use of earthen pond as a culture medium for *C. gariepinus* appears more favourable than tank for intensive and commercial venture under proper management. However, the tank culture system could be of choice for smaller operations.

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