AN INTEGRATED CHICKEN-FISH SYSTEM IN CONCRETE PONDS

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ABSTRACT

Four treatments (in duplicate) were used to determine the optimum combination ratio in the chicken-fish integrated system in 4 m^2 concrete ponds. Treatment 1 (T1) consisted of a concrete pond integrated with one point-of-lay chicken while treatment 2 (T2) had two point-of-lay chickens integrated over a concrete pond. Treatment 3 (T3), consisted of three point-of-lay chickens integrated over a pond and treatment 4 (T4) was the control and involved no integration. Each concrete pond was stocked with a poly-culture of *Oreochromis niloticus* and *Clarias gariepinus* in a ratio of 3:1. Compounded fish feed was used to feed the fish in T4 twice daily at 5% of their body weight while fish in T1, T2 and T3 fed on wet chicken manure and spilled chicken feed that fell directly into the ponds. The daily manure loading rate ranged from 55.80g in T1R2 (treatment1 replicate 2) to 117.37 g in T3R1while spilled feed loading rate ranged from 2.52 in T2R2 to 9.27g in T3R2. The total number of eggs laid was 871 in 84 days. For *C. gariepinus*, fish in T4R1 had the highest mean weight gain of all the treatments and T1R1, the lowest. T3R2 had the highest mean weight gain of all the integrated treatments. For *O. niloticus* fingerlings, fish in T4 which were fed compounded feed had the highest mean daily weight gain and while those in T1 had the lowest. T4R1 fish had the highest mean weight gain while T1R2 fish had the lowest. Fish in T3 had the highest mean weight gain of all the integrated treatments followed by fish in T2. However, physico-chemical parameters were more adverse and survival was lower in T3 than in T2 and so a combination ratio of 20 fingerlings in a 4 m^2 concrete tank integrated with two laying chickens (mean weight 1.93 kg) is recommended. This translates to 50 laying chickens/100 m^2 concrete pond stocked with 500 fingerlings.

INTRODUCTION

Integrated chicken-fish farming converts two normally separate farming systems into one system where the waste of the chicken sub-system becomes an input into the fish sub-system (Siaw-Yang, 1991). Simultaneous production of fish in ponds with chicken rearing in sheds beside or over the ponds constitutes a continuous organic fertilization of the pond by the livestock (Ita *et al.*, 1986). This practice increases the efficiency of both livestock farming and fish culture through the profitable utilization of animal and feed wastes. According to Gabriel *et al.* (2007), chicken-fish farming is the most popular form of integrated poultry-fish farming in Nigeria. Excessive amounts of Nitrates and phosphates released from the decomposition of manure can lead to eutrophication which can cause algae blooms, impaired fisheries, fish kills, odours and increased turbidity in ponds (Delmendo, 2003). Thus, control of manure load into the system is important and only fish species that can grow well and survive in such a system should be used. Fish species like *Oreochromis niloticus* and *Clarias gariepinus* that directly consume manure are good for the system.

MATERIALS AND METHODS

Eight concrete fish ponds (area of each, 4 m^2) were used in the experiment i.e. four treatments in duplicate. A stocking density of 5 fish/m^2 was used and each concrete pond was stocked with a poly-culture of *O. niloticus* and *C. gariepinus* in a ratio of 3:1. Six chicken sheds (1.5m x 0.75m) were constructed over six concrete ponds (each 4 m^2) with wood and the sides and floor of each shed was covered with wire mesh. The floors were made with wire mesh so that the faecal droppings and spilled feed can drop directly into the concrete ponds without hindrance. The sheds were 1m above the ponds. The treatments were allocated randomly to the ponds. Treatment 1 (T1) consisted of a concrete tank integrated with one point-of-lay chicken; treatment 2 (T2) had two point-of-lay chickens integrated over a concrete pond. Treatment 3 (T3) consisted of three point-of-lay chickens integrated over a pond and treatment 4 (T4) was the control and involved no integration but had fish stocked into a concrete pond. Chickens (Nera Brown breed) with similar weights were used for the study.

The weights of fish fingerlings were recorded at stocking and during each sampling period. The weight of each chicken was measured with a top loading balance. Pond water was changed every two weeks after the integration. The ponds were sampled every two weeks before water change and the weights of fish were taken to determine growth parameters. Wet chicken manure was weighed and air dried before being used for proximate analysis. Proximate composition of fish feed, chicken feed and dry chicken manure were determined according to AOAC (2000). Temperature, pH, conductivity, dissolved oxygen, turbidity, total solids (TS), total suspended solids (TSS) and total dissolved solids (TDS) of the pond water were measured before the fish were stocked into the ponds. Temperature and pH were measured with ATC portable pH/temperature meter. Conductivity was measured with ELE conductivity meter (model DA-1) while turbidity was measured with a Secchi disc of 20cm diameter. Dissolved oxygen was measured with HACH dissolved oxygen meter (model 50175). TS, TSS and TDS were analysed according to APHA (1992). The daily manure and spilled feed loading rates into each pond were determined along with the laying rate of chickens per shed for 84 days.

RESULTS AND DISCUSSION

Table 1 shows the mean weights of chickens and mean daily manure and spilled feed loading rates.

Table 1. Mean weight of chickens and mean daily manure and spilled feed loading rates.

Treatment	Mean weights (kg)	Daily manure loading rates (g)	Daily spilled feed loading rates (g)
T1R1	1.92 ±0	56.05 ± 1.05	2.90 ± 1.2
T1R2	1.95 ±0	55.80 ± 1.23	3.44 ± 0.09
T2R1	1.93 ± 0.03	81.65 ± 1.51	5.09 ± 0.88
T2R2	1.935 ± 0.015	86.80 ± 2.02	2.52 ± 1.95
T3R1	1.95 ± 0.041	117.37 ± 3.11	8.60 ± 1.3
T3R2	2.00 ± 0.056	105.22 ± 1.07	9.27 ± 0.55

The chickens used were of the same age (20 weeks) and had similar weights (1.90-2.08 kg). Mean daily manure load ranged from 56.05 ± 1.05 in T1R1 to 117.37 ± 3.11 in T3R1 while mean daily spilled feed load ranged from 2.52 ± 1.95 in T2R2 to 9.27 ± 0.55 in T3R3. Doubling the number of chickens in a treatment did not necessarily double the amount of manure produced by each treatment. Indeed the amount of manure produced by three chickens was about two times that produced by one chicken in this experiment. The feed spilled by chicken is dependent on the activity of the chickens and not their number. The feed spilled by T2R2 was lowest in the experiment despite the fact that it contained one chicken more than T1R1 and T1R2. However, the chickens in Treatment 3 spilled more than double the feed spilled by those in treatment 1. Proximate analysis of chicken feed, fish feed and dry chicken manure showed that the crude protein content of fish feed (35.89 %) was higher than that of dry chicken manure (25.70%). Over half of the crude protein content of livestock manure is usually non-protein nitrogen like uric acid (Siaw-Yang, 1991) which is not assimilated by fish. However, the fish in the integrated treatments also consumed spilled chicken feed which had a crude protein content of 16.19 %, and this contributed to growth. Table 2 shows growth parameters and survival of *O. niloticus* fingerlings in each treatment.

Table 2. Mean weights (g ±SD) of *Oreochromis niloticus* fingerlings in each treatment

Treatment	T1R1	T1R2	T2R1	T2R2	T3R1	T3R2	T4R1	T4R2
Mean initial weight	6.90 ± 0.14	5.80 ± 0.15	6.35 ± 0.22	6.01 ± 1.02	7.50 ± 0.08	6.80 ± 0.21	5.35 ± 0.02	6.40 ± 0.05
Mean final weight	30.86 ± 0.21	35.25 ± 0.25	45.40 ± 0.17	48.40 ± 0.73	54.65 ± 0.28	51.17 ± 1.06	69.05 ± 1.21	61.49 ± 0.73
Mean weight gain	23.96 ± 0.09	29.45 ± 0.13	39.05 ± 0.19	42.39 ± 1.22	47.15 ± 1.14	44.37 ± 0.83	63.7 ± 0.94	55.09 ± 0.55
Mean daily wt. gain	0.29 ± 0.001	0.35 ± 0.002	0.46 ± 0.002	0.50 ± 0.015	0.56 ± 0.014	0.53 ± 0.010	0.76 ± 0.009	0.66 ± 0.008
Specific growth rate	1.78	2.15	2.34	2.48	2.36	2.40	3.04	2.69
Survival (%)	86.7	100	100	66.7	86.7	60.0	100	93.3

Fish in T4 which were fed compounded feed had the highest mean weight gain and those in T1 had the lowest. T4R1 had the highest mean weight gain while T1R2 had the lowest. T3R1 had the highest mean weight gain of all the integrated treatments. The concrete ponds integrated with three laying chickens (treatment 3) gave the best growth performance among the integrated treatments. However, survival is relatively low in the treatments integrated with three chickens. Table 3 shows the growth parameters for *Clarias gariepinus*. Fish given compounded feed performed better than those in the integrated system.

Table 3. Mean weights (g ±SD) of *Clarias gariepinus* fingerlings in each treatment

Treatment	T1R1	T1R2	T2R1	T2R2	T3R1	T3R2	T4R1	T4R2
Mean initial weight	6.05 ± 0.09	4.40 ± 0.62	4.75 ± 0.59	5.71 ± 0.07	7.20 ± 0.93	3.15 ± 0.04	2.80 ± 0.13	5.35 ± 0.24
Mean final weight	61.08 ± 1.14	66.11 ± 0.99	70.07 ± 0.87	74.83 ± 0.59	80.17 ± 1.08	78.88 ± 1.12	95.01 ± 1.20	89.92 ± 0.75
Mean weight gain	55.03 ± 0.57	61.71 ± 0.81	65.32 ± 0.34	69.12 ± 0.39	72.97 ± 0.70	75.73 ± 1.08	92.21 ± 0.99	84.57 ± 0.61
Mean daily wt. gain	0.66 ± 0.007	0.73 ± 0.010	0.78 ± 0.004	0.82 ± 0.005	0.87 ± 0.008	0.90 ±0.013	1.10 ± 0.012	1.00 ±0.007
Specific growth rate	2.75	3.22	3.20	3.06	2.87	3.83	4.19	3.36
Survival (%)	100	100	100	100	100	60	60	100

T4R1 had the highest mean weight gain of all the treatments and T1R1, the lowest. T3R2 had the highest mean weight gain of all the integrated treatments and T1R1, the lowest. Mean values of Physico-chemical parameters measured in all the treatments showed that temperature ranged from 20.30 °C in T2R2 to 22.10 °C in T4R2. pH values were generally low with pH in the integrated treatments getting as low as 4.89 in T3R1 which is dangerous for the fish. Dissolved oxygen was lower than the 5mg/lit lower limit usually recommended for freshwater aquaculture. Conductivity ranged from 530 µs/cm in T4R2 to 750 µs/cm in T3R2 while all the turbidity values were below the 20-50 cm recommended by Nath (2003). As expected, total solids and total suspended solids are much higher in treatment 3 than in others due to the higher quantity of manure and spilled feed falling into it. The total number of eggs laid was 871 eggs in 84 days at an average of 10.370 eggs/day. Chicken mortalities occurred in T2R2 and T3R1 towards the end of the experiment when air temperature rose to 28 °C at the onset of the hot season in New Bussa.

The study has shown that integrated chicken-fish farming in concrete ponds is feasible if water is changed regularly. Water was changed every two weeks and the fish still survived though pH, DO and turbidity were at dangerous levels in some cases. Due to the adverse physico-chemical parameters and lower survival experienced in TR 3, it is recommended that 2 laying chickens (mean wt. 1.93 kg) should be integrated over a $4m^2$ concrete pond with 20 fingerlings of *O. niloticus* and *C. gariepinus*. This is equivalent to 5,000 laying chickens and 50,000 fingerlings/ha or 50 birds/500 fingerlings/$100m^2$ pond.

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