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PERFORMANCE OF *Clarias gariepinus* IN A POLYCULTURE WITH *Oreochromis niloticus* UNDER THE INTEGRATED BROILER CHICKEN/FISH FARMING

BY

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ABSTRACT

A study of the performance of *Clarias gariepinus* (African Mudfish) in a polyculture with *Oreochromis niloticus* (Tilapia), integrated with broiler chicken production. was carried at the African Regional Aquaculture Centre, Nigeria. Three experimental treatments were utilized. Treatment I was a polyculture of *C. gariepinus* and *O. niloticus* integrated with broiler chicken production, with application of supplemental feed to fish. Treatment II was a repeat of treatment I, except that no supplemental feed was applied to fish, while treatment III was a polyculture of the two fish species *per se* with application of supplemental feed to fish. Results showed that the final individual weight, individual weight gain and recovery rate were best for *C. gariepinus*, under treatment I. Moreover, *C. gariepinus* yield in treatment II was 47.7% of that of treatment I, while yield in treatment III was 15.6% and 32.7% of those of treatments I and II respectively. Furthermore the comparisons of the daily growth rate for each of the fish species under different treatments, were made.

Statistical analysis showed that there is no difference ($F \ngtr 0.10$ and $F \ngtr 0.05$) in the mean growth rate and average yield of both fish species, in all the treatments. A further comparison of these parameters (mean daily growth rate and average yield) showed that there was significant difference in the mean daily growth rate between treatments I and III only, and in the mean yield between treatment I and II, I and III and II and III. Furthermore, the possible effect of some physico-chemical parameters of the pond water, on the growth and survivability of the stocked fish species were discussed.

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INTRODUCTION

Aquaculture has recycled animal waste as fertilizer for centuries, with the aim of boosting pond productivity of plants and animals (Velasquez, 1980). According to Nash *et al* (1980), animal wastes, apart from their use for fertilization, have many qualities which make them valuable. They contain protein, amino acids and other nutrients, and thus can be processed into animal feed and feedstuffs.

Due to the short digestive tract of poultry, 80% of chicken manure represents undigested feedstuffs (Chen, 1981), with as high as 20 – 30% total protein (Pudadera *et al* 1986). In integrated poultry-fish farming, the protein rich chicken droppings is made available to fish either directly or indirectly (via the primary aquatic foodweb; Pudadera *et al*, 1986), with a resultant increase in fish yield. Apart from the diversification of crop, integrated livestock-fish farming also ensure a spread of financial risk (Chen *et al* 1980).

Various researchers have worked on the economics and management practices of integrated poultry-fish farming, but this study takes a look at the performance of *Clarias gariepinus* in a polyculture with *Oreochromis niloticus*, under the integrated broiler chicken - fish farming. The choice of fish species in this study was greatly influenced by their feeding habit as well as anatomical and physiological endowment, to thrive well in manure loaded ponds (Viveen *et al* 1984 and Pudadera *et al* 1986). Also, the interest of fish farmers was considered in the choice of fish species used.

MATERIALS AND METHODS

Experimental setting:

Four ponds of $1000m^2$ size each (pond 6, 7, 8 and 9) were utilized, and three experimental treatments were tested in duplicates, for this study:

i. Treatment I: Polyculture of *C. gariepinus* and *O. niloticus* integrated with broiler chicken production, with application of supplemental feed to fish.

ii. Treatment II: Polyculture of *C. gariepinus* and *O. niloticus* integrated with broiler chicken production, without application of supplemental feed to fish.

iii. Treatment III: Polyculture of *C. gariepinus* and *O. niloticus* only, with application of supplemental feed to fish (control).

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The study was carried out in two stages. Stage one which comprised of treatment I only (using ponds 6 and 7), was terminated before the commencement of stage two comprising of treatments II and III (using ponds, 6, 7, 8 and 9). The experimental setting sort of studies the *C. gariepinus* under two basic variations:

i. The effect of application of supplemental feed on the performance of *C gariepinus* under the integrated poultry-fish farming and,

ii. the effect of integration on the performance of *C. gariepinus* compared to polyculture production *per se.*

Pond Preparation and Stocking:

Prior to stocking of fish, the ponds were desilted, limed (6kg CaO/pond) and stale chicken droppings was applied to ponds 8 and 9 (used for the polyculture treatment) at 25kg/pond, and same quality per week subsequently at the crib corner. The ponds were stocked at the rate of 1.5 fish/m^2 pond area in all the treatments (at the ratio of 2.*O. niloticus* to 1 *C. gariepinus).* Tilapia were harvested from the production ponds and were measured for standard and total lenght, and weighed (@ range, 20.7 – 35.55g) before stocking. Hatchery produced *C. gariepinus* fingerlings were stocked a month later, after being measured and weighed (@ ranged; 9.0 – 17.5g) also. The one month interval in the stocking of the fingerlings of both fish species, was to avioid early predation of tilapia by the AFrican Mudfish and to allow the former to produce fry to the advantage of the latter, as regards availability of live feed sources

Poultry:

Poultry cages (4.57 x 3.05m x 2.13m) were erected on ponds 6 and 7. Each cage, constructed of wood planks and corrugated iron roofing with slated wood floor, can house 150 chicken, at a rate of 15 chicken/ are pond area (Viveen *et al* 1984).

Day old broiler chicken (weight range; 0.040 – 0.044kg) were purchased and housed under controlled temperature in the brooding house for 4 weeks, after which they were then transfered to the cages on ponds 6 and 7. Replacement stocks were purchased from local agents a week following the transfer of the former stock, and sales of chicken was done between 8th and 10th week (with average final body weight of between 1.60 – 1.72kg). The chicken were fed on commercial poultry diet (Top feed; starter diet 21% protein, and finisher diet 19% protein), at a rate of 25kg/100 birds/week of starter diet for the first four weeks, and 50kg/100 birds/week of finisher diet from four weeks old to market.

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Sampling:

Biweekly samplings of fish were carried out and observations recorded for twenty sample fish for each species, for standard and total lenght, and weight. The mean weight of fish were then used in calculating the quantity of feed to be applied to fish in each of the ponds (5% total fish biomass). Supplemental feeding were applied only in treatments II and III (Nigerian Institute for Oceanography and Marine Research (NIOMR) fish diet; 30% protein), twice daily.

Faecal droppings from twenty chickens randomly selected and weight, was quantified on weekly basis. The selected chickens were isolated in a cubicle, carved out of one of the cages (1.5m x 1.2m). The observation recorded was then used in estimating the manure loading of ponds under the integrated system, for the corresponding week.

Pond Water Quality:

To enable easy monitoring of the effect of the manure loading on the pond system, some physico-chemical parameters of the pond water were observed on monthly basis, for all the treamtments. These parameter include pond water temperature, dissolved oxygen, hydrogen ion concentration (pH), pond primary productivity and ammonia nitrogen concentration. The range and mean values for each paremeter were observed and recorded.

Data Analysis:

The information generated from the biweekly sampling on size and weight of fish were statistically analysed, and graphical presentations of the commulative weight gain were made for both the *C. gariepinus* and *O. niloticus.* The final individual weight, individual weight gain and recovery rates were calculated for both fish species as well. Analysis of variance test was carried out for the mean daily growth rate and mean fish yield between the three experimental treatments, for both fish species. Further statistical test using the confidence interval for the mean differences of the same growth parameters, between the treatments, was also analysed.

The culture period was 120 days and 94 days for *O. niloticus* and *C. gariepinus* respectively.

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RESULT

Growth response:

Figure 1 compares the commulative weight gain for *C. gariepinus* over a culture period of 94 days (12 weeks). Observations revealed that the growth of this species was fastest at the latter part of the culture period, for treatment I and III (between 10 – 12 weeks). Growth in treatment II was however observed to be fastest in the early part of the culture period (0 – 6 weeks). Same pattern was observed for *O. niloticus* for the corresponding treatments (Fig. 2).

Fish Yield:

Fish yield under the different experimental treatments are shown on Table 4. For *C. gariepinus,* the average individual weight gain, recovery rate and total fish yield were highest in treatment I; 291. 14g, 85% and 133.10k respectively. Treatment II gave a total of 63.4kg, with an average individual weight gain of 165.79g and a recovery rate of 72%. Harvest of *C. gariepinus* was poorest in treatment III, where the final fish yield was 20.75kg. with an average individual weight gain of 83.75g. In a nutshell, the final *C. gariepinus* yield in treatment II was 47.7% of the yield in treatment I, while the yield in treatment III was only 15.6% and 32.7% of those treatments I and II respectively.

The recovery rate of *O. niloticus* in treatment I (51.2%) and II (50.7%) were almost the same differing only slightly, but the final individual weight of 109.03g in treatment II as compared to 79.0g in treatment I, made a noticeable difference in the final *O. niloticus* yield for both experimental treatments (40.45kg for treatment I and 55.28kg for treatment II). Yield for *O. niloticus* in treatment III, was lowest; 26.20kg with a recovery rate of 41.10% and a final individual weight of 63.75kg.

Furthermore, the production of *O. niloticus* fingerlings in the ponds under the three treatments, were observed to differ greatly. The highest fingerlings harvest was made in treatment I (3, 841), while treatment II and III had 1,863 and 941 fingerlings harvest respectively.

Poultry Yield:

Table 6 shows the yield obtained from poultry production per 1000m^2 pond area at a stocking rate of 15 heads per are pond area. A mean weight gain of 1.605kg and a percent survival of 88.5 gave an average total chicken yield of 426.62k (live

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weight) in an average of 66.5 days rearing period. The mean daily growth rate of the birds was observed to be 0.57, with an average final live weight of 1.67kg.

There was an outbreak of pullorum (white bacillary diarrhoea) disease suspected to be hatchery transimitted, in the second batch of chicken. This was observed to be responsible for the low percent survival in this batch as compared to the first batch

Satistical analysis:

For *C. gariepinus,* the mean daily growth rate and the mean fish yield were in the order; treatment I > II > III. For *O. niloticus* however, while the growth rate was in the order; treatment I < II < III, the mean fish yield was in the order; treatment II > I > III.

Comparing with the analysis of varience test, it was observed (Table 3A and 3B) that there was no difference in the mean daily growth rate and mean fish yield for both fish species, under the three treatments. The calculated values of the 'F' statistic were observed to be lower than the critical values (F0.01 and F0.05). Moreover, with the use of the confidence interval for the mean differences between treatments, it was observed that there was significant difference ($P \not> 0.05$) in the mean daily growth rate between treatments I and III only, and in the mean yield between treatments I and II, I and III, and II and III. However, the statistical comparison showed that *O. niloticus* yield is better under treatment II than treatment I. Table 4A and 4B shows the comparison based on the confidence interval of the mean differences between the treatments.

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TABLE 1

COMPARING THE GROWTH PARAMETERS OF G. GARIEPINUS AND O. NILOTICUS UNDER THE THREE DIFFERENT CULTURE TREATMENTS

TREATMENT	GROWTH PARAMETER	FISH BREED	STOCKING	1ST SAMPL. 2WKS, (6Wks)	2ND SAMPL. 4Wks (8Wks)	3RD SAMPL. 6Wks (10Wks)	4TH SAMPL. 8Wks (12Wks)	5TH SAMPL. 10Wks (14Wks)	HARVESTING 12Wks (16Wks)
I	AVERAGE WEIGHT (g)	*C. gariepinus*	9.00	78.00	88.75	97.10	133.20	165.88	300.14
		O. niloticus	32.50	40.45	46.85	52.50	57.50	61.15	79.00
	AVERAGE TOTAL LENGTH (cm)	*C. gariepinus*	8.06	21.08	21.08	22.98	23.67	25.33	32.84
		O. niloticus	11.89	14.15	14.34	14.50	15.50	15.73	16.88
	DAILY GROWTH RATE	*C. gariepinus*	–	0.55	0.316	0.188	0.21	0.22	0.34
		O. niloticus	–	0.0058	0.0069	0.0088	0.0092	0.0089	0.013
II	AVERAGE WEIGHT (g)	*C. gariepinus*	10.46	43.00	82.00	120.50	133.00	145.21	176.25
		O. niloticus	35.55	88.75	89.00	99.25	101.75	108.93	109.03
	AVERAGE TOTAL (cm) LENGTH (g)	*C. gariepinus*	11.16	1[illegible].49	21.16	23.83	24.95	25.07	30.88
		O. niloticus	16.32	16.69	17.25	18.16	18.23	18.44	18.48
	DAILY GROWTH RATE	*C. gariepinus*	–	0.22	0.24	0.209	0.184	0.188	–
		O. niloticus	–	0.035	0.027	0.025	0.21	0.018	–
III	AVERAGE WEIGHT (g)	*C. gariepinus*	17.50	34.36	29.75	18.05	25.95	38.40	101.25
		O. niloticus	20.70	20.83	27.60	31.00	40.70	50.00	63.75
	AVERAGE TOTAL LENGHT (cm)	*C. gariepinus*	10.97	13.15	13.87	15.59	16.63	16.67	20.55
		O. niloticus	10.25	10.35	11.33	12.26	13.67	14.30	14.61
	DAILY GROWTH RATE	*C. gariepinus*	–	0.068	0.025	0.00075	0.00086	0.017	0.057
		O. niloticus	–	0.00015	0.006	0.007	0.012	0.014	0.018

( ) = FOR TILAPIA

WKS = WEEKS

$$\text{DAILY GROWTH RATE (dgr)} = \frac{\text{WEIGHT GAIN PER DAY (g)}}{\text{INITIAL WEIGHT (g)}}$$

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TABLE: 2

AVERAGE FISH YIELD UNDER THE VARIOUS CULTURE TREATMENTS FOR 100m^2 POND AREA FOR A CULTURE PERIOD OF 12 WEEKS (*C. gariepinus*) AND 16 WEEKS (*O. niloticus*)

EXPERIMENTAL TREATMENT	FISH BREED	AV. QTY. STOCKED	AV. INITIAL WEIGHT (G)	AV. QTY OF FEED APPLIED (KG)	AV. FINAL BODY WT (G)	AV. WT. GAIN (G)	RECOVERY RATE %	AV. TOTAL FISH YIELD (KG)
Treatment I	*C. gariepinus*	500	9.00	20 . 82	300. 14	291. 14	88. 6%	133.00
	O. niloticus	1000	32. 50	—	79. 00	46. 50	51 . 2%	40. 45
Treatment II	*C. gariepinus*	500	10. 46	—	176. 25	165. 79	72 . 0%	63. 45
	O. niloticus	1000	35. 55		109 . 03	73. 48	50 . 7%	55. 28 (1,863)
Treatment III	*C. gariepinus*	500	17. 50	13. 61	101. 25	83. 75	41 . 0%	26 . 20
	O. niloticus	1000	20. 70		63. 75	43 .05	41. 1%	26. 20 (941)

(   ) = *O. niloticus* fingerlings harvest (number)

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TABLE: 3A COMPARING THE MEAN DAILY GROWTH RATE FOR THE VARIOUS CULTURE TREATMENTS USING THE ANALYSIS OF VARIANCE TEST

FISH SPECIES	OBSERVATION	TREATMENTS			F. STATISTIC		
		I	II	III	COMPUTED VALUE	CRITICAL VALUE	
						0. 01	0. 05
C. gariepinus	1	0. 457	0. 175	0. 037	6. 095	30. 82	9. 55
	2	0. 254	0. 159	0. 086			
	MEAN	0. 355 ± 0. 144	0. 167 ± 0. 011	0. 062 ± 0. 035			
O. niloticus	1	0. 0096	0. 0176	0. 0089	0. 292	30. 82	9. 55
	2	0. 0170	0. 0194	0. 033			
	MEAN	0. 0133 ± 0.0052	0. 0185 ± 0.0013	0. 0210 ± 0. 017			

* Analysis of varience test shows that there is no difference in the mean daily growth rate of both fish species under the three treatments.

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TABLE 3B COMPARING THE MEAN FISH YIELD FOR THE VARIOUS CULTURE TREATMENTS USING THE ANALYSIS OF VARIANCE TEST

FISH SPECIES	OBSERVATION	TREATMENTS			F. STATISTIC		
		I	II	III	COMPUTED VALUE	CRITICAL VALUE	
						0.01	0.05
	1	0.344	0.200	0.087			
C. gariepinus	2	0.240	0.131	0.081	8.46	30.82	9.55
	MEAN	0.292 ± 0.074	0.166 ± 0.048	0.084 ± 0.004			
	1	0.0405	0.076	0.025			
O. niloticus	2	0.053	0.071	0.061	2.45	30.82	9.55
	MEAN	0.0465 ± 0.009	0.074 ± 0.0035	0.043 ± 0.025			

* Analysis of various test shows that there is no difference in the mean yield of both fish species under the three treatments.

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TABLE : 4A COMPARING THE MEAN DAILY GROWTH RATE BETWEEN THE VARIOUS CULTURE TREATMENTS USING THE CONFIDENCE INTERVAL FOR THE MEAN DIFFERENCES

CULTURE TREATMENT COMPARED	FISH SPECIES			
	C. gariepinus		*O. niloticus*	
	COMPUTED CONFIDENCE INTERVAL	P0 . 05	COMPUTED CONFIDENCE INTERVAL	P0 . 05
I vs II	$-0.0745 \leqslant u_1 - u_2 \leqslant 0.47$	–	$-0.0382 \leqslant u_1 - u_2 \leqslant 0.0278$	–
I vs III	$0.0215 \leqslant u_1 - u_2 \leqslant 0.565$	+	$-0.041 \leqslant u_1 - u_3 \leqslant 0.025$	–
II vs III	$-0.167 \leqslant u_2 - u_3 \leqslant 0.377$	–	$-0.036 \leqslant u_2 - u_3 \leqslant 0.031$	–

u_1, u_2, u_3 – Mean daily growth rate for the corresponding fish species under treatments I, II and III respectively.

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TABLE 4B COMPARING THE MEAN FISH YIELD BETWEEN THE VARIOUS CULTURE TREATMENTS USING THE CONFIDENCE INTERVAL FOR THE MEAN DIFFERENCES

CULTURE TREATMENT COMPARED	FISH SPECIES			
	C. gariepinus		*O. niloticus*	
	COMPUTED CONFIDENCE INTERVAL	P0. 05	COMPUTED CONFIDENCE INTERVAL	P0 . 05
I vs II	$0.188 \leqslant u_1 - u_2 \leqslant 0.134$	†	$-0.0275 \leqslant u_1 u_2 \leqslant -0.0275$	+ *
I vs III	$0.199 \leqslant u_1 - u_3 \leqslant 0.216$	+	$0.0027 \leqslant u_1 - u_3 \leqslant 0.0043$	+
II vs III	$0.074 \leqslant u_2 - u_3 \leqslant 0.09$	+	$0.03 \leqslant u_2 - u_3 \leqslant 0.032$	

u_1, u_2, u_3 Mean yield of the corresponsing fish species under treatments I, II and respectively.

P0 05 = 95% significance level

† = There is significance difference

= There is no significance difference

vs = Versus

* = Mean yield for treatment II prefered =

TABLE: 5 **SHOWING THE MEAN VALUE OF SOME PHYSICO - CHEMICAL PARAMETERS OF THE POND WATER FOR THE VARIOUS CULTURE TREATMENT FOR THE FOUR MONTH CULTURE PERIOD.**

PARAMETER	CULTURE TREATMENTS					
	I		II		III	
	Range	Mean	Range	Mean	Range	Mean
Water temperature (oC)	28.0- 30.0	29 . 08 ± 0.66	28.0-30 .5	29. 33 ± 0.90	29. 0 -31. 0	30. 08 ± 0. 83
Hydrogen ion concentration (pH)	6.4-7.4	6 .93 ± 0.43	6.4-7.6	6.9 ± 0.47	6.0-6. 6.	6. 23 ± 0.23
Dissolved i oxygen (mg/1	2. 27 - 6.40	4. 16 ± 1. 60	2.86 - 5.99	2. 24 ± 2. 80	6. 41-8.06	7. 01 ± 0. 57
NH_3–N	0.30 - 1. 10	0. 42 ± 0.11	0.20-0.45	0. 43 ± 0. 15	0. 115 - 0.60	0. 32 ± 0.15
Primary Productivity	90.00 -387. 5	230. 78 ± 113.54	90-322.5 ±	185.63 ± 89. 18	51.25-108.13	84.22 ± 19 . 20

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TABLE: 6 SHOWING THE MEAN CHICKEN YIELD IN THE POULTRY PRODUCTION

Poultry Batch	Quantity Stocked	@ Initial Weight	@Final Weight (kg)	@ Weight Gain (kg)	Survival Rate (%)	Daily Growth Rate Kg/Day	Total Yield (kg)
1st	300	0 . 044	1 . 72	1 . 67	91	0 . 54	455 . 91
2nd	300	0.040	1.58	1. 54	86	0 . 61	397 . 32
MEAN	300	0. 042	1 . 65	1. 605	88 . 5	0 . 57	426 . 62

NB 1st Batch was reared for 70 days
2nd Batch was reared for 63 days

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TABLE: 7 AVERAGE TOTAL MANURE LOADING UNDER THE INTEGRATED SYSTEM PER DAY IN 1000m^2 POND AREA

WEEK	Average Weight of Bird (kg) manure per	Average Weight of chicken manure per Kg/Bird/Day	Average Total number of bird (kg) TREATMENT		Average Total – manure loading Kg/DAY/1000m^2 TREATMENT	
			I	II	I	II
5	0. 69	0. 047	133	135	6.25	6. 35
6	0 . 92	0. 961	132	135	8. 052	8. 24
7	1 . 24	0. 084	132	135	11. 09	11 .34
8	1 . 48	0 . 100	131	134. 5	13 .10	13 .50
9	1. 52	0 .103	131	134. 5	13. 50	13. 85
10	1 .69	0. 113	131	–	14. 80	–

TABLE: 8 COMPOSITION OF NIGERIAN INSTITUTE FOR OCEANOGRAPHY AND MARINE RESEARCH (NIOMR) FISH DIET

Ingredient	% Weight in diet
Yellow maize	36 . 80
Groundnut cake	32. 97
Fish meal	9. 89
Blood meal	6 . 59
Oil	5 . 00
Brewer's waste	5 . 00
Bone meal	2. 00
Oyster shell	0 . 50
Vitamin Premix	0 . 60
Sodium chloride	0. 25

TABLE : 9 PROXIMATE COMPOSITION OF NIOMR FISH DIET

Crude Protein %	30 . 96
Oil / Fat %	10 . 20
B Fibre %	3 . 54
Moisture %	13 . 42
Ash %	9 . 71
N F %	32 . 39
ME Kcal/kg	3,106.00
Calorie / Protein Ratio	100 . 32

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Water Quality:

The effect of the manure loading on the water quality in the two integrated culture treatments is observed in the range and the mean values of the water quality parameters, as shown on Table 5. The mean values of hydrogen ion concentration (pH), Ammonia nitrogen concentration and primary productivity, were higher in the integrated culture treatments (I and II) while the dissolved oxygen level and water temperature were observed to be lower, than in the non-integrated culture treatment (III). The mean ammonia nitrogen concentration in the pond water under treatment I was lower than in treatment II, although the upper-limit of the range in the former was much higher (1.10mg/1) than in the latter (0.45mg/1).

Furthermore, the pond mean primary productivity under treatment I was much higher than for treatment II possibly because of the application of supplemental feed, of which the uneaten feed was also a good fertilizer sources.

Manure loading of the pond system under the integrated culture treatments is as shown on Table 7. The average total manure loading per day was observed to increase with increase weight of the birds. However, the range of manure loading per day was observed to be 62.50 – 148.0 kg/ha/day, and 63.5kg – 138.50kg/ha/day for treatments I and II respectively.

Other Observations:

Interesting observations very much connected to this project, were made during the study. The ease at which fresh chicken droppings were expressed from the protruding belly of the robust *C. gariepinus* (under the integrated broiler chicken - fish farming system) during samplings, shows that the fish were really engorging directly on, and benefitting from the fresh chicken droppings. Furthermore, big, wild predator birds (unidentified), were seen all around the ponds, with tilapia hanging down their beak, frequently.

DISCUSSION

The sources of natural feed in *C. gariepinus* and *O. niloticus* polyculture includes the phyto and zooplanktons and the benthic organisms for tilapia, while the zooplankton, benthic organisms and tilapia fry and fingerlings, are sources for *C. gariepinus,* in a simple aquatic foodweb (Schroeder (1980) and Viveen *et al* 1984). The wide buccal cavity of the omnivorous *C. gariepinus* is an advantage, that enables it prey on *O. niloticus* fry and fingerlings, depending on the relative size of the prey (Carreon *et al* 1976).

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Under the integrated poultry - fish farming system, both the tilapia and the African mudfish, have two additional sources of feed apart from the higher rate of plankton bloom (Schroeder) in the pond system. Uneaten chicken feed which could have passed for waste, and fresh chicken droppings that are consumed directly by both fish breeds, are added advantages in terms of feed sources (Pudadera *el al* 1986 and Barash *et al* 1982). It is not surprising therefore, that *C. gariepinus* yield, recovery rate and individual weight gain were highest in treatment I, that enjoyed additional supplemental feed application, neither was the better performance of same fish species in treatment II over those in treatment III, unexpected.

The performance of *O. niloticus* in terms of fish yield and final weight gain in treatment I as compared to treatment II, was poor. Also the recovery rate of this fish species, at harvest in all the treatments was lower than the observations of Viyeen *et al* (1984) for the polyculture of *C. gariepinus* and *O. niloticus.* This might not be unconnected with an interplay of unfavourable excremes of some environmental factors, in the pond ecosystem, as well as predation by big size mudfish and wild predator birds to which the tilapia become susceptible following stress due to the former.

According to Boyd (1979), toxic concentration of ammonia for short term exposure range between 0.6 – 2.0mg/1. However, ammonia is said to be more toxic with low dissolved oxygen. Therefore, then poor growth rate of tilapia in treatment I (which received the heaviest manure loading, recording the highest upperlimit of ammonia nitrogen concentration range, and the lowest dissolved oxygen concentration range, and the lowest dissolved oxygen concentration), might be due to undesirable excremes of chemical factors of the pond water, culminating in ammonia toxicity, to which the air breathing mudfish may likely have a higher tolerance level.

The hydrogen ion concentration of the pond water in treatment III (6.23) was out of the 6.5 – 9 range, recommended for pond fish culture generally (Boyd 1982) This condition might be responsible for the poor performance in terms of final individual weight and the survival rate of both fish species, under the non integrated culture treatment.

However, although the analysis of variance test indicated no difference in the mean daily growth rate and the mean yield, for both fish species in all the treatments, the confidence interval of the mean differences for these same parameters, between treatments, still favours treatment I. This implies that the application of supplemental feed to fish under the integrated polyculture system is more advantageous. The cost effectiveness of such practise will however have to be proved for different locality.

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Moreover, the average final chicken yield of 426.62kg (262 heads; average total harvest) obtained from the 2 batches of poultry reared in a fish culture period of 112 days, was better than the yield of 217.3kkg in a 120 days culture period (at a higher stocking rate of 18 heads/are pond area), in a similar experiment carried out by Pudadera *et al* (1986). The method of brooding the young chicks in a seprated confinement before transfering to the cages on the ponds, gave room for a quick replacement of the brooders, as well as a higher number of poultry batches. To a large extent, this method contributed to the higher yield in this study. However, the cost of providing a seperate brooding house will have to be seriously considered, to enable a good accessment of the cost effectiveness of this husbandry method.

Also, the stocking rate of 15 heads/are pond area is considered safe since the manure loading produced per day at this stocking rate was less than the recommended safe level of 100 – 200kg/ha/day Schroeder (1980). However strict monitoring of the water quality parameters will have to be ensured.

Finally, researches, have shown that fish cultured under the integrated chichen-fish farming system are fit for human consumption. According to Pudadera *et al* (1986), pathological examination of such fish prior to harvest showed that they are not infected by any micro-organism that could render them unfit for human consumption Also Yingxue *et al* (1986) observed that the nutrient content of the fish fed on pelleted fish diet is not better than that for fish fed on chicken manure.

In conclusion, observation made in this study has shown that the performance of *C. gariepinus in* polyculture with *O. niloticus* under integrated poultry cum fish farming technique, is best with the application of supplemental feeding. However, the importance of possible pollution hazard, and the use of cost effective production imputs and husbandry techniques, in the integration of poultry with fish farming, cannot be over emphasised.

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REFERENCES

1. Barash H. I. Planik and R. Moar (1982): Integrated duck and fish farming: experimental results. Aquaculture Vol. 27 No. 2 pp 129.

2. Carreon, J. A., Estocarpio, F. A. and Enderez, E. M. (1976): Recommended procedure for induced spawning and Fingerlings produced of *Clarias* gariepinus Aquaculture 269 – 281.

3. Chen, Y. (1981): Chicken farming in integrated fish farming Vol. II pp 4 – 30. Regional Aquaculture Lead Centre Wixi, China.

4. Chen. Y. P. and Yenpin Li: Integrated Agriculture – Aquaculture Farming studies in Taiwan pp. 239 – 241. In Roggers S. V. Pullins and Ziad, H. Schehadeh (eds) Integrated Agriculture – Aquaculture Farming systems (1980) (1980). ICLARM – SEARCA, Manila Phillippines.

5. Claude E. Boyd (1982): Development in Aquaculture and Fisheries Science. Vol. 9 Elsevier, New York pp 17, 30 and 37.

6. Claude E. Body (1979): Water Quality in Warmwater Fish Ponds. Craftmaster Printer, Alabama pp 73.

7. Nash, E. Collins and Brown, M. Carol: A theoretical comparison of Waste treatment processing ponds and fish product ponds receiving animal wastes pp. 87 – 97. In Rogers S. V. Pullins and Ziad, H. Shehadeh (eds): Integrated Agriculture – Aquaculture Farming System (1980): ICLARM – SEARCH Manila, Phillipines.

8. Pudadera, B.J.J., K.C. Corre; E. Coniza and G. A. Taleon (1986): Integrated farming of broiler chicken with fish and shrimp in brackish water ponds, pp. 141 – 144. In J. L. Macleen, L. B. Dixon and L. V. Hosillos (eds). The First Asian Fisheries Forum. Asian Fisheries society, Manila, Phillipines.

9. Schroeder, G. L. : Fish Farming in Manure Loaded Ponds pp. 73 – 86. In Rogers S. V. Pullins and Ziad, H. Schehadeh (eds). Integrated Agriculture – Aquaculture Farming System (1980). ICLARM - SEARCA. Manila, Phillippines.

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10. Velasquez, C. C. : Health constraints to integrated animal-fish farming in the Phillippines pp. 103 – 111. In Rogers S. V. Pullins and Ziad, H. Shehadeh (eds) Integrated Agriculture – Aquaculture Farming System (1980). ICLARM – SEARCA, Manila, Phillippines.

11. Viveen, W. J. A. R., C. J. J. Ritcher; P.G.W.J. Van Oordit; J.A.L. Janseen and E. A. Huisman (1984): Practical manual for the culture of the African Catfish *Clarias gariepinus)* pp. 7, 68 and 72. Netherlands.

12. Wetchagarum, Kachorasak: Integrated Agriculture - Aquaculture Farming Studies in Thailand with case studies in chicken - fish farming pp 243 – 249. In Rogers S. V. Pullins and Ziad, H. Shehadeh (eds) Integrated Aquaculture – Aquaculture Farming System (1980). ICLARM – SEARCA Manila, Phillipnes.

13. Yingzue, F., Xianzhen, G. , Jikun W., Xiuzheng, F. and Zhinyna, L. : Effect of different animal manures in Fish Farming pp. 117 – 120. In Macleen, J. L.: L. B. Dixon and L. V. Hosillos (eds) First Asian Fisheries Forum (1986). The Asian Fisheries Society, Manila, Philippines.

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