Role of Ducks in Improving the Nutrient Levels in Fish Pond Ecosystem in Tarjhunga Village, Chhattisgarh State

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Paper Received on August 06, 2017, Accepted on September 06, 2017 and Published Online on September 10, 2017

ABSTRACT

*In the present study two ponds were selected, one pond treated with ducks (T_2) and another pond treated without ducks (T_1). The ponds are located at Tarjhunga village of Raipur district in Chhattisgarh state. The ponds were stocked with fingerlings of Indian Major Carps (*Catla catla, Labeo rohita *and* Cirrhinus mrigala *at the ratio of 3:3:4) at stocking density of 6000 ha^{-1}. Duck rearing was done under scavenging mode. Major feed of the ducks was from the ponds consisting of insects, leeches, snails and other bottom detritus plant and animal material. The mean loading rate of duck manure was estimated at 5.27 kg dry wt. 2.2 ha^{-1} day^{-1} in the pond treated with ducks. Corresponding loading rates of nutrients were 0.05, 0.03 and 0.02 kg ha^{-1} day^{-1} for nitrogen, phosphorus and potassium respectively. The proximate composition of N: P ratio was approximately 1.7:1. The weight gain of fish was significantly higher in treatment under integrated system than in the control. Better growth and maximum survival contributed to a yield of 2029.57 kg/ha by raising of ducks in T_2. Poor yield was observed in T_1 i.e.1286.68 kg/ha. The cost of production per kg was found to be Rs. 7.29, Rs. 4.82 for T_1 (Control), T_2 (Ducks) respectively. The benefit : cost ratio in case of integration of duck with fish was found to be that 3.49 : 1 which was much more profitable to farmers than in case of fish culture without ducks was found to be at 2.74 : 1 under village conditions of Chhattisgarh.*

Key words: *Integration; Ducks; Nutrients;*

Fisheries is destined to play an important role in human nutrition but the cost is beyond reach of many people. Utilization of grain and animal protein as feed in aquaculture may not be economical as it might lead to food crisis and attention is being redirected to wider use of all resources and integrated fish farming offers a solution to the problem. Recycling of organic wastes for fish culture serves the dual purpose of cleaning the environment and providing economic benefits. In India about 40% of cultivated area is under irrigation and 60% of cultivated area is under rain fed condition. Where as in Chhattisgarh the irrigation percentage to net sown area is 32.10% and the rest is rain fed (67.9%). At village level in Chhattisgarh the main water resource is village ponds. The village ponds are used for irrigation, fish culture and other multipurpose domestic activities (bathing, washing etc). These ponds are rain fed. In which no inputs are given and nutrient availability is very poor, as a result there is low fish production. In such ponds, recycling of nutrients through integrated farming is a suitable alternative (*Anonymous 2006*). The recycling of animal dung/ wastes in fish ponds is important for natural fish production as also sustainable aquaculture and to also reduce expenditure on costly feeds and fertilizers which form more than 60% of the total input cost in semi intensive fish culture systems. However, the indiscriminate use of these manures in fishponds, instead of improving the pond productivity, may also lead to pollution. Although some work has been done on animal manures like cow dung, poultry droppings and biogas slurry which are suitable substitutes for costly feeds and fertilizers (*Schroeder 1980*), there are few reports on the recycling of duck manure in fish ponds and more so under Chhattisgarh and Indian conditions. Chhattisgarh has large number of water bodies as village ponds to the tune of 60,029 ha which

can efficiently be utilized for fish production and will add to the microeconomics of the village. The ducks make their way into the ponds during day time and release the droppings into the water. These droppings contain undigested grains that can be consumed by the fish and is also nutrient rich, which will improve the plankton (ultimately fish production) through nutrient accumulation over a period of time. At harvest in addition to fish, duck eggs and duck meat will also become available to the farmers as an additional source of income as also nutritional security to his family.

METHODOLOGY

The present study was conducted at Tarjhunga village of Raipur district, Chhattisgarh state, India for 257 days. The study involved two ponds measuring 2.2 ha and 2.4 ha water area designated as T_2 and T_1 respectively. T_2 was a treated pond where in ducks were allowed in to the pond for wild grazing during day time whereas T_1 is without ducks. No fertilizer or feeds were given as inputs in the ponds. Statistical analysis was carried out by using T-test at 5% level of significance.

Stocking of fish and Ducks : Advanced fingerlings of Indian major carps (*Catla catla, Labeo rohita and Cirrhinus mrigala* in a ratio of 3:3:4) were stocked at 6000/ha. Initially the ducklings were reared at the farmers residence till they attained three months age after which they were allowed to make entry into the ponds for feeding etc. The ducks Indian runner (*Anas platyrhions*) were reared at farmer's houses, which were released in the morning (9.00 am) towards the pond and herded back in the evening (5.00 pm). The total loading density of ducks in T_2 was 300 ducks/2.2ha water area. All the family members of the villagers were involved in this experiment thus each family having 3 to 5 ducks to raise. The ducks were fed with fresh left over kitchen wastes by the farmers.

Observations recorded: Water quality parameters of the ponds were studied fortnightly for temperature, pH, dissolved oxygen, free CO_2, total alkalinity, total hardness, conductivity, biochemical oxygen demand (BOD), ammonia, nitrate nitrogen (NH_3-N), total orthophosphate, phytoplankton and zooplankton (*APHA, 1989*). Length and weight of fish were recorded on monthly basis. The manure loading rate was determined randomly by collecting fecal samples from 4 ducks under the same conditions of treatment in the wet laboratory. Harvesting of fish was carried out after 9 months of experiment.

RESULTS AND DISCUSSION

The duck manure was analyzed and its chemical composition is detailed in Table 1. The duck manure was analyzed and the chemical composition is 52.5% Moisture, 0.95% Nitrogen, 0.54% Phosphorus and 0.37% Potassium. *Woynarovich (1979)* reported composition of duck droppings as Moisture 57%, organic matter 26%, Nitrogen 1% and Phosphorus 1.4%. *Kalita (2006)* reported composition of duck manure as 81% Moisture, 0.91% Nitrogen and 0.38% Phosphorus.

Ratio of nitrogen: phosphorus, crucially determines the productivity potential of water body, as exploitation efficiency of added nitrogen decreases with the increasing nitrogen and phosphorus ratio (*Singh and Sharma, 1999*). Nitrogen and phosphorus ratio, 2:1 was found to be most efficient in fertilizing ponds (*Saha and Chatterjee, 1997*). *Sarkar (2002)* reported N:P ratio in cow dung (1.25:1), pig dung (1:1), poultry droppings (2:1) and vermicompost (2.6:1). The mean loading rate of duck manure was estimated as 5.72 kg dry wt. 2.2 ha^{-1} day^{-1} in the pond treated with ducks (Table 4.1). Corresponding loading rates were 5.72 kg 2.2 ha^{-1} day^{-1} with 0.05, 0.03 and 0.02 kg ha^{-1} day^{-1} for nitrogen, phosphorus and potassium respectively. On the basis of N:P ratio proximate composition was approximately 1.7:1.

Table 1. Duck (T_2) manure composition and mean loading

Proximate composition of manure %	
Moisture	52.5±1.25
Proximate composition of manure % DM basis	
Nitrogen	0.95 ± 0.05
Phosphorus	0.54 ± 0.02
Potassium	0.37 ± 0.04
Mean loading rate of kg dry wt. 2.2 ha^{-1} day^{-1}	
Total input	5.72
Total nitrogen	0.05
Total phosphorus	0.03
Total potassium	0.02

Physico chemical parameters : The mean water quality parameters of the experimental period are presented in Table 2. During the 257 days of culture water temperature fluctuated widely between 22.0 to 33.5 ^{0}C. The pH of water varied from 6.6 to 8.0. The mean pH of the water in T_2 was distinctly alkaline while it was near neutral in T_1.During the present investigation, clearly demonstrate that with the duck droppings used as manure, the pH of the water is an important parameter to determine the acidic, alkaline and neutral

Table 2. Mean values of physico chemical parameters of water

Parameters	T_1-Control (Range)	T_2-Ducks (Range)	Cal. t value
pH	6.9 (6.6-7.2)	7.4 (6.9-8.0)	5.469*
DO (mg/l)	5.85 (5.4-6.2)	6.94 (6.4-7.6)	9.965*
BOD (mg/l)	8.71 (8.2-10.2)	6.84 (6.0-8.0)	9.457*
Free CO_2 (mg/l)	1.23 (0.80-2.00)	1.14 (0.80-1.50)	1.072
Total alkalinity (mg/l)	143.4 (114-165)	196.5 (165-230)	9.271*
Hardness (mg/l)	155.0 (125-175)	173.9 (135-202)	3.437*
Conductivity (µmhos/cm)	198.3 (156-242)	213.9 (175-265)	1.934
Nitrate (mg/l)	0.185 (0.152-0.240)	0.211 (0.152-0.310)	2.334*
Phosphate (mg/l)	0.078 (0.04-0.12)	0.148 (0.15-0.20)	7.863*
Ammonia (mg/l)	0.005 (0.001-0.012)	0.008 (0.002-0.015)	1.923
Plankton (no/l)	88 (69-116)	282 (83-607)	5.300*

(* $p<0.05$)

conditions for certain reactions i.e. release of essential nutrients, etc. Use of duck excreta is likely to be more beneficial in production system as it is maintaining an alkaline state leading to better productivity.

In the present studies, dissolved oxygen was relatively better (6.94 mg/L) in T_2 (Ducks) than in T_1 (5.85 mg/L) (Control). It was observed that, dissolved oxygen is high in T_2 (ducks) than T_1 (control). This indicates that oxygen content may have also increased with the activities of ducks in the pond. The oxygen content was low during summer, with the increase in temperature. Dissolved oxygen (DO) level in this study was not a constant for a productive fish pond ecosystem. Fishes respond differently to low oxygen levels, the sensitivity depends on species, life stages and life process (*Albaster and Lloyd, 1980*). From the results it is apparent that there is a wide fluctuation in oxygen, however, there is no cause for alarm as these levels.

The dissolved carbon dioxide varied from 0.80 to 2.0 mg/l having negative correlation with phytoplankton. The alkalinity of water was found to differ significantly and in the two treatments the higher mean value of alkalinity was found in T_2 (196.5 mg/l) than in T_1 (143.4 mg/l).

During the experiment period, biochemical oxygen demand (BOD) @ 6.0-8.0 mg/l is recorded. The highest mean value of nitrate nitrogen was observed in T_2 (0.211 mg/l) than T_1 (0.185 mg/l). *Maitra (1991)* recorded BOD @ 5.0-6.0 mg/l content in fish cum duck integration where as it was 6.0-8.0 mg/l in the present study. Maitra further observed that the BOD amount was low in comparison to fish cum pig and fish cum poultry integration systems. Gradual contributions of duck droppings might not have created any oxygen stress.The nitrate nitrogen of water was found to be significant among both treatments. The nitrate nitrogen was positively significant with plankton in both the treatments. Orthophosphate varied from 0.15-0.20 mg/l in T_2 followed by T_1 (0.04-0.12 mg/l). Orthophosphate level in water was found to be significant between the two treatments. However *Geeta et al (1988)* did not exhibit any significant variation between the two treatments.

Biological parameters : The plankton production was found to differ significantly between the two treatments. The higher mean value observed in T_2 (282 no/l) than in T_1 (88 no/l). Phytoplankton ranged from 56 to 449 organisms litre^{-1} and zooplankton ranged between 27 to 177 organisms litre^{-1} in T_2. T_1 showed less population of phytoplankton (39 to 82 organisms litre^{-1}) and zooplankton (30 to 51 organisms litre^{-1}). Among phytoplankton the population of Chlorophyceae was maximum in T_1 and T_2 (28.70% and 37.11% respectively). Rotifers dominated in both the treatments followed by copepods.

The biological productivity of any aquatic body is generally judged through the qualitative and quantitative estimation of plankton, which form the natural food of fish (*Ahmed and Singh, 1989*). As far pond productivity is concerned duck manure was found to release nutrients continuously resulting in greater production of plankton population. The plankton production is higher in T_2 compared to T_1. This may be attributed to the contribution of duck excreta in to the pond giving better plankton production.

Fish yield : Average daily gain (ADG) was found to be highest in T_2 treatment i.e. 2.32 g, 2.05 g, and 1.93 g/ day and in T_1 it was 1.75 g, 1.57 g and 1.53 g/day for catla, rohu and mrigal respectively and the differences were significant. The growth (weight gain) of the different fish species cultured revealed that in *C. catla, L .rohira and C .mrigal* ADG was significantly more in T_2 (Ducks) than T_1 (Control) (fig.1 and fig.2). Better growth and maximum survival contributed to highest yield (2029.57 kg/ha) by raising ducks in T_2. Poor yield was observed in T_1 i.e. 1286.68 kg/ha (Table 3, 4).

CONCLUSION

This study concludes that duck excreta is a good source of nutrients in water and so contribute to plankton production. Physico chemical parameters of water were

Table 3. Growth and yield of fish in T_1 (Control)

Area (ha)	Species	Av. daily gain	Total production (kg/2.4 ha)	Productivity (kg/ha)
2.4	Catla	1.75	1110.29	462.62
	Rohu	1.57	900.29	375.12
	Mrigal	1.53	1077.89	448.94
Total			3,088.47	1,286.68

Table 4. Growth and yield of fish in T_2 (Ducks)

Area (ha)	Species	Av. daily gain	Total production (kg/2.2 ha)	Productivity (kg/ha)
2.2	Catla	2.32	1605.33	729.69
	Rohu	2.05	1325.36	602.43
	Mrigal	1.93	1534.39	697.45
Total			4,465.08	2,029.57

better in duck manure treated pond than without duck manure. The plankton production is more in fish duck integrated system than in control. All the above have contributed in maximizing survival and yield of fish over control. The fish cum duck farming has given better returns in terms of fish growth, survival and productivity as compared to fish farming without ducks.

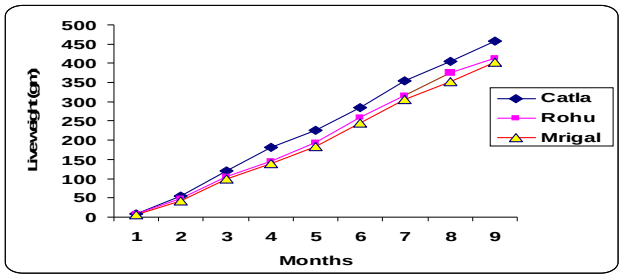

Fig 1. Body weight of Indian major carps during culture period in T1 (control)

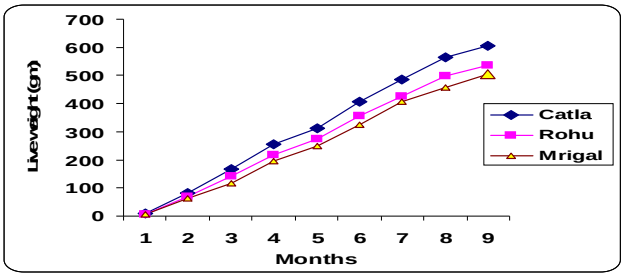

Fig 2. Body weight of Indian major carps during culture period in T_2 (ducks)

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