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RESEARCH ARTICLE.....

Effect of integrated fish cum duck farming system on productivity of fish ponds

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ABSTRACT..... The experiment was conducted at Bastar disrtict of Chhattisgarh to assessment of fish cum duck farming system on physico-chemical, biological parameters of pond ecosystem and overall fish production in the ponds. This trial was conducted during three successive years 2014-2016 for the period of 8 months. The pond was stocked with fingerlings @6000 /ha of indian major carps (*Catla catla, Labeo rohita, Cirrhinus mrigala* in a ratio of 4:3:3) to utilize the maximum energy in the pond through polyculture. The Muscovy (Local name-Naghansh, S.N. – *Cairina moschata*) breed of ducks was used for the integrated system to fulfill the purpose of obtaining the meat and for deliver the excreta into the ponds during wild grazing. Under such cultural practice at village level no supplementary feed was given to the fish while the ducks were fed with fresh kitchen leftovers and agricultural by products as kanki (broken cereal grains), kodha (rice bran) which are easily available commodities in rural areas. The study revealed that water quality parameters *i.e.* pH, dissolved oxygen, alkalinity were significantly higher in integrated pond than control pond (without ducks). Further plankton levels (Phyto and zooplankton) were also improved considerably in integrated pond. Indian major carps in the integrated ponds exhibited better body weight than the control pond. Better growth rate in fishes was contributed to a yield of 1.980 tonnes/ha/year with integration of ducks in fish pond whereas 1.052 tonnes/ha/year yields were observed in the control pond. The results conclude that integrated fish cum duck farming is more profitable than farming fish alone with no inputs under rural conditions of Chhattisgarh.

KEY WORDS..... Fish cum duck farming, Plankton, Village pond

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INTRODUCTION.....

Integrated farming system is one of the best methods for maximizing animal and plant protein production through optimum use of land, water and waste resources at sustainable level. In this system, nothing is wasted and ecological balance is maintained. Recycling of organic wastes for fish culture serves the dual purpose of cleaning the environment and providing economic benefits (Shyam *et al.,* 2012). The recycling of animal dung/wastes in aquaculture ponds is important for natural fish production, which supports sustainable aquaculture

and also reduces expenditure on supplementary feeds and fertilizers. Some works have already been reported on animal manures like cow dung, poultry droppings and biogas slurry which are suitable substitutes for costly feeds and fertilizers (Schroeder, 1980). This type of integration can increase overall production intensity and economics on land, labour and feed requirements for both poultry and fish. Fish-cum-duck integration is very common in countries like China, Hungary, Germany, Poland, Russia and to a very small extent in India (Ayyappan *et al.*,1998). From the point of view of input-output relationship fish cum-duck integration is the best model of integrated fish livestock and poultry. However, fish-cum-duck farming practices are lagging far behind in Bastar district than other district of Chhattisgarh, India.

Presently the village tanks are being utilized for domestic purposes and no inputs are allowed into it for fear of killing the aesthetic value of the pond. So only fish seed as input is allowed and any other input is taken as a cognizance offence by the village folk hence, fish production of pond is very low. This type of culture practice of fish is dominated as traditional fish farming in Bastar district of Chhattisgarh. To overcome this problem integration of fish with duck farming is a suitable alternative for which the village folk do not have any objection. Therefore, the present study has been undertaken to work out the effect of integrated fish cum duck farming system on productivity of fish pond of Bastar district.

RESEARCH METHODS.....

The present investigation was carried out in different village pond of the Bastar district of Chhattisgarh during three successive years 2014-2016 for the period of 8 months. The study involved two ponds – one with ducks (0.4 ha) another without ducks (0.5 ha). Both ponds are seasonal and shrinking in nature. Advanced fingerlings of Indian major carps (catla, rohu and mrigal) were stocked @ 6,000 ha^{-1} in the ratio of 40:30:30 measuring 90±20 mm and weighing 8.5±2.0 g. After one month of stocking, 90 days old ducks of Muscovy breed were brought into use. Some farm families which live nearer to fish pond already have few numbers of Muscovy breed of ducks. Hence, these ducks were given to farm families of the village as per requirement to fulfill number of duck recommended for per hectare of pond area. Ducks were allowed in to the treated pond for wild grazing during day time where as control pond is without ducks. Muscovy (Naghansh) breed of ducks were used and reared for meat purpose @ 250 ducks /ha area of fish pond. No fertilizer or feeds were given as inputs in the pond. Ducks were reared at farmers houses which were released in the morning (9.00 am) towards the pond herded back in the evening (5.00 pm). The ducks were fed with fresh left over kitchen wastes and agricultural by-products as kanki (broken grains), kodha (rice bran) etc. by the farm families to raise. Incubation and hatching of eggs is the characteristic feature of this Muscovy breed of duck which produce ducklings.

Water quality parameters of the ponds were studied monthly for temperature, pH, dissolved oxygen, free CO_2, total alkalinity, total hardness, conductivity, ammonia and plankton (APHA 1989, Waterproof pH Pocket Tester, Aquacheck Water Testing Kit). Plankton were collected by filtering the water through plankton net (mesh number 25, pore size 60µm) and counted under the microscope using sedgewick-rafter counting cell. Manure loading rates in treated pond was determined by randomly collecting samples from 5 ducks over a period of time. Growth of fish was recorded on monthly basis from sample catches obtained by use of cast netting.

RESEARCH FINDINGS AND ANALYSIS.....

Duck dropping loads were analyzed for seven days in a week and an average dropping per day has also been recorded. The ducks excrete 38g-55g excreta/day, thus,100 ducks excrete 4.85 kg/ha/day. Growth of fish was observed on monthly and the net and gross fish productions were calculated annually.

Physico-chemical properties of water:

Physico-chemical properties of water play an important role in regulating the various metabolic activities of fish. These parameters are essential for the better survival and growth of fish. The duck manure influence the quality of water to a large extent (Dhawan and Singh, 2000). The estimated values of physico-chemical properties of pond water are depicted in Table 1. Water temperature fluctuated in the range of 20.2 to 29.2 °C, which was may be due to seasonal change. The pH of water varied from 6.2 to 8.07 with moderate fluctuations. The pH of the water in treated pond was distinctly alkaline. Chari (2003) has also observed that the use of duck excreta likely to be more beneficial in

production system as it maintains an alkaline condition. Golterman (1970) while analyzing natural waters was noticed relation between pH and percent of free CO_2, HCO_3 and CO_3. It was reported that an increased pH means higher carbonate values. The present studies were found with higher pH values and decreased CO_2 values*i.e*. negative correlation was found between pH and CO_2.

The dissolved oxygen was relatively high in duck treated pond which indicates favourable condition for fish growth. It may be concluded that the movement of ducks in the pond helped in aerating the pond water. Dissolved oxygen is significantly correlated with zooplankton in treated pond. The free carbon dioxide (Free CO_2) of different experimental waters was found non-significant between the two treatments. The negative correlation was observed between phytoplankton and Free CO_2. Chari (1983) also noticed non significant negative correlation between phytoplankton and free CO_2 and explained that free CO_2 may not be a controlling factor for phytoplankton production. Higher values of alkalinity were observed in duck treated pond (108-194 ppm) in comparison to pond without duck (93-172 ppm). Alkalinity is positively correlated with pH and DO in the present study. In this study the plankton production was found to differ significantly between the two treatments. Phytoplankton and zooplankton biomass were high in treated pond with stocking of ducks, which might be due

Table 1: Variation mean value for physico- chemical parameters in the experimental ponds

Parameters	Control (Range)	Treated pond (Range)
Air temperature	28.1 (22.1 – 35.2)	27.5 (22.8 – 34.7)
Water temperature	25.2 (20.2 – 28.5)	25.0 (20.5 – 29.2)
pH	6.9 (6.2 – 7.4)	7.6 (6.5 – 8.1)
DO, mg/1	6.00 (5.2 – 6.4)	6.90 (5.5 – 7.8)
Free CO_2, mg/1	1.60 (0.9 – 2.0)	1.45 (0.8 – 1.8)
Total alkalinity, mg/1	128 (93 – 172)	153 (108 – 194)
Hardness, mg/1	86 (69 – 118)	114 (80 – 137)
Conductivity, µmhos /cm	129 (123 – 171)	169 (130 – 218)
Ammonia, mg/1	0.005 (0.003 – 0.009)	0.013 (0.004 – 0.018)
Plankton vol., ml/50l sample	0.21 (0.16 – 0.34)	0.64 (0.21 – 1.30)

Table 2 : Growth parameters of fish species in different treatments

Parameters	Control pond (Area-0.5ha)	Treated pond (Area - 0.4ha)
Growth rate of catla, g day^{-1}	1.70	2.47
Survival of catla, %	48.0	65.0
Average weight at harvest, g	422	610
Yield of catla, kg	243	380.4
Growth rate of rohu, g day^{-1}	1.49	2.07
Survival of rohu, %	43	60.0
Average weight at harvest, g	370	510
Yield of rohu, kg	143.5	220.4
Growth rate of mrigal, g day^{-1}	1.47	1.92
Survival of mrigal, %	42.5	56.0
Average weight at harvest, g	365	474
Yield of mrigal, kg	139.5	191.2
Total yield, kg	420.8	792
Productivity, kg/ha	1052	1980
Mean survival, %	44.5	60.3

to high rate of manuring.

Growth performance of fish:

The growth parameters of fish species under different treatments are shown in Table 2. The average initial length and weight of fingerlings (catla, rohu and mrigal) at the time of stocking was 8.5, 9.2, 10.0 cm and 8.9, 7.8, 7.2 g for both the treatments. The average final mean length of fishes was 27.8, 28.1 and 29.6 cm in treated pond followed by 23.5, 21.7 and 24.8 cm in control pond for catla, rohu and mrigal, respectively. The average final mean weight of fish at the time of harvesting was 610, 422 g (catla), 510, 370 g (rohu) and 474, 365 g (mrigal) for treated and control pond, respectively (Table 2).

Chand *et al.* (2006) observed that the stocking of fishes of Indian major carps in the treatments D_0 (No ducks), D_{200} (200 ducks), D_{300} (300 ducks) and D_{400} (400 ducks) for 10 months culture period were 602,763,827 and 708 g (catla), 516,688,715 and 721 g (rohu), 475, 516, 623 and 636 g (mrigal), respectively. Average daily gain (ADG) was found to be higher in treated pond *i.e.* 2.47 g, 2.07 g and 1.92 g/day as compared to control pond, where it was 1.70g, 1.49 g and 1.47 g/day for catla, rohu and mrigal, respectively. Chand *et al.* (2006) also reported average daily gain (ADG) in D_{400} (400 ducks) at 2.67, 2.35g, 2.08g/day, in D_{300} (300 ducks) at 2.70g, 2.33g and 2.04g/day, in D_{200}(200 ducks) at 2.49g, 2.24g and 1.68g/day and in D_0 (control) 1.95 g, 1.67 g, 1.54 g/day for catla, rohu and mrigal, respectively.

Growth performance of ducks:

Growth performance of duck was studied at fortnightly interval measuring weight gains in ducks. The average initial mean weight of ducks was 650g. At the end of experimentation period the final weight of ducks was 1800 g. The survival rate of duck was 95 per cent. Chand *et al.* (2006) recorded survival rates at different stocking densities *i.e.* 93 per cent, 91 per cent and 90 per cent in D_{200}, D_{300} and D_{400}, respectively.

Economics of the study:

The integrated fish cum duck farming improved the economic returns from the fish ponds as additional income from duck meat and eggs with increased fish production. The cost benefit ratio in case of integrated fish cum duck farming was found to be 3.11 which was much more profitable to farmers than in case of fish culture without ducks, found to be at 1.4 under village conditions of Chhattisgarh (Table 3).

Conclusion:

This study proved that duck excreta are a very good source for improvement in productivity of fish pond by increasing production of plankton in treated ponds.

The physio-chemical properties of water in treated

Table 3 : Economics of fish cum duck farming system

Sr. No.	Particulars	Control pond (0.5 ha)	Integrated pond (0.4)
1.	Fixed cost (Rs.)	14400	11520
2.	Variable cost (Rs.)	7500	30800
3.	Total cost in Rs. (A+B)	21900	42320
4.	Total cost per ha (Rs.)	43800	105800
5.	Returns		
	Sale of fish (Rs.100/kg)	52600	79200
	Sale of egg, (Rs.4/egg)	-	8494
	Duck meat (Rs.250/kg)	-	42660
	Ducklings (Rs. 80/Nos)	-	43684
6.	Gross return (Rs.)	52600	174038
7.	Net return in Rs. (F-C)	30700	131718
8.	Net return per ha (Rs.)	61400	329295
9.	Cost benefit ratio	1.4	3.11

pond are in more productive range, giving good survival of fish and duck.

All the above have contributed in maximizing yield of fish over control pond.

The cost benefit ratio of fish-cum-duck farming is more profitable than fish farming alone.

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