J. Aqua., **15** (2007): 17-21

STUDIES ON GROWTH AND SURVIVAL OF COMMON CARP (*CYPRINUS CARPIO*) AT DIFFERENT STOCKING DENSITIES UNDER PADDY-CUM-FISH CULTURE SYSTEM IN MANIPUR

B. K. Behera, B. B. Panda, P. Das and A. K Sahu*

ICAR Research Complex for NEH Region, Manipur Centre, Imphal-795004, India
**Central Institute of Freshwater Aquaculture, Bhubaneswar-751002, India*

Experiment was conducted during 2005-07 in the farmers' field in Manipur to study the effect of stocking density on growth and survival of fish under paddy-cum-fish culture system. Highest average daily growth (1.77 g/day) and survival (85.2%) were observed at the stocking density of 4000 fingerlings/ha. Fish production, however, was highest at stocking density of 6000 fingerlings/ha. The rice crop performed better under paddy-cum-fish culture compared to paddy cultivation alone. The grain and straw yield increased by 12.45 and 8.39% respectively under paddy-cum-fish culture. The highest grain (5215 kg/ha) and straw yield (8879 kg/ha) was achieved in paddy-cum-fish culture at a stocking density of 8000 fingerlings/ha. However, the highest net returns (Rs. 58,592/ha) and benefit: cost ratio (3.62) was obtained at stocking density of 6000 fingerlings/ha.

INTRODUCTION

Rice, the predominant crop of the state, Manipur, covers an area of about 175,000 ha, out of which 40,000 ha is suitable for paddy-cum-fish culture. Rice is grown in diverse ecological conditions of rainfed terraces of hilly slope and valleys under various abiotic, biotic and socio-economic stress situations leading to lower productivity. On the other hand, increased population pressure over the years has led to decline in per capita land availability, thereby hindering further scope for horizontal expansion for food production. Vertical expansion through integration of appropriate farming components, therefore, is suggested to be an appropriate option for enhancing sustainability of land and achieving food security. Among the various farming options, rice-fish integration has been identified as an promising farming activity in the valley areas of the state. Moreover, high rainfall during the monsoon that leads to water stagnation, favours paddy-cum-fish culture in the valley. Information on scientific paddy-cum-fish culture in the state, however, is scanty. The common carp (*Cyprinus carpio*) was reported to be one of the most suitable fish species to grow in paddy-cum-fish culture in Manipur, because of its detritovorous feeding habit and eurythermal nature. Considering stocking density to have immense influence on growth, survival and total production, experiment was carried out to standardize the stocking density in paddy-cum-fish culture and further to

assess the effect of the fish integration in paddy cultivation on productivity and economics of the system in the sub tropical plain zones of Manipur.

MATERIALS AND METHODS

The study was conducted during 2005-07 in the farmers' field at Sawombung gate, Imphal East District of Manipur, India. Experiment was taken up in eight plots ranging from 3750 to 4125 m^2 area, located at an elevation of 746 m from the mean sea level. The treatments constituted three stocking densities of fish i.e., 4000, 6000 and 8000 fingerlings of 8-10 cm size/ha in paddy-cum-fish culture system and control i.e. paddy cultivation alone (without stocking of any fish fingerlings) in two replications. The peripheral dyke height of the paddy plot was 60 cm. The additional trench was not constructed for fish rearing; however one side of the paddy-fish plots was slightly deepened for holding more water. At the inlet and outlet of each plot a bamboo mat mounted on a wooden frame was fixed to restrict the movement of fishes in the experimental plot.

Field preparation was started by ploughing the field in the month of February and spreading the paddy straw over the plot which was left as such up to the month of April. On the onset of monsoon puddling was done twice in the last week of April and first of week of May with tractor and power tiller, respectively. After leveling, the paddy variety KD-263 was directly sown in wet fields at a seed rate of 100 kg/ha. The crop was fertilized with a dose of 60:40:30 kg N, P_2O_5, K_2O/ha. Full dose of P_2O_5 and K_2O and 50% N was applied at the time of sowing in the form of diammonium phosphate, urea and muriate of Potash and rest 50% of nitrogen was applied at panicle initiation stage. Weeding was done twice at four and seven weeks after sowing, and gap filling was done along with first weeding to maintain a spacing of 15-20 cm from plant to plant. Nuvacron and Endosulphan was sprayed @ 250 ml/ha each to control the insect pest after 30 days of showing. Fingerlings of common carp, *Cyprinus carpio* was stocked in the experimental plots after 21 days of spraying of insecticides. Raw cowdung was applied @ 10 tonnes/ha thrice at 15 days interval after a fortnight of stocking of fish fingerlings. The crop as well as the fish was harvested in the first week of October with a cultivation period of 150 days for rice and 100 days for fish. Water level was maintained at 8-10 cm in first month and later maintained at 30- 45 cm till harvesting. No supplementary feed was provided for the fish.

At the time of harvesting, sample was taken from 1×1 m^2 area randomly from three places in each plot for calculation of yield attributes and yield of rice. But, fish was harvested from total plot area and converted to per hectare yield. Weight and length of the fish and number of fishes was recorded for each plot. The economics of the system was calculated by considering local price of the products and the input costs borne upon.

RESULTS AND DISCUSSION

The results indicated that the highest average growth rate of common carp (1.77 g/day) was achieved in with lowest stocking density at 4000 fingerlings/ha and the average daily growth rate decreased with the increase in stocking density. The survival rate of fish was higher (85.2%) at low stocking density (4000 fingerlings/ha), which decreased with increase in density (Table1). However, the highest fish yield of 832 kg/ha was achieved in at stocking density of 6000 fingerlings/ha. An increase of 36.17% fish production was recorded with increasing stocking density from 4000 to 6000 fingerlings/ha. The overall fish production showed a direct relationship with the stocking density, with highest production in treatment with higher density and vice versa. This finding corroborates the results of Gurang and Wagle (2005). The lower growth rate at higher stocking density is attributed to lower availability of space and food for fishes in the paddy plot.

Table 1. Growth and survival of *C. carpio* at different stocking densities in paddy-cum-fish culture system

Treatment (nos of fingerlings /ha)	Mean length (cm)		Mean body weight (g)		Mean daily growth (g)	Survival (%)	Fish production (kg/ha/ 100 days)
	Initial	Final	Initial	Final			
4000	2.71±0.35	13.25±2.23	3.25±0.23	180.27±20.12	1.77	85.2	611
6000	2.82±0.25	12.13±2.12	3.51±0.52	171.24±30.35	1.67	81.0	832
8000	2.64±0.42	10.71±1.57	3.12±0.45	130.25±10.15	1.27	72.3	747

Integration of fish in paddy fields increased all the yield attributing characters and yield of rice (Table 2). The integration increased the numbers of effective tillers, grains per panicle and thousand grain weights by 13.43, 24.05 and 2.87% over control. Similarly, the rice grain and straw yield increased by 12.45 and 8.39% respectively, under paddy-cum-fish culture compared to only paddy cultivation. This was probably due to the frequent locomotory movement of fish under paddy-cum-fish culture, which improves the dissolved oxygen, soil organic matter and nutrient status by adding fecal matter leading to high uptake of Fe and N (Panda *et al.*, 1987), controlled plankton population, micro and macro aquatic insects, bacteria and organic detritus that compete with paddy for material and energy (Mohanty, 2003). Besides, movement of fish in rice field might have caused high turbidity which prohibits photosynthesis and growth of under water weeds (Caguan, 1994). In contrast, rice plant above the water can harvest abundant light and nutrients from under water (Gurang and Wagle, 2005). Among the treatments, the highest number of effective tillers/m^2 (324.1), grain yield (5215 kg/ha) and straw yield (88.79 kg/ha) was recorded with the stocking density of 8000 fish

fingerlings/ha. The grain yield was increased by 5.12 and 5.66% at stocking density of 6000 and 8000 fingerlings/ha respectively, over 4000 fingerlings/ha. This might be due to the higher level of exploitation of the symbiotic relationship and positive effect i.e. better oxygenation, higher uptake of Fe and N and better control of insect pest and weed at high stocking density.

Table 2. Yield attributes of rice at varied stocking densitie s of fish under paddy-cum-fish culture system

Treatment (nos. of fingerlings/ha)	Effective tillers/m^2	Grains/ panicle	Thousand grain weight (g)	Grains yield (kg/ha)	Straw yield (q/ha)
4000	309.2	125.2	28.4	4920	85.47
6000	319.7	130.1	29.0	5172	87.96
8000	324.1	126.9	28.3	5215	88.79
Control	280.0	102.7	27.8	4537	80.66

Table 3. Economics of paddy-cum-fish farming system in Manipur

Treatment (nos of fingerlings/ha)	Gross return/ha (Rs.)	Net return/ha (Rs.)	B:C ratio	Net return/ rupee investment
4000	66,180.00	46,320.00	3.33	2.33
6000	80,952.00	58,592.00	3.62	2.62
8000	76,110.00	51,250.00	3.06	2.06
Average (Rice +Fish)	74,414.00	52,054.00	3.34	2.34
Control (only rice)	27,222.00	12,362.00	1.83	0.83

The integration of fish enhanced the gross return, net return and benefit cost ratio of the production system than cultivation of rice alone (Table 3). On an average paddy-cum-fish culture gave a gross return of Rs. 74,414/ha compared to Rs. 27,222/ha and net return of Rs. 52,054/ha against Rs.12, 362/ha under rice cultivation alone. The benefit: cost ratio (B:C ratio) also almost doubled due to integration of fish. Among the stocking densities, the highest gross return (Rs. 80,952/ha), net return (Rs. 58,592/ha) and B: C ratio (3.62) was obtained with stocking density of 6,000 fish fingerlings/ha. This is normally attributed to higher production of fish at the stocking density of 6000 nos/ha compared to 4,000 and 8,000 fish fingerlings/ha. The study suggested that paddy-cum-fish culture can be highly remunerative farming practice in terms of system production and economics in the valley area of Manipur.

ACKNOWLEDGEMENTS

The authors are grateful to the Dr. S. V. Ngachan, Director, ICAR Research Complex for NEH Region, Umiam for his constant guidance and support to carry out this experiment.

REFERENCES

Gurang, T. B. and S. K. Wagle, 2005. Revisiting underlying ecological principles of Rice-Fish integrated farming for environmental, economical and social benefits. *Our Nature*, **3**: 1-12.

Panda, M. M., B. C. Gosh and D. P. Sinhababu, 1987. Uptake of nutrients by Rice under Rice-cum-fish culture in intermediate deep-water situation (upto 50 cm water depth). *Plant and Soil*, **102**(1): 131-132.

Cagauan, A. G., 1994. Overview of the potential roles of pisciculture on pest and disease control and nutrient management in rice fields. *In*: Seminar on Management of Integrated Ecosystem in Tropical Areas. (Eds. J. J. Symoens and J. C. Miche), Technical Centre for Agriculture and Rural Co-operative (CTA), Royal Academy of Overseas Sciences, 203-244 pp.

Mohanty, R. K., 2003. Studies on various patterns of paddy-cum-fish/prawn integrated culture system. *Fishing Chimes*, **23**(1): 124-126.