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Growth and Economic Assessment of Multiple Fish varieties-paddy Model and its Suitability in the Integrated Paddy Cum Fish Culture System (IPFCS) under Hill Zone of Karnataka, India

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ABSTRACT: Paddy cultivated areas in Malnad regions are transforming into fallow because of low economic returns from the paddy cultivation. Paddy cum fish culture system is the integrated approach which enhances the productivity of paddy as well as fish. In present investigation, performance of different fish varieties *viz.*, Common carp, Red platy, Black molly, white molly and Red sword tail in paddy ecosystem (CTH-1 or Kempumukthi variety) was studied at AHRS, Kademadkal. Paddy and fishes were cultivated in the same field. The result revealed that, the growth (length and weight) was increased in the all the fish varieties. The survivality of all the fishes were more than 80 per cent except common carp fish. In paddy monoculture, 5300 m^2 area of paddy produced the grain yield of 10.73 quintals and straw yield of 16.17 quintals. In paddy cum fish culture, 12.44 q/5300 m^2 of grain yield and 18.74 q/5300 m^2 of straw yields were produced. The grain and straw yield of paddy was higher in paddy-cum-fish culture system compared to paddy monoculture. In paddy cum fish culture, the total production cost (expenditure) and total returns were Rs. 90461.40 and Rs. 126603.96 respectively for 6000 m^2 area (5300 m^2 paddy area + 700 m^2 fish area). Cost-benefit analysis revealed that, paddy-cum-fish culture system was beneficial in terms of economic returns compared to paddy monoculture. Hence, paddy-cum-fish culture is successful in Malnad due to continuous availability of water and economically benefited to farmers.

Keywords: Kempumukthi, Black molly, Common carp, Paddy cum fish culture and Hill zone.

INTRODUCTION

Hill zone of Karnataka is known for undulated geographical area and higher rainfall (>2500 mm). Paddy is major crop in this region with cultivation area of about 80,669 hectares. The varieties like Tunga, Intan, KHP-11 and CTH-1are occupied predominant cultivated area in hill zone of Karnataka .CTH-1 variety is also called as Kempumukthi or Red mukthiand it was released in 1992.Important characteristics of CTH-1 are medium-bold grains, high yielding (3.80-4.00 t/ha), early duration (130-135), tolerant to blast disease, suitable for late planting (July 2nd week) and suitable for low land as well as upland conditions. The monocropping of paddy in low land eco-system is becoming less remunerative as only one crop being cultivated in a year. Hence, integrated paddy-cum-fish culture system (IPFC) was highly adaptable to hill zone of Karnataka (Swamy *et al.*, 2018).

Paddy-cum-fish culture is an age old practice in India, Japan, Malaysia, China and Italy. In India it is popular in Arunachal Pradesh, Tripura, Assam, West Bengal, South Bihar, Andhra Pradesh, Tamil Nadu and Kerala. In Karnataka, IPFC system was first scientifically evaluated in Agricultural and Horticultural Research Station (AHRS), Kademadkal under the University of Agricultural and Horticultural Sciences, Shivamogga, Karnataka. Integrated Paddy-cum-Fish Culture is a system of producing fish in combination with paddy cultivation using the same resources in the same unit area. There are two types of IPFCS *viz.*, Simultaneous or Concurrent method (where fish and paddy grow together in the same field at the same time) and Alternate or rotation method (where fish are cultured in the paddy field during paddy off-season).Integrated paddy-cum-fish culture system has several advantages *viz.*, a) Full utilisation of the paddy field in all seasons, b)Does not require use of fertilisers, herbicides and pesticides, c) Fish metabolic waste acts as nutrient and boost paddy production, d) Presence of fish reduces weeds and pests, e) Increased crop yield in same unit area, and f) Enhanced income generation with little modifications to the paddy field.

In hill zone of Karnataka, due to acidic soil and heavy rain fall conditions, the paddy grain yield is low (8-9 quintals/acre : average farmers field yield). Because of low gross returns or net profit from paddy monoculture in hill zone of Karnataka, many paddy fields are becoming fallow and farmers are shifting to other crops. There is a need to intensify the paddy production through increasing cropping intensity; this can be achieved through paddy based cropping system. The information on performance of different paddy based cropping systems with regarding suitability, productivity and profitability are plenty but the information on fish culture in a paddy cropping system to increase the productivity is lacking in Karnataka. Hence, the present investigation on evaluation of growth and survival performance of five different fishes (Common carp, Red platy, Black molly, white molly & Red sword tail) in paddy field and its impact on paddy production as well as economic returns were initiated.

MATERIALS AND METHODS

Site selection:

The present investigation was carried out at Agricultural and Horticultural Research Station (AHRS), Kademadkal, Chikmagalur, Karnataka, India (Fig. 1). The low land paddy field was selected for the experiment. The interaction between rice variety CTH-1 (Kempumukthi) and five different fishes (Common carp, Red platy, Black molly, white molly & Red sword tail) was studied in this experiment. Duration of the study was 92 days. Date of stocking was 05/06/2020 and date of harvest was 12/10/2020.

Allocation of Area :

Total area	6000 m^2
Area under common carp (trench area)	700 m^2
Area under colour fishes*	216 m^2
Area under paddy crop	5300 m^2

*Haphas were setup without disturbing or reducing the trench area

Preparation of paddy plots:

a) Bundh construction:

The plots selected for paddy cum fish culture are normally prepared in the month of February by raising their embankment all along the plots. The paddy fields are suitable for fish culture at the areas because of strong bundh, which prevent leakage of water to retain water up to desired depth and also guarded the escape of cultivated fishes during the floods. The dykes should be built strong enough to make up the height due to geographical and topographic location of the paddy field. Inlet and outlets were covered with metal mesh.

b) Dressing of paddy field:

After the completion of bundh construction the base of paddy fields are levelled with the help of spade and local made wooden plates called manr. Manual weeding was done based on need followed by construction of irrigated channel for easy passage, storage and draining of water. There are 7 channels constructed at the middle of paddy field for water management. That channel divides the paddy field perpendicular and horizontally. The former serve as entry of water required for the field and the later as outlets, one which remains at the bottom side of the dykes is meant for draining out the water for harvesting paddy crops and fishes. The remaining outlet constructed at the middle height of the dykes is meant for maintaining desirable water depth. Once the dressing work is over, the paddy field is ready for transplantation of rice seedling and fish seed stocking. However, the stocking of fish seed is done after 10-15 days of transplantation of rice seedling from its nursery bed.

Fig. 1. Field view of the experiment.

Source of fish seed: The fish seeds were collected from Inland Fisheries Division, Zonal Agricultural and Horticultural Research Station, Mudigere, Chikmagalur district, Karnataka.

Stocking of fish seeds:

Before releasing of fish seed to paddy field the paddy transplantation from rice seed beds to main paddy fields is done in the month of July, and there after paddy is left for 25 days for strengthening of paddy roots. Common carp was stocked in the trench area of 700 m^3 @ 30 fish fingerlings /m^3.The colour fishes *viz.*, Red platy, Black molly, White molly and Red sword tail were stocked in the Nylon hapa having an area of 18 m^2 @30 fisher lings /m^3.

Tieing of Nylon haphas :

The nylon haphas (6 m length: 3 m width: 1 m depth) were tied for rearing of colour fishes (Fig. 2 and 3). The fish varieties used for experiment were Gold fish (*Carassius auratus*), Koi carp (*Cyprinus rubrofuscus*), Red platy (*Xiphophorus Maculatus*), Common carp (*Cyprinus carpio*), Black molly (*Poeciliasphenops*) and Red swordtail (*Xiphophorus hellerii*).

Fig. 2. Tieing of haphasin paddy field.

Paddy field preparation: Paddy field was ploughed by using tiller and levelled by using leveller. Simultaneously the sides of the bunds were trimmed. Paddy field was fertilised with farm yard manure @ 3000 kg/1000 m^2. CTH-1 paddy seeds were sown separately in nursery and raised the seedlings. 21 days old paddy seedlings were planted manually. After 25 days of after transplanting, fish fingerlings were released. No chemical fertiliser and insecticides were used for paddy field. Finally, paddy crop was manually harvested and processed.

Water management: The inlet and outlet of the pipes were covered with nylon mesh. The water level in the paddy field was maintained one inch above the ground level. Upper surface of study area was covered with bird scaring net. Agriculture lime was applied @20 g/m^2. After three days, raw cow dung slurry was applied to the trench area @ 300 g/m^2 before stocking the fish seeds. After stocking the fish seeds, lime was applied @ 2 g/m^2/month and 100 g of raw cow dung slurry/m^2/month was applied.

Feed and feeding: Floating fish feedhaving28% Crude protein was used as feed @ 10 % of their body weight.

Water quality parameters:
Water quality parameters viz., temperature, pH, dissolved oxygen and colour of water were recorded once in month.
Harvesting:
Gears use for harvesting fishes is simple bamboo made basket called cane/bamboo. The fish culture for the period of 3-4 months in rice field, a production of 200-300 Kgs/ha achieved and while fish grown for the period of 5-6 months; 400-500Kgs/ha yield has been reported in the same season. Methodology used for harvesting used for harvesting, first the water is drained through outlet pipe, and thus allowing fishes and water accumulated in mid channel of paddy field, thereby the fishes are caught with the help of tasing puda, hand picking etc. and then stocking in large plastic bucket in live condition. After completion of fish harvesting the paddy harvesting followed. Normally paddy harvesting is made last part of Sept. & Oct. The paddy production range from 3500-4500 Kgs/ha from the same plot of land.
Measurement and Analysis: The growth performance of fish seeds was recorded once in a month. At the end of the study, water was drained and collected the fish seeds. The individual length and weight of each fish were recorded. Further, survival percentage and net production were calculated.
Marketing: Fish harvested from the paddy field are marketed at the local market a live or fresh condition because of high market demand, live fish sold @ Rs. 120/- per Kg and fresh fish @ 100/- per Kg. during the lean season, the market price fluctuates. Marginal fish farmer sell their produce in fish market or in the paddy field itself. During the peak season, the fish production from these paddy fields also reaches in the capital markets. During the due rearing period paddy and fish no chemical insecticide/ pesticide/ fertilizer apply in the entire paddy field.

Fig. 3. Setup of haphas for colour fish rearing in IPFCS Unit.

RESULTS AND DISCUSSIONS

The paddy cum fish cultivation can be practiced where paddy fields are waterlogged for about 3 to 8 months in the year (Pullin et *al.*, 1989). Paddy cum fish cultivation is beneficial for the farmers as integrated farming system reduces the problem of low returns. The monoculture of paddy and fishes increases the cost of cultivation but if it is integrated, the cost of cultivation decreases and economic returns increases. The influence of different fish varieties cultivation in paddy field on water quality parameters was studied. The temperature, pH and dissolved oxygen ranges were in permissible range. After completion of the study period, water was completely drained and collected the fish seeds (Table 1).

Table 1: Water quality parameters recorded during experimental period.

Parameters/ Treatments	Common carp	Red platy	Black molly	White molly	Red sword tail
Water Temperature (°C)	23.00-26.00	24.00-26.50	24.00-26.00	24.00-27.00	24.00-26.00
pH	7.00-7.20	7.00-7.50	7.00-7.50	6.90-7.00	7.00-7.50
Dissolved oxygen(mg/lt)	3.20-4.20	3.60-4.50	3.50-4.20	3.50-4.00	4.50-4.80
Sechhi disc reading (Cm)	20.00-23.00	22.00-24.00	21.00-23.00	22.00-24.00	23.00-25.00

The individual length and weight of each fish was recorded. The length and weight of black molly increased from 2.50 cm and 2.10 g to 4.60 cm and 4.80 g respectively. The length and weight of white molly increased from 2.50 cm and 2.00 g to 4.50 cm and 4.50 g respectively. The length and weight of Red platy increased from 2.50 cm and 2.00 g to 4.10 cm and 4.30 g respectively. The length and weight of Red sword tail increased from 2.50 cm and 2.20 g to 5.20 cm and 5.10 g respectively. The length and weight of common carp increased from 1.50 cm and 1.20 g to 4.10 cm and 4.30 g respectively. The survivality of black molly, white molly, Red platy, Red sword tail and common carp was 87.00 %, 86.00 %, 85.00 %, 80.00 % and 57.00 % respectively (Table 2).

Table 2: Growth performance of different fish varieties in paddy cum fish culture ecosystem.

Fish Varieties	Parameter	Initial	Final	Net gain	Survival (%)
Black molly	Length (cm)	2.50 ± 0.02	4.60± 0.08	2.10 ± 0.05	87.00 ± 0.98
	Weight (g)	2.10 ± 0.06	4.80 ± 0.10	2.70 ± 0.08	
White molly	Length (cm)	2.50 ± 0.05	4.50± 0.09	2.00 ± 0.08	86.00 ± 1.22
	Weight (g)	2.00 ± 0.02	4.50 ± 0.07	2.50 ± 0.04	
Red platy	Length (cm)	2.50 ± 0.02	4.10 ± 0.11	1.60 ± 0.09	85.00 ± 1.09
	Weight (g)	2.00 ± 0.05	4.30 ± 0.13	2.30 ± 0.12	
Red sword tail	Length (cm)	2.50 ± 0.03	5.20 ± 0.18	2.70 ± 0.13	80.00 ± 0.88
	Weight (g)	2.20 ± 0.02	5.10 ± 0.10	2.90 ± 0.08	
Common carp	Length (cm)	1.50 ± 0.08	4.10 ± 0.11	2.60 ± 0.10	57.00 ± 1.17
	Weight (g)	1.20 ± 0.05	4.30 ± 0.09	3.10 ± 0.06	

After completion of the study period, the paddy was also harvested and yield was analysed. In paddy monoculture, 5300 m^2 area of paddy produced the grain yield of 10.73 quintals and straw yield of 16.17 quintals. In paddy cum fish culture, 12.44 q/5300 m^2

of grain yield and 18.74 q/5300 m^2 of straw yield were produced (Table 3). Similarly, Mohanty *et al.* (2004) evaluated the performance of rice-fish integration model in rainfed medium land eco-system for 3 years (1999 to 2001). They reported that, faster growth rate of fishes (*Catlacatla, Cyprinus carpio, Cirrhinusmrigula* and *Labeorohita*) and higher paddy yield in integrated fish-paddy system. Similarly, Caguan *et al.* (2000) studied the integrated fish-azolla-rice system. Kurup and Ranjeet (2002) studied the performance of fresh water prawn with rice farming in Kuttinad, India. Shingare *et al*. (2020) studied the role of paddy cum fish culture as an additional economic return in Konkan region of Maharashtra. They reported that, They reported that, under the integrated culture system, the common carp fish production of 149 kg/ha was harvested in 90 days period without any providing any artificial feed to fishes with increase in yield of rice by 38% in the rice plot with fish culture than in case of the plot with rice cultivation alone.

Table 3: Yield of paddy in the experiments.

Sr. No.	Treatment	Yield/5300 m^2		Yield/Acre	
		Grain yield	Straw yield	Grain yield	Straw yield
1.	Paddy alone	10.73 q	16.17 q	8.10 q	12.21 q
2.	Paddy cum fish culture	12.44 q	18.74 q	9.39 q	14.15 q

Cost-Benefit analysis: In paddy monoculture, the total production cost (expenditure) and total returns were Rs. 30334.50 and Rs. 39,120.46 respectively for 5300 m^2 area. In paddy cum fish culture, the total production cost (expenditure) and total returns were Rs. 90461.40 and Rs. 126603.96 respectively for 6000 m^2 area (5300 m^2 paddy area + 700 m^2 fish area) (Table 4 and 5). The net profit in paddy monoculture and paddy cum fish culture was Rs. 8785.96 and Rs. 36142.56 respectively (Table 6). The results of the paddy cum fish culture experiment were demonstrated to the Malnad farmers along with technical consultation (Fig. 4). Similarly, Saikia *et al.* (2015) analysed the economics of paddy cum fish culture in Sivsagar, Assam, India. They reported that, paddy cum fish culture was more economical compared to paddy monoculture.

Table 4: Production cost (in Rs.) of paddy cum fish culture and paddy monoculture.

Input variable	Paddy monoculture for 5300 (paddy) m^2 area (Rs.)	Paddy cum fish culture for 5300 (paddy) + 700 (fish) m^2=6000 m^2 area (Rs.)
Operational cost		
Lime and its application (124.2 kg)	—	1490.40
Cost of fingerlings a) Common carp (21000 No. × 0.33Rs.) b) Black molly (1620 No. × 5 Rs.) c) White molly (1620 No. × 5 Rs.) d) Red platy (1620 No. × 5 Rs.) e) Red sword tail (1620 No. × 5 Rs.)	——	 6930.00 8100.00 8100.00 8100.00 8100.00
Fish Feed and Feeding	—	13682.00
Raw cow dung	—	3500.00
Other miscellaneous charges	—-	5000.00
Cost of cultivation of Rice	30334.50	27459.00
Total	**Rs. 30334.50**	**Rs. 90461.40**

Note : Cost of 12 haphas (Rs.10800) and Trench preparation and levelling (Rs. 16000) are the permanent expenditure cost. Theses will remain for subsequent years of cultivation and these are balanced in subsequent second year onwards.

Table 5: Total returns (in Rs.) from paddy cum fish culture and paddy monoculture.

Particulars	Paddy monoculture for 5300 (paddy) m^2 area (Rs.)	Paddy cum fish culture for 5300 (paddy) + 700 (fish) m^2=6000 m^2 area (Rs.)
Common carp fish returns (11970 No. × Rs. 2)	—	23940.00
Black molly fish returns (1407 No. × Rs. 10)	—	14070.00
White molly (1392 No. × Rs. 10)	—	13920.00
Red Platy (1377 No. × Rs. 10)	—	13770.00
Red sword tail (1296 No. × Rs. 12)	—	15552.00
Paddy grain yield returns	32190.00 (10.73 q × Rs. 3000)	37320.00 (12.44 q × Rs. 3000)
Paddy straw yield returns	6930.46	8031.96
Total	**Rs. 39,120.46**	**Rs. 1,26,603.96**

Table 6: Profit comparison between paddy cum fish culture and paddy monoculture.

	Total Expenditure	Total return	Net Profit
Paddy Monoculture	Rs. 30334.50	Rs. 39,120.46	Rs. 8785.96
Paddy cum fish culture	Rs. 90461.40	Rs. 1,26,603.96	Rs. 36142.56

Fig. 4. Demonstration of IPFCS experiment to farmers.

CONCLUSIONS

In integrated paddy cum fish culture system, the grain and straw yield of paddy were higher compared to paddy monoculture. Along with economic returns from paddy, an additional return of fish yield was obtained. The net profit of paddy cum fish culture was more than four folds of paddy monoculture. The multiple fish varieties-Kempumukthi paddy variety is well suited for hill zone of Karnataka and gave higher economical returns compared to paddy monoculture. This paddy cum fish culture system or two tier farming system (common carp + colour fishes) improves socio-economic status of farmers in hill zone of Karnataka. In future, there is a scope to investigate the detailed interaction of fish and paddy in relation to nutrient recycling and weed management.

REFERENCES

Caguan, A.G., Branckaert, R.D. and Van Hove, C. (2000). Integrating fish and azolla into rice –duck farming in Asia. *Naga, ICLARM Q., 23* (1): 4-10.

Kurup, B.M. and Ranjeet, K. (2002). Integration of freshwater prawn culture with rice farming in Kuttanad, India. *Naga, World Fish Centre, 25* (4), 16–19.

Mohanty, R. K., Verma, H.N. and Brahmanand, P.S. (2004). Performance evaluation of rice-fish integration system in rainfed medium land ecosystem. *Aquaculture, 230* : 125-135.

Saikia,A. K., Santosh, K. A., Debangshu, N. D. and Biswas, S. P. (2015). Economics of paddy cum fish culture: A case study in Sivsagar, Assam. *International Journal of Fisheries and Aquatic Studies, 2*(5): 198-203.

Shingare, P. E., Chaudhari, K. J.,Pagarkar, A. U., Dhaker, H. S., Naik, S. D., Shingare, S. P., Sawant, N. H. and Kunkerkar, R. L. (2020). Role of rice cum fish culture as an additional source of income in Konkan region of Maharashtra. *J. Exp. Zool. India, 23* (1) : 961-963.

Swamy, A.V., Rajanna, C., Prasad, T.S.G. and Hulkoti, S.H. (2018). Evaluate the growth performance of fish seeds and paddy production through establishment of simultaneous fish seeds rearing and paddy production at hilly and coastal zone of Karnataka. *Trends in Biosciences, 11* (20): 2919-2921.