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UTILIZING VILLAGE WATER BODIES FOR POLYCULTURE OF FISH AND PRAWN: ROLE OF INPUTS IN PRODUCTION ENHANCEMENT

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AUTHORS' CONTRIBUTIONS

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

A field study on participatory technology development (PTD) approaches was taken up in the southern transitional zone (Zone 7) of Karnataka in village water bodies leased by the Grama Panchayat. Polyculture of Indian Major Carps catla and rohu with freshwater prawn *Macrobrachium rosenbergii* was investigated. The experimental water bodies were of the size 0.8 to 1.0 ha, having an average depth of 1.8 m to 2 m. After observing pre-stocking management measures, the water bodies were stocked with fingerlings of catla and rohu at 0.5 /m^2each and juveniles of prawn at1/m^2. In T_1, replicate water bodies received cow dung as manure at 6 t/ha, applied in split doses of 375 kg once every fortnight and the fish were fed at the rate of 3% of body weight daily in the morning hours. Water bodies receiving only cow dung at 6t/ha were designated T_2. Two water bodies without either of the inputs served as the control and were designated as T_3. The average total production in T_1 treatment was significantly higher at 3401.40 kg/ha compared to T_2 and T_3, which recorded 1674.25 kg/ha and 975.75 kg/ha production respectively. Production of the prawn was 544.50 kg/ha, 146.75 kg/ha and 45.25 kg/ha in T_1, T_2, and T_3 treatments. The average survival rate of fish was 83.41%, 54.39%, and 32.16%, while that of the prawn was 64.55%, 34.65% and 28.6% respectively. The study indicates that use of manure and feed in polyculture of fish and prawns could be a viable strategy for enhancing productivity and profitability in village water bodies.

Keywords: Catla; fish; *Macrobrachium rosenbergii;* polyculture; rohu; prawn; cow dung; Karnataka.

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1. INTRODUCTION

Aquaculture engrossed in India in past few years and made a remarkable market with shift in capture fisheries to inland water bodies culture like rivers, dams, lakes and small water bodies in villages made it has a largest fresh water aquaculture system. In few states of India aquaculture farmers utilize these form of water bodies for poly culture with low maintained inputs including organic based fertilizers and fam made feeds. In this context Karnataka is among the richest states in India in terms of Inland water resources (5.60 lakh ha); in which major water bodies (3,399 no's) and minor water bodies (22,624 no's) all together account for 2.93 lakh ha [1]. Fish culturable water bodies provide immense scope for augmenting fish production, generating employment opportunities and income in the rural sector. The village tank resources and small water bodies of Karnataka hitherto have mainly been subjected to aquaculture with only a few species of fish, mainly Indian major carps and/or common carp, depending on access to seed and investment capacity of the farmer. In such a practice, wide variation is noticed in stocking density, feeding and management of water bodies.

Prawn culture, either in monoculture or in combination with fishes that started in the late 1980's and early1990's is more profitable than traditional carp polyculture or monoculture [2,3,4,5]. The induction of prawn *Macrobrachium rosembergii* into freshwater aquaculture system paved the way for substantial improvement in the profitability of the operation and therefore triggered its expansion as against subsistence operation [6]. Zimmermann et al. [7] highlighted the rational use of ponds for polyculture of fish and prawns underlining the different feeding habits of the species and the additional income from freshwater prawn that commands high market value. The present investigation was undertaken to study the effect of inputs on production enhancement in polyculture of fish and prawn (catla, rohu, *M. rosenbergii*) in village tank water bodies.

2. MATERIALS AND METHODS

This study was conducted in the southern transitional zone (Zone-7) in Karnataka under the Rastriya Krishi Vikasa Yojana (RKVY) project for a period of 8 months from August to March in six identical water bodies of the sizes 0.8 to 1.0 ha having an average depth of 1.8 m to 2 m. The bottom of the natural water bodies was naturally sun-dried during the summer months. The water bodies get filled due to Southwest monsoon rains with water flowing from the catchment area in the months of June-July. By the end of July, the village water bodies receive a sufficient quantity of rainwater up to a depth of 1.8 to 2 m. The intermittent North-East monsoon in the region helps in maintaining the water depth in the water bodies. Area of tanks were maintained at different treatments accordingly fishes were disbursed, T1 0.8 ha {Catla (2400) + Rohu (2400) Prawn (8000)}1.0 ha {Catla (3000) + Rohu (2000) + Prawn (10000)} T2 0.8 ha {Catla (2400) + Rohu (1600) + Prawn (8000)} 1.0 ha Catla (3000) + Rohu (2000) + Prawn 10000. T_3 0.8 ha {Catla (2400) + Rohu (1600) + Prawn (8000)} 1.0 ha {Catla (3000) + Rohu (2000) + Prawn 10000}. Prior to stocking of fingerlings of fish and juveniles of prawn, the pond was prepared as per farmer practice to enhance planktons after a week of water logging. Physical and chemical testing of water parameters were done. Fingerlings of catla and rohu were stocked at 0.5/m^2 each and juveniles of *M. rosenbergii* were stocked at 1/m^2. In order to reduce mortality of prawn juveniles, coconut fronds were provided as shelters in the experimental water bodies. The mean initial weight of catla, rohu and prawn was 5.82g± 0.4, 6.26g± 0.53 and 1.45g± 0.3 respectively. The stocked fishes and prawns were fed once daily in the morning hours with a commercial dry pelleted carp grow-out feed (crude protein 29%, fat 4%, fiber 7%, moisture 11%) at 3% of body weight. The physio-chemical parameters viz, Water Temperature, pH, Dissolved oxygen, Total alkalinity, Water Transparency were analyzed at monthly intervals following APHA [8].

The fish and prawn were sampled once in a month with the help of a drag net for measuring body weight; final body weight (g), survival rate (%) and yield (kg/ha) data were compiled statistically by correlation coefficient method on harvest at the end of 8-month culture period. The survival rate and yield of fish and prawn were estimated using the following formulae.

$$\text{Survival rate \%} = \frac{\text{No. fish/prawn harvested}}{\text{No. of fish/prawn stocked}} \times 100$$

Yield/production = No. fish/prawn harvested x final weight of fish/prawn

2.1 Statistical Analysis

Comparison among different treatments was done by student t- test to determine the difference among treatment means at 5% and 1% levels of significance and correlation coefficient were determined between total yield in reference to stocked and surviva l% .

3. RESULTS

Data pertaining to physio-chemical parameters of water monitored during the culture period is given in Table 1. They ranged as follows. Water

Temperature:25.7 °C -29.4 °C, 25.4 °C -30.2 °C, 24.1 °C -31.3°C, pH: 7.10-8.34, 6.81-8.16, 7.21-7.95, Dissolved oxygen: 4.89 mg/l -6.65 mg/l, 4.38-6.70, 4.38-6.68 mg/l, Total alkalinity: 81 mg/l -132 mg/l , 82 mg/l -102 mg/l , 42 mg/l – 68 mg/l and Water Transparency: 35.4 cm-47.2 cm, 45.5 cm-49.1 cm, 48.2 cm-55.8 cm in T_1, T_2 and T_3 respectively. The final weights of catla, rohu and prawn after 8 months of the cultured period in T_1, T_2 and T_3 treatments varied from 460-975 g, 430-720 g and 12.8 to 64.5 g. Comparison among different treatments (T_1 and T_2, T_1 and T_3 and T_2 and T_3) by t- test revealed significant difference both at 5% and 1% levels of significance, the mean value of T_1 being greater than that of other two treatments. The total production of fish and prawns was 3401.40, 1674.25 and 975.75 kg/ha in T_1, T_2 and T_3treatments respectively (Table 2). Correlation analysis was carried out between yield with species stocked and survival percentage. A highly significant correlation (r=0.819**) was noticed between survival percentage and yield. But, a negative correlation ($r = -0.213^{NS}$) was observed with respect to yield and species stocked which is not significant.

The share of fish and prawn to total production in the present study follows: 84% and 16% in T_1 treatment, 91.23% and 8.77% in T_2 treatment and 95.36 % and 4.64% in T_3 treatment. The monthly average weight (g) of fish and prawn grown in different treatments are shown in Fig. 1. Catla, rohu and prawn attained mean weights of 860 g, 690g and 50.8g in T_1 treatment, 580g, 520g and 25.3g in T_2treatment and 510g, 450g and 12.8g in T_3 treatment. The fish and prawn under T_1 treatment grew significantly faster than in T_2 and T_3 ($P < 0.05$), reflecting the combined effects of feeding and fertilization as compared to lower level of tank management in T_2 and T_3. The average survival rate of fish was 83.41, 54.39 and 32.48% in T_1, T_2 and T_3 treatments, whereas that of prawn was lower at 65.05, 34.65 and 28.6% respectively.

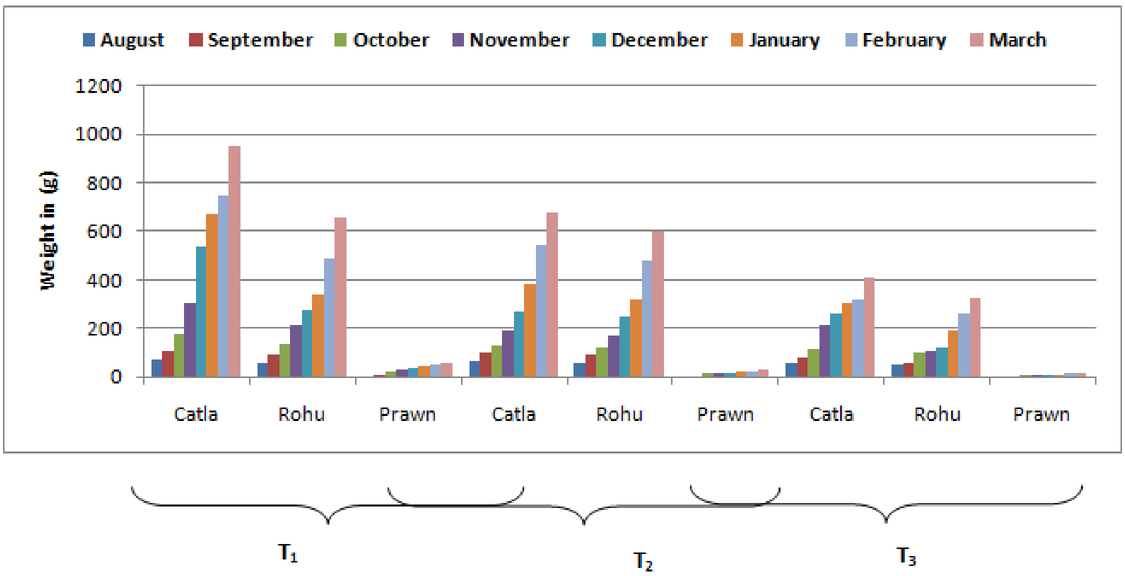

Fig. 1. Graphical representation of monthly average weight (g) of fish and prawn in different treatments

Table 1. Range and mean values of water quality parameters in the experimental water bodies

Parameters	T_1	T_2	T_3
Temperature (°C)	27.7-29.4	25.4-30.2	24.1-31.3
Mean	27.22	27.38	26.74
pH	7.10-8.34	6.81-8.16	7.21-7.95
Mean	7.54	7.4	7.56
DO(mg/l)	4.89-6.65	4.38-6.7	4.38-6.68
Mean	6.12	6.23	5.82
Total alkalinity (mg/l)	81-32	82-102	42-68
Mean	102.62	93.25	53.87
Water transparency (cm)	35.4-47.2	45.5-49.1	48.2-55.8
Mean	39.63	47.47	50.58

Table 2. Growth, survival and production of fish and prawn in different treatments

Treatment/ Area of Water bodies (ha)		Species and numbers stocked		Survival (%)	Production (kg/unit)	Total yield (kg /ha)	Average yield of fish and prawn (kg /ha)	Total yield of fish and prawn (kg /ha)
T_1	0.8 ha	Catla	2400	89.80	1639	2048.75	Fish : 2856.87	3401.40
		Rohu	1600	85.25	752	940.00	Prawn:544.50	
		Prawn	8000	68.70	468	585.00		
	1.0 ha	Catla	3000	81.50	1832	1832.00		
		Rohu	2000	77.10	893	893.00		
		Prawn	10000	61.40	504	504.00		
T_2	0.8 ha	Catla	2400	57.75	697	871.25	Fish : 1527.50	1674.25
		Rohu	1600	52.60	435	543.75	Prawn: 146.75	
		Prawn	8000	36.50	126	157.50		
	1.0 ha	Catla	3000	52.40	958	958.00		
		Rohu	2000	54.80	682	682.00		
		Prawn	10000	32.80	136	136.00		
T_3	0.8 ha	Catla	2400	36.50	532	665.00	Fish : 930.50	975.75
		Rohu	1600	41.25	328	410.00	Prawn: 45.25	
		Prawn	8000	30.40	34	42.50		
	1.0 ha	Catla	3000	27.00	487	487.00		
		Rohu	2000	25.30	299	299.00		
		Prawn	10000	26.80	48	48.00		

4. DISCUSSION

The estimated water quality parameters did not show wide variations and were within the acceptable limit for carps [9]. According to Dennis Rouse [10], Secchidisc visibility in the range of 30-60 cm is generally adequate for good production of fish, whereas a value above 60 cm encourages saprophyte growth, affecting production. The values recorded in the present study fall within this limit. DO values were above 4mg/L, indicating suitability for carp and prawn culture. Generally, cyprinids are capable of tolerating a low oxygen level of 3 mg/l [11].

Final weights of catla, rohu and prawn after harvest appears to be no adverse effect of stocking prawn on the growth and yield of fish. On the contrary, New [12] reported synergistic beneficial effects of freshwater prawn inclusion in polyculture systems. These include the maintenance of more stable dissolved oxygen levels, reduction in predators and increased feeding efficiency and pond productivity. Though the stocking size of fish and prawn was uniform, their weight gain and total yield were affected strongly in different treatments due to management practices.

Siddique et al. [13] experiment on polyculture of prawn with carps for 105 days in earthen ponds at 1:1:1:1 ratio of prawn: catla: rohu: mrigal, where the stocking density was 1.5 individual /m^2. They found the growth of prawn, catla, rohu and mrigal to be 38,281,302 and 151g,the total production ranging between 1976 and 2445 kg/ha/105 days. Vasudevappa et al. [14] carried out polyculture of *M. rosenbergii* with Indian major carps and reported a gross production of 2418 kg/ha and 781 kg/ha fish and prawn. Huq et al. [15] studied the production performance of *M. rosenbergii* with Indian major carps rohu and catla and reported a production of 1203.3 kg/ha fish and 605.18 kg/ha prawn at the end of seven months. Hossain and Islam, [16] tested five stocking densities of *M. rosenbergii* 2500, 5000, 7500, 10000 and 12000/ha in polyculture with catla, rohu and silver carp at fish densities of 2500, 5000 and 2500/ha respectively over 3 months of culture period. They observed that overall total production of prawn and fish was significantly higher at prawn stocking densities of 7500 and 10000 /ha (2916 and 2914 kg/ha) with the stocking ratio of 4:1:2:1 of prawn: catla: rohu: silver carp at a total density of 20,000/ha. Sheery et al. [17] conducted a polyculture trial of 150 days employing freshwater prawn at a stocking density of 25000/ha and fish viz. silver carp, catla, and rohu stocked at a density of 5,000/ha in the ratio of 2:1:2. They recorded a production of 730 kg/ha prawn and 3321 kg/ha fish. The average growth of silver carp, calta and rohu was 490 g, 410 g and 375 g respectively. The total production of fish and prawn obtained in the present study under T_1 treatment (3401.4 kg/ha) is higher compared to that reported by Siddique et al. [13], Vasudevappa et al. [14] and Hossain and Islam [4]. This higher production level might be due to the improved nutrient status achieved through regular fertilization and supplementary feeding.

Islam et al. [16] and Rahman et al. [18] observed that species composition and densities are important factors for maximizing carp production in polyculture with prawn. The species of fish and prawn with the size and density used in the present study ensured good production. The production observed in the 3 treatments clearly brings out the role of inputs in enhancing production. In T_3, nutrients present in the soil must have mainly contributed to the production recorded (975.75 kg/ha) since no external input other than lime was used. The impact of fertilization on production can be realized from the results obtained in T_2(1674.25kg/ha). Application of both fertilizer and feed further enhanced production in T_1 (3401.40 kg/ha). The increase in production works out to 71.6%in T_2 and 248.6% in T_1 as compared to the control. It is103.2% in T_1 in comparison with T_2. Thus, feeding has greater impact on fish and prawn production than fertilization. According to Boyd and Tucker [19], unfertilized aquaculture ponds usually produce between 50 to 500 kg/ha/crop of fish or shrimp. Further, Boyd [20] indicated that pond fertilization increases concentration of nitrogen, phosphorus and other plant nutrients that stimulate phytoplankton production which is the base of food web culminating in shrimp and fish production. Earlier studies on polyculture have also shown significant effect of fertilization and feeding on the growth of fish and prawn [21,22,23,24,25].

There exists vast scope for freshwater prawn and fish polyculture in India, particularly in village freshwater bodies/irrigational water bodies located in villages. These need to be utilized for aquaculture in order to increase fish production, especially for local consumption. The results obtained in the present study clearly indicate the possibility of utilizing village water bodies for grow-out polyculture. village water bodies form a small segment of the freshwater resources, but are important from the point of view of poor farmers; they should be supported with scientific knowledge and financial assistance so that the twin objectives of enhancing fish production and doubling of farmers' income are realized. It may be concluded that fish and prawn could be stocked in village water bodies and good production obtained with reasonable management measures, in particular the use of growth enhancing inputs.

5. CONCLUSION

The present study indicates that there is a scope of using manure and feed in polyculture of fish and prawns culture and it could be a viable strategy for enhancing productivity and profitability in village water bodies.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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