http://www.pjbs.org

PJBS

ISSN 1028-8880

Pakistan Journal of Biological Sciences

ANSInet
Asian Network for Scientific Information
308 Lasani Town, Sargodha Road, Faisalabad - Pakistan

Pakistan Journal of Biological Sciences 6 (1): 61-64, 2003
ISSN 1028-8880

Economics of Carp–SIS Polyculture in Rural Farmer's Pond

N.C. Roy, M.A. Wahab, H. Khatoon and [1]S.H. Thilsted
Department of Fisheries Management, Bangladesh Agricultural University, Mymensingh-2202, Bangladesh
[1]Research Department of Human Nutrition, The Royal Veterinary and Agricultural University,
Rolighedsvej 30, 1958 Frederiksberg C, Denmark

Abstract: Preliminary investigation was carried into the economics of polyculture of Indian major carps with small indigenous fish species (SIS) mola and chela. The culture strategies consist of stocking the ponds with only carp's (T_1), carps with mola (T_2) and carps with chela (T_3). The economic feasibility of three different combinations was analyzed on the basis of the expenditure incurred and total return from sale price of fish in the local market. The net benefits per hectare per 7 months for only carps, carps plus mola and carps plus chela polyculture systems were Tk. 94,925, 88,330 and 68,270 respectively which largely reflected the gross fish production levels of 2,560, 2,412 and 2,176 kg ha^{-1}. However, only carp polyculture system provided higher benefit (Tk. 94,925 ha^{-1}), followed by carps-mola polyculture (Tk. 88,330 ha^{-1}) with non-significant difference but the net benefit in carp-chela polyculture was significantly ($P<0.05$) lower than others. Benefit-cost ratio was obtained higher in only carp polyculture, followed by carp-mola and carp-chela polyculture systems. Farmers are no need to stock mola for next year in carp-mola polyculture system, in that case total benefit would be higher then other systems. So, carp-mola polyculture may be better as it has ensured higher production of nutritionally rich mola and also economic point of view and this system is encouraging for rural people because they would get mola regularly for consumption and carps as cash crop.

Key words: Economics, carp-SIS polyculture, farmers' pond

Introduction

Production systems targeting resource poor farmers must be at a modest level of intensification in order to keep investments and risk of production failure low. In such semi-intensive aquaculture production systems as practiced in rural Bangladesh, small indigenous fish species (SIS) are already native in the ponds. The presence of SIS should be manipulated and stimulated to optimize their production, rather than using resources to eliminate SIS, which has a common practice in aquaculture production. The fish production can be improved by integrating mola or other SIS in a polyculture, because SIS can make use of unutilized food resources in the pond (Roos, 2001).

It is fact that polyculture may produce an expected production of fish with different feeding habits if stocked in proper ratios, densities and combinations (Halver, 1984). Rural farmers of Bangladesh are becoming interested to culture small indigenous fish species (SIS) like mola, chela, punti etc. with their existing carp polyculture systems. Because of small indigenous fish species have a high nutritional value in terms of both protein content and the presence of micronutrients, vitamins and minerals, which are not commonly available in other foods in Bangladesh (Ahmed, 1981; Zafri and Ahmed, 1981; Thilsted *et al.*, 1997).

Economic feasibility is an important and correlation with sustainable carp-SIS polyculture system. Shang (1981) emphasized the importance of economic analysis, as it provides a basis not only for the decision making of the individual farmers but also for the formulation of aquaculture policies. Different researchers have been done some works of carp-SIS polyculture, but economic feasibility has been overlooked. So, this study has been designed in the rural farmers' ponds to assess the economic return of carp-SIS polyculture under low input management.

Materials and Methods

Thirty ponds were selected for this study in the Boilor-Dhanikhola village under Trishal Upazila in Mymensingh district, Bangladesh during June 1999 to January 2000. Ponds were prepared by using lime ($CaCO_3$) @ 250 kg ha^{-1}. After seven days of liming, the ponds were fertilized with cow manure @ 1,000 kg ha^{-1} and urea and TSP @ 12.5 and 25 kg ha^{-1}, respectively.

The experiment consisted of three treatments with ten replications. The stocking density of Indian major carps, rohu (*Labeo rohita)*, catla (*Catla catla)* and mrigal (*Cirrhinus mrigala*) was 9,500 fishha^{-1} with a ratio of 1:1:1, respectively. Grass carp (*Ctenopharyngodon idella*) was stocked @ 500 fish ha^{-1} (Table 1). The small

Table 1: Fish species composition and stocking densities per hectare pond in treatments

	Treatments		
Fish species	T_1	T_2	T_3
Grass carp (*C. idella*)	500	500	500
Rohu (*L. rohita*)	3,167	3,167	3,167
Catla (*C. catla*)	3,167	3,167	3,167
Mrigal (*C. mrigala*)	3,166	3,166	3,166
Mola (*A. mola*)	-	25,000	-
Chela (*C. cachius*)	-	-	25,000

indigenous species of fish (SIS), mola (*Amblypharyngodon mola)* and chela *(Chela cachius*) were stocked separately @ 25,000 fishha^{-1}. Large carps, rohu (*L. rohita*), catla (*C. catla*), mrigal (*C. mrigala*) and grass carp (*C. idella*) were stocked in all treatments. Small indigenous fishes, mola (*A. mola*) and chela (*C. cachius*) were stocked only in ponds under T_2 and T_3, respectively. In T_1, only carps were stocked with same ratio and density (Table 1). Commonly farmers available agricultural by-product rice bran (100%) were used as supplementary feed @ 3% of total body weight of carps. All ponds were fertilized with cow manure @ 1,000 kg ha^{-1} at fortnightly intervals. Last two months were not fertilized cow manure due to the decrease of water level in the ponds. The initial length (cm) and weight (g) of all fishes were recorded and the final length and weight were obtained after harvesting. The following parameters were used to evaluate the growth of fishes:

$$\text{Weight gain (cm)} = \text{Average final weight (g)} - \text{average initial weight (g)}$$

$$\text{Survival rate (\%)} = \frac{\text{No. of fish harvested}}{\text{Initial no. of fishes}} \times 100$$

The net benefit and benefit-cost ratio (BCR) were calculated by using following formula:

$$\text{Net benefit} = \text{Total revenue (Tk.)} - \text{Total cost (Tk.)}$$

$$\text{BCR} = \frac{\text{Total revenue}}{\text{Total cost}}$$

The overall economics of different treatments were calculated on the basis of the expenditure incurred and the total return from the selling price of fish. The cost of lime, cow manure, fertilizer, fish seed price (including transport) and rice bran was estimated. At the end of the experiment, fishes were sold in a local market and the return was estimated. The calculation of expenditure was made excluding farmers' physical labour and establishment costs.

Results and Discussion

Total fish production after seven months of culture period, were 2,560, 2,412 and 2,176 kg ha^{-1} in three treatments, respectively (Table 2). The maximum total fish production was obtained in T_1, where only carps were stocked and lower production in T_3, where carps and chela were stocked. The medium fish production was obtained in T_2, where carps and mola were stocked. However, while there was no significant difference in fish production between T_1 and T_2, the production in T_3 was significantly ($P<0.05$) lower than T_1. It is clear that the stocking of small fish in large carp polyculture has affected the growth of rohu and catla. Kohinoor *et al.* (1998) also found similar results in an on-station research. A severe competition for food between planktivorous native carps and exotic carps has been observed by Dewan *et al.* (1991). Roos *et al.* (1999) recorded the fish production of 28 ton ha^{-1} during 7 months in farmers' pond where as Kohinoor *et al.* (1998) obtained a

Table 2: Growth, survival and production of fish under different treatments

					Production (kg/ha/7 months±SE)	
Treatments	Fish species	Av. initial wt. (g)	Av. final wt. (g)	Sp.wise survival (%)	Species wise	Total
Only carp (T_1)	Grass carp	9.20	896.2	76.6	346.5±42NS	
	Rohu	10.00	275.7	87.8	754.1±58*	2,560 ± 179a
	Catla	9.00	295.8	84.0	698.4±72*	
	Mrigal	8.70	298.2	88.6	761.4±60NS	
Carp-mola (T_2)	Grass carp	9.20	934.7	72.3	358.2±29NS	
	Rohu	10.00	222.3	87.3	589.6±26*	
	Catla	9.00	206.4	80.0	486.9±40*	2,412 ± 77ab
	Mrigal	8.70	265.7	86.7	721.2±40NS	
	Mola	2.00	1.67	-	256.3±41	
Carp-chela (T_3)	Grass carp	9.20	876.2	74.8	315.3±25NS	
	Rohu	10.00	231.7	84.2	605.5±27*	
	Catla	9.00	222.5	79.9	557.3±31*	2,176 ± 65b
	Mrigal	8.70	256.3	80.2	633.6±37NS	
	Chela	2.50	1.89	-	64.0±20	

*Significant at 5% level, NS = Non significant

Table 3: Cost and revenue analysis (kg ha^{-1}) of only carp polyculture treatment (T_1)

Items	Item required	Price @ Tk. Kg^{-1}	Total price (Tk.)
Lime (kg)	250	5.00	1250.00
Cattle manure (kg)	11,000	0.30	3300.00
Urea (kg)	12.5	6.00	75.00
TSP (kg)	25.0	13.00	325.00
Rice bran (kg)	4375	4.00	17,500.00
Carp fingerlings (No.)	10,000	1.00	10,000.00
Small fish	-		-
Total cost			32,450.00
Revenue:			
Carps fish (kg)	2560	50.00	128,000.00
Small fish (kg)		-	
Total revenue			128,000.00
Net benefit			94,925.00
Benefit-cost ratio			3.94:1

Table 4: Cost and revenue analysis (kg ha^{-1}) of carp-mola polyculture treatment (T_2)

Items	Item required	Price @ Tk. Kg^{-1}	Total price (Tk.)
Lime (kg)	250	5.00	1250.00
Cattle manure (kg)	11,000	0.30	3300.00
Urea (kg)	12.5	6.00	75.00
TSP (kg)	25.0	13.00	325.00
Rice bran (kg)	4375	4.00	17,500.00
Carp fingerlings (No.)	10,000	1.00	10,000.00
Mola fish seed	-		7,500.00
Total cost			39,950.00
Revenue:			
Carps fish (kg)	2156	50.00	107,800.00
Small fish (kg)	256	80.00	20,480.00
Total revenue			128,280.00
Net benefit			88,330.00
Benefit-cost ratio			3.21:1

Table 5: Cost and revenue analysis (kg ha^{-1}) of carp-chela polyculture treatment (T_3)

Items	Item required	Price @ Tk. Kg^{-1}	Total price (Tk.)
Lime (kg)	250	5.00	1250.00
Cattle manure (kg)	11,000	0.30	3300.00
Urea (kg)	12.5	6.00	75.00
TSP (kg)	25.0	13.00	325.00
Rice bran (kg)	4375	4.00	17,500.00
Carp fingerlings (No.)	10,000	1.00	10,000.00
Chela fish seed	-		10,000.00
Total cost			42,450.00
Revenue:			
Carps fish (kg)	2112	50.00	105,600.00
Small fish (kg)	64	80.00	5,120.00
Total revenue			110,720.00
Net benefit			68,270.00
Benefit-cost ratio			2.61:1

production of 1,127 kg ha^{-1} during 4 months in on-station research of carp-mola polyculture system.

The economics of different cultural operations have been calculated (Tables 3, 4, 5). Operational cost involved are the cost of the pond preparation, the purchase of fingerlings, feed and fertilizers. It may be mentioned here that the cost of physical labour involved in the production system was not considered because simple pond management works have been done by farmers/family members themselves with their other business.

The total operational cost was observed Tk. 32,450.00, 39,950.00 and 42,450.00 in treatments 1, 2 and 3, respectively per ha pond per 7 months duration (Tables 3, 4, 5). Fingerlings were the main investment and the profit was calculated by subtracting the expenditures on pond management from the value of the harvested fish (Tables 3, 4, 5). The net benefit per pond not adjusted for variable pond area, it was calculated per hectare area. The production cost was comparative higher in treatments 2 and 3 where mola and chela was stocked separately with carps, because the seed price of mola and chela were comparatively higher. It may be noted here the production cost should be lower for next year because mola and chela self-recruiting species and farmers have not purchased their seed during next time culture period but in order to expand this production technology, it is necessary to ensure availability of local brood stock. Roos *et al.* (1999) noted similar recommendation in their farmers' field trial. Other input costs were more or less similar among three treatments.

The total revenue was calculated Tk. 128,000.00, 128,280.00 and 110,720.00 in treatments 1, 2 and 3, respectively per ha pond per 7 months duration (Tables 3, 4, 5). The revenue was similar in treatments 1 and 2, where only carps and carps with mola were stocked. Among three treatments, only carp polyculture system (T_1) was made Tk. 94,925 net benefit, then carp-mola culture system (T_2) was earned Tk. 88,330 and carp-chela culture system (T_3) earned Tk. 68,270 per hectare per 7 months (Tables 3, 4, 5). Benefit-cost ratio (BCR) was obtained 3.94, 3.21 and 2.61 in T_1, T_2 and T_3, respectively. BCR was higher in only carp polyculture system because the operational cost was comparatively lower due to the absence of small fish. The second highest BCR was observed in carp-mola polyculture where mola was present. From the analysis of the costs and revenues of three different polyculture systems, it was estimated that the highest benefit was obtained from only carp polyculture treatment, followed by carp-mola treatment. The lowest benefit was obtained from carp-chela polyculture treatment. This may be due to interspecies competition between large carp and chela, for which lower production was occurred in this treatment. Similar finding was observed by Kohinoor *et al.* (1998) in their experiment. However, while there was no significant difference in net benefit between T_1 and T_2, but net benefit in T_3 was significantly ($P<0.05$) lower than T_1. Roos *et al.* (1999) conducted a farmers' field trial of SIS with normally culture carp and reported that the average net profit from fish production per household was 1,236 Tk. per production season where the households had an annual income of less than 35,000 Tk. and land holding less than 0.8 ha. However, market price and local demand

along with the compatibility of the species in our local condition should be considered before introducing small fish in carp polyculture. Though, the preliminary finding of this study has generated interest to farmers to culture small indigenous fish species (SIS) with their existing carp polyculture system. Therefore, a further study is needed for various aspects of economic feasibility as well social acceptability of carp-SIS polyculture in rural farmers' livelihood.

Acknowledgments

The authors are thankful to the farmers and their families of the Boilor village who participated in the field trial. The financial support secured from DANIDA funded ENRECA Project, to conduct this field based poverty focused research is gratefully acknowledged.

References

Ahmed, K., 1981. Nutritional Blindness in Bangladesh. In: Touch: VHSS Newsletter, No. 45 (Feb.), pp: 1-2.

Dewan, S., M.A. Wahab, M.C.M. Beveridge, M.H. Rahman and B.K. Sarker, 1991. Food selection, electivity and dietary overlap among planktivorous Chinese and Indian major carp fry and fingerlings grown in extensively managed, rainfed ponds in Bangladesh. Aquaculture and Fisheries Management, 22: 277-294.

Halver, J.E., 1984. Special Methods in Pen Fish Husbandry. Akademiai Nyomda, Budapest, pp: 146.

Kohinoor, A.H.M., M.L. Islam, M.A. Wahab and S.H. Thilsted, 1998. Effect of mola (*Amblypharyngodon mola* Ham.) on the growth and production of carps in polyculture. Bangla. J. Fish. Res., 2: 119-126.

Roos, N., M.M. Islam, S.H. Thilsted, M. Ashrafuddin, M. Mursheduzzaman, D.M. Mohsin and A.B.M. Shamsuddin, 1999. Culture of Mola (*Amblypharyngodon mola*) in Polyculture with Carps- Experience from a Field Trial in Bangladesh. NAGA, The ICLARM Quarterly, 22: 16-19.

Roos, N., 2001. Fish consumption and aquaculture in rural Bangladesh: nutritional contribution and production potential of small indigenous fish species (SIS) in pond polyculture with commonly cultured carps. Ph.D. Thesis, Research Department of Human Nutrition, The Royal Veterinary and Agricultural University, Frederiksberg, Denmark.

Shang, Y.C., 1981. Aquaculture Economics: Basic Concept and Methods of Analysis. West View Press. Boulder, Colorado.

Thilsted, S.H., N. Roos and N. Hassain, 1997. The role of small indigenous fish species in food and nutrition security in Bangladesh. NAGA, The ICLARM Quarterly, July- December. 13-15.

Zafri, A. and K. Ahmed, 1981. Studies on the vitamin A content of freshwater fish: content and distribution of vitamin A in mola (*Amblypharyngodon mola*) and dhela (*Rohtee cotio*). Bangla. J. Biol. Sci., 10: 47-53.