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Increasing farm income by introducing fish culture in deepwater rice environment

M. Hazrat Ali, M. Nazrul Islam Miah[1] and M. Nur-E-Elahi

Rice Farming Systems Division
Bangladesh Rice Research Institute, Gazipur-1701, Bangladesh
[1]Institute of Postgraduate Studies in Agriculture, Salna, Gazipur-1703, Bangladesh

Abstract

Fish culture in deep-water-rice (DWR) environment using net pen and polder systems was evaluated. In net pen rohu and Thai silver barb were cultured, whereas a 5-species combination (rohu, mrigal, common carp, grass carp and Thai silver barb) were cultured with BR3 rice variety and DWR. Boro-fish production system produced 2.8 t/ha of fish and 7.33 t/ha of rice in polder system with 5-species combinations.

Key words : Polder, Net pen, Deep water rice, Fish culture

Introduction

In Bangladesh, about 73 percent of rural people are engaged in either full or part time fishing which supplies about 80 percent of animal protein of their diets. Fishing also provides poor rural families with income (ODA 1995). But presently, natural catches have declined drastically due to degradation of fish habitat. The situation has aggravated by imbalance use of fertilizer and pesticides for modern Boro rice cultivation. Moreover, in recent years fish diseases have significantly reduced fish production. All these contribute to low fish consumption and malnutrition among rural population. In order to maintain the level of fish consumption (7.9 kg/person/year), fish production has to be increased from 0.8 million ton to 1.2 million ton (Gupta and Mazid 1993). To meet the demand of this increased fish production, rice fields could be explored since marine fisheries and fish production from open water bodies are declining as a result of over fishing and degradation of fish ecology.

An estimated area of 2.86 million hectares of medium lowland and lowland are annually inundated to a water depth of 1-3 m for a period of 4-6 months in a normal flooding year. This area usually remains fallow after the harvest of irrigated boro rice or a few farmers practice of growing DWR either transplanted or direct seeded when flood occurs at least 20-30 days after boro harvest (Ali *et al.* 1993). DWR ecosystem is highly fertile due to silt deposition and decomposition of organic matter which favours the growth of flora (phytoplankton) and fauna (zooplankton). The phytoplankton provides fish feed which is enough for fish rearing for a period of 4-5 months (Ali *et al.* 1993, Das

et al. 1990). Therefore, the experiment was conducted to evaluate the biological and economic performance of different production systems involving fish culture with and without DWR in seasonally flooded areas of Bangladesh.

Materials and methods

Deepwater rice (DWR) seedling were raised in the farmers homestead area. Sixty days old DWR seedlings (Hijolidigha) were transplanted in the field immediately after the harvest of Boro rice (BR3) where DWR+fish experiment was conducted.

Two nylon net pen, one with DWR and another without DWR were installed at Mirzapur, Bangladesh immediately after flood water entered into the field. The size of net pen was 20 m x 20 m each. Under the polder system, two sides of the plot were closed by roads and one side by raised homestead. Only one side was open where 250 m net was installed to made the plot like a pond. The area of polder measured 6000 m^2. For all cases, the height of the nets were 3.5 m. Bamboo poles were placed 2 m apart and the bottom end pushed into the soil approx. 0.5 m deep. The poles were 7 m high to facilitate increasing net heights with the rise of flood water. The poles were also tied horizontally with the upright ones to protect against waves and wind. At the bottom the nets were pushed into the soil. The nets were also tied up with the help of bamboo pegs pushed into the soil, so that there was no scope of fish to escape from the pens. Fingerlings of the selected fish species were released in net pens and polder on June and July '93, respectively. The size of the fingerlings varied from species to species depending on the availability. The initial length and body weight were recorded. The growth of fish species depended on availability of feeds within the pens and the supply of aquatic weeds at weekly interval. Fish were harvested from the net pens and polder on November '93, when the depth of water in the field was about 50 cm. The length and gain in body weight were recorded at harvest. The cost of nets and bamboo poles were computed based on depreciation value determined by straight line method. All collected data were analyzed for statistical comparison and for economic performance of different production systems.

Results and discussion

Net pen with and without DWR

The body weight gain and fish yield of rohu (*Labeo rohita*) and silver barb (*Puntius gonionotus*) were higher when reared without DWR in net pen than that of with DWR (Table 1). Similar results were also observed in case of recovery percentage. The yield of rice was not affected but the fish yield was reduced by 43 percent when reared in association with DWR. Perhaps, dense canopy of DWR restricted fish movement, suffocation which results in lower recovery

percentage, body weight gain as well as fish yield. Results further indicates that after the harvest of Boro rice, an additional fish yield can be obtained if fish is cultured with and without DWR in net pens. Lightfoot *et al.* (1989) shown an increased rice yield of 5-30 percent from rice-fish system, but he also reported some negative effects of rice yield in Asian countries.

Table 1. Body weight gain, recovery percentage and yield of rohu and silver barb in net pen with and without deepwater rice

Fish species	At release			At harvest			Recovery (%)	Yield (t/ha)
	Length (cm)	Weight (g)	No.	Length (cm)	Weight (g)	No.		
With DWR								
Rohu	9.1	20.03	200	18.17	87.58	130	65	0.44
Silver barb	10.4	23.35	200	18.87	108.90	104	52	0.50
Without DWR								
Rohu	9.1	20.03	200	20.70	127.75	140	70	0.75
Silver barb	10.4	23.35	200	21.05	164.10	130	65	0.91

Stocking density = 1 fingerling/m^2

Table 2. Productivity of different production systems in deepwater rice environment.

Production systems	Rice yield (t/ha)		Fish yield (t/ha)			Prodn. cost Tk/ha)		Gross return (Tk/ha)		Net return (Tk/ha)	BCR
Boro -DW	Boro -	DWR	Rohu	Silver barb	Total	Rice	Fish	Rice -	Fish		
BR3 -Fallow	6.25	-	-	-	-	14300	-	31250	-	16950	2.19
BR3 -Fish	6.25	-	0.75	0.91	1.66	14300	26650	31250	56750	55150	2.29
BR3-DWR+Fish	6.25	1.52	0.44	0.50	0.94	14300 +3500	26650	38850	37600	30450	1.72
BR3 -DWR	6.25	1.45	-		-	14300 +3500		38500	-	20700	2.16

Price (Tk/kg): Fish=40, Rice=5, Fingerlings = Tk 1 each

Cost (Tk/ha): Fingerlings = 10000; Net= 4000 (Total value = 32000 (Tk 32/1m length x 1.96 m height net), salvage value = 4000, useful life = 7 years); Bamboo = 2000 (Total cost = 6200, salvage value 200, useful life = 3 years) and Labour (installation, care taking, ropes, harvesting of fish etc.) = 10600.

Table 2, revealed that BR3-fish pattern had the highest net return (Tk 56,750/ha) and higher benefit cost ratio (BCR) followed by BR3-fish+DWR (Tk 30,450/ha). This study suggests that 70 percent contribution of the total net returns comes from fish component in the BR3-fish production system which

justify the importance of fish culture after Boro rice harvest in the DWR ecosystem.

Polder system

Silver barb, common carp (*Cyprinus carpio*), grass carp (*Ctenopharyngodon idella*), rohu and mrigal (*Cirrhinus mrigala*) cultured in the polder system performed better compared to net pens (Table 3). However, grass carp gave the highest fish yield (1.3 t/ha) followed by common carp (0.61 t/ha), but the individual body weight gain was the highest in common carp (712 g) followed by grass carp (680 g) having almost similar recovery percentage. The increased fish yield of grass carp came from the high fish density with supply of natural aquatic weeds. Silver barb, rohu and mrigal performed relatively poor. This might be due to common carp and grass carp are fast growing compared to rohu, mrigal and silver barb.

Table 3. Performance of different fish species in polder system

Fish species	At release		At harvest		Number released	Number harv-ested	Reco-very (%)	Yield (t/ha)
	Length (cm)	Weight (g)	Length (cm)	Weight (g)				
Silver barb	7.1	6.0	23.7	270.2	1000	627	63	0.28
Common carp	9.62	6.8	32.7	712.2	1000	536	54	0.61
Grass carp	6.5	5.0	37.5	680.0	2000	1164	58	1.31
Rohu	10.5	14.3	28.2	290.8	1000	743	74	0.35
Mrigal	11.0	12.5	29.1	291.0	1000	546	55	0.25

Polder area (m^2) = 6000, Stocking density = 1 fingerling/m2

Boro-fish production system produced 2.8 t/ha of fish and 7.33 t/ha of rice (Table 4). This production system gave a net return of Tk 109,955/ha while BR3 alone gave the net return of Tk 21,150/ha. BCR also followed similar trend. The higher net return from rice-fish production system is mainly derived by the contribution of fish yield.

Table 4. Economic performance of Boro-fish production system in polder

Season	Yield (t/ha)		Production cost (Tk/ha)		Gross return (Tk/ha)		Net return (Tk/ha)	BCR
Boro - DWR	Rice	Total fish	Rice	Fish	Rice	Fish		
BR3 - Fallow	7.33	-	15500		36650		21150	2.36
BR3 - Fish	7.33	2.80	15500	23195	36650	112000	109955	3.84

Prices (Tk/kg): Rice = 5, Fish = 40, Fingerlings = Tk 1 each,

Cost (Tk/ha): Fingerlings = 10,000; Net = 1666 {Total cost = 13333 (Tk 32/1 m length x 1.96 m height net), salvage value = 1666, useful life = 7 years}; Bamboo poles = 1029 (Total cost = 3187, salvage value = 100, useful life = 3 years); Labour (Installation, care taking, weed supply as feed, fish harvesting etc.) = 10,500.

Fish growth under net pen and polder system

The body weight gain for both rohu and silver barb were more or less similar in net pen culture with and without DWR (Fig. 1). But in polder system, the l body weight gain were higher for rohu and silver barb than that of net pen culture with and without DWR (Fig. 1). However, body weight gain in polder system was the highest in case of common carp and grass carp. The higher body weight gain as well as fish yield in polder system might be attributed to larger space for fish movement and availability of natural fish food.

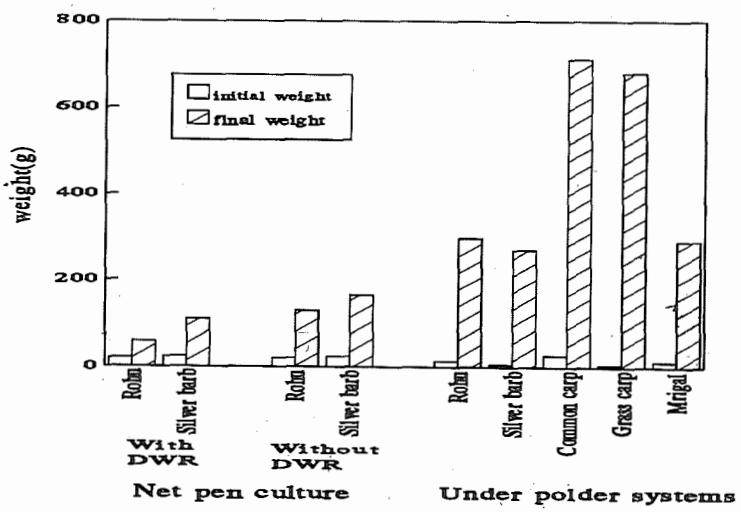

Fig-1 : Body weight gained by different fish species under net pen and polder systems.

Conclusions

Based on growth performance, the present study indicates that fish culture in polder system was found more profitable then net pen culture. If farmers are provided with necessary training and credit to adopt the rice-fish production system, the net return could be higher. Community approach will reduce cost of production, provide employment opportunity and ensure better utilization of the potential resources of the ecosystem.

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