

## Rice-fish and rice mono-crop production at Gouripur, Mymensingh : an economic analysis

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### Abstract

This study examines the relative profitability of rice-fish culture and rice mono-crop production at Gouripur thana of Mymensingh district. The results of the study show that the rice-fish farming was economically more rewarding than the rice mono-crop farming, although both the farming activities were found profitable over cash as well as full costs. In addition to extra earnings from fish, the rice-fish farming produced significantly a higher yield of rice requiring very minimum extra cost for fish. Rice-fish farming also reduced variability in yield of and return from rice.

**Key words** : Rice-fish, Economics

### Introduction

The notion of rice-fish culture originated with a view to ensure better return from high yielding variety (HYV) boro rice to farmers thorough the best and maximum use of scarce land resources. The increased fish production harvested from simultaneous production of rice and fish is expected to lift the national fish consumption and to contribute much to the household welfare. Although the rice-fish culture under scientific management (i.e. in irrigated boro rice fields) is relatively a new gesture in Bangladesh, on-station rice-fish culture of the Bangladesh Fisheries Research Institute (FRI), the Farming Systems and Environmental Studies (FSES) and the Bangladesh Rice Research Institute (BRRI) proved to be technologically feasible and economically viable. This performance, of course, is based on the results of the experimental stations. However, only a few farmers in some places have already changed their farm planning towards rice-fish farming from irrigated rice mono-crop farming.

According to Dewan (1992) Bangladesh has 10,22,9000 ha area under rice production of which irrigated area is 12,27,000 ha and potential area for rice-fish culture is 6,15,000 ha. Unfortunately, rice-fish farming presently occupy a very small portion of the suitable area of Bangladesh.

To become accepted by the farmers a technology must satisfy farmers' socioeconomic settings and farm environment. But detailed farm level study is yet to be done to confirm rice fish production system. Thus the present study aimed at determining farm level profitability of rice-fish farming against rice mono-crop farming.

## Materials and methods

The farmers of Gouripur in Mymensingh district have been cultivating HYV boro rice under irrigated condition for last few years, although the area is well-suited for rice-fish culture. In 1992, rice-fish culture was initially introduced in this area by the FRI in the form of some field experiments. The encouraging yield of both rice and fish in the experimental plots attracted the farmers to adopt this new technology. That is why, the area was selected for the study.

A stratified random sampling technique was followed in this study. In total, sixty farms taking thirty from rice with fish and the remaining thirty from rice without fish, were randomly selected for this study. The study covered only the Boro cropping season beginning from December'94 to May'95.

To collect necessary primary data a sample survey was conducted by using a set of well designed questionnaires. The collected data were analysed by using enterprise costing technique and the results were presented in the tabular form with the help of simple statistical measures like arithmetic mean, percentage and ratio. Whenever necessary the results were confirmed with the help of 't' test.

## Results and discussion

The profitability analyses of HYV boro rice with and without fish were done on the basis of full and cash costs. In the case of full costs, all input items both family supplied and purchased were valued at the market prices of the inputs. On the other hand, only the out of pocket costs were taken into consideration to arrive at the cash cost. The major findings of the study are presented in the following sections.

### *Production cost of HYV boro rice with fish*

Per hectare cost of producing HYV boro with fish in the sample farms is shown in Table 1. The table reveals that the cost of simultaneous rice-fish farming stood Tk 32,666.00 on the basis of full cost. The analysis showed that operating costs represented 64.18 percent (Tk 20,966.00/ha) of total costs and the rest 35.82 percent (Tk 11,700.00/ha) was interest cost in which interest on land value alone accounted for 34.90 percent (Tk 11,400.00/ha). The major part of the operating cost was shared by human labour and irrigation charge representing 17.99 (Tk 5877.00/ha) and 13.45 percent (Tk 4393.00/ha) of total costs, respectively. The other important operating cost items were fertilizer, animal power, seedlings and cow-dung. Fish culture in the rice fields added extra cost of Tk 3331.00/ha (10.20 percent) to the total costs of which 5.94 percent was shared by fingerlings. It may be noted here that the family supplied inputs accounted for 15.19 percent (Tk 4962.00/ha) of full cost.

**Table 1.** Per hectare input use and cost in rice-fish production

Cost item	Unit of quantity	Quantity	Cost			
			Full cost		Cash cost	
			Tk/ha	% of total	Tk/ha	% of total
Human labour	Man-day	167.91	5876.85	17.99	3286.15	20.53
Animal labour	Pair-day	30.45	1827.00	5.59	1624.20	10.15
Seedling	Kg	45.42	1589.70	4.87	635.60	3.97
Cow-dung	ton	5.06	1265.63	3.87	337.88	2.11
Fertilizer	-	-	2682.37	8.21	2682.37	16.76
Urea	kg	205.05	1127.78	3.45	1127.78	7.05
TSP	kg	107.72	969.48	2.97	969.48	6.06
MP	kg	51.03	357.21	1.09	357.21	2.23
Gypsum	kg	22.45	67.35	0.21	67.35	0.42
Oil cake	kg	32.11	160.55	0.49	160.55	1.00
Irrigation	-	-	4393.00	13.45	4393.00	27.45
Fingerling	Nos	3878.00	1939.00	5.94	1939.00	12.12
Feed	kg	259.50	519.00	1.59	232.00	1.45
Lime	kg	9.12	72.96	0.22	72.96	0.46
Excavation of ditch	-	-	800.00	2.45	800.00	5.00
Int. on oprt. capital	-	-	300.06	0.92	-	-
Int. on land value	-	-	11400.00	34.90	-	-
Total	-	-	32665.57	-	16003.16	-

On the basis of cash cost, the production cost (Tk 16,003.00/ha) of rice-fish, as expected, was less than half of the cost calculated on full cost basis (Tk 32,666.00/ha). Irrigation, human labour, fertilizer and animal power appeared to be the most important items of cash costs. These cost items accounted for 74.89 percent of cash costs of rice-fish production. The extra cost for fish in the rice field was Tk 3044.00/ha (19.02%) of which fingerlings alone accounted for Tk 1939.00/ha (12.12%) and the rest Tk 1105.00/ha (6.89%) was represented together by feed, lime and excavation of ditch.

#### ***Production cost of HYV boro without fish***

Per hectare cost of producing rice without fish is given in Table 2. Per hectare cost of producing HYV boro as a single enterprise was estimated at Tk 28,263.00 of which Tk 16,631.00 (58.84%) and Tk 11,632.00 (41.16%) were, respectively operational and interest costs. As a single cost item, interest on land value represented the lion's share (40.34%) of total costs. Among the operational cost items human labour, irrigation and fertilizer accounted for 19.34, 12.32 and 11.34 percent, respectively of total costs of producing boro rice. Animal power and seedlings appeared to be other two important cost items representing 6.23 and 6.08 percent of total costs, respectively. In producing HYV boro rice, more than 15 percent (Tk 4263.00/ha) of total costs was represented by family supplied inputs.

**Table 2.** Per hectare input use and cost in rice mono-crop production

Cost item	Unit of quantity	Quantity	Cost			
			Full cost		Cash cost	
			Tk/ha	% of total	Tk/ha	% of total
Human labour	Man-day	156.20	5467.00	19.34	3132.15	25.33
Animal labour	Pair-day	29.35	1761.00	6.23	1516.80	12.26
Seedling	Kg	49.10	1718.50	6.08	563.15	4.55
Cow-dung	ton	3.14	785.25	2.78	256.25	2.07
Fertilizer	-	-	3206.44	11.34	3206.44	25.93
Urea	kg	238.05	1309.28	4.63	1309.28	10.59
TSP	kg	118.36	1065.24	3.77	1065.24	8.61
MP	kg	63.11	441.77	1.56	441.77	3.57
Gypsum	kg	33.00	99.00	0.35	99.00	0.80
Oil cake	kg	58.23	291.15	1.03	291.15	2.35
Irrigation	-	-	3481.00	12.32	3481.00	28.15
Insecticides	-	-	212.00	0.75	212.00	1.71
Int. on oprt. capital	-	-	231.90	0.82	-	-
Int. on land value	-	-	11400.00	40.34	-	-
Total	-	-	28263.09	-	12367.75	-

The total cash costs of producing HYV boro rice as a single enterprise stood Tk 12,368.00/ha which, as expected, was much lower (43.76%) than the full cost of production. As were in the full costs, the most important cost items in the total cash costs were irrigation (28.15%), fertilizer (25.93%), human labour (25.33%) and animal power (12.16%). However, seedlings, cow-dung and insecticides combinedly shared only 8.33% of total cash cost of HYV boro rice production.

### ***Comparison of input use in rice-fish and rice mono-crop farming***

It is evident from the results presented in Tables 1 and 2 that there is a variation in input use in producing HYV boro with and without fish. It can be seen from the Tables that more human labour (167.91 man-day/ha) was used in rice-fish farming than the farm producing boro rice without fish (156.20 man-day/ha). This was due to some extra activities required to produce fish in rice fields. The amount of seedlings (45.42 kg/ha) used for producing rice in rice-fish farming was lower by 3.68 kg/ha than the amount used in rice mono-crop farming (49.10 kg/ha). This was resulted from alternate double row system of transplanting rice which gave adequate space for easy movement of fish in the rice fields and saved some seedlings. A substantial difference in using fertilizers and cow-dung was also observed between the above mentioned two types of farming. In the case of rice-fish farming, amount of all types of fertilizer used were much lower than the amount used in rice as single crop. In fact, the application of fertilizer was substituted partially by higher amount of cow-dung used in rice-fish fields (higher by 1.92 t/ha). The higher amount of cow-dung contributed in the production of micro organisms for fishes to eat and also

added nitrogen to rice plants. To maintain sufficient standing water for fishes to move in the rice fields the rice-fish farmers paid Tk 912.00/ha more for irrigation than paid for that by the rice mono-crop farmers. It may be noted here that in the case of rice mono-crop farming the farmers paid Tk 212.00/ha for insecticides while the rice-fish farmers paid nothing for that. Like all other studies (Grist 1965, Coche 1967 and Dela Cruz 1980) it was also observed that fishes helped to control some insects biologically.

### ***Agro-economic performance of rice-fish and rice mono-crop farming***

Agro-economic performance of rice-fish as well as rice mono-crop farming was examined in terms of yield, gross return, net return and undiscounted benefit-cost ratio (BCR). The results are presented in Table 3. The table shows that per hectare yield of rice (4.77 t/ha) in rice-fish farming was significantly higher ( $t = 5.09$ ) than the yield (4.23 t/ha) obtained from rice mono-crop farming. Similar findings were also found in several experimental studies conducted by the FSES (Mazid *et al.* 1992), the FRI (FRI 1995) and the BRRI (Ali *et al.* 1993).

Hora and Pillay (1962) also observed that the yield of rice increased by approximately 15.00 percent in Indo-Pacific countries due to adoption of fish culture. According to Dela Cruz *et al.* (1980) rice-fish farming provides higher yield of rice through reducing rice pests, aerating bottom soil and making more nitrogen and phosphorus available to rice plants. In this regard Grist (1965) and Coche (1967) put arguments that this extra increase in yield is due to biological control of harmful insects and pests and grazing of the fish on weeds. Apart from the paddy, 159.32 kg/ha of fish was harvested from rice-fish fields during the boro season of 1995.

To obtain gross return, total produced was multiplied by the prevailed farmgate prices of the products. At the rate of Tk 7,011.30/t, gross return from rice stood Tk 33,465.00/ha and Tk 29,672.00/ha, respectively under rice-fish and rice mono-crop farming. The estimated gross return from straw in rice-fish and rice mono-crop farming were Tk 1,176.00/ha and Tk 1,030.00/ha, respectively. Gross return obtained from fish was Tk 6,381.20/ha where the prevailed farmgate price of fish was Tk 40.00/kg. Thus, the overall gross return from rice-fish and rice mono-crop farming amounted Tk 41,022.00/ha and Tk 30,702.00/ha, respectively.

To arrive at net return, gross cost was deducted from gross return and was calculated on both full cost and cash cost basis. Per hectare net return in rice-fish farming was Tk 8357.00/ha over full cost and Tk 25,019.00/ha over cash cost while net returns in rice mono-crop farming stood Tk 2,439.00/ha and Tk 18,334.00/ha, respectively over full cost and cash cost. It is noted here that the net return per hectare from rice-fish farming was significantly higher ( $t = 7.75$ ) than the net return earned from rice mono-crop farming. As a measure of average return to each Taka spent in production, undiscounted BCR was calculated. Table 3 reveals that regardless the methods of estimating cost, the

BCR in rice-fish farming appeared to be relatively higher (1.26 and 2.56) than in rice mono-crop farming (1.09 and 2.48). The results of the study clearly shows that both rice-fish farming and rice mono-crop farming are profitable business from the view point of individual farmers considering both cash as well as full costs.

**Table 3.** Per hectare costs and returns of producing HYV boro with and without fish at Gouripur, Mymensingh

Particular	HYV boro with fish	HYV boro without fish
<b>Yield</b>		
Rice (t/ha)	4.77*	4.23
Fish (kg/ha)	159.53	-
<b>Gross return (Tk/ha)</b>		
Rice	41,022.14	30,701.82
Straw	33,464.94	29,671.82
Fish	1,176.00	1,030.00
<b>Gross cost (Tk/ha)</b>		
Full cost basis	6,381.20	-
Cash cost basis	32,665.57	28,263.09
<b>Net return (Tk/ha)</b>		
Full cost basis	16,003.16	12,367.75
Cash cost basis	8,356.57*	2,438.73
<b>Benefit-cost ratio</b>		
Full cost basis	25,018.98*	18,334.07
Cash cost basis	1.26	1.09
	2.56	2.48

\*Significant at 1% level

### **Variability in yield and net return from HYV boro**

An attempt was made in this section to examine farm to farm variation in yield and net return from rice under rice-fish and rice mono-crop farming. The results are presented in Tables 4 and 5.

**Table 4.** Variation in per hectare yield of HYV boro with and without fish at Gouripur, Mymensingh

Yield group (t/ha)	Farms producing HYV boro with fish		Farms producing HYV boro without fish	
	Number	% of total	Number	% of total
3.49-3.99	3	10.00	8	26.67
4.00-4.39	4	13.33	11	36.67
4.40-4.79	9	30.00	9	30.00
4.80-5.47	14	46.67	2	6.67
Total	30	100.00	30	100.00

**Table 5.** Variation in net return per hectare from HYV boro with and without fish at Gouripur, Mymensingh

Net return group (Tk/ha)	Farms producing HYV boro with fish		Farms producing HYV boro without fish	
	Number	% of total	Number	% of total
12,721-15,000	1	3.33	6	20.00
15,001-18,000	1	3.33	10	33.33
18,001-21,000	3	10.00	9	30.00
21,001-24,000	4	13.33	5	16.67
24,001-27,000	11	36.68	-	-
27,001-29,776	10	33.33	-	-
Total	30	100.00	30	100.00

***Variation in yield of HYV boro***

The average per hectare yield of HYV boro in the rice mono-crop farming was not only significantly lower than the yield obtained in the rice-fish farming but the variability in yield obtained was also higher in rice mono-crop farming (Table 4). The highest and the lowest yields recorded in rice-fish farming were 5.47 t/ha and 3.67 t/ha, respectively while the yield of rice obtained in rice mono-crop farming varied from 3.49 to 4.81 t/ha. Table 4 reveals that 46.67 percent (14 farms) of the sample farms under rice-fish farming had yield between 4.80 to 5.47 t/ha while only 6.67 percent (7 farms) of the rice mono-crop farms had yield in this range of yield. Again, in the case of rice-fish farming only 23.33 percent (7 farms) farms obtained yield of rice between 3.49 to 4.39 t/ha but 63.34 percent (19 farms) of the rice mono-crop farms fall in this group. The results indicated that most of the rice-fish farms were concentrated in the highest yield group but the rice mono-crop farms were scattered in lower yield groups. Variation in yield of rice in rice-fish farming was relatively lower due to even management practices of rice-fish plots required for fish over the growing period.

***Variation in net return from HYV boro***

Only the variation in net returns over cash cost from rice were analysed. Table 5 reveals that the net return from rice in rice-fish farming varied from Tk 12,721.00 to Tk 29,796.00/ha while the net return from rice mono-crop farming ranged between Tk 14,511.00 to 22,673.00/ha. The distribution of rice mono-crop farms was scattered over the lower net return groups. But in the case of rice-fish farming the distribution was concentrated mainly over the two high net return groups which is similar to the concentration of rice-fish farms over the yield groups (Tables 4 and 5).

## Conclusions

The results of the present study clearly indicate that farmers can make profit from both rice-fish and rice mono-crop farming. The farmers, however, can make more profit from rice-fish culture than the farms producing only HYV boro rice. Extension workers should, therefore, encourage farmers to adopt this new technique (rice-fish culture) of farming. Thus, both the production of rice and fish could be increased within the shortest possible time. This will contribute much to farmers' income and thereby in well being of rural people. The government and non-governmental organizations should strengthen their efforts to disseminate rice-fish culture technology elsewhere in the country where similar type of topography (low-lying area) is found.

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(Manuscript received 11 September 1997)