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An overview of the traditional rice-prawn-fish farming in Kalia of Narail district, Bangladesh

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Abstract

This study was conducted in Narail district, Bangladesh between January and June, 2012; with a view to describing the status of rice- prawn-finfish based aquaculture practices. Average area of plots was 0.55±0.44 ha, of which mean ditch area was 4.35±2.02% of total land. All farmers dry their plots and made renovation prior to start of a new growing season followed by liming and fertilization. No standard stocking density was maintained, prawns were stocked at 15895 PL/ha, whereas fin fishes at 1551 seeds/ha. Commercial feed was applied in all the plots. Production of prawn, stocked and non-stocked fin fishes were found 380.34±155.25 kg/ha; 713.65±352.99 kg/ha and 51.73±24.55 kg/ha respectively. Average cost and income for fish culture were 120514.07±36758.35 BDT/ha and 232497.48±76594.80 BDT/ha respectively. Average rice production was 4229.78±856.71 kg/ha. Low growth and high mortality of PL; scarcity, high and uprising price of feeds; and floods were identified as the major problems.

Keywords: Rice-fish farming, rice-fish plots, prawn farming, *gher* farming, white fish, freshwater aquaculture

INTRODUCTION

Integration of different crops helps to secure better profit level and minimize risks in any farming system. Culture of fishes in rice fields is now a proven technology in Bangladesh. Incorporation of freshwater prawn into this system will surely increase the chance of getting more profit. Bangladesh is considered one of the most suitable countries in the world for freshwater prawn (*Macrobrachium rosenbergii*) farming, because of its favorable resources and agro-climatic conditions (Rahman *et al.* 2010) and one of the most important sectors of the national economy especially because of export potential (Ahmed *et al.* 2010) particularly to the USA, Europe and Japan (Ahmed *et al.* 2007). A sub-tropical climate and a vast area of shallow water bodies provide a unique opportunity for freshwater prawn production (Ahmed *et al.* 2008). In Bangladesh, 65% of the people are poor and with limited lands (Rahman *et al.* 2011). Moreover, as the water bodies are shrinking with the passes of time in our country (Islam *et al.* 2010), fish culture in rice fields would play a key role here in maintaining aquaculture production. The practice of small-scale prawn farming in rice fields is widespread in south-west Bangladesh due to the availability of wild post larvae and low-lying rice fields, a warm climate, fertile soil, and cheap and abundant labor (Rahman *et al.* 2010). Fish culture in suitable rice fields can reduce poverty, improve paddy yield, creates employment opportunity, increases nutrient intake which brings food security for farmers (Rahman *et al.* 2012). Shrimp culture is popular and widely used practices in the southern part of Bangladesh. At present time inclusion of saline water due to shrimp farming is a burning issue because it adversely affecting other agricultural production. Research findings also revealed that use of saline water have long-term effect of soil salinization and poses a real threat towards sustainability of shrimp farming as well as coastal development (Chowdhury *et al.* 2011). But freshwater prawn culture does not affect the environment in such ways, and could be supplementary to the shrimp culture practice. The total area of rice fields in Bangladesh is about 10.14 million ha, which can play an important role in increasing fish production (Rahman 1995). In addition, the country has more than 2.83 million ha of seasonal paddy fields where water remains for 4-6 months (Karim 1978). There exists tremendous scope for increasing fish or prawn production by integrating aquaculture in these inundated rice fields.

To our knowledge, information of rice-fish culture in Bangladesh are seldom found (Kunda *et al.* 2008, Wahab *et al.* 2008, Rahman *et al.* 2010 and 2012) and there is lack of information on the production performances of prawn farming (Rahman *et al.* 2010). The outcomes of present study would reveal management status and financial aspects of prawn-fish-rice culture. These findings may inspire other farmers from different localities to involve in this practice and would help researchers to commence further studies on related subject.

METHODOLOGY

Study area and duration: The present study was conducted in Kalia Upazilla (located between approximately 89’30”-89’49” East and 22’96”-23’06” North) of Narail district for a period of six months, from January 2012 to June 2012 (Figure 1). Study area is about 15 kilometer south-east from the Narail district proper. At present time, Kalia Upazilla is became a famous place for producing giant freshwater prawn, *M. rosenbergii*, in rice plots taking the topographical advantages of agricultural lands and suitable water sources, both rain and ground water.

Study methods: Field survey was carried out during the period of study. For the present study a total of 93 rice-fish farmers were randomly selected. A standard questionnaire was purposively developed, pre-tested and finalized for data collection.

Focus group discussions (FGDs) were also employed to identify existing problems and to explore possible solution or farmer’s recommendations. Collected data were cross-checked with the key informants.

Data analyses: Finally, all the data were subjected to descriptive analyses using the computer software Statistical Package for Social Science (SPSS, version 15.0), Microsoft Excel 2007 and 2010 to understand the differences of the variables.

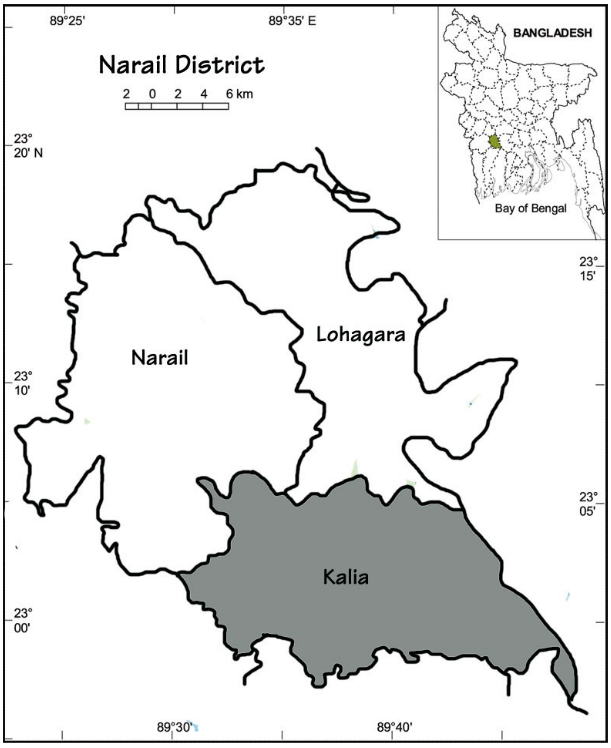

Figure 1: Map of the Narail district showing the study area (Kalia Upazila)

RESULTS AND DISCUSSIONS

Plot and ditch sizes: Sizes of surveyed rice-fish plots were found to be varied from 0.093 ha to 1.619 ha with an average size of 0.55±0.44 ha. Ditch sizes were found quite small in all the plots, occupying 4.35±2.02% (2.00-8.70%) of the total plot area. However there were no literatures were found about the ditch size in rice-fish plots in Bangladesh. So it was not possible to compare the present findings.

Plot preparation: Rotational or alternate farming practice of rice and fishes was practiced by all the farmers in the study area, *i.e.* rice production after fish or vice-versa. All the farmers dried their plots and made renovation by removing bottom mud prior to start of a new growing season. All the respondents applied lime (lime stone, $CaCO_3$) in their plots during this time. Mean application rate was recorded 130.38±68.94 kg/ha (Table 1). This rate of lime application was much lower considering the findings of Mohsin *et al.* (2012c) who reported that majority fish farmers of Bangladesh applied lime at the rate of 245-367 kg/ha during preparation of their culture ponds.

Both organic and inorganic fertilizers were used during preparation of these plots. Cow dung was used as an organic fertilizer in all most all the plots (96.77%). Whereas inorganic fertilizers urea, triple super phosphate (TSP) and murate of potash (MP) were used in 96.77%, 100% and 12.90% plots respectively (Table 1). Application rates of these fertilizers were found to be varied greatly with plot to plot- cow dung, 580.79 kg/ha; urea, 136.85 kg/ha; TSP, 130.63 kg/ha; and MP, 33.80 kg/ha (Table 1). In a study by Rahman *et al.* (2012) it was revealed that plot preparation cost may be high depending on geographical location and other factors. They have found that more than half of their respondents (55%) reported high cost of plot preparation for rice-fish culture in Mymensingh district.

Table 1: Status of lime and fertilizers application during preparation of rice-fish plots

Lime/fertilizer name	*% of plots*	*Application rate (kg/ha)*		
		Min	*Max*	*Mean (±SD)*
Lime stone	100	24.70	282.29	130.38±68.94
Cow dung	96.77	107.39	1693.71	580.79±426.50
Urea	96.77	49.40	296.40	136.85±77.87
TSP	100	24.70	494.00	130.63±106.87
MP	12.90	24.70	44.64	33.80±10.60

Water supply and sources: All the respondents were dependent on both rain water and ground water for supplying water to the rice-fish plots. Ground water was used only when there was insufficient raining. Pump machine was used for using ground water. Farmers were not interested in using this machine unless extreme condition *i.e.* when scarcity of rain water reaches to its maximum, because this costs extra money and increase the investment.

Prawn post larvae (PL) and fish seed collection: All the farmers collect prawn PL through local depot owners. The depot owners collect these PL from hatcheries of nearby districts, especially from Vola and Jessore districts. Jessore is an adjacent district and existence of several hatcheries were reported by the respondents; and road communication and transportation system with study area were much developed. Islam *et al.* (2011) reported establishment of 25 PL farms in the greater Jessore district, of these majority were privately owned.

On the other hand, finfish seeds were purchased from the travelling vendors or local nursery pond operators. The farmers brought PL and finfish seeds from middlemen, and they did not evaluate quality issues of those PL and seeds. This type of purchase may result in high mortality and low growth of fishes and prawn. Selection of finfish species was determined by several factors: availability of seeds, growth rate, consumer preference and market price. Farmers have mentioned that they stock silver carp for its high demand market and great acceptability among rural people. Similar result also reported by Galib *et al.* (2013) while working with rural people of the country. They have noted that silver carp was the most commonly consumed fish by the rural people. In the study site, farmers stocked both exotic and native species in their plots (Table 2).

Stocking of prawn and finfishes: No standard stocking density was followed by the respondents in the study area, and as a result, stocking density found to be varied farmer to farmer. Stocking density of prawn was found 15895±8371 PL/ha (Table 2).

Seven species of fin fishes were also stocked along with prawn in different combinations. Not all these species were stocked in all the plots. These fishes were silver carp (*Hypophthalmichthys molitrix*), catla (*Catla catla*), rui (*Labeo rohita*), Thai sarputi (*Barbanemous gonionotus*), grass carp (*Ctenopharyngodon idella*), common carps (*Cyprinus carpio*) and black carp (*Mylopharyngodon piceus*) and they were stocked in 83.87%, 100%, 100%, 29%, 54.84%, 9.68% and 3.23% plots respectively (Table 2).

Average stocking density varied greatly and was recorded *H. molitrix* 529 seeds/ha, *L. rohita* 612 seeds/ha, *C. catla* 320 seeds/ha, *B. gonionotus* 350 seeds/ha, *C. idella* 83 seeds/ha, *C. carpio* 274 seeds/ha and *M. piceus* 14.14 seeds/ha (Table 2). Stocking size and weight also varied greatly from farmer to farmer, and as a result stocking densities were also varied to a high extent. Overall stocking density of fin fishes were found 1551±1883 seeds/ha (Table 2).

Table 2: Stocking of prawn and fish species into the rice-fish plots

Prawn/fish species	*% of plots*	*Stocking density (number/ha)*		
		Min	*Max*	*Mean (±SD)*
Macrobrachium rosenbergii	100.0	2964	38422	15895±8371
Hypophthalmichthys molitrix	83.87	079	4347	529±842
Labeo rohita	100.0	105	3623	612±748
Catla catla	100.0	040	1811	320±326
Barbanemous gonionotus	29.00	042	864	350±285
Ctenopharyngodon idella	54.84	012	263	083±071
Cyprinus carpio	09.68	082	593	274±277
Mylopharyngodon piceus	03.23	007	020	014±7.00

Stocking density of prawn was found lower than the recommended stocking density (12500 PL/ha) in carp polyculture system by Hossain and Islam (2006). Kunda *et al.* (2008) recommended 20000 PL/ha stocking density of prawn with 20000 seeds/ha of native mola carplet in rice fields as optimum stocking density.

Feeding: A total of five supplementary feeds were found to be applied by the farmers. Commercial sinking pellet feeds, snail meat, rice bran, mustard oil cake and fish meal were supplied in 100%, 35.48%, 6.45%, 6.45% and 6.45% plots respectively (Figure 2).

Application rate of these feeds were varied greatly depending on buying capability of the respondents. Application rates were commercial pellet feeds, 1818.77±957.26 kg/ha (494 – 4528.33 kg/ha); snail meat, 749.10±731.04 kg/ha (128.87 – 2470 kg/ha); rice bran, 211.71±99.80 kg/ha (141.14 – 282.29 kg/ha); mustard oil cake, 214.07±256.16 kg/ha (32.93 – 395.2 kg/ha); and fish meal, 451.14±609.53 kg/ha (20.14 – 882.14 kg/ha) (Figure 3). According to the respondents, snail meat can rapidly increase the body weight of prawn. But scarcity of snails in nearby water bodies hampering continuous supply of it to the rice-fish plots. However, feed were applied more or less on regular basis which is essential to obtain a good production. Similar comment also made by Nahar (2010).

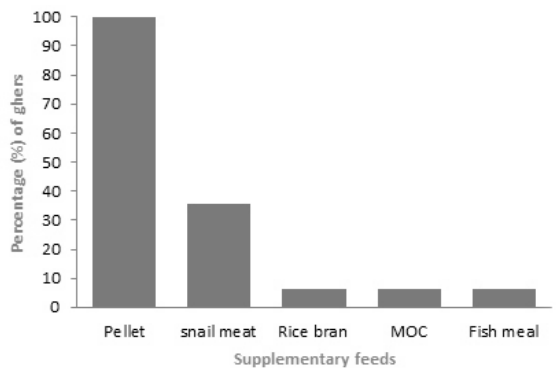

Figure 2: Different supplementary feeds used in plots.

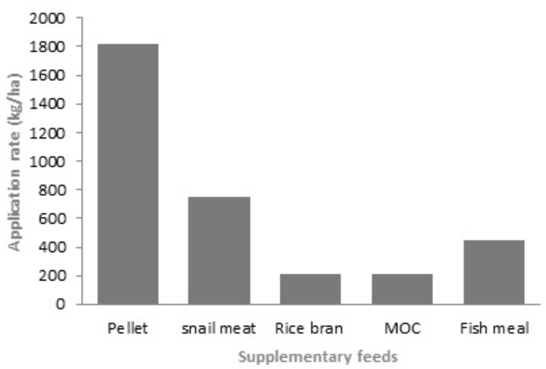

Figure 3: Average application rate of different supplementary feeds in plots.

Prawn-fish production: Three major categories of fishes were harvesting during the period of culture, prawn, stocked fin fishes (locally known as white fishes) and non-stocked indigenous fin fishes (mainly *Puntius* sp., *Channa* sp., *Mystus* sp., *Esomus danricus* etc.). Natural stock of native fin fishes was found to be harvested in all the plots. Similar result also reported by Mohsin *et al.* (2012a) while working with culture of carps in ponds of two north-western districts of Bangladesh.

However, the production of fishes in the present study were found as- prawn, 380.34 kg/ha; stocked finfishes, 713.65 kg/ha; and non-stocked finfishes, 51.73 kg/ha. Overall combined fish production (prawn and fin fish) was 1145.73 kg/ha (Table 3).

Table 3: Stocking of prawn and fish species into the rice-fish plots

Production type	***Production (kg/ha)***		
	Min	***Max***	***Mean (±SD)***
Prawn	88.92	902.09	380.34±155.25
Stocked finfishes	144.50	1429.64	713.65±352.99
Non-stocked finfishes	21.17	123.50	51.73±24.55
Overall	510.93	1959.53	1145.73±422.85

Mean prawn and finfish production lower than that of the findings of Ahmed *et al.* (2010) who reported prawn and fish production as 467 kg/ha and 986 kg/ha respectively. However, the production rate of shrimp and prawn in *gears* (prawn/shrimp culture ponds with inlet and outlet) in the country is 713 kg/ha (DoF 2013); this was higher than that of the prawn production in the study area.

Cost-benefit analyses (prawn and fin fishes): Mean cost for fish culture was calculated 120514.07±36758.35 BDT/ha (71221.08 - 264166.50 BDT/ha), whereas the mean income or return was 232497.48±76594.80 BDT/ha (104965.04 - 474025.22 BDT/ha). Profit found in the present study was higher than that of profit reported (69006 BDT/ha) by Hossain and Islam (2006) from prawn-carp polyculture in ponds under climatic conditions of Bangladesh. So, it can be said that culture of rice-fish-prawn is more profitable venture than that of prawn-fish culture in ponds.

Rice production: Two high yield varieties (HYVs) of rice were cultivated in all the plots, BR-28 and BR-29. Average paddy production was found 4229.78±856.71 kg/ha with the highest and the lowest production of 6422 kg/ha and 2371.2 kg/ha respectively. Straw production was recorded 3206.28±675.91 kg/ha (1852.50 - 4940.00 kg/ha). Rice production was found much more than the production (2257 kg/ha) reported by Ahmed *et al.* (2010). In another experiment by Nahar (2010) 3450 kg/ha rice production was obtained from rice-fish culture plots. This might be due to fertility of soil in the study area.

Cost of production was 25304.04±5279.28 BDT/ha (13960.87 - 37050.00 BDT/ha), whereas the average gross income was 85875.29±17720.29 BDT/ha (48239.1 -

132721.3 BDT/ha). The production cost was found much lower than the cost of rice mono-culture (Rahman *et al.* 2012). They reported cost of BDT 45600 per hectare area while working in Mymensingh district of Bangladesh. All the respondents reported no or less use of fertilizers in rice fields which reduced the overall cost involvement to a great extent, ensuring maximum profit. Similar findings were reported by Barmon *et al.* (2008) and Rahman *et al.* (2010).

Existing problems: Several problems were also mentioned by the respondents during FGDs. Major problems identified were low growth and high mortality of prawn PL, scarcity of snail in natural sources for feeding, high and uprising price of supplementary feeds and floods.

Identification of problems and constraints are the prerequisites for mitigating any problems and to enhance aquaculture production (Mohsin *et al.* 2012b). Problems of low growth, high mortality and high price of feeds in aquaculture practice of Bangladesh were not new; all were reported by Mohsin *et al.* (2012b) earlier while working with carp culture in ponds. Ali (2013) mentioned that excess and indiscriminate application of various antibiotics for the treatment of PL in hatcheries after hatching was responsible for the low growth of prawn. He also reported that this problem became severe after 2010 in Bangladesh. As the farmers in the study area did not collect PL directly from the hatcheries and they had to rely on middlemen for the collection so they did not get any opportunity to choose PL according to their preference.

CONCLUSION

Low-laying rice fields can effectively be used for integrating prawn and finfishes with rice production. It can bring more profit to the farmers than prawn polyculture with carp species in ponds. However different crops (rice, prawn and finfishes) may help to meet up the diversified demands for foods. This technology would not pose any salinization threat to environment that shrimp culture threatening at present. As no saline water is essential for prawn culture, the technique may spread out to all over the country. But use of snail as food for prawn is badly affecting the abundance and existence of snail community. Alternate food source is essential which will replace snail community and ensure conservation of snails. However, further research efforts, initiatives by the government and concern authorities are also recommended to mitigate the existing problems to ensure sustainability of the technology.

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