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Present Status and Prospect of Integrated Rice-Fish Farming in Chapainawabganj District

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ABSTRACT

The study was conducted to know the present scenario, problems and prospect of the integrated rice-fish farming at Chapainawabganj district in Bangladesh during October 2021 to December 2021. The primary data were collected through interview with well-structured questionnaires. Fifteen farmers were included in this study who were directly and indirectly involved in integrated rice-fish farming. Most of the farmers belonged to age category 31-40 years. All of the respondents had some form of education where highest (40%) was in primary level. 46.7% of the farmers had less than five family members where very few were solely dependent on integrated rice-fish farming, fishermen (26.7%), agriculture farmers (60%) and other occupations (13.3%). Among the respondents, 40% used their own land in the culture and 60% used land on lease. Among the respondents, 60% were introduced to integrated rice-fish farming technology directly by training and rest of them started without any training. Highest production and return per year were found in respondent four (308000 Tk), on the other hand lowest was found in respondent eight (24500 Tk). The highest BCR was found 4.56 whereas the lowest was 1.31 and average moderate BCR was 1.82. In the study area, the farmers earned 44% profit from rice production and 56% from fish production in integrated rice-fish culture. Problems like lack of nearby hatchery and lack of quality fingerlings were prominent in the study area. Assurance of good quality fingerlings, need based training, development of a community based integrated rice-fish farming should be taken into account on a priority basis to improve and utilize integrated rice-fish farming technology in Chapainawabganj district.

Keywords: Chapainawabganj, Fish farming, Integrated rice-fish farming, Rice farming, Socioeconomic status

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1. INTRODUCTION

Bangladesh is one of the poorest and most densely populated countries in the world, covering an area of 144,000 km^2 with a population of 164 million (Chowdhury, 2009). The people of Bangladesh are commonly referred to as 'Macche-Bhate Bangali' (i.e., the people made of fish and rice). Rice and fish have been an essential part of the life of Bangladeshi people from time immemorial. The staple foods of the people of Bangladesh are rice and fish. Rice is the foremost agricultural crop in Bangladesh with an annual production of over 25 million tons per annum (BRKB, 2020), while annual fish production is 5.8 million tons (DoF, 2020). The demand for rice and fish is constantly increasing in Bangladesh with nearly three million people being added each year to the population of the country (Chowdhury, 2009). Nevertheless, integrated rice-fish farming offers a solution to this problem by contributing to food, income and nutrition. Not only the

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adequate supply of carbohydrate, but also the supply of animal protein is significant through rice-fish farming. Fish, particularly small fish, are rich in micronutrients and vitamins, and thus human nutrition can be greatly improved through fish consumption (Roos et al., 2003; Larsen et al., 2000).

The total area of rice fields in Bangladesh is about 10.14 million ha with an additional 2.83 million ha of inundated seasonal rice fields where water remains for about 4–6 months (BRKB, 2020). The carrying capacities of these lands and waters are not fully utilized, but there exists tremendous scope for increasing fish production by integrating aquaculture (Wahab et al., 2008). Integrated rice-fish production can optimize resource utilization through the complementary use of land and water (Frei & Becker, 2005). Integration of fish with rice farming improves diversification, intensification, productivity, profitability, and sustainability (Ahmed et al., 2007; Nhan et al., 2007).

However, rice-fish farming remains marginal in Bangladesh because of socioeconomic, environmental, technological, and institutional constraints (Nabi, 2008). Although rice-fish technology has been demonstrated successfully and a considerable number of farmers have been trained through various projects, this integration has yet to be widely practiced. Traditionally wild fish have been harvested from rice fields as many fish species prefer rice fields for reproduction (Fernando, 1996; Little et al., 1993; Kangmin, 1988). The natural aggregation of fish in rice fields inspired the combination of rice farming with fish to increase productivity (Gurung & Wagle, 2005). However, the introduction of high yielding varieties (HYV) of rice with accompanying pesticides reduced fish yields (Gupta et al., 2002).

Integrated fish farming is a technique of fish culture with other organisms (animals or plants). Major objective of this technique is to get maximum output through involving minimum input supply in minimum time duration. Rice-fish farming is the culture of rice-fish in a same piece of land.

Fish culture with rice can be practiced in two ways- (1) rice-fish together in the same time (concurrent system) and (2) fish culture after harvesting rice (alternative system). In Bangladesh, generally this culture is practiced during Boro and Amon seasons. Suitable paddy type are- Amon season: BR-11, BR-3 and BRRI-30 and Boro season: BR-16 and BR-14.

Culture of rice-fish together/concurrent system is generally practiced during Aman season in moderate to low paddy fields where water logging exists for 4-5 months naturally. Mirror carp and Thai barb are highly suitable for this practice but Tilapia or giant freshwater prawn can also be stocked with rice.

In the fish culture after harvesting rice technique, fish are stocked in the paddy field after harvesting rice from the land. 6-7 months rearing of fish is possible by this way until rice plantation in the next season. Carp and barb species are suitable for stocking but grass carp (*Ctenopharyngodon idella*) can also be stocked. In case of grass carp stocking, precaution must be taken so that this fish cannot eat young paddy. Many reports suggest that integrated rice-fish farming is ecologically sound because fish improve soil fertility by increasing the availability of nitrogen and phosphorus (Dugan et al., 2006; Huy Giap et al., 2005). The feeding behavior of fish in rice fields causes aeration of the water. Integrated rice-fish farming is also being regarded as an important element of integrated pest management (IPM) in rice crops (Halwart & Gupta, 2004; Berg, 2001). Fish play a significant role in controlling aquatic weeds and algae that carry diseases, act as hosts for pests and compete with rice for nutrients. Moreover, fish eat flies, snails and insects, and can help to control malaria mosquitoes and water-borne diseases (Matteson, 2000). Interactions of fish and rice also help lower production costs because insects and pests are consumed by the fish. On the other hand, rice fields provide fish with planktonic, periphytic and benthic food (Mustow, 2002). Shading by rice plants also maintains the water temperature favorable to fish during the summer (Kunda et al., 2008).

Above situation clearly indicates the necessity to observe the present status and potentiality of integrated rice-fish farming in Bangladesh. Therefore, the present study evaluated socioeconomic condition of the involving farmers and their production and economics of integrated rice-fish farms in Chapainawabganj district, Bangladesh.

2. MATERIALS AND METHODS

2.1 Study Area

The study was confined to Chapainawabganj Sadar Upazila, Chapainawabganj District, Bangladesh (Fig. 1). Fifteen integrated rice-fish farms located in 5 villages were selected and monitored using random sampling method. Random sampling technique is simple and best suited for smaller population (Moore et al., 2014). The entire process of data collection was conducted from October 2021 to December 2021.

2.2 Data Collection

Data were collected by participant observation, group discussions, interview scheduled and informal conversations and questionnaires. For quantitative data, pre-structured questionnaire was used to address different issues of integrated rice-fish farms, crop culture and production, farmer's socioeconomic conditions and problems related to integrated culture and correlation between different independent variables (farmer's age, family size, education level, occupation, land used, sources of information, production, income and experience) in this study. Age of a respondent was measured in terms of actual years on the basis of their statement. Educational status was measured by the number of years of schooling. Uneducated respondents were scored nil (0).

2.3 Data Analysis

All collected data were carefully scrutinized, recorded and analyzed using SPSS data editor and Microsoft Excel with the

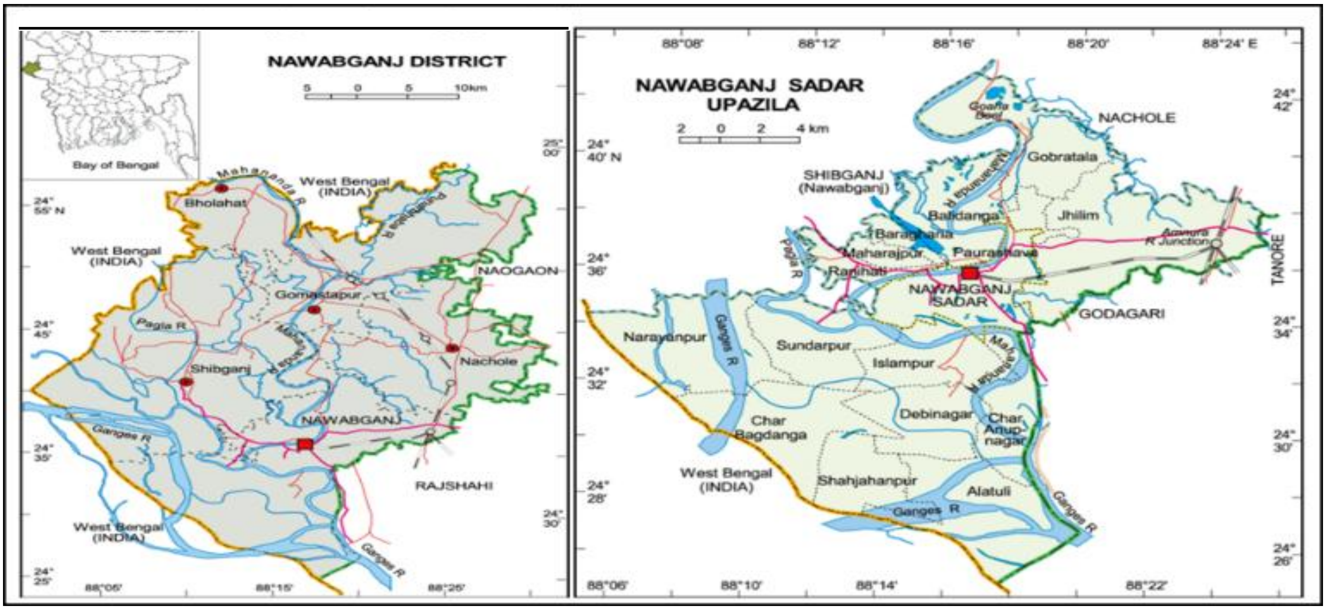

Fig. 1 Map of the study area.

simple statistical method and presented in both graphical and tabular form for better understanding. Outline of the methodological approach is presented (Fig. 2).

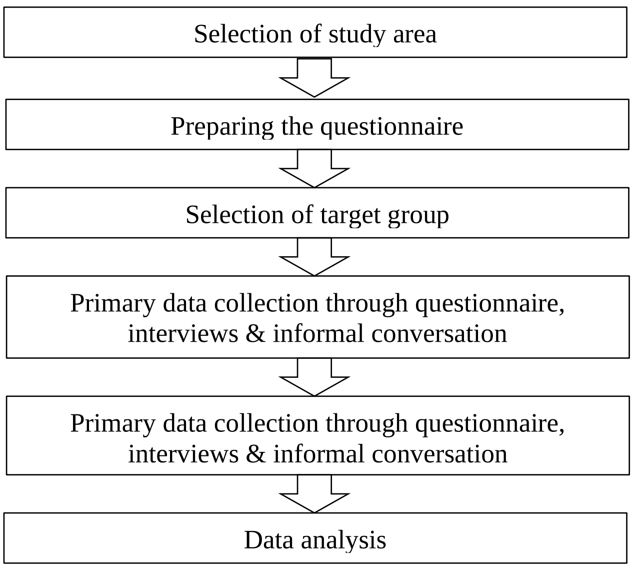

Fig. 2 Outline of the methodological approach.

3. RESULTS AND DISCUSSION

3.1 Demographic profile of fish farmers

Different demographic status (age, family size, education level, occupation, land used, primary information source etc.) of 15 farmers were measured in the present study (Table 1).

3.2 Age group

In the present study 26.7% of the respondents were old aged whereas 20% and 53.3% were young and middle aged, respectively. The higher involvement of middle-aged people in integrated rice-fish farming indicated that middle aged people were more interested in integrated farming than older and younger farmers and it also indicated that middle aged farmers were more cautious about this technology. This value is more or less similar to the finding of Ali et al. (2008) who reported 52% respondents of young and middle aged in the fish farming.

3.3 Family size

The family size usually has a considerable influence on the income and expenditure of the family. The family sizes of the farmers were divided into 3 categories according to the number of the family members (Table 1). Out of the 15 farmers, 46.7% had small (1-4) sized family, 33.3% had medium sized (5-7) family and 20% had large sized (>7) family. The present finding has similarity with the findings of Ali et al. (2008) and Das et al. (2018).

3.4 Education

According to the present study, 33.3% farmers were illiterate whereas 40%, 20% and 6.7% had primary, secondary and higher secondary level of education, respectively. In the study, it is seen that level of education of farmers hugely affects the adoption and utilization of integrated farming technology. The similar views also expressed by Little et al. (1996).

3.5 Occupation

The 60% of respondents are agricultural farmers. Farming is their primary occupation, whereas 26.7% respondents have chosen fishing as their primary occupation. They are fishermen. And the rest 13.3% were occupied in agriculture, service and business respectively. None of the respondents chose integrated farming as primary occupation; most of them are habituated to alternate farming.

3.6 Land Used

The study sketched that majority of the farmers (60%) used land on lease for integrated rice-fish farming while the rest (40%) used their own land. Nabi et al. (2008) reported that most of the farmers of Bangladesh culture integrated rice-fish farming in land taken on lease. Ahmed et al. (2008) found almost similar values (67%) in Mymensingh for farming investment.

Table 1 Demographic profile of integrated rice-fish farmers in the study area

Category	Frequency	Percentage (%)
Age Group		
Young	3	20
Middle	8	53.3
Old	4	26.7
Family Size		
Small (1-4)	7	46.7
Medium (5-7)	5	33.3
Large (>7)	3	20
Education Level		
No formal education	5	33.3
Primary (I-V)	6	40
Secondary (VI-X)	3	20
Higher secondary (XI-XII) and above	1	6.7
Occupation		
Fisherman	4	26.7
Agricultural farmer	9	60
Other	2	13.3
Land Used		
Own land	6	40
Land taken on lease	9	60
Primary Information Source		
Upazila Fisheries Office	8	53.3
Nearby farmers	5	33.3
Internet	2	13.3

3.7 Primary Source of Information

From the study, it was found that, 53.3% respondents got introduced to integrated rice-fish farming by Upazila Fisheries Office and they took training under it, whereas the rest 33.3% and 13.3% were informed by nearby farmers and got the information from internet respectively. So, the data strongly indicates that Department of Fisheries played a vital role in dispersing this technology and it can keep playing a vital role in future expansion work of this type of technologies. Moreover, a recent study by Islam et al. (2020) has also found social media like Facebook and YouTube can be used to spread new techniques and culture practices to the field. So, building community network, developing community infrastructure and community-based fisheries management will also be easy to implement through the utilization of such media. The education levels of the farmers are the reasons behind the lack of proper utilization of these media. Since majorities were informed by the Upazila Fisheries Office, they can be categorized as early adopters in the technology adoption stages.

3.8 Production

The first cycle harvest of rice of the respondents is given in Table 2. The highest production was found 3550 Kg followed by 3500 Kg and 3100 Kg, respectively. On the other hand, the lowest production was observed 500 Kg.

Table 2 Production and return of rice of respondents

Respondents	Production (Kg)	Return per cycle (Tk.)	Return per year (Tk.)	Total production (Kg)
R1	1800	16000	32000	
R2	800	10000	20000	
R3	3550	35000	70000	
R4	3050	39000	78000	
R5	3100	30000	60000	
R6	1100	11000	22000	
R7	2600	17500	35000	
R8	500	4250	8500	29300
R9	1500	14500	29000	
R10	1000	7500	15000	
R11	1500	15000	30000	
R12	2000	15000	30000	
R13	2200	14000	28000	
R14	3500	30000	60000	
R15	2500	15000	30000	

The first cycle harvest of fish of the respondents is given in Table 3. The highest production was found 930 Kg followed by 400 Kg and 390 Kg. On the other hand, the lowest production was observed 70 Kg followed by 130 Kg and 200 Kg. The production varied because of the land size, topography as well as experience and management of farmers and importantly of fingerlings quality and market price of the harvested rice and fish.

3.9 Economics

In the present study, cost of production was collected from 15 respondents and then a simple economic analysis was performed to estimate different costs of production and returns of all respondents (Table 4, Fig. 3-5). Among the studied farms the highest return from rice per cycle was found to be 39,000 Tk. (respondent 4) and the lowest was 4,250 Tk. (respondent 8). On the other hand, the highest return from fish per cycle was found to be 115,000 Tk. (respondent 4) and the lowest was 8,000 Tk. (respondent 8). Additionally, the highest production cost of rice was found to be 42,000 Tk. and the lowest cost of production was 4,000 Tk. On the other hand, the highest production cost of fish was found to be 190,000 Tk and the lowest cost of production was 12,000 Tk.

Table 3: Production and return of fish of respondents.

Respondents	Production (Kg)	Return per cycle (Tk.)	Return per year (Tk.)	Total production (Kg)
R1	220	30000	60000	
R2	930	55000	110000	
R3	330	105000	210000	
R4	400	115000	230000	
R5	280	90000	180000	
R6	390	53700	107400	
R7	260	35000	70000	
R8	70	8000	16000	4600
R9	200	30000	60000	
R10	130	15000	30000	
R11	200	27500	55000	
R12	250	25000	50000	
R13	280	30000	60000	
R14	400	50000	100000	
R15	260	27500	55000	

The production cost varied due to the land size, topography as well as experience and management and importantly the fingerlings' quality and market price of the harvested crops.

The highest BCR was found to be 4.56; on the other hand, the lowest was 1.29. Among the studies the highest and the lowest BCR were exception. But the moderate value was found to be 1.82 in respondent 12. Among 15 respondents, respondent 15 was suitable candidate according to BCR for integrated rice-fish farming. In the study area, majority of the farmers reported higher return from fish rather than rice. Profit frequency from rice and fish were estimated through simple economic analysis (Fig. 6) and the result showed 56% profit from fish, on the other hand 44% was from rice (Fig. 6). Huy Giap et al. (2005) also found similar result in his study.

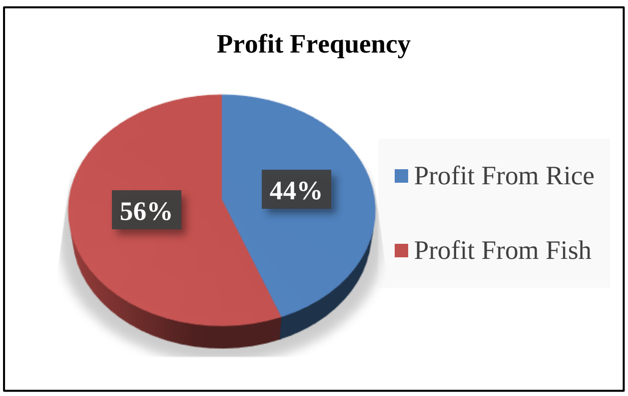

Fig. 3 Frequency of profit from rice and fish.

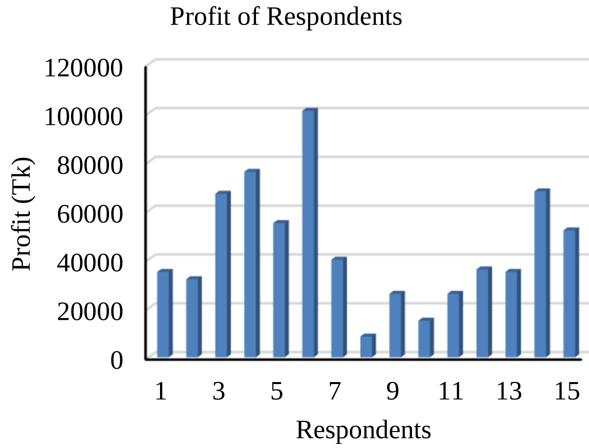

Fig. 4 Profit of respondents.

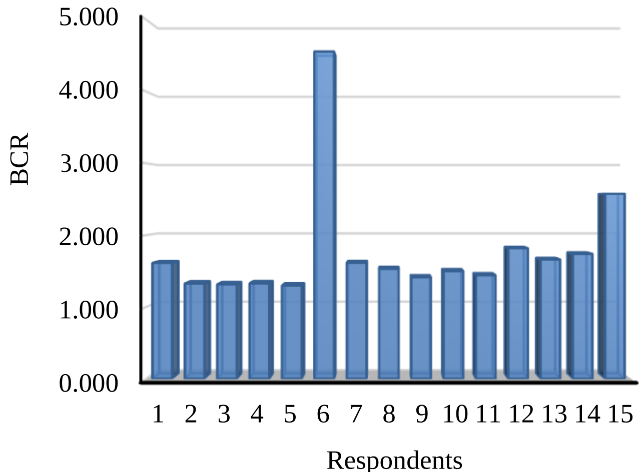

Fig. 5 Benefit-Cost Ratio of the respondents.

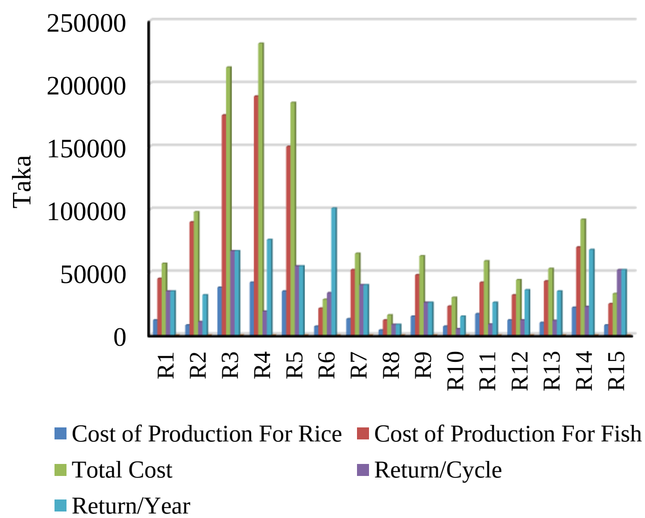

Fig. 6 Variations in the mean values of different parameters of respondents' economy.

Table 4 Variations in the mean values of different parameters of different respondent's economics

Respondents	Cost of production (Rice) (Tk.)	Cost of production (Fish) (Tk.)	Total cost (Tk.)	Return per cycle (Rice) (Tk.)	Return per cycle (Fish) (Tk.)	Total return per year (Tk.)	BCR
R1	12000	45000	57000	16000	30000	92000	1.614
R2	8000	90000	98000	10000	55000	130000	1.327
R3	38000	175000	213000	35000	105000	280000	1.315
R4	42000	190000	232000	39000	115000	308000	1.328
R5	35000	150000	185000	30000	90000	240000	1.297
R6	7000	21400	28400	11000	53700	129400	4.556
R7	13000	52000	65000	17500	35000	105000	1.615
R8	4000	12000	16000	4250	8000	24500	1.531
R9	15000	48000	63000	14500	30000	89000	1.413
R10	7000	23000	30000	7500	15000	45000	1.500
R11	17000	42000	59000	15000	27500	85000	1.441
R12	12000	32000	44000	15000	25000	80000	1.818
R13	10000	43000	53000	14000	30000	88000	1.660
R14	22000	70000	92000	30000	50000	160000	1.739
R15	8000	25000	33000	15000	27500	85000	2.576

4. CONCLUSION

In order to meet the soaring demand for food, there is a need for increased rice and fish production in Bangladesh. This study concludes that rice-fish integration could be a viable option for diversification. Integrated rice-fish farming increases rice yields and makes the rice field ecosystem an efficient and environmentally sound production system for rice and fish. Rice monoculture cannot alone provide a sustainable food supply, while integrated rice-fish farming is the best in terms of resource utilization, productivity and food supply. It is therefore suggested that integrated rice-fish farming is a sustainable alternative to rice monoculture.

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