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Present status of freshwater prawn (*Macrobrachium rosenbergii*) farming in Dinajpur District of Bangladesh

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Abstract
A year-long investigation, on the farming status of freshwater prawn in Dinajpur district of Bangladesh, revealed that prawn was cultured in polyculture systems with finfish in ponds (94.64%) and rice fields (5.36%). Average pond areas of 51.78% farmers were less than 0.50 acre and average depth 1.52m. Solely farm made feeds, manufactured with mustard oil cake, rice bran, maize bran, wheat bran, were applied by 41.07% farmers and commercial feeds by 30.36%. Feeds were applied manually twice daily by most of the farmers. Different social, technical and financial problems faced by farmers (91.07%) were unavailability and higher price of prawn seed, electricity, lack of proper knowledge on prawn farming etc. Although prawn culture can contribute to uplift the socio-economic status of the farmers, it was a recent and subsistence practice and not adopted widely by the farmers.

Keywords: Freshwater Prawn, *Macrobrachium rosenbergii,* Pond culture, Dinajpur district, Bangladesh

Introduction

In Bangladesh, freshwater prawn (*Macrobrachium rosenbergii*) farming is currently one of the most important sectors of the national economy and during the last two decades its development has attracted considerable attention due to its export potentials. Freshwater prawn, locally known as *golda chingri*, is a high value product in international markets; almost all prawns are therefore exported, particularly to the USA, Japan and European countries [1]. The quantity of prawn exported remains rather obscure because export statistics often do not distinguish between prawn and shrimp.

Bangladesh exported 46,533 tons of prawn and shrimp valued at US$ 351.01 million in which 15-20% was contributed by prawn [24]. This figure is expected to rise with the expansion of freshwater prawn cultivation in new areas of Bangladesh. Freshwater prawn farming is mostly concentrated in southwest Bangladesh, mainly Khulna, Bagerhat and Satkhira districts. The increase in demand for prawn in international markets attracted many fish farmers to switch to prawn cultivation in different parts of Bangladesh. Freshwater prawn cultivation practices in this area have developed as an indigenous technology, with no planning and little support or assistance from any outside sources, including the government [3]. Different government and non-government organizations as well as international agencies have shown to respond to the opportunities of the sector and exploring options for working with prawn farmers in Dinajpur district. The livelihoods of a considerable number of farmers are associated with prawn farming in Dinajpur district. Freshwater prawn farming first started in this area in 1997, when a few local farmers first converted their lands and/or ponds into prawn farms. Subsequently, it spread throughout other parts of Dinajpur district especially at Parbatipur upazila. Prawn farming has been expanding rapidly in recent years, at an average of 10% per annum, due to higher economic returns, and most farmers consider prawn farming to be more profitable than agriculture [4]. While there is great potential for increasing family incomes through engaging in prawn cultivation, a number of factors might contribute to the vulnerability of prawn farmers. These could include increase production costs, poor institutional support and inadequate extension services [5]. With this view, it is essential to the development and management of a farm to know the production costs and their evolution, and to determine where cost reduction can be achieved. Production cost data also help the farmers in decision making and in adjusting to changes, and determine the price level under which the product cannot be sold without losses.

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Therefore, a careful investigation of the economics of prawn farming would benefit both producers and policy makers. Considering the above facts, the investigation was carried out to assess the present status of freshwater prawn farming in Dinajpur district and to identify the constraints and problems of prawn farming.

Materials and Methods
Study Area and Duration
The study was conducted in some selected areas of Dinajpur district of Bangladesh (Fig 1), and the duration was one year from September 2019 to August 2020.
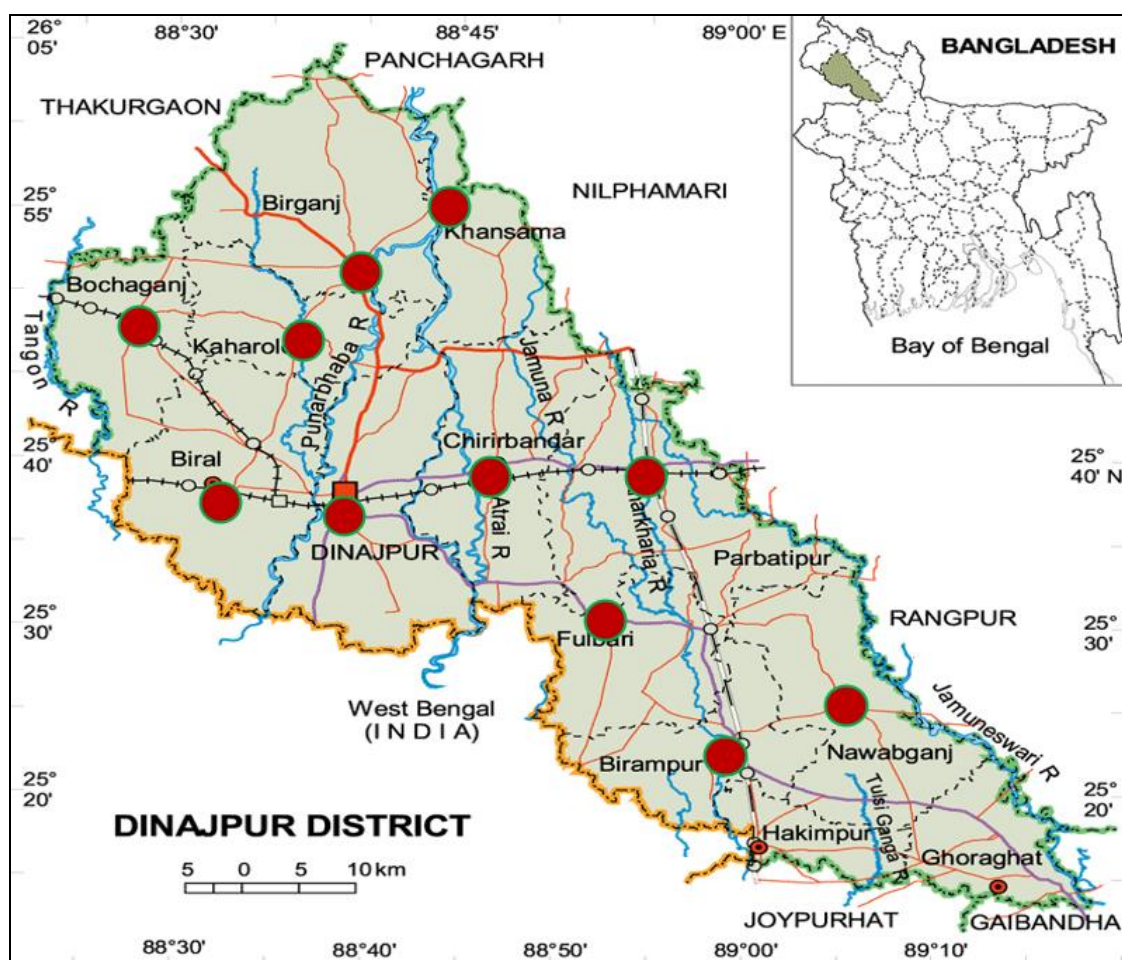

Fig 1: Map of Dinajpur district showing the study areas

Preparation of the Survey Schedule and Questionnaire
A questionnaire was prepared with the intention of getting a complete picture of the present status of freshwater prawn farming in the selected areas. The questionnaire was developed in a logical sequence so that the target group could answer chronologically. Questions related to the prawn farmers, their prawn farming status, water quality, species cultured, feeds used, marketing related information etc. were included in the questionnaire.

Data Collection
Data were collected both from primary and secondary sources. Primary data were collected through direct interview with 56 respondents. It was quite difficult to collect data as the farmers did not keep any written records on prawn culture

activities, and the data they provided were mostly from their memory. Therefore, it is necessary to verify the collected data. Since there were no other alternatives, the accuracy of the primary data were verified by the secondary sources such as different literatures, statistical data from district fisheries office (DFO), upazilla fisheries offices (UFOs) etc. For ensuring the collection of reasonable accurate information from the field, all possible efforts were taken.

After completing the interview, the collected information was checked carefully before leaving the study area and other confusion arisen was rationalized and corrected by the help of the respondents. An arrangement of questionnaire interview, Participatory Rural Appraisal (PRA) tool such as Focus Group Discussion (FGD) and cross-check interviews with key informants were used for prawn farmers (Fig 2).
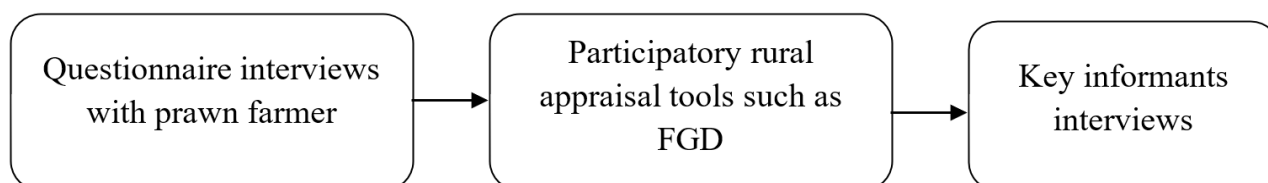

Fig 2: Steps of data collection from the respondents

Questionnaire Interview

Before starting primary data collection, the draft questionnaire was tested with 10 prawn farmers. Then the questionnaire was modified and rearranged according to the experiences gathered in the trial. The respondents were selected using simple random sampling method. The information was collected at home and farms sites.

Focus Group Discussion (FGD)

During the study, FGD was used to acquire outline particular issues such as existing prawn and fish composition in case of polyculture, fishing systems, management of the feeding system in the pond and also feeds used as well as marketing related information of prawn, socio-economic conditions of farmers etc. Including 3-5 farmer comprises an FGD sessions and a total of two (FGD) sessions were conducted in the selected areas.

Cross-Check Interview

It was quite indispensable to check the information for justification of the collected data, after completing the collection of the data through questionnaire interviews and FGDs. The information was collected from key informants if there were any items incongruous. In some cases cross-check interviews were conducted with key person in the selected areas such as Upazila Fisheries Officers (UFOs), District Fisheries Officer (DFO), school teachers, local leaders etc. NGO workers wherever information was opposing or demanded for additional measurement. For this purposes the interviews of the key respondents were conducted in their office during office hour or in houses.

Summarizing, Tabulating and Checking Reliability of Data

After collection of data from the field, the data were recorded in an Excel master sheet. Actual tabulation work was started, after completion of the pre-tabulation task. On the basis of aims and objectives of the study, a number of tables were prepared. Lastly, tabulated data were analyzed and condensed by using averages, percentages etc. to obtain the results.

Processing and Analysis of Data

The collected data were coded, summarized and processed. All possible errors and inconsistencies were eradicated for verification. Then the collected data were analyzed with a computer based software-Statistical Package for Social Sciences (SPSS), Version 22, and MS-Excel (Microsoft excel 2010) was used for preparing the tables and graphs.

Results and Discussion

Education has great impact on prawn farming because educated people are more positive in adapting with new species farming than the uneducated people. Annual family income has a direct impact on freshwater prawn farming because costs of seed and feeding of prawn are higher than the other fishes. Therefore, preparing personal profile of the respondents, prawn culturing profile, feed and feeding profile of prawn and marketing profile are important to create and explain the possible relationships among different variables.

Age Group

In the study areas, the highest number of farmers (44.64%)

belonged to the age group of 31-40 years, while only 1.79% farmers belonged to the age group 21-30 years (Fig 3). Different factors of the farmers like age, education levels, economic condition etc. greatly influence the adoption of any occupation or technology. Understanding of the age structure of prawn farmers is significant in estimating potential creative human resources. Adequate data relevant to age structures is required for planning of education, health and employment generation. The age distribution of prawn farmers has a vital influence on labor and also on their opinions of the future. Majority of the prawn farmers (94.64%) were male, and belong to the age group of 31-40 years. Acording to Reza *et al.* [6], majority of the farmers in Dinajpur district were 31-45 years old which is somewhat relevant to the present findings. Due to personal choice, ease of operation, physical capabilities and social interactions among the fish farmers, differential participation of various age-grouped prawn farmers appeared in the study areas.
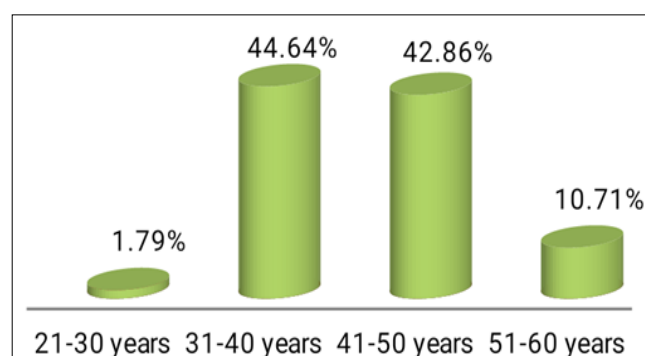

Fig 3: A graphical presentation of age distribution of prawn farmers

Gender

Participation of women in prawn farming in the research areas was very low (5.36%) comparing to the male participants (94.64%) (Fig 4).
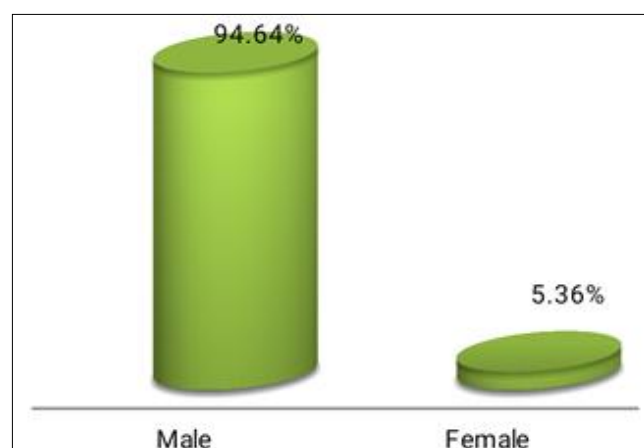

Fig 4: A graphical presentation of genders of the prawn farmers

Educational Status

Majority of the prawn farmers had primary level of education (64.28%), followed by can sign only (14.29%), secondary (10.71%), higher secondary (5.36%), and graduate (3.57%) levels. The number of illiterate farmers was negligible (1.79%) (Fig 5). It is quite interesting that graduates are taking interest in prawn culture practices recently.
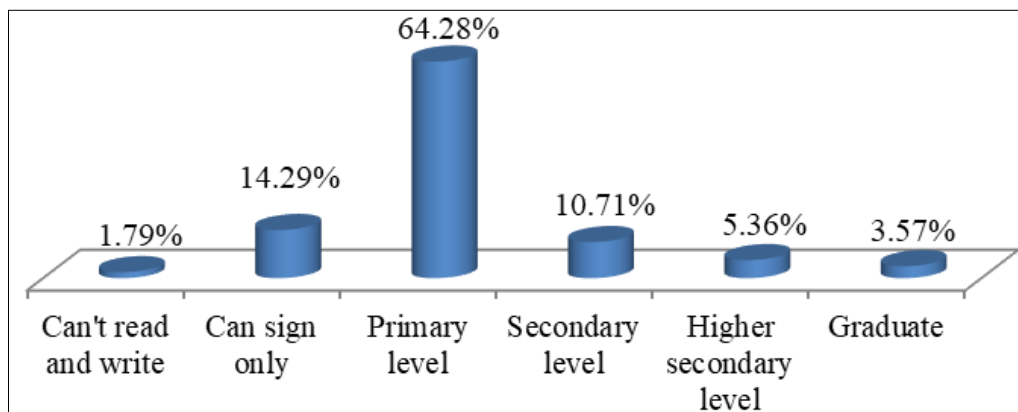
Fig 5: A graphical presentation of educational status of the prawn farmers

Annual Income
Employment and income are the factors mostly used for determining the living standard of any community or area in general. Reasonable distribution of income further improves the social synchronization among different classes of a population in a region. It was found that annual income of prawn farmers varied from below Tk. 50,000 to more than Tk. 200,000, and the highest percentage of prawn farmers (41.07%) earned from Tk. 50,000 to 100,000 in the investigation areas (Fig 6). This low level of income reflects their poor economic conditions, which was not sufficient to maintain their normal livelihood. At the same time, they cannot afford much for prawn culture activities. The average annual income of the one third of the respondents (34%) was found between Tk. 75,000 and 100,000 [7], which is more or less similar to the findings of the present study.
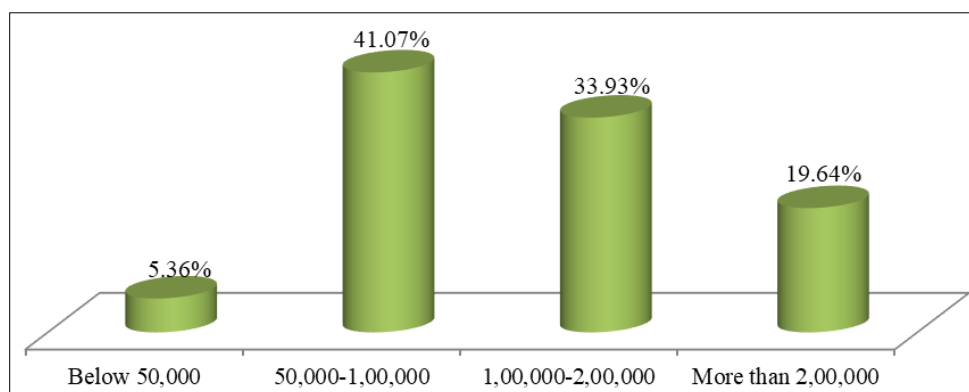

Fig 6: A graphical presentation of annual income of the prawn farmers

Culture Related Information
Farm Type
The study showed that absolute majority of the farmers cultured prawn in ponds (94.64%), a very little portion of the respondents (5.36%) cultured in rice fields (Fig 7). Farming of the freshwater prawn in rice fields was widespread in southwest Bangladesh [8], the technology was not structured to address the food security goal of smallholders and, therefore, it was adopted by only those who were better placed to assume the risks [9] which may be a major reason for minimal rice-prawn integrated culture in the study area.
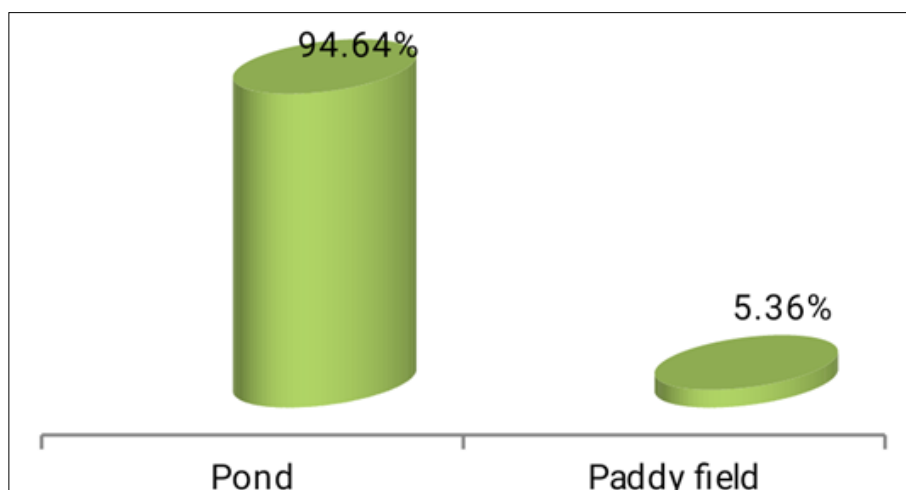

Fig 7: A graphical presentation of farm type observed in the study areas

Farm Size and Depth

In the present study, it was found that pond areas of over half of the respondents (51.78%) were less than 0.50 acre, where minimum size was found to be 0.10 acre; some (33.93%) were 0.5-1.0 acre and a few (14.29%) were larger than 1.0 acre (Table 1). According to Hossen *et al.* [10], the average pond size in Barisal district was 0.12 ha which can relate to the present findings. The average depth of ponds in the study area was 1.52 m which is almost similar to the findings of DoF [11].

Table 1: Farm Size of the respondents in the study areas

Farm size (acre)	No. of Respondents	Respondents (%)
< 0.5	29	51.78
0.5-1.0	19	33.93
> 1.0	8	14.29
Total	56	100

Water Sources

The study showed about 35.71% of the prawn farmers used ground water, on the other hand, 51.79% of the farmers were depended both on the ground and rain water, and 12.5% of the farmers relied solely on the rain water (Fig 8). The provision of clean and safe water considered to be the most valued element in the pond aquaculture. For prawn growth and survival, good water source was undoubtedly becomes a prerequisite. Water quality also plays a significant role in the culture of fish and other aquatic organisms. Shirazy [12] found that soil of Dinajpur district possesses sandy properties and water retention capacity of the soil is very poor especially in dry season. For that reasons fish farmer used shallow tube well to supply water in fish ponds. Ground water was used by 55% of the fish farmers; on the other hand, 35.80% and 9.20% farmers were depended on the rain water and surface water [13], respectively.
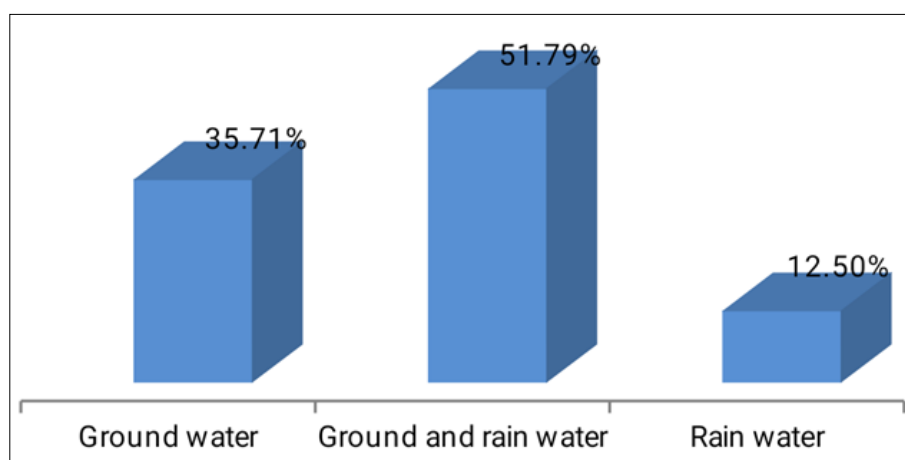

Fig 8: A graphical presentation of water supply in prawn farms

Culture Systems

Although all the farmers (100%) in the selected areas adopted polyculture systems, most of them did not follow any scientific combination of the species. It was observed that freshwater prawn (*M. rosenbergii*) was stocked with rohu (*Labeo rohita*), catla (*Gibelion catla*), mrigal (*Cirrhinus cirrhosus*), silver carp (*Hypophthalmichthys molitrix*), grass carp (*Ctenopharyngodon idella*), common carp (*Cyprinus carpio*), sarputi (*Puntius sarana*), bighead carp (*Hypophthalmichthys nobilis*), tilapia (*Tilapia mossambicus*) etc. A study by Rahman [14] found that almost all the farmers carried out polyculture system which is similar to the present study. The species have a well-defined spatial distribution in

the environment due to benthic habitat, thus favoring interaction with various species of fish, other animals, and even with plants [15].

Stocking Density of Prawn PL

Number of prawn PL stocked in ponds or paddy fields was classified into four categories. Just over half of the respondents (51.79%) released 101-500 prawn PL per acre, followed by 28.57, 12.50 and 7.14% respondents stocked 501-1000, >1000, and <100 prawn PL per acre, respectively (Fig 9). Most of the farmers (67.86%) reared prawn for 4-8 months (Table 2).
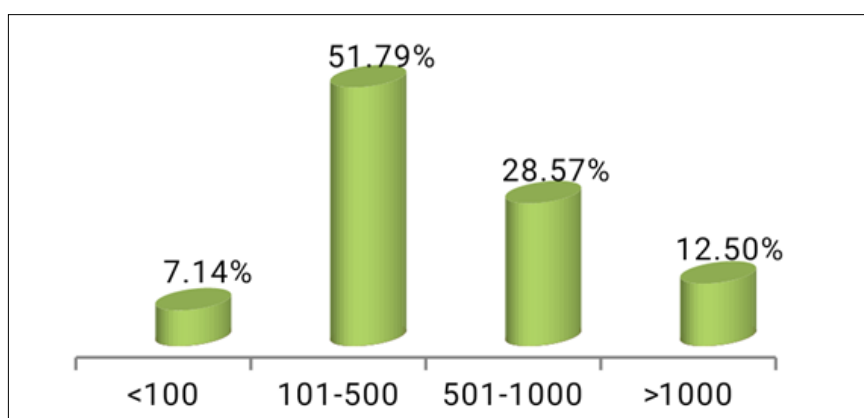

Fig 9: A graphical presentation of stocking density of prawn PL cultured per acre

Table 2: Duration of prawn culture in the study areas

Culture duration (month)	No. of respondents	Respondents (%)
< 4	7	12.5
4-8	38	67.86
> 8	11	19.64
Total	56	100

Feed Related Information
Feeds Applied by Prawn Farmers
According to the study, 100% prawn farmers used different type of fish feeds in their ponds in the selected areas. It was found that farm made feeds were used by 41.07% farmers followed by 30.36 and 28.57% respondents applied commercial feed (prepared using rice bran, rice flour, maize bran, maize flour, wheat bran, wheat flour, mustard oil cake etc.) and both farm made and commercial feeds, respectively (Fig 10).
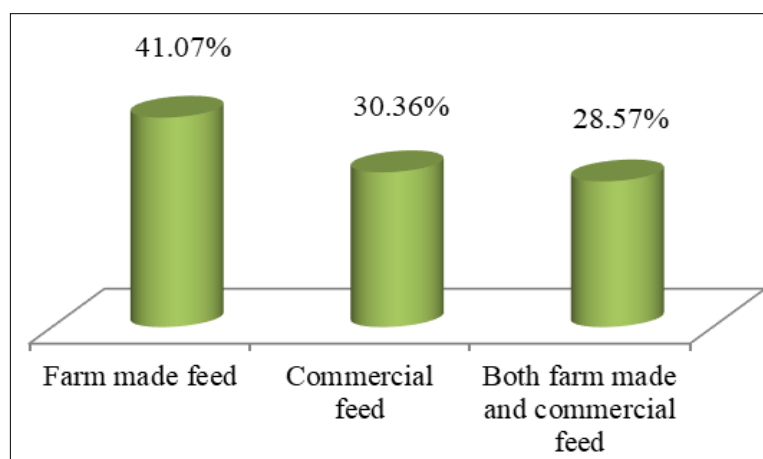
Fig 10: A graphical presentation of fish feed types applied by the farmers

Commercial Feeds Types
The study indicate that 69.64% fish farmers used floating feeds, on the other hand, 17.86% provided sinking feeds and only 12.50% used both floating and sinking feeds to the cultured species (Table 3).

Table 3: Types of commercial feeds in the selected areas

Feed types category	No. of respondents	% of respondents
Floating	39	69.64
Sinking	10	17.86
Both floating and sinking	7	12.50
Total	56	100

Feeding Frequencies
Approximately 53.57% of the prawn farmers supplied feeds in their ponds two times in a day; on the other hand, 42.86% gave once in a day and only 3.57% applied three times in a day (Fig 11). It was found that 100% of the prawn farmers delivered feeds to the culture systems by manual methods.
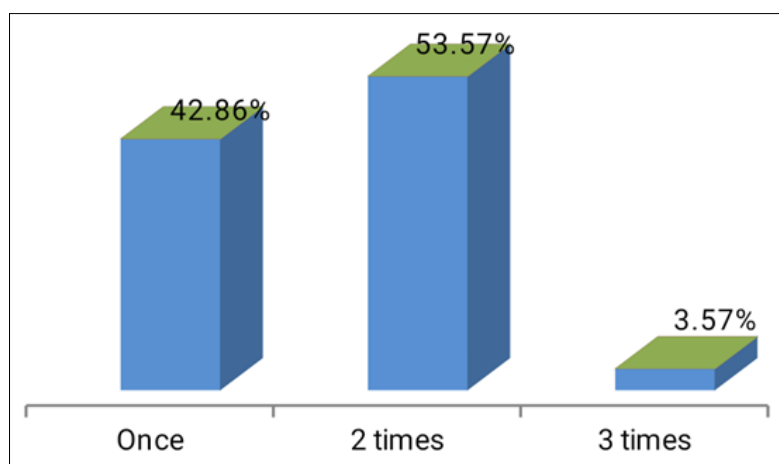
Fig 11: A graphical presentation of feeding frequencies of fish

Storage Condition of Feeds

Half of the respondents (50.98%) had *'kacha'* rooms for feed storage; whereas 19.61% had *'pakka'* room, 31.37% had 'semi-pakka' room (Fig 12). This reflects the poor storage condition of the feed in the study area because `*kacha'* rooms causes several problems that deteriorate the fish feed.
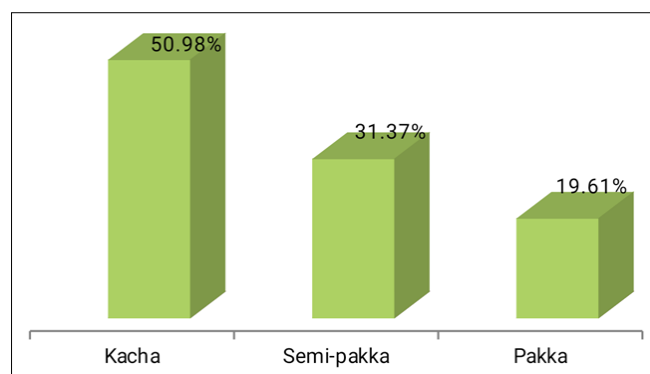

Fig 12: A graphical presentation of storage condition of feed in the study areas

According to the study, 100% prawn farmers used different type of fish feeds in their ponds in the selected areas. Similar results were observed by Kundu [16]. In this study, it was found that 41.07% farmers used farm made feeds; on the other hand, 30.36% used commercial feeds prepared with rice bran, rice flour, maize bran, maize flour, wheat bran, wheat flour, mustard oil cake etc. and the rest 28.57% farmers used both farm made and commercial feeds for the cultured species. Eighty percent of the farmers applied supplementary feed prepared with rice bran and mustard oil cake [17]. Another finding reported by Jahan *et al.* [13] stated that farmers used fish feed such as mustard oil cake, rice bran, wheat bran, fish meal, soy bean meal etc. in their farms. Similar findings were also reported by Islam [18] and Biswas [19].

Problems Encountered During Data Collection

A number of problems were encountered during data collection such as business and unwillingness of the farmers. Some farmers might think that the researcher could be from taxation or other government departments and ultimately some of them got afraid and not willing to supply the real information and hiding tendency was observed among some farmers. Language and communication was also a little barrier for data collection because they use their local names and terminologies for prawn and culture systems. However, the above problems were overcome tactfully and real information was collected as far as possible for the sake of a successful investigation.

Prawn Culture Problems

According to the present study, 44.64% farmers reported financial problems as the single most important problem for prawn culture. The respondents identified social problems (25%), technical problems (21.43%) to be the other important problems. Lack of money, higher production cost, lower market price etc. were the financial problems. Among the social problems theft, poisoning and multiple pond ownership were of great importance and the technical problems might include lack of availability of seed, lack of technical knowledge, lack of awareness of prawn production technology etc. It was found that no farmers had icing facilities during transportation of prawn to the market.

Almost half of the respondents had financial problems in the selected areas. Lack of capital is the most common problem [20], which had a similarity with the present study. On the other hand, lack of technical knowledge was the major problem for the fish farmers [21]. Inbreeding problems, lack of quality seed, inadequate technical knowledge on scientific aquaculture, incidence of fish disease, poor credit facilities, security, marketing, multiple ownership and lack of feed were identified as the important constraints by Robbani [22].
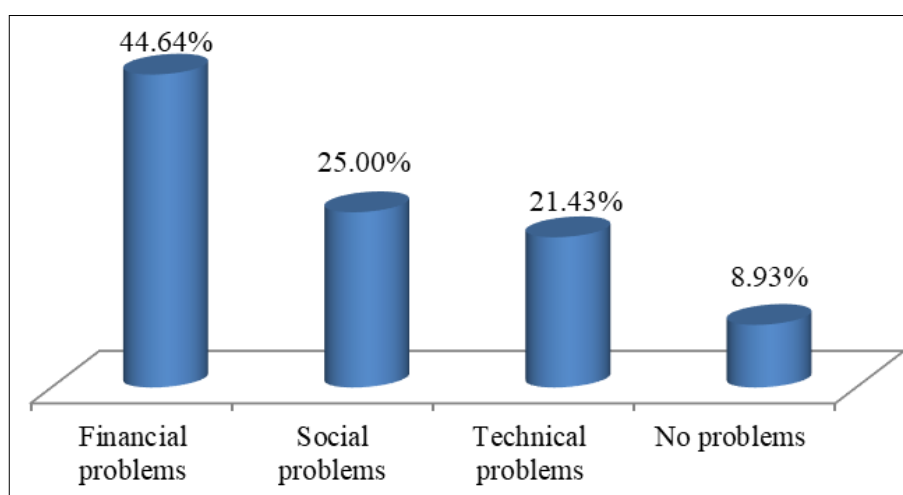

Fig 13: A graphical presentation of prawn culture problems in the study areas

According to the study only 16.07% of the farmers had faced constraints during marketing and selling of the prawn, on the other hand 83.93% of the farmers did not face any constrains (Fig 13). In prawn farming, a key task is the installation of prawn seed in ponds. The availability of prawn seed is an important factor because there is lack of number of prawn hatchery in the study area. Besides the availability of prawn post larvae (PL) was very limited in the study areas. In 2017-18, there were 46 *M. rosenbergii* (*golda chingri*) hatcheries in Bangladesh and approximately 521 lac PL were produced in these hatcheries. However, most of the hatcheries were located at Cox's Bazaar and Khulna regions of Bangladesh [23]. Therefore, the unavailability of post larvae was a major problem of prawn farming in the selected areas.

Conclusion

Freshwater prawn (*M. rosenbergii*) culture is very important in the economy of Bangladesh because of its high market demand and price, and suitability to stock with other commercially important fish species. Although prawn farming is widely practiced in southern region of Bangladesh, it is not so popular with the farmers of the northern region of the country. However, people are adopting it day by day. The main constraint to the cultivation of the species is the availability of seeds, in spite of that northern region becoming a favorable place because of the topographical advantages of agricultural lands and suitable water sources, both rain and ground water. As there is lack of knowledge on prawn farming in rice fields and ponds, proper training and technical support should be provided with the farmers, with increased awareness, for the success and sustainability of the culture technology. The Government should take necessary steps to solve the constraints for the enhancement of prawn production as well as revenue of the country.

Acknowledgements

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