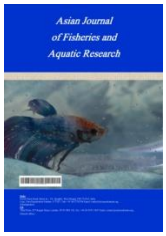

Asian Journal of Fisheries and Aquatic Research

17(5): 32-48, 2022; Article no.AJFAR.87771
ISSN: 2582-3760

Carp Fattening and Socio-economic Status of Farmers of Dinajpur District, Bangladesh: An Expedient Overview

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/AJFAR/2022/v17i530417

Open Peer Review History:
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://www.sdiarticle5.com/review-history/87771

Original Research Article

Received 20 March 2022
Accepted 30 May 2022
Published 02 June 2022

ABSTRACT

A Survey work was designed to explore the present status of carp fattening and socio-economic standing of the fish farmers of three upazillas of Dinajpur district such as Dinajpur Sadar, Parbatipur, and Birampur, and was continued until June 2021 from July 2020. Several methodological tools, including participatory rural appraisal (PRA) and primarily a questionnaire survey were used to collect data from 59 fish farmers. The majority of the farmers were between the ages of 41–50, where 45% of them had four to five family members, representing 71.19% nuclear and 28.81% joint families. Large number of the farmers (28.81%) could only sign their names. Approximately 81.35% were Muslims and 18.65% belonged to the Hindus where near about half of the farmers' (47.46%) annual income were in between BDT 1,00,001-2,0,000. *Paka* sanitary was utilized by 49.15% respondents. All the farmers drank from tube wells and had access to electricity. The typical pond size was 0.31-40 ha (27.12%), with an average depth of 1.7 m. Farmers owned 59.33% of the ponds, on the other hand, 40.67% were leased ponds and 79.66% had the provision of groundwater for cultivation; however, 50.84% exchanged water whenever required. About 57.63% prepared the ponds and applied 123.5 kg/ha of salt, 12.35-44.5 kg/ha of TSP, and 12.35-75.25 kg/ha of urea. To boost carp growth, 83.08% employed availed growth promoters. Indian major carp and exotic carp were considered for this purpose and have had only fish lice as a constraint throughout the nine to ten months of cultivation period. Commercial feeds were utilized by 40.68% farmers and 81.35% maintained a feeding frequency of two times a day.

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Majority of them (72.89%) sold live fishes. Lack of scientific knowledge, shortage of high-quality seeds and feeds, lack of funds, and lack of marketing facilities were found to be the main obstructions.

Keywords: Aquaculture; carp fattening; survey; Dinajpur District; Bangladesh.

1. INTRODUCTION

Fish is the second most valuable agricultural produce in Bangladesh, and its production contributes to the livelihoods and employment of millions of people all over the globe. Bangladesh ranked 3rd in inland open water capture production and 5th in world aquaculture production [1]. GDP growth rate in the fisheries sector is 5.74%. The fisheries sector contributes 3.57% to the national GDP and 26.50% to the agricultural GDP of the country. As a result of the implementation of fisheries-friendly activities of the government and the provision of demand-based and appropriate technical services at the farmer and entrepreneurial levels, fish production has increased to 45.03 lakh MT in the Fiscal Year (FY) 2019-20, which is 27% more than the total production (35.48 lakh MT) in FY 2013-14. It mentioned that the total fish production in the country was 7.54 lakh MT in FY 1983-84. Fish production has increased more than six times in 37 years [2]. Fish and fisheries have been an indispensable part of the life and livelihood of the country's people since immemorial time [3]. Pond aquaculture represents huge potentiality accounting for 44.43% of the total recorded production and 57.70% of the area under culture and it has the potential to increase further [4]. There are approximately 47.12 million ha inland closed water bodies in Bangladesh, of which 3.98 million ha ponds are suitable for fish culture [5].Therefore, the country has huge potential for freshwater aquaculture; this potential cannot be fully utilized for various reasons [3].

The potentiality of carp polyculture is beyond the reach to be sustainable due to climate change which makes the fisheries and aquaculture sectors of Bangladesh vulnerable to environmental degradation in various magnitudes, such as groundwater sinking and contamination through pollutants etc. [6]. Fisher folks are considered one of the most backward sections in our society. Information on the socio-economic framework of the fish farmers forms a good base for planning and development of the economically backward sector. The lack of adequate and authentic information on the socio-economic conditions of the target population is one of the serious impediments to the successful implementation of the developmental program [7]. Dominating species for pond aquaculture are Indian major carps and exotic carps [8].

Dinajpur district is situated at a higher level from the Bay of Bengal and the dry part of Bangladesh [9] where the total fish production in pond culture was 48170 MT [10]. The farmers of Dinajpur are facing problems of scarcity of water throughout the year except the monsoon season [9]. Fattening is a popular technique to increase biomass in animal rearing and this practice is often followed for the production of beef cattle [11] and crab [12] in Bangladesh. Stocking of overwintered and larger size fish species in carp fattening is considered beneficial to mitigate the fish culture problem of lower water columns under drought-prone Barind areas, because overwintering is a proven technique to obtain the fast growth of fish [13,14] and larger stocking size under lower density can help to get maximum fish biomass within a shorter period of time [15]. There are some research efforts to mitigate the low alkalinity and high turbidity problems and to use the larger stocking size of fish than traditional practice [16] to increase fish production in carp polyculture ponds under the Barind area.

Meanwhile, some aquafarmers improved the traditional carp polyculture system into carp fattening technology. This approach has enhanced output than that of the traditional systems. Most of the species cultured in carp fattening are rui, catla, mrigal, silver carp, mirror carp, grass carp, pangasius, tilapia etc. These species are popular with the Bangladeshis and have high market value. Both small- and large-scale aquaculture are being practiced in rural Bangladesh. Small-scale aquaculture is becoming more popular day-by-day because of its low investment and high production rate. There are huge scopes to convert small scale aquaculture practices into carp fattening system to increase carp production in the country. However, the socio-economic conditions of the farmers are not so good, which is the driving force of fish culture as it is a capital intensive venture. Many different social, financial and

technical problems are the main constraints to aquaculture. However, its success largely depends on the extension activities provided by different government and non-government organizations. Therefore, the research investigation was implemented to assess the present status of carp fattening, and to mark out the socio-economic status of the farmers as well as social and technical problems associated with carp fattening technology in Dinajpur district of Bangladesh.

2. MATERIALS AND METHODS

2.1 Study Period

The survey was conducted for a period of one year from July 2020 to June 2021. Frequent field visits were conducted to collect the data from the fish farmers of the selected upazilas of Dinajpur district.

2.2 Selection of Study Area

The study was conducted in three upazilas of Dinajpur district, namely Dinajpur Sadar, Parbatipur, and Birampur. The study area is located in between 25°10' and 26°04' north latitudes and in between 88°23' and 89°18' east longitudes (Fig. 1).

2.3 Collection of Data

2.3.1 Questionnaire survey

The present study collected data through the questionnaire interview and participatory rural appraisal (PRA) from fish farmers. For the questionnaire interview, a set of preliminary questionnaires was prepared. For the interview, a simple random sampling method was followed. A total of 59 farmers were interviewed. Before the field survey, background information on the number, location and distribution of fish farms and aquaculture activities was collected.

The questionnaire was divided into several sections. The first section focused on farmers personal information, the second section on-farm information, the third one on culture-related information, the fourth on feed and feeding, and the final section focused on cost analysis.

During the survey, questions were asked systematically and explanations were made wherever necessary. The information supplied by the selected farmers was recorded directly on the interview schedules. To minimize errors, data were collected in local units. These were subsequently converted into appropriate units.

2.3.2 Focus group discussion (FGD)

During this study, FGD was used to acquire particular significant issues such as pond preparation, enhanced natural feed, use fertilizer, fishing systems, management of the feeding system in the pond and also feeds used as well as marketing related information of carp fattening, socio-economic conditions of farmers, etc. Each FGD session was conducted including 8-10 fish farmers and overall two sessions were conducted in each upazila.

2.3.3 Cross-check interview

It was essential to check the information to justify the collected data after completing it through questionnaire interviews and FGDs. In some cases, cross-check interviews were conducted with the key person in the selected areas, such as Upazila Fisheries Officer (UFO), School teachers, local leaders. NGO workers wherever information was opposing or demanded additional measurement.

2.4 Analysis of Data

After collection, data were coded and entered into a computer for analysis. All possible errors and inconsistencies were eradicated for verification of the collected data. The tabular description procedure was mainly used to analyze the collected data. This tabular technique was applied to analyze data using simple statistical tools like averages and percentages. Then the collected data were analyzed, preparing tables and graphs with MS-Excel (Microsoft Excel 2016).

3. RESULTS AND DISCUSSION

3.1 Personal Information of Farmers

This section deals with the farmer's personal information, i.e. age group, sex, religious status, educational status, marital status, size and types of family, annual income, health facilities, sanitary facilities, organizational membership, etc. A total of 59 respondents participated in the survey from three upazilas; Dinajpur Sadar, Parbatipur, and Birampur (Table 1).

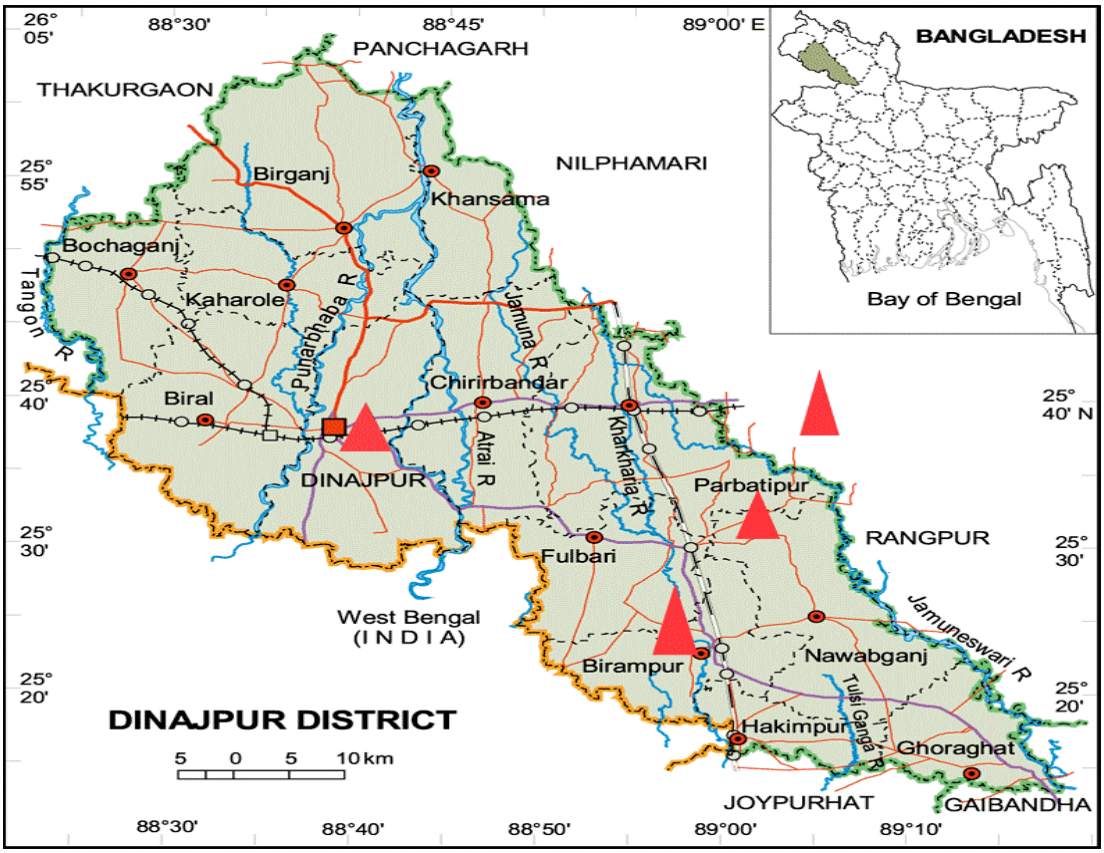


Fig. 1. Map showing selected upazilas in Dinajpur district

3.1.1 Age group

The present study showed that majority of the farmers (35.60%) was between 41 to 50 years of age group; whereas in Sirajgonj district, the farmers were a bit younger (18 to 43 years) than the present study according to Rana [17]. Middle-aged people are generally active, and they are the most productive group in terms of adopting new technologies and making quick decisions (Fig. 2).

3.1.2 Gender

In the survey, among the selected farmers, 89.83% were male and 10.17% were female. This value represents that a deficient number of women participate in this technology of carp fattening (Fig. 3).

3.1.3 Religious status

From the present survey, it was found that 81.35% of fish farmers were Muslims and remaining 18.65 % were Hindus (Fig. 4). The findings resembles to the status in Gazipur district [18].

3.1.4 Educational status

Education has a significant impact on the modernization of farm business operations since it provides a person with up-to-date information about current procedures as well as technological advances in various production processes. The respondents were classified into five categories. It was found that 28.81% can sign names only, 18.65% can't write and read (Fig. 5). The findings made clear that educational status of the representative farmers in this area was not that much improved [19].

3.1.5 Family type

From the study, two types of the family had seen, joint and nuclear. The nuclear family generally presents two-generation and in this survey area, where Fig. 6 shows that 71.19% of families were nuclear and the rest, 28.81% families were joint which is similar to the findings of Alam [20].

Table 1. Number and percentage of respondents participated in the survey

Name of the study area	Respondents (No.)	Respondents (%)
Dinajpur Sadar	16	27.12
Parbatipur	25	42.38
Birampur	18	30.5

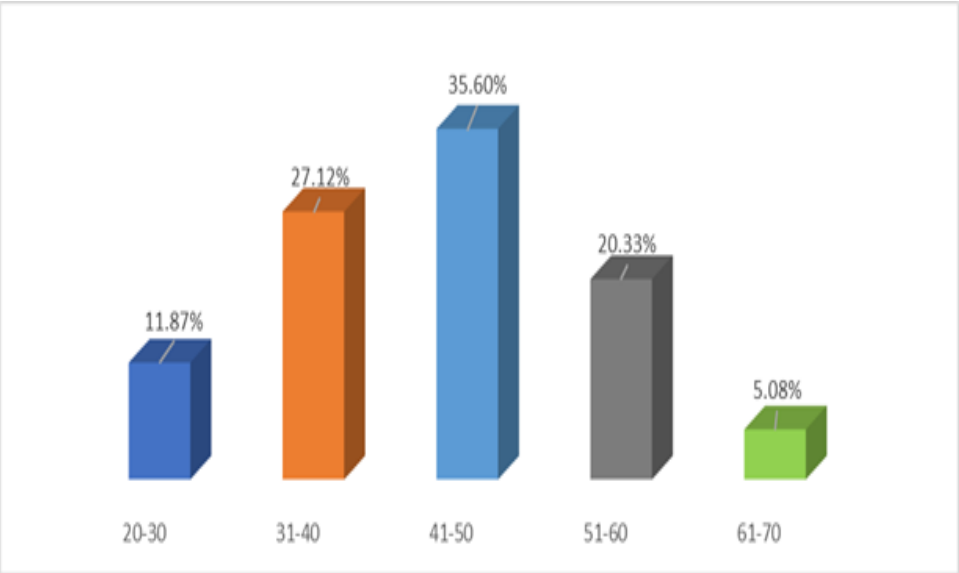


Fig. 2. Age distribution of the selected fish farmers in the study area

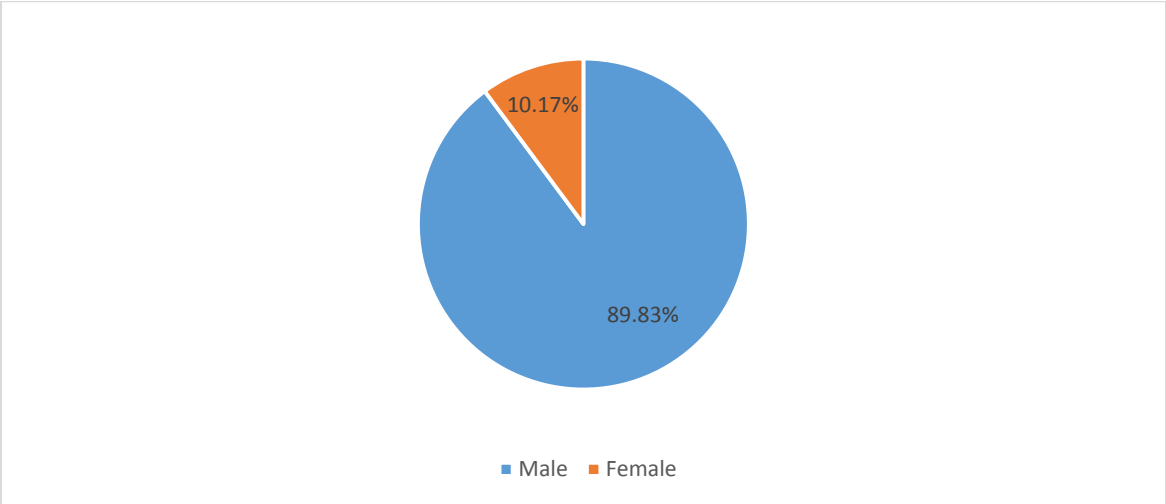


Fig. 3. Gender distribution of farmers

3.1.6 Family Size

The family sizes of the fish farmer were divided into four categories according to the number of the family member. The highest percentage was obtained in the 4 to 5 members family (42.38%) and lowest was above 7 members family which connects to the findings of Ali et al [19]. (Fig. 7).

3.1.7 Annual income of farmers

The selected fish farmers were grouped into five categories based on the level of their annual income. The second category had the highest proportion (47.46%) of farmers while the lowest proportions of farmers (3.39%) were in the fifth category (Table. 2). According to Zafar et al. [9], 46% of farmers' annual income was BDT 1.51-1.8 lac, this relates to the current study.

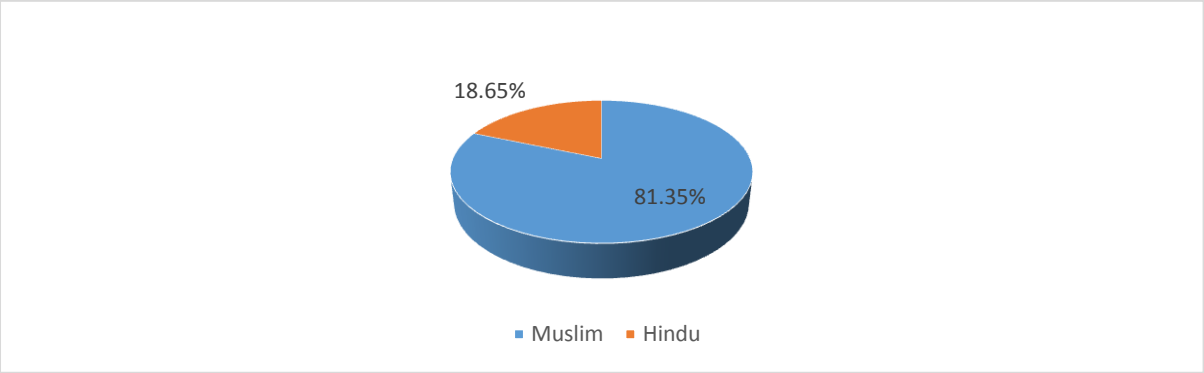


Fig. 4. Religious status of the farmers

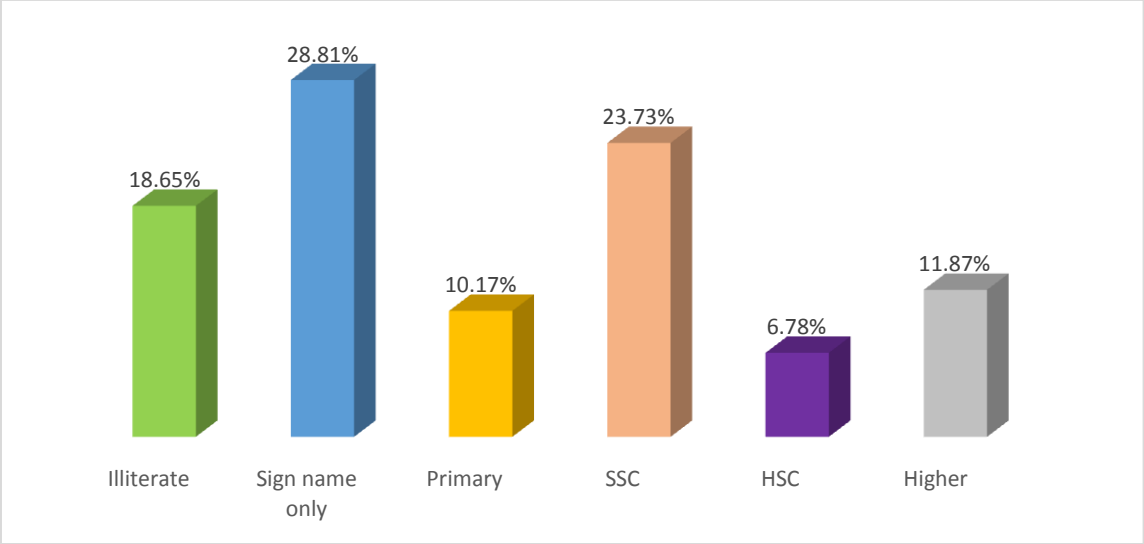


Fig. 5. Educational status of the fish farmers in the study area

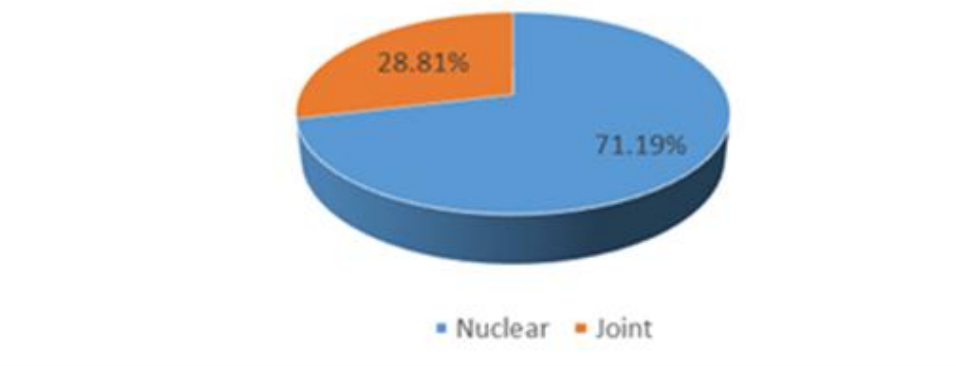


Fig. 6. Family type of fish farmers in the selected area

3.1.8 Drinking water facilities

The provision of clean and safe drinking water is regarded as one of the most valuable aspects of a society. The study showed that 100% of fish farmers household used tube-wells for drinking water [21].

3.1.9 Sanitary facilities

It was observed that all respondents had sanitary facilities. From the survey, it was found that 49.15% of the farmers were used *paka* sanitary, whereas 6.78% of them used *kacha* (Fig. 8). The fish farmers' sanitary conditions were better than those of the rice-fish farmers in Mymensingh district [22].

3.1.10 Electricity facilities

In this digital era, one of the visions of the Bangladesh Government is to provide electricity to every household. All the respondents of the surveyed area had electricity facilities whereas Ali et al.[19] found it to be only 62%.

3.1.11 Organizational membership

From the present study, it was found that 47.446% farmers were member of organization such as MBSK, GBK and 52.54% were not involved with any organization (Table 3). These findings were more or less similar to the findings of Ali et al. [19].

3.2 Farm Related Information

3.2.1 Size of pond

The size of the ponds is an important factor manipulating the use of inputs in the fish pond. The sample ponds were grouped into five categories depending upon their different sizes in the surveyed area. The ponds (27.12%) were dominated by those with a water spread area of 0.31-0.40 ha, (Fig. 9). As per Saha et al. [23] the size of the ponds ranged from 0.05 to 0.15 ha which is lesser than the present reports.

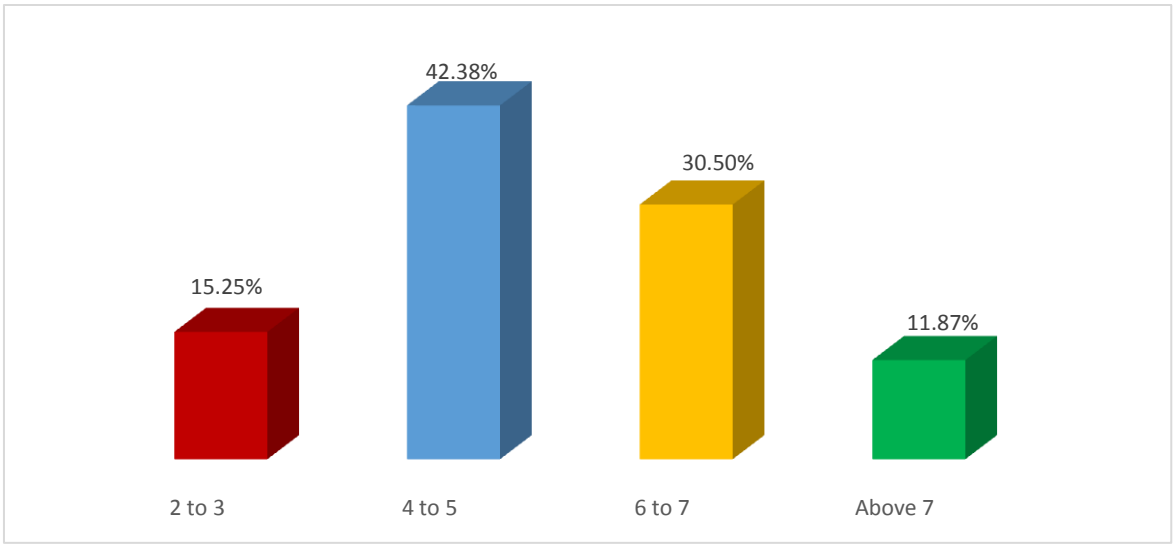


Fig. 7. Family size of farmers in the study area

Table 2. Number and percentage of annual income of the selected fish farmers in the study area

Income Level (BDT)	Respondents (No.)	Respondents (%)
Below-1,00,001	14	23.72
1,00,001-2,00,000	28	47.46
2,00,001-3,00,000	9	15.26
3,00,001-4,00,000	6	10.17
Above 4,00,0000	2	3.39

Table 3. Number and percentage of organizational membership of selected farmers

Organization Name	Respondents (No.)	Respondents (%)
MBSK	8	13.56
GBK	20	33.9
NO	31	52.54

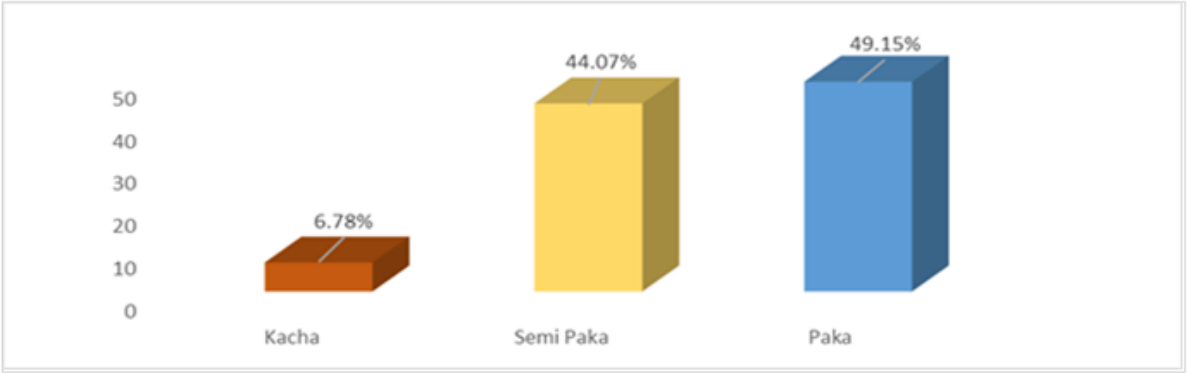


Fig. 8. Sanitary facilities of the selected fish farmers in the study area

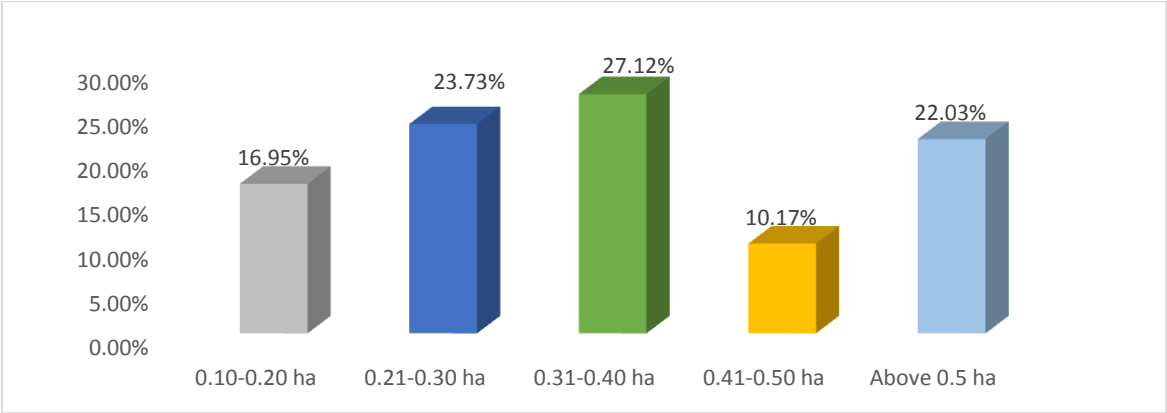


Fig. 9. Pond size of the selected fish farmers in the study area

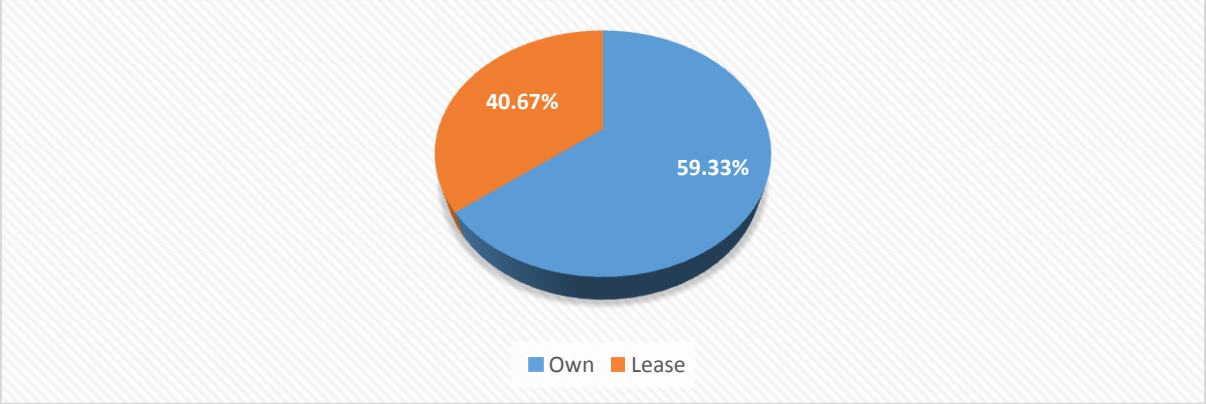


Fig. 10. A graphical presentation of pond ownership of farmers

3.2.2 Pond ownership

According to the study, 59.33% farmers owned their ponds, while 40.67% leased them. And there was 93.22% single ownership and 6.78% multi-ownership (Fig. 10). This statement is confirmed by Pravakar et al. [24].

3.2.3 Average depth

It was observed that the average water depth of ponds were 1.7 m, whereas 50.85% were within 1.82-2.13 m and 49.15% ponds were 1.21-1.52 m (Fig. 11). This statement was afirmed by Jahan et al. [25].

3.2.4 Water source

The water capacity of the pond is meager. In the selected study area, 79.66% of farmers used ground water and the rest of 20.34% used surface water whereas Ahmed [26] found it to be 55 % only (Fig. 12).

3.2.5 Water exchange

In was observed that, 45.76% of the farmers do not exchange water. Among them, 50.84% exchange water when required, 1.69% weakly and 1.69% on monthly (Fig. 13). These findings were a bit different from that of Ali et al. [27].

3.3 Culture Related Information

3.3.1 Pond preparation

The selected farmers followed semi-intensive culture system for carp fattening. Before culture, 57.63% of farmers prepared their ponds. Among them, 26.47% farmer prepared dike, 97% cleaning weed, liming and rotenone used 94.12% and 52.95%. Very few farmers, about 14.70%, were drying their pond before culture where 42.37% did not prepare their pond before culture (Table 4). The guidelines for good aquaculture practice aspects were followed after [3].

3.3.2 Use of lime

All the participants of the study area used lime. The amount of lime varies with the duration and condition of water in the pond (Table 5).

3.3.3 Salt

Salt is used to treat bacterial gill infections, controlling many external parasites, protects from fungus spores in water and relieve stress during handling and transport. In the winter season, they used it. 123.5 kg/ha salt used one-month interval.

3.3.4 Triple super phosphate (TSP)

TSP was used in 12.35-44.5 kg/ha in seven days intervals. Keep the TSP into the water with an oilcake and use urea before serving where Hossain et al. [28] stated it to be 635 kg/ha/month) to enhance the natural feed.

3.3.5 Urea

To increase pond carrying capacity, off-farm inputs such as chemical fertilizers and supplementary feeds are required. So that vast amounts of nitrogen (urea) are used to increase the growth of fish during the short period. The farmers in the selected study areas used urea 12.35-75.25 kg/ha in a seven days interval.

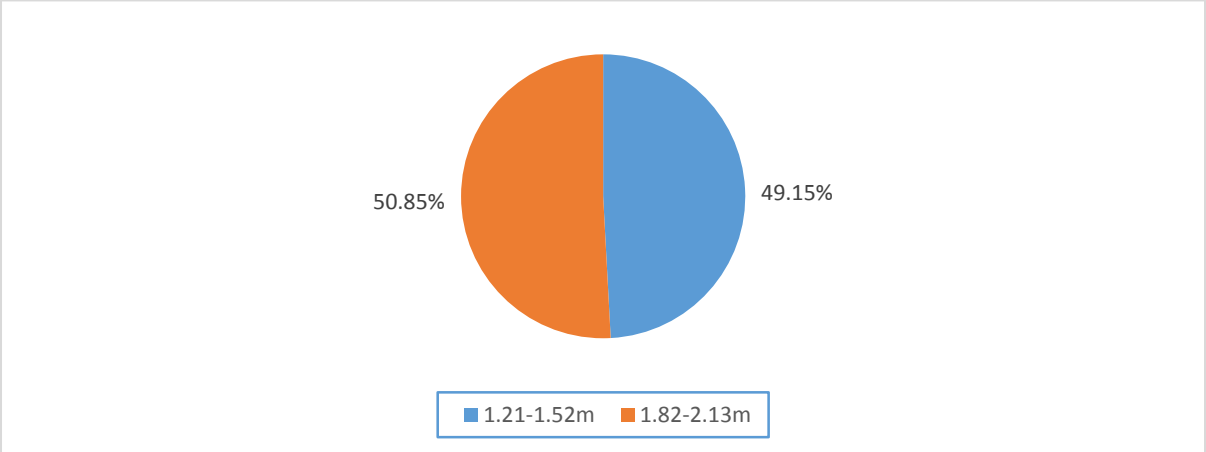


Fig. 11. Average depth of ponds in the selected areas

Table 4. Preparation of pond before carp fattening

Respondents (%)		
Yes (57.63)		
Dike	26.47	
Weed cleaning	97	
Liming	94.12	No (42.37)
Rotenone	52.95	
Drying	14.70	

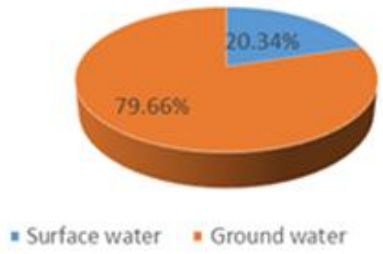


Fig. 12. A graphical presentation of water source of farmers

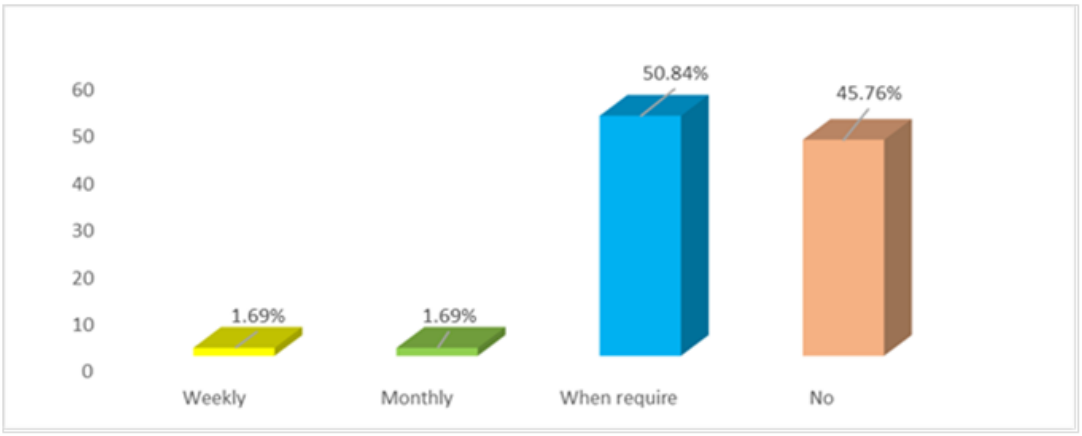


Fig. 13. Water exchange by fish farmers of the selected areas

Table 5. Use of lime in carp fattening ponds

Amount (kg/ha)	Interval (days)	Respondents (No.)	Respondents (%)
123.5	30	26	44.07
61.75	15	14	23.74
49.4	15	10	16.94
Required amount	When required	9	15.25

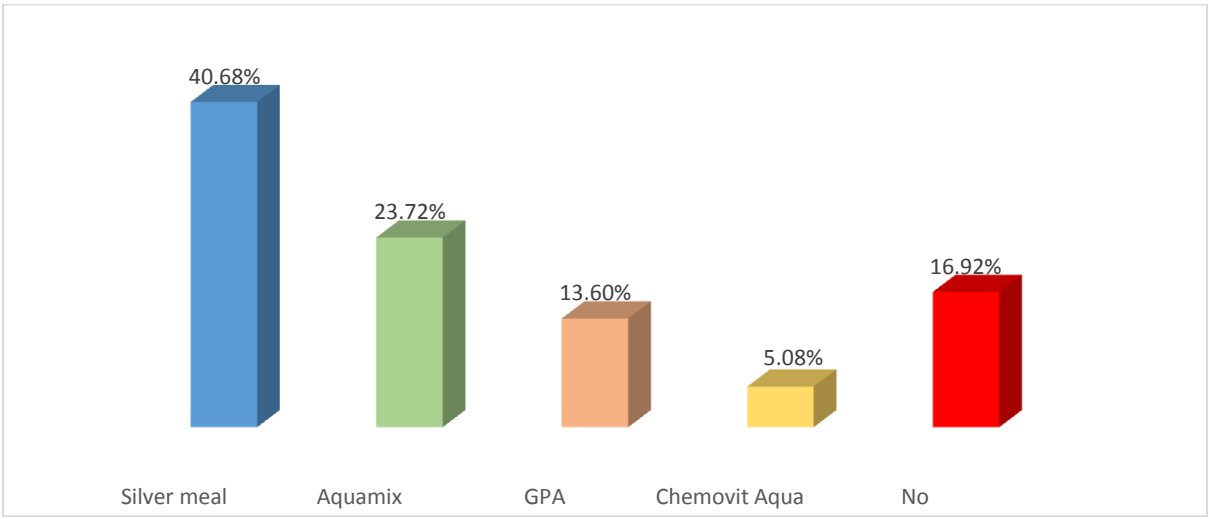


Fig. 14. Growth promotor used by farmers of the selected areas

3.3.6 Growth promotor

Growth promoters were chemical and biological substances which were added to fish's food with the aim to improve the growth of fishes. G.P.A, Aquamix, Cemovit, at a dose of 7-8 g/kg feed and Silver meal 2 ml/kg was used by the farmers, 40.16% was used Silver meal, GPA - 13.60%, Aquamix - 23.72% and Chemovit - 5.08%. And 16.92% used no growth promotor (Fig. 14).

3.3.7 Species

Species selection for carp fattening based on diversified feeding habits, including surface, column and bottom feeder fish species. Catla (*Catla catla*), mrigal (*Cirrhinus cirrhosis*), rui (*Labeo rohita*), grass carp (*Ctenopharyngodon idella)*, bighead (*Hypophthalmichthys nobilis)*, silver carp (*Hypophthalmichthys molitrix)*, mirror carp (*Cyprinus carpio)* were considered for carp fattening. With these species, some farmers culture tilapia (*Oreochromis niloticus)*, pangas (*Pangasius pangasius)* as well as shing (*Heteropneustes fossilis)* which is encouraged by Bhanu et al*.* [29] and Azad et al. [30]

3.3.8 Density

Farmers in the study area maintained fish density by utilizing sufficient natural food and allowing fish to move freely. Fish were stocked based on feeding habits and the objective of proper feed use (Table 6).

3.3.9 Weight of species

Farmers considered a variety weight of fish seed for culture. It is believed that large size seeds grow up more rapidly than others (Table 7).

3.3.10 Price of seed

The price of carp seed varied from farmer to farmer. Generally, it fluctuates due to availability, season and location (Table 8).

3.3.11 Disease

The survey found that among 59 respondents, 51 respondents faced the lice problem. Few farmers, only four, said about bacterial and fungal disease problems. For bacterial disease, they use Chemistpro, Pond Care (S.K.F.). Thiovit (Syngenta) was used for fungal infection. After one month of stocking, they used medicine at 500ml/ha at a 15 days interval to control lice. A significant portion of the study areas farmers at 55.93% used Killer Argulouse (Anjum), Deltrix (Fishtech) used 25.42% and 6.78% Sumithion (Fig. 15).

3.3.12 Problems

Most of the farmers of the survey areas were facing technical and social problems. The main problems are lack of capital, high price of quality fish seeds and feeds, less protein in feed, poor technical knowledge, lack of social awareness etc. It was observed that 89.83% of farmers of

Table 6. Stocking density of fish in the selected study area

Species	Feeding habit	Density/ha
Catla	Surface feeder	247-494
Silver	Surface feeder	124-247
Grass carp	Surface, column and marginal	247-494
Bighead	Surface feeder	124-247
Rui	Column feeder	494-980
Mrigal	Bottom feeder	494-1100
Mirror carp	Bottom feeder	247-770

Table 7. Weight of fish seed considered for culture

Fish species	Weight (g)
Rui	250-500
Mrigal	250-500
Catla	500-1000
Silver	350-500
Bighead	350-500
Grass carp	350-1000
Mirror carp	250-350

Table 8. The price of fish seeds used for carp fattening

Species	Price of seed (Tk/kg)
Rui	175-200
Mrigal	175-200
Catla	175-200
Silver	90-110
Bighead	90-110
Grass carp	170-200
Mirror carp	150-180

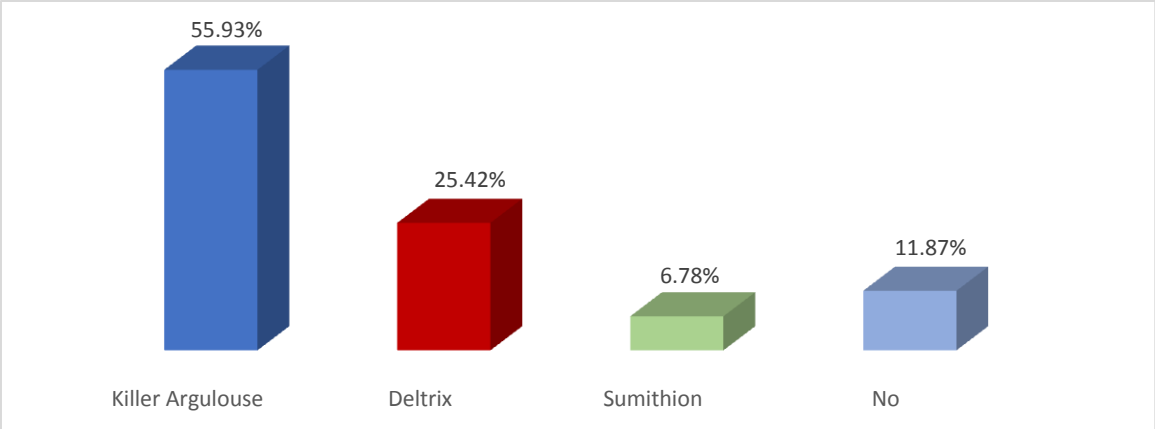


Fig. 15. Medicines used for control of fish lice by farmers

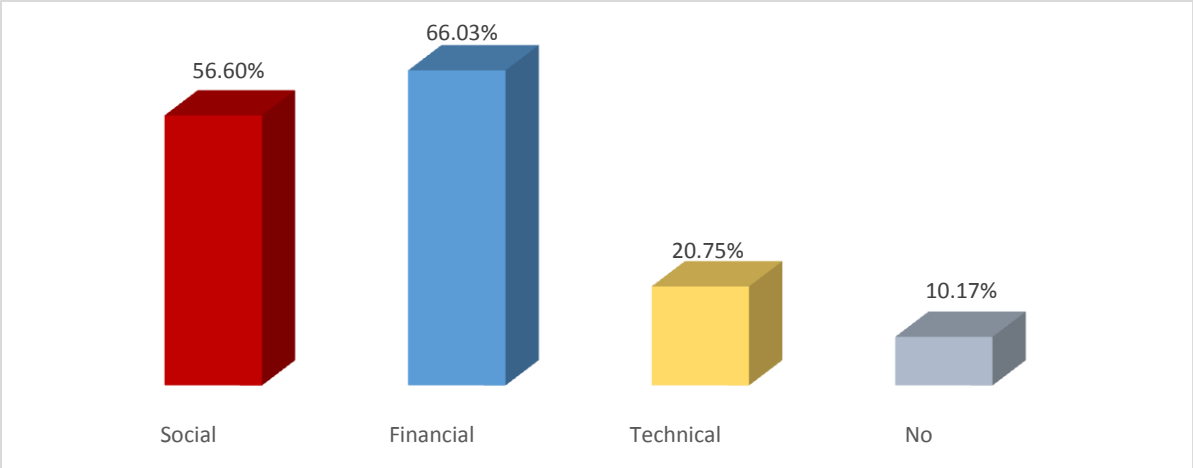


Fig. 16. A graphical presentation of problems faced by farmers

the study areas were at problem. Among them, 66.03% faced financial and 50.85% social issues where 20.75% were in technical problems. Only 10.17% had no problem (Figure 16). Similar issues were also confronted by Mohsin [31], Habib *et al.* [32] and Saha [33] as well.

3.4 Feed and Feeding Information

This section deals with the findings related to the feeds found in the study. The selected characteristics were fish feed used by farmers, feed types, feeding frequencies, feed application methods, feed storage facility, name of feed companies, etc.

3.4.1 Use of feed by farmers

In this study area, all the respondents used different types of feed in the ponds which connects to findings of Islam et al. [34].

3.4.2 Feed types

Farmers of the study areas used ready or commercial; farm made and commercial+farm made feed. Among them, 40.68% used commercial feed, which indicates the maximum number of farmers depend on commercial feed. Only 20.34% of farmers use commercial +farm made feed (Fig. 17).

3.4.3 Commercial feed company

A total of forty out of 59 people used commercial feed from various companies. The most common commercial feeds were Aci godrej, Quality, Narish, Tongwei, Meghna, Purobi and Aman. Aci godrej used by 55% farmers (Table 9).

3.4.4 Feeding frequency

Farmers were applied feed in the morning, noon and afternoon. It was found that 81.35% of the farmers supplied feed twice a day, morning and afternoon. On the other hand, 18.65% farmers supplied feed thrice daily, in the morning, noon and the evening which resembles to the findings of the other researchers [35] (Fig. 18).

3.4.5 Feeding method

It was found that all the farmers applied feed manually in the selected study area.

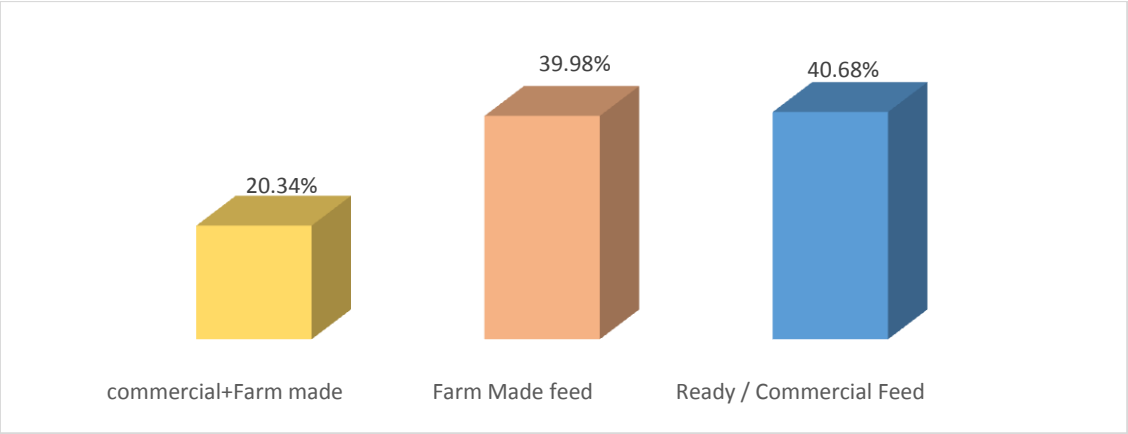
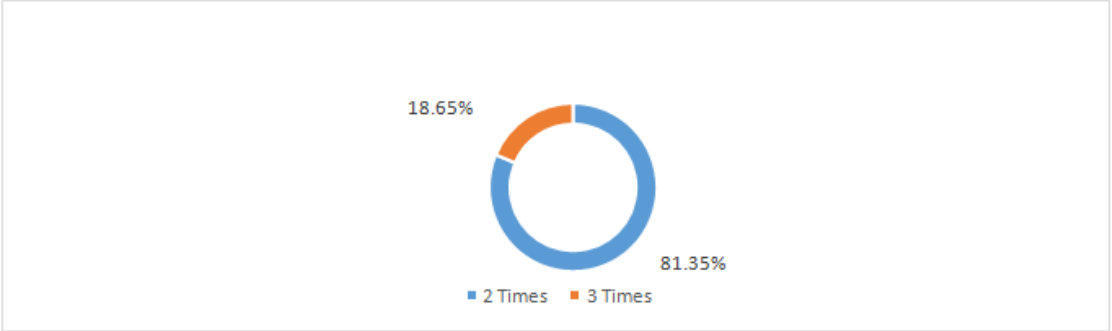


Fig. 17. Feeds used by farmers of the selected areas

Table 9. Feed from different companies used by farmers

Companies Name	Respondents (No.)	Respondents (%)
Aci godrej	22	55
Quality	8	20
Narish	4	10
Tongwei	2	5
Meghna	2	5
Purobi	1	2.5
Aman	1	2.5



Fig, 18. A graphical presentation of feeding frequency

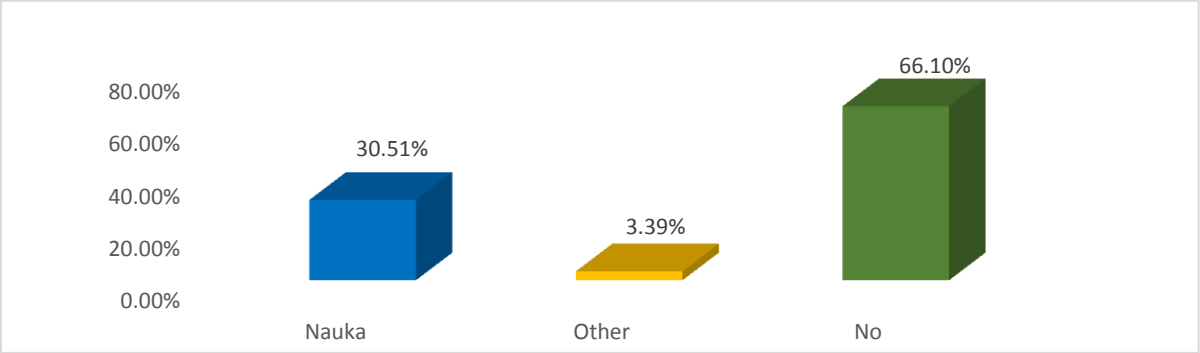


Fig. 19. Vehicle use by farmers of the selected study area

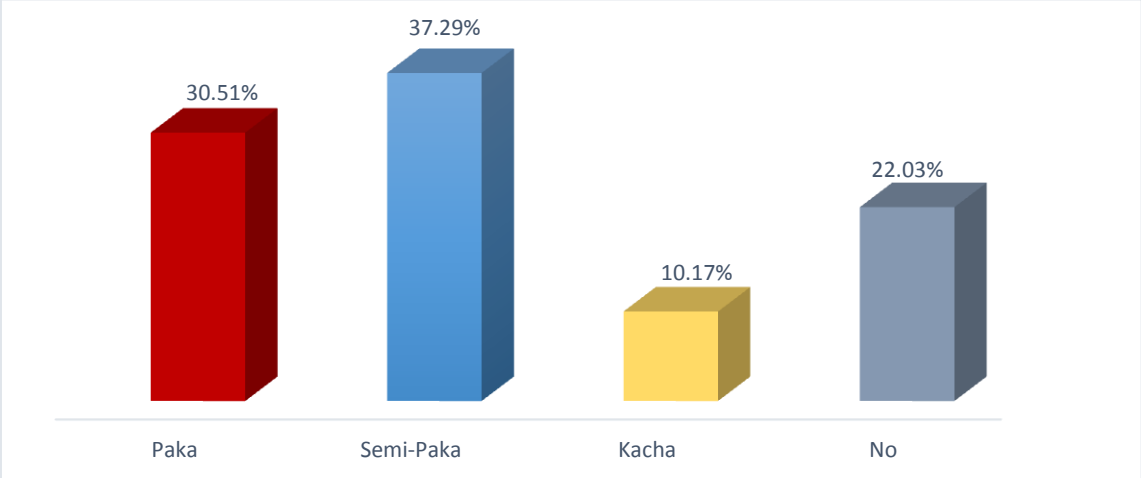


Fig. 20. Storage facilities of feed in the selected study area

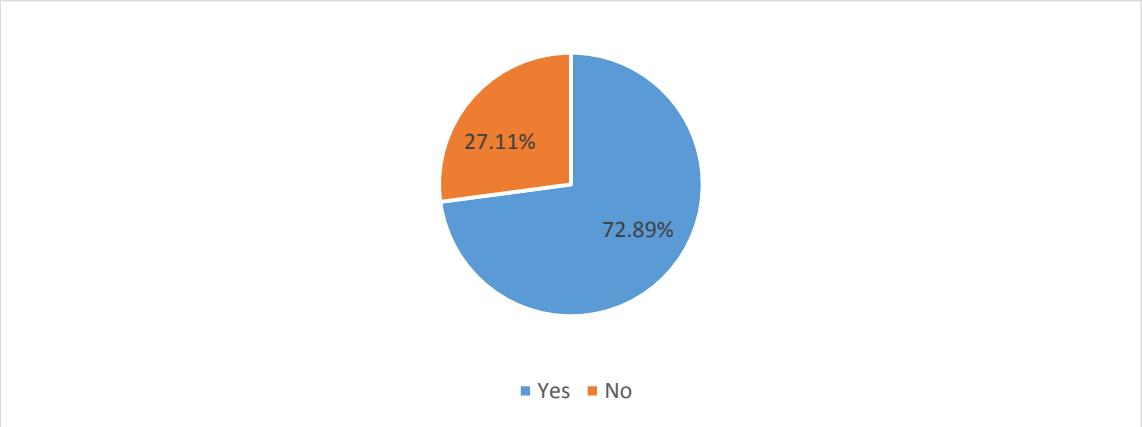


Fig. 21. Marketing of live fish by fish farmers of the selected are

3.4.6 Use of vehicle

In the selected study area, it was found that 33.89% of farmers used vehicles to apply feeds to fish and 90% used nauka (boat) and the rest used other types. The significant portion, which was about 66.11% had no vehicles (Fig. 19).

3.4.7 Storage facilities of feed

It was found that 30.51, - 37.29 and 10.17% of the farmers had *paka*, semi-*paka*, and *kacha* feed storage facilities and the rest of 22.03% farmers had no storage facility which resembles many other research works [25] (Fig. 20).

3.4.8 Marketing live fish

In the study areas, 72.89% of farmers were marketing fish as live. About 27.11% were not marketing live fish (Fig. 21).

4. CONCLUSION

Carp polyculture is an important fish production technology because of the suitability of carps for stocking with other aquaculture species and high market demand as well as price. Among the polyculture systems, carp fattening is a relatively new and the latest technology having very high productivity. Due to different problems like lack of capital, high price of inputs, poor technical knowledge, social problems etc the culture method is not so popular and successful so far in the study areas. In spite of different problems and constraints, carp fattening is a potential system offering opportunities to increase fish production as well as income of the aquafarmers because of the high price of large fish produced by applying the technology. Therefore, the government should take the necessary steps to overcome the drawbacks and hindrances to the sustainability of the fish-producing technology that can improve the livelihood of the poor farmers, and play significant roles in the economy of the country.

CONSENT

According to the international standard, participants' written consent has been collected and preserved by the author(s).

DISCLAIMER

The products used for this research are commonly and predominantly use products in our area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. The research was funded by the Ministry of National Science and Technology, Bangladesh.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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