AN INVESTIGATION ON CARP FATTENING IN NATORE DISTRICT

A Thesis

By

MD. SAKOAT HOSSAIN

Examination Roll No. 1606045

Session: 2022

Semester: July-December 2024

MASTER OF SCIENCE (MS)

IN

AQUACULTURE

DEPARTMENT OF AQUACULTURE

HAJEE MOHAMMAD DANESH SCIENCE AND TECHNOLOGY UNIVERSITY, DINAJPUR-5200

DECEMBER 2024

AN INVESTIGATION ON CARP FATTENING IN NATORE DISTRICT

A Thesis

By

MD. SAKOAT HOSSAIN

Examination Roll No. 1606045

Session: 2022

Semester: July-December 2024

Submitted to the Department of Aquaculture
Hajee Mohammad Danesh Science and Technology University, Dinajpur
In Partial Fulfillment of the Requirements
for the Degree of

MASTER OF SCIENCE (MS)

IN

AQUACULTURE

DEPARTMENT OF AQUACULTURE

HAJEE MOHAMMAD DANESH SCIENCE AND TECHNOLOGY UNIVERSITY, DINAJPUR-5200

DECEMBER 2024

AN INVESTIGATION ON CARP FATTENING IN NATORE DISTRICT

A Thesis

By

MD. SAKOAT HOSSAIN

Examination Roll No. 1606045

Session: 2022

Semester: July-December 2024

Approved as to style and content by

.....	**.....**
(Dr. A.S.M. Kibria)	**(Dr. Md. Reazul Islam)**
Professor	**Professor**
Supervisor	**Co-Supervisor**

…….....

(Prof. Dr. A.S.M. Kibria)

Chairman

Examination Committee

and

Chairman

Department of Aquaculture

Hajee Mohammad Danesh Science and Technology University, Dinajpur-5200

DECEMBER 2024

Dedicated

To My

Beloved Parents

&

Wife

DECLARATION

I declare that this MS thesis entitled 'An investigation on carp fattening in natore district' which I submit to Department of Aquaculture, was conducted by me for the degree of Masters in Aquaculture under the guidance and supervision of Dr. A.S.M. Kibria, Professor, Department of Aquaculture, Hajee Mohammad Danesh Science and Technology University, Dinajpur.

Furthermore, I took reasonable care to ensure that the work is original and has not been taken from other sources except where such work has been cited and acknowledged within the text.

The author

ABSTRACT

A survey was conducted to assess the current status of carp fattening and the socio-economic situation of fish farmers in three upazilas of Natore district: Natore Sadar, Singra, and Gurudaspur. The study took place from July 2022 to June 2023 and involved gathering information from 80 fish farmers through interview with structured questionnaires. Results showed that 40% farmers were within the 41–50 age groups, with 65% belonging to nuclear families and 35% to joint families. In terms of education, most farmers (30%) had secondary-level education, while only 14.5% were illiterate. The annual income of a significant portion of respondents ranged from BDT 1,00,000 to 2,00,000, making up 33.34% of the sample. All farmers had access to electricity, and 41.67% were members of organizations like ASA and BRAC. The study found that the majority of ponds (58.5%) in the study area were between 0.5-1.0 acres in size, with an average depth of 1.5 meter. Additionally, 70% of the ponds used for fish culture were owned by the farmers themselves, while the remaining 30% were leased. Groundwater was the primary water source for 78% of farmers, with 42% exchanging water as needed. Most farmers (57.63%) prepared their ponds and applied specific amounts of salt, TSP, and urea per hectare. Growth promoters were used by 88% of farmers to enhance carp growth, with various probiotics such as Safe gut, Navio plus, Protox aqua, Aquaphoto, and Dellomax being employed. Indian major carp and exotic carp were the preferred species for cultivation, experiencing only fish lice as a constraint during the nine to ten months of cultivation. 63.33% farmers used commercial feeds. The main obstacles identified were a lack of scientific knowledge, insufficient high-quality seeds and feeds, funding shortage and inadequate marketing facilities.

Key Words: Aquaculture, Carp fattening, Growth promoter, Probiotics, Questionnaire

CONTENTS

CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF PLATES

CHAPTER I

INTRODUCTION

Bangladesh is a riverine country with vast water resources. Bangladesh has become one of the world's leading fish producers thanks to its plentiful water resources. Bangladesh's favorable geographical location attracts a large number of aquatic species and provides ample resources to support fisheries potential. The fisheries sector is a cornerstone of Bangladesh's economy, significantly contributing to the national GDP and providing substantial export revenue. The fisheries industry in Bangladesh has been growing at a rate of 5.74% annually. This sub-sector contributes 3.57% to the national GDP and makes up 26.50% of the agricultural GDP. In the fiscal year 2021-22, fish production reached 4.759 million metric tons, which is a 55.42% increase compared to the 3.062 million metric tons produced in 2010-11. Back in 1983-84, total fish production was just 0.754 million metric tons (DoF, 2022). The government’s Vision-2021 aimed for a fish production target of 4.552 million metric tons by 2020-21, a goal that has been surpassed. According to a report from the "Jatiyo Matsyo Soptaho" for the fiscal year 2022-23, Bangladesh earned over Tk 4,790 crore from exporting around 70,000 tons of fish and fish products. By 2041, Bangladesh aims to produce 8.5 million tons of fish (DoF, 2023). Currently, the fisheries sector represents 1.24% of the country's export revenue, with fish exported to over 50 countries worldwide. In the fiscal year 2021-22, the export volume was 78,042.67 metric tons of fish and fish products, generating revenue of Tk 5,191.75 crore, marking a 26.96% increase from the previous year.

Bangladesh's aquaculture sector has witnessed remarkable growth over the past few decades where carp fattening playing a pivotal role. According to the Food and Agriculture Organization (FAO), Bangladesh is one of the world's leading fish-producing

countries, with carp species contributing significantly to this production. This growth is driven by the increasing demand for fish as a source of protein, employment opportunities in rural areas, and the government's support for aquaculture development. Carp fattening is a significant aspect of aquaculture in Bangladesh, contributing substantially to the country's economy and food security. This process involves the cultivation of carp species in controlled environments to enhance their growth and weight, making them market-ready in a shorter period. Bangladesh, with its extensive water resources, provides an ideal environment for aquaculture, including carp farming (FAO, 2020).

Carp fattening holds significant importance in Bangladesh, both economically and nutritionally. The country's extensive network of rivers, ponds, and floodplains provides an ideal environment for aquaculture, particularly for the cultivation of carp species. This practice involves rearing juvenile fish to marketable size in a controlled setting, thereby enhancing production efficiency and meeting the increasing demand for fish protein (Kibria, 2022) Bangladesh has emerged as one of the top fish producers globally due to its plentiful water resources (Khan 2020). Carp species, such as Rohu (*Labeo rohita*), Catla (*Catla catla*), and Mrigal (*Cirrhinus cirrhosus*), are among the most commonly farmed fish in Bangladesh. Indian major carps and foreign carps are the most popular species for pond aquaculture (Hasan and Ahmed, 2002). These species are favored due to their high growth rates, adaptability to local environmental conditions, and market demand. Carp fattening helps optimize the use of water bodies, increasing fish production and income for farmers (Hossain, 2014).

In underdeveloped countries like Bangladesh, aquaculture has shown itself to be a viable and economical means of reducing poverty and achieving food self-sufficiency (Ahmed, 2003). Freshwater aquaculture has enormous potential in the nation, but for a variety of

reasons it is not being fully utilized. Approximately 10% of the population makes their living directly or indirectly from the fishing industry (DoF, 2012). Three types of aquaculture systems exist: extensive systems, which rely on naturally occurring food in the body of water without the need for additional inputs; semi-intensive systems, which use natural feed primarily but also receive feed and fertilizer supplements; and intensive systems, which require feed and fertilizer that are nutritionally complete (Halim, 2021).

The rate of fish growth and feed conversion efficiency heavily depend on the quantity and quality of fish feeds used. This highlights the importance of aquaculture feeds in Bangladesh and suggests a promising method for boosting fish production. Consequently, the feed milling industry in the country regards aquaculture feeds as a crucial subsector. The increasing demand for fish feed has led to a daily rise in the number of fish feed companies. Additionally, hundreds of small-scale, non-commercial producers across the nation are engaged in fish feed production (Bhuiyan, 2002).

Despite its potential, the carp fattening industry faces several challenges. These include the availability of quality fingerlings, disease management, and ensuring sustainable practices. Additionally, environmental factors such as water quality and seasonal variations affect the growth and survival rates of carp. Addressing these challenges through research and development is crucial for the continued success and sustainability of carp fattening in Bangladesh (Belton, 2011).

Carp farming is susceptible to various diseases, including bacterial, viral, and parasitic infections, which can lead to significant economic losses. Diseases like *Aeromonas hydrophila* infection and White Spot Syndrome Virus (WSSV) have been reported to impact carp production in Bangladesh (Rahman *et al*. 2019). Maintaining optimal water quality parameters such as dissolved oxygen levels, pH, and temperature is crucial for

the health and growth of carp. Pollution from agricultural runoff, industrial effluents, and urban waste can degrade water quality, posing a challenge to carp farming (Saha *et al.* 2020). Ensuring a steady supply of high-quality fingerlings for stocking is essential for successful carp fattening. However, the availability of certified disease-free fingerlings can be limited, leading to issues with stocking density and growth uniformity (Sarker *et al.* 2018). Carp require a balanced diet to support growth and development. However, the availability of quality feed ingredients and formulated feeds at affordable prices can be a challenge for carp farmers, impacting feed conversion efficiency and overall production costs (Das *et al.* 2020). This investigation aims to analyze the current practices, challenges and potential improvements in carp fattening in Bangladesh. By understanding the intricacies of this aquaculture practice, the research seeks to provide insights that can help enhance productivity, ensure environmental sustainability, and improve the livelihoods of those involved in the sector.

Objectives of the study

- To investigate the current status of carp fattening in Natore district.
- To know the socio-economic conditions of the carp fatteners.

CHAPTER II

REVIEW OF LITERATURE

Saha *et al.* (2022) delved into the economic viability of carp polyculture farming, with a primary focus on profitability, profit sensitivity, economies of scale, and liquidity. Their findings highlighted that feed emerged as the most critical production input, constituting a significant portion of operating costs (57.3%). While freshwater carp polyculture farming proved to be generally profitable, profits were notably sensitive to changes in feed and fish prices. The study revealed a high cash flow coverage ratio attributed to higher yield strategies and low debt-servicing ratios, indicating reduced liquidity risk in carp polyculture farming. The authors recommended that farmers concentrate on optimizing input usage to enhance cost efficiency, ensure consistent cash flow, and foster a sustainable increase in fish production.

Rahman *et al.* (2021) explored the factors that enhance the uptake of advanced management practices and their impact on productivity. Their study revealed that only about 10% of participants were high adopters of these practices. Key determinants for adopting improved management practices included the education level of spouses, training, extension services, and sources of off-farm income. High adopters exhibited a productivity increase of 38% compared to non-adopters. The research underscored the importance of marital education, training, extension services, and off-farm income in facilitating adoption, with high adopters achieving significantly higher productivity than non-adopters. Farmers who implemented complex practices (high adopters) achieved greater productivity compared to those who employed intermediate or simple techniques.

Taylor *et al.* (2021) reported that Africa contributes approximately 2.7% to global fish farming production with Egypt being the foremost producer, showing an 8.4% growth rate between 2009 and 2018 (FAO 2020). Additionally, aquaculture in Sub-Saharan Africa, driven by countries like Nigeria, Uganda, and Ghana, has seen significant growth over the last decade, rising from 106,000 tonnes in 2000 to 709,000 tonnes in 2018, with a farm-gate value of approximately USD 1.68 billion (FAO 2021). Most of Africa's fish production (99%) is derived from freshwater systems, with tilapia and African catfish being the predominant species produced.

Halim *et al.* (2021) gathered information from 20 fish farmers in Mithapukur Upazila, Rangpur district. Farmers utilized a variety of fertilizers, foods, nutrients, chemicals, and antibiotics. Nearly 83% of the farmers provided feed to their cultivated species, whereas the remaining 17% depended entirely on the natural food produced by the ponds. The study revealed that 87% of the farmers used supplemental feed made from rice bran and mustard oil cake, while 13% used commercially manufactured feed.

Rahman *et al.* (2020) conducted a study to examine the socioeconomic characteristics, the tilapia-carp polyculture system, and its profitability. The results indicated that 36% of the participants were aged between 25 and 29 years, 68% came from medium-sized families (5 to 6 members), 44% had attained a higher secondary education, 44% considered fish farming as their primary occupation, and 46% had an annual income ranging from Tk. 150,001 to 200,000 ($1770 - $2360). The study identified several key challenges in pond fish production, including fingerling mortality, high ingredient costs, low fish prices, high interest rates, and the unavailability of quality fingerlings at the appropriate times.

Rahman *et al.* (2018) conducted a survey to evaluate the current status of integrated aquaculture. The study identified three main types of integrated aquaculture systems: rice-fish culture (46%), fish-horticulture (33%), and fish-poultry culture (21%). Fish were raised using polyculture methods, and crops like banana, papaya, and various vegetables were planted on pond embankments. Key findings included: the majority of farmers (76%) were aged between 41 and 60 years, 40% had an educational level up to the eighth grade, 66% had received training, and the average farm size was 0.29 hectares. Significant challenges included low water retention capacity, a shortage of quality seeds, limited capital, high labor costs, and inadequate extension services. The study suggested that adopting improved farming practices through integrated methods could enhance the socioeconomic conditions of the farmers.

Asif (2017) gathered data from 50 fish farmers to assess their livelihoods and socioeconomic conditions in Jhikargachha upazila, Jessore, Bangladesh. Most of these farmers cultivated rui (Labeo rohita), catla (Catla catla), and mrigal. The study found that 72% of the farmers used supplementary and homemade feed made from rice bran and mustard oil cake, while 28% relied on commercially manufactured feed. Additionally, 62% of the farmers had undergone training in fish farming, whereas 38% had not. The study also highlighted various constraints and risks faced by the farmers.

Kawsar (2012) investigated the effectiveness of several commercial fish feeds available in Trishal upazila and Mymensingh sadar. The study uncovered significant discrepancies between the nutritional values claimed by the manufacturers and those determined through analysis. Most feed samples were found to have lower crude protein levels, with differences ranging from 0.05% to 8.05% less than what was advertised by the companies.

Kabir (2009) discovered that the average farm size in the studied regions was 0.525 hectares. Around 80% of the farmers were illiterate. They made use of both surface and subsurface water on their farms. Nearly 90% of the farmers had enhanced their socioeconomic status through fish farming.

Monir *et al.* (2015) conducted a study to identify parasitic diseases and assess the losses caused by parasite infestations in three Indian major carps (*Labeo rohita, Catla catla,* and *Cirrhinus mrigala*). They discovered nine species of ectoparasites and three species of endoparasites in the examined carp fish. The highest infection prevalence was observed in *L. rohita* during winter (94.54%), while the lowest was in *C. catla* during summer (72.68%). *L. rohita* showed the highest abundance and mean density of parasites, both recorded at 14.38 and 12.64, respectively. Conversely, the lowest abundance and mean density were also found in *C. catla*, at 14.38 and 12.64, respectively. The study estimated the total economic loss due to parasitic diseases to be BDT 35,552.50 per hectare per year. The overall impact of parasitic diseases included an 11% mortality rate, 11% costs for chemicals, and a 65% reduction in carp growth in the study areas.

Monir *et al.* (2015) conducted a study to identify parasitic diseases and measure the losses caused by parasite infestations in three main Indian carp species: *Labeo rohita, Catla catla,* and *Cirrhinus mrigala*. They discovered nine ectoparasite species and three endoparasite species in the carp fish. Notably, *L. rohita* had the highest incidence of infection during the winter (94.54%), whereas *C. catla* had the lowest prevalence during the summer (72.68%). *L. rohita* had the highest parasite abundance and mean density, measuring 14.38 and 12.64, respectively. In contrast, *C. catla* had the lowest abundance and mean density, measuring 14.38 and 12.64, respectively. The study estimated that parasitic illnesses cause a total economic loss of BDT 35,552.50 per acre per year.

Hossain *et al.* (2013) conducted an experiment to evaluate the current status of Carp-SIS polyculture in the Dinajpur district of Bangladesh. The majority of respondents (31.0%) practiced an undeveloped type of aquaculture system in medium-sized ponds, followed by 4.0% in both large and small pond categories. The highest income among respondents (6.89%) was observed in the large pond category, with 12.64% in the medium pond size category. Conversely, the lowest income (4.59%) was reported in the large pond category based on technological practices in these regions. Regarding cultured species, Silver carp was the most dominant (98.5%), followed by Rui (95%), Mola (91.5%), Prawn (89.3%), and Bighead carp (85.4%) among the respondents.

Alam *et al.* (2012) studied the socioeconomic and aquaculture conditions of fish farm owners in the Fulpur upazila of Mymensingh district, as well as the nutritional composition of commercial fish feed. Their studies revealed that just 10% of farm owners choose homemade feed, with the remaining 90% dependent on additional feed from various firms. Most commercial fish feeds have uniform chemical compositions.

Tanjeena *et al.* (2007) conducted research in Mohanpur upazila, Rajshahi, to evaluate pond fishing resources and the livelihoods of fish farmers. Pond sizes varied from 15 to over 180 decimal, with the majority (57.8%) being under the management of a single owner.

Sayeed *et al.* (2008) conducted a study to explore the impacts of three different feed types on the growth of Thai pangus (*P. hypophthalmus*) and rohu (*L. rohita*) in a polyculture setup. They compared the growth performance achieved with Hand-made Feed (A) to two commercially available fish feeds, Sunney Feed (B) and Saudi-Bangla Feed (C). The specific growth rates recorded were 1.58% and 0.93% per day for T1, 1.59% and 0.95% per day for T2, and 1.60% and 0.93% per day for T3, respectively.

Kunda *et al.* (2020) conducted a survey to assess the socioeconomic conditions of fish farmers in the Habiganj Sadar Upazila, Habiganj, Bangladesh, aiming to identify constraints and vulnerabilities in aquaculture communities. Among the farmers surveyed, the majority (37.61%) had pond sizes ranging from 0.02 hectares to 0.06 hectares, and 63.33% of ponds were owned by single individuals. Most farmers showed interest in stocking rohu, catla, mrigal, and other species, with an average stocking density of 16,236 fry per hectare. All farmers provided feed for the cultured species, and 73.33% had taken measures to prevent disease outbreaks. The study suggests that providing technical training, economic support through low-interest loans, access to affordable feed and fertilizer, and guidance on disease management could lead to higher profit margins for farmers. Overall, fish farming is identified as a profitable venture that could contribute significantly to the livelihood improvement of fish farmers.

Khan *et al.* (2009) examined the effects of feeding frequency on the development, yield, and economics of catfish (*P. hypophthalmus*) and silver carp (*H. molitrix*) polyculture in earthen ponds. The study included three treatment groups. The species composition (1:1) and stocking density (25,000 fish per hectare) were constant across all treatments. Feeding rates were gradually reduced depending on weekly samples, beginning at 10% and gradually dropping to 3% throughout the final four weeks of the trial.

Hossen *et al.* (2019) investigated the effect of water depth on the growth performance (length and weight) of table-sized Indian main carp, which included *Gibelion catla, Labeo rohita*, and *Cirrhinus mrigala*. The study indicated that *Labeo rohita* fish had the maximum survival rate (99.23±0.4%) at 2.80 meters of water depth, while *G. catla* fish had the lowest survival rate (95±2.1%) at 1.20 meters. The study found that fish raised in lesser water depths had slower growth rates and shorter lengths than those raised in deeper pond water.

Islam *et al.* (2018) conducted a study to assess the current state, challenges, and future potential of fish farming. They found that Gazipur Sadar Upazila possesses 14,462.42 hectares of potential fisheries resources, with floodplains, seasonal water bodies, and ponds constituting 71.01%, 13.04%, and 8.57% respectively. Among different farming systems, the semi-intensive system yielded the highest fish production output, totaling 2826 metric tons. Exotic Carp emerged as the most commonly produced fish species in ponds. Khan *et al*. (2009) investigated the impact of feeding frequency on the growth, productivity, and economics of catfish (*P. hypophthalmus*) and silver carp (*H. molitrix*) polyculture in earthen ponds. Three treatment groups were constructed, with a constant species ratio of 1:1 and a stocking density of 25,000 fish per acre throughout all treatments. The feeding regimen began at 10% and gradually lowered to 3% during the trial period, with changes made based on weekly sampling data.

Munguti *et al.* (2014) conducted an assessment of the existing conditions of the fish feed industry in Kenya, along with on-farm feed management practices and the perceived potential and limitations from the perspective of fish farmers. A significant proportion of aquafeeds utilized in Kenya are either manufactured on-site at farms or produced by small-scale, semi-commercial feed producers. The majority of fish farming activities in Kenya take place in earthen ponds ranging from 150 to 500 square meters in size, which are supplied with readily available and reasonably priced agricultural byproducts. This production method accounts for over 90% of the cultured fish output in the country.

CHAPTER III

MATERIALS AND METHODS

Methodology serves as an essential element within any research endeavor, offering various approaches and techniques for data collection, contingent upon the research's aims, objectives, and nature. This study employed both primary and secondary data collection methods. Prior to gathering primary data, a preliminary questionnaire was formulated. This section outlines the methodology employed in fulfilling the study's objectives, including the selection of research instruments and data collection techniques.

3.1 Study period

The survey ran from July 2022 to June 2023, for a total of one year. To collect data directly from fish farmers living in different areas in Natore district, field visits were conducted on a regular basis.

3.2 Selection of the study area

Selecting the study region is a crucial step in research, and for this study, three upazilas from the Natore district which were Natore Sadar Upazila, Singra Upazila, and Gurudaspur Upazila. Natore is distinct due to its advanced stage of development and excellent connections to the capital city of Bangladesh as well as the divisional headquarters. Bangladesh's Natore district is well-known for its extensive fish output and aquaculture activities. The 1900.05 square kilometer Natore district is perfectly located at approximately 24.41° North latitude and 89.00° East longitude (Plate 3.1).

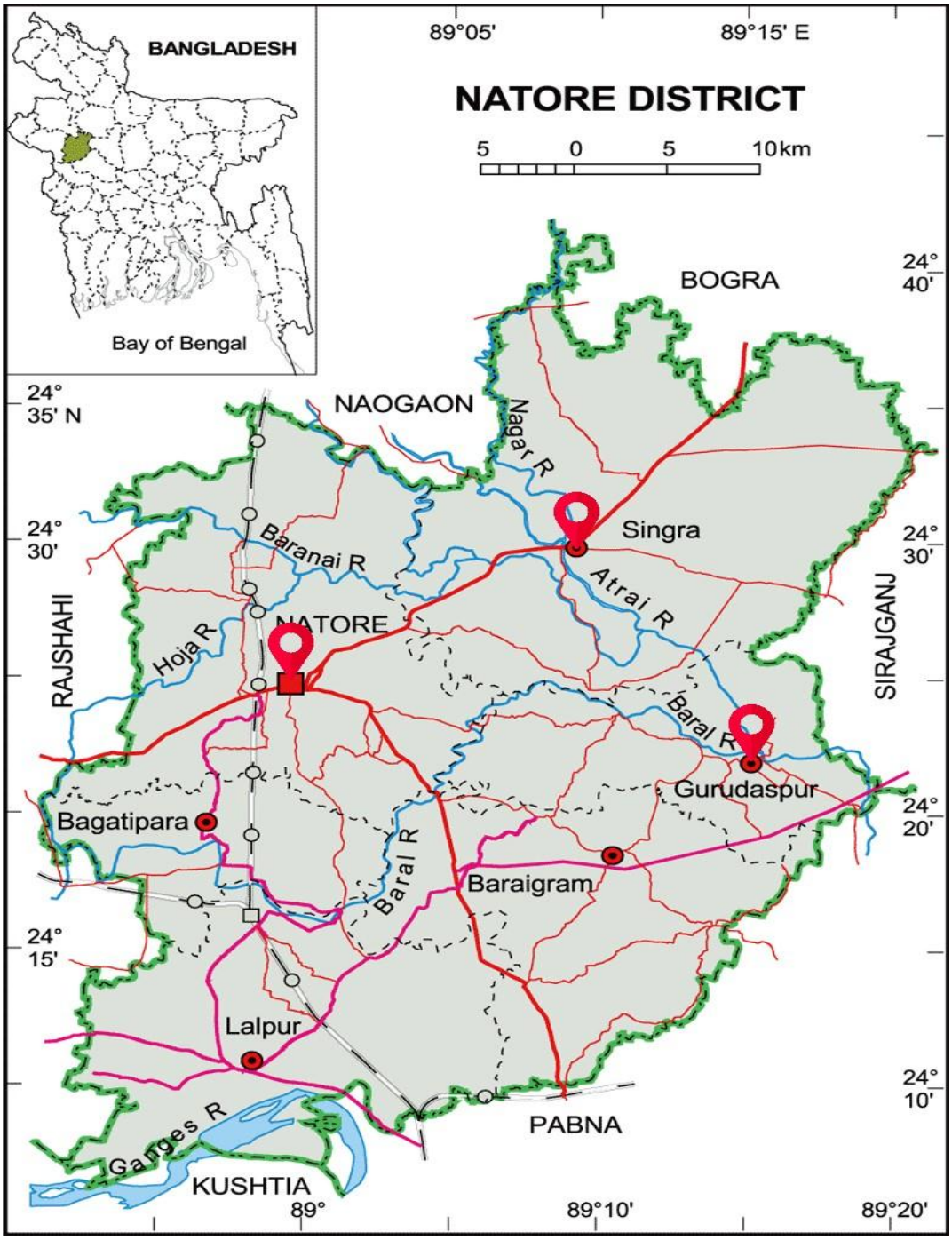

Plate 3.1: Map showing selected upazilas in Natore district (Indicated by red colored location indicator)

3.3 Collections of data

3.3.1 Questionnaire survey

The current research employed a data collection approach utilizing questionnaire interviews and participatory rural appraisal (PRA) sessions with fish farmers. Initially, a series of preliminary questionnaires was developed and field-tested with a select group of fish farmers across various representative locations. Feedback from these interactions guided necessary adjustments to the questionnaire. A simple random sampling technique was adopted for the interviews, encompassing a total of 60 farmers. Ahead of the field survey, background data pertaining to the quantity, geographic distribution, and prevalence of fish farms and aquaculture activities were gathered. The questionnaire was structured into distinct sections. The initial section concentrated on gathering personal information from the farmers, followed by a segment dedicated to on-farm details. Subsequent sections delved into culture-related aspects, feed and feeding practices, and concluded with a focus on cost analysis.

Throughout the survey, questions were posed in a systematic manner, with explanations provided as needed. Responses provided by the selected farmers were directly documented on the interview schedules. Prior to departing from the study area, the information was meticulously reviewed, and any discrepancies were resolved by referencing local standards to ensure data consistency. To mitigate errors, data were initially collected in local units and later converted into appropriate units as necessary (Plate 3.2).

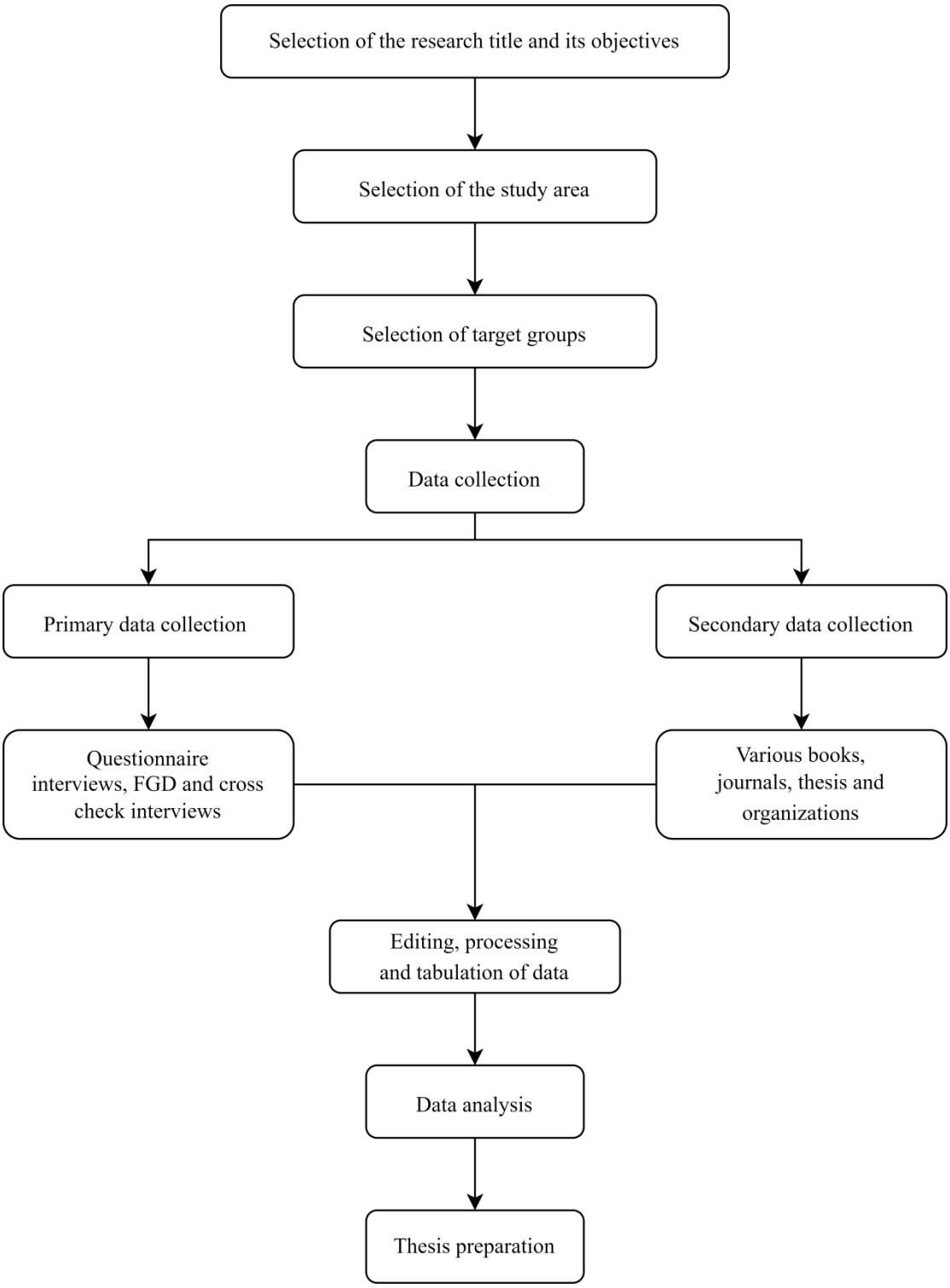

Plate 3.2: Flow chart of the research methodology

3.3.2 Focus Group Discussion (FGD)

FGD was employed in this study to gather information on specific important issues like pond preparation, improved natural feed, fertilizer use, fishing systems, management of the pond's feeding system and feeds used, marketing-related information about carp fattening, farmers' socioeconomic circumstances, etc. Eight to ten fish farmers participated in each FGD session, with two sessions held overall in each upazila.

3.3.3 Cross-Check Interview

Verifying the information was crucial in order to validate the data that was gathered through questionnaire interviews and focus group discussions. If there were any dissimilar things, information was gathered from key informants. Cross-check interviews were carried out in certain instances with key personnel in the designated areas, including local leaders, school instructors, and Upazila Fisheries Officers (UFOs). NGOs' employees in cases when data contradicted or required more measurements. Key respondent interviews were conducted for this purpose in their offices during business hours.

3.4 Analysis of data

Data obtained for analysis were coded, summarized, and processed. The tabular description process was mostly employed for the analysis of collected data. The acquired data were then analyzed, preparing tables and graphs using MS Excel (Microsoft Excel 2010).

Plate 3.3: Data collection from fish farmers

CHAPTER IV

RESULTS

According to the study objectives, the data was presented methodically in another portion of this chapter. The first portion contains personal information about farmers; the second has farm information; the third contains cultural information; and the final piece contains feed, feeding, and marketing information for the Natore district.

4.1 Personal Information of Farmers

The personal details of the farmer are included in this part, including age, sex, marital status, religious affiliation, level of education, family size and composition, yearly income, access to sanitary facilities and health services, and membership in organizations. The Natore District accounts for sixty of the survey's participants.

4.1.1 Age Group

Five categories were created based on the respondents' ages. Approximately 40% of the farmers in the research region were between the ages of 41 and 50, whereas 35% of farmers were between the ages of 31 and 40, and just 15% were above 50 years (Figure 4.1).

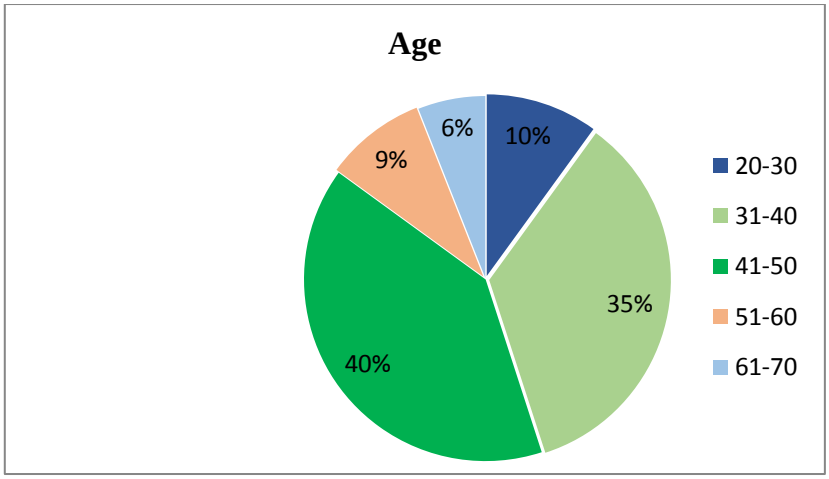

Figure 4.1: Age distribution of the selected fish farmers in the study area

4.1.2 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 (Table 4.1).

Table 4.1: Gender variations of fish farmers

Gender	Percentage (%)
Male	95
Female	5

4.1.3 Educational Status

The bulk of fish farmers (30%) have secondary educational level, followed by primary level (24%), higher secondary (22.5%), graduate (9%) and 14.5% fish farmers were illiterate (Figure 4.2).

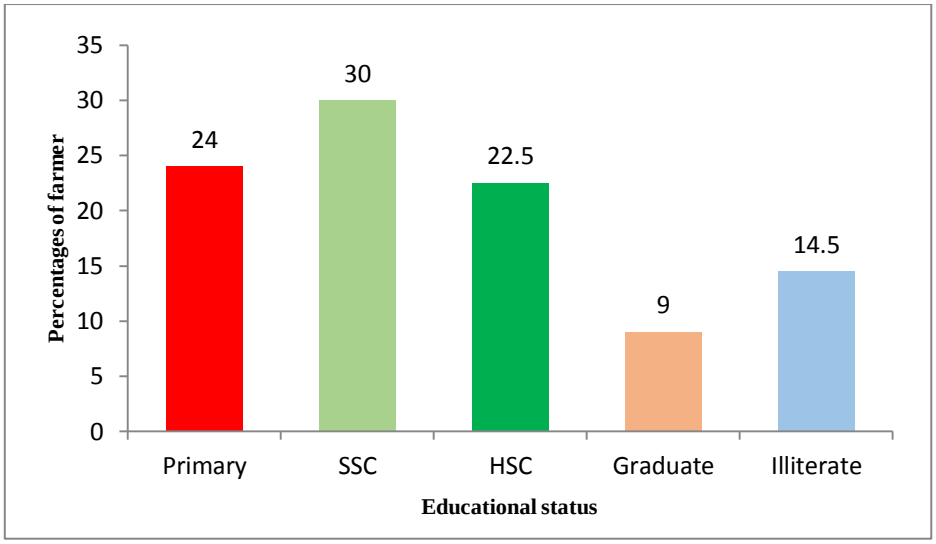

Figure 4.2: Educational status of the fish farmers in the study area

4.1.4 Family Type

Families owned by fish farmers were divided into two categories in the current study: nuclear families and joint families. 35% farmers lived in joint families, whereas 65% farmers lived in nuclear families. In the research area, nuclear families were the majority. The size of the family has a big impact on the family's income and expenses (Figure 4.3).

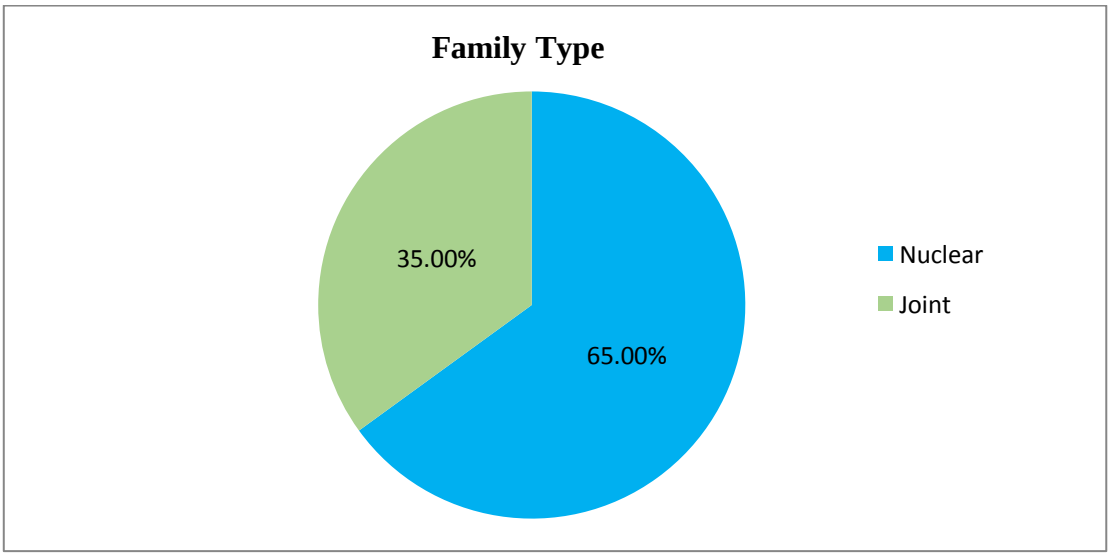

Figure 4.3: Family types of fish farmers in the selected area

4.1.5 The Annual Income of Farmers

The fish farmers were divided into five income categories, ranging from those earning less than 100,001 Tk annually to those earning more than 400,000 Tk. Notably, the majority of the respondents fell into the second category, which comprised 33.34% of the farmers. In contrast, the fifth category had the smallest representation, with only 8.33% of the farmers (Table 4.2).

Table 4.2: Annual income of the selected fish farmers in the study area

Income-Level (BDT)	Respondents (No.)	Respondents (%)
< 1,00,001	8	13.35
1,00,001-2,00,000	20	33.34
2,00,001-3,00,000	15	25
3,00,001-4,00,000	12	20
> 4,00,0000	5	8.33

4.1.6 Electricity Facilities

In today's digital age, one of the key goals of the Bangladesh Government is to ensure every household has access to electricity. In the surveyed region, all respondents reported having electricity services.

4.1.7 Organizational Membership

The current study revealed that 41.67% of the farmers were members of organizations like ASA and BRAC, while 58.33% were not affiliated with any organizations (Table 4.3).

Table 4.3: Number and percentage of organizational membership of selected farmer

Organization Name	No of respondents	Respondents (%)
ASA	10	16.67
BRAC	15	25
NO	35	58.34

4.2 Farm Related Information

4.2.1 Size of Pond

The findings of the current study indicate that most ponds (58.5%) in the selected area ranged from 0.5 to 1.0 acre in size. Additionally, 22% of the ponds measured between 1.1 and 2.0 acres, 11.5% ranged from 2.1 to 3.0 acres, and 21% were larger than 3 acres (Figure 4.4).

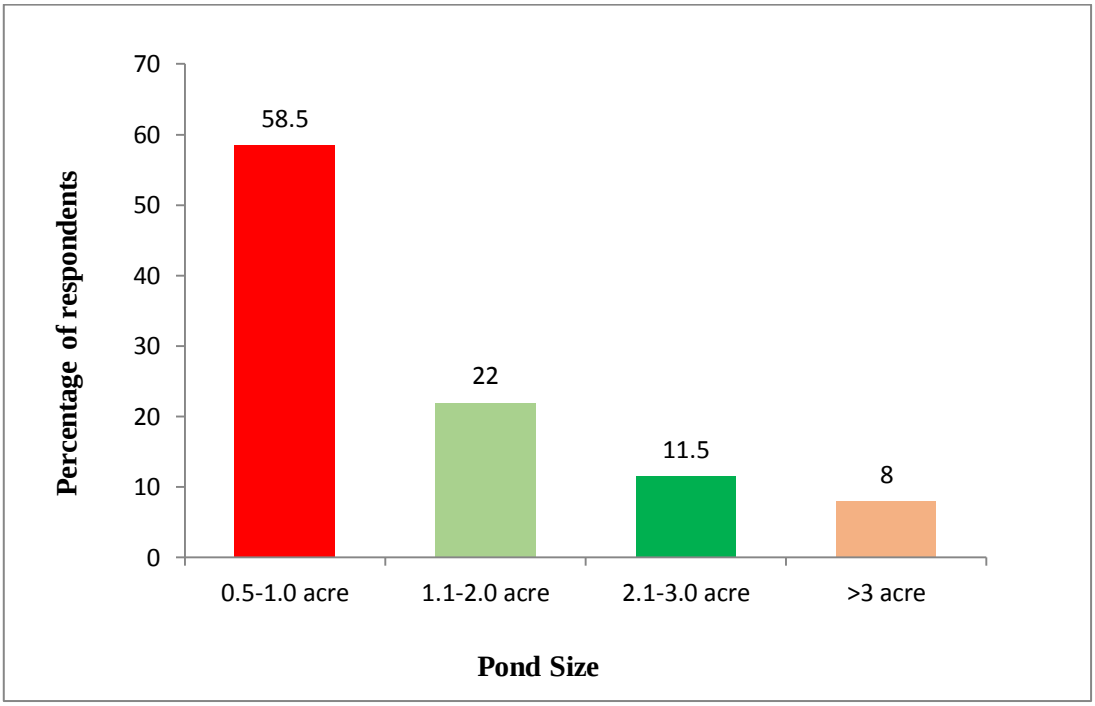

Figure 4.4: Pond sizes of the selected fish farmers in the study area

4.2.2 Pond Ownership

Owning a pond allows farmers to invest in long-term improvements such as better water quality management, enhanced infrastructure, and sustainable practices. The study shows that 70% of the ponds used for fish culture were owned by the farmers, while the remaining 30% were leased (Table 4.4).

Table 4.4: Pond ownership of farmers

Ownership	Percentage (%)
Own	70
Lease	30

4.2.3 Average Depth

It was observed that the average water depth of the ponds was 1.5 meters. Additionally, 59.5% of the ponds had depths ranging from 1.1 to 1.5 meters, while 34.8% had depths between 0.5 and 1 meter (Figure 4.5).

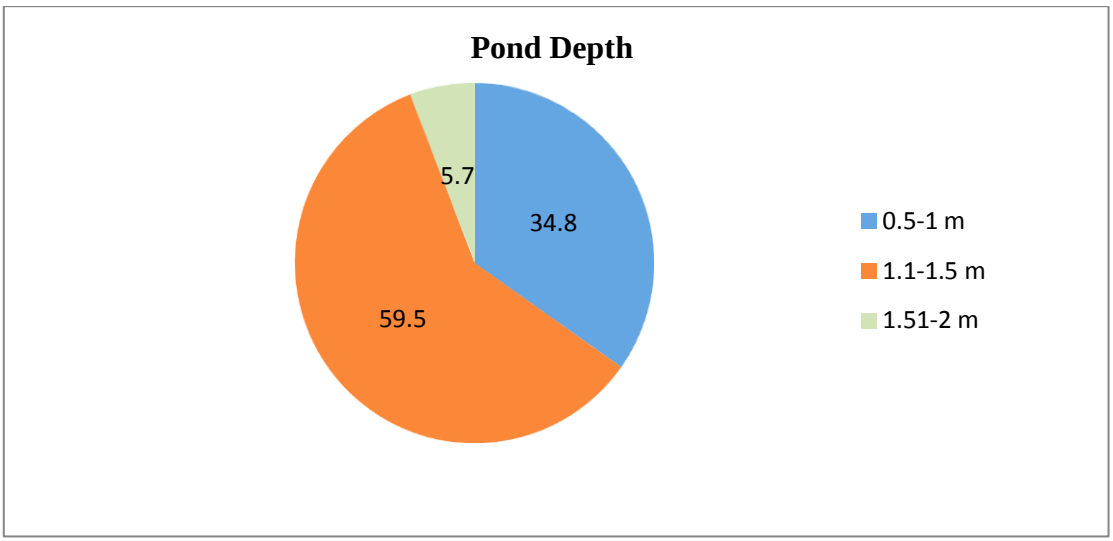

Figure 4.5: Average depth of the selected areas pond

4.2.4 Water Source

In the selected study area, 78.00% of farmers used ground water and the rest of 22% used surface water .Groundwater sources often provide a consistent and reliable supply of water throughout the year, even during dry seasons or droughts. Groundwater tends to have fewer contaminants compared to surface water sources, reducing the risk of introducing harmful substances into the fish ponds. This can contribute to better water quality management and healthier fish populations (Figure 4.6).

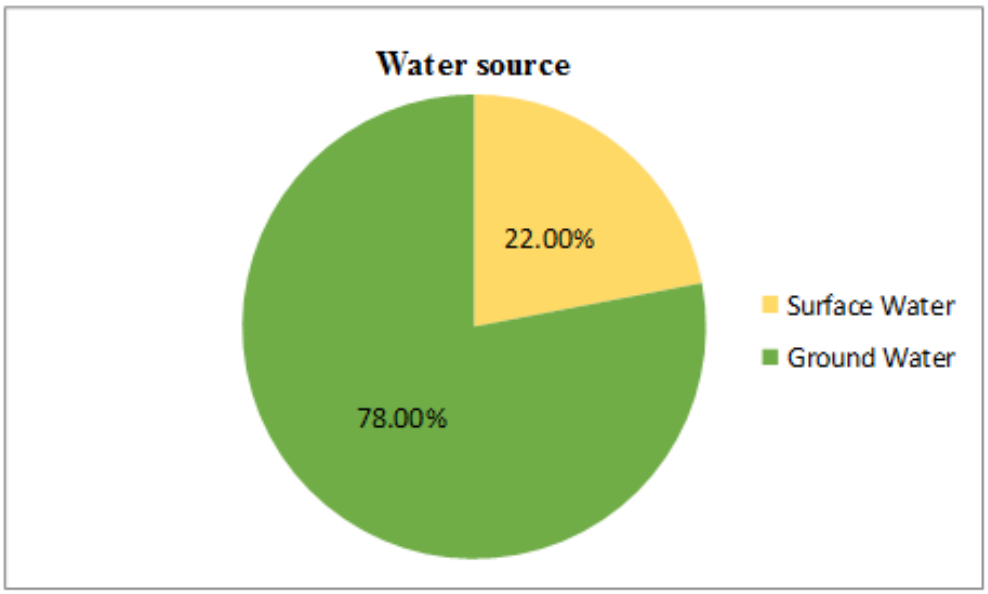

Figure 4.6: A graphical presentation of water source of farmers

4.2.5 Water Exchange

The observation revealed that 42% of fish farmers exchanged water as needed, while 11.8% performed weekly exchanges and 17.6% did on a monthly basis. Additionally, 28.6% of farmers did not engage in water exchange practices (Figure 4.7).

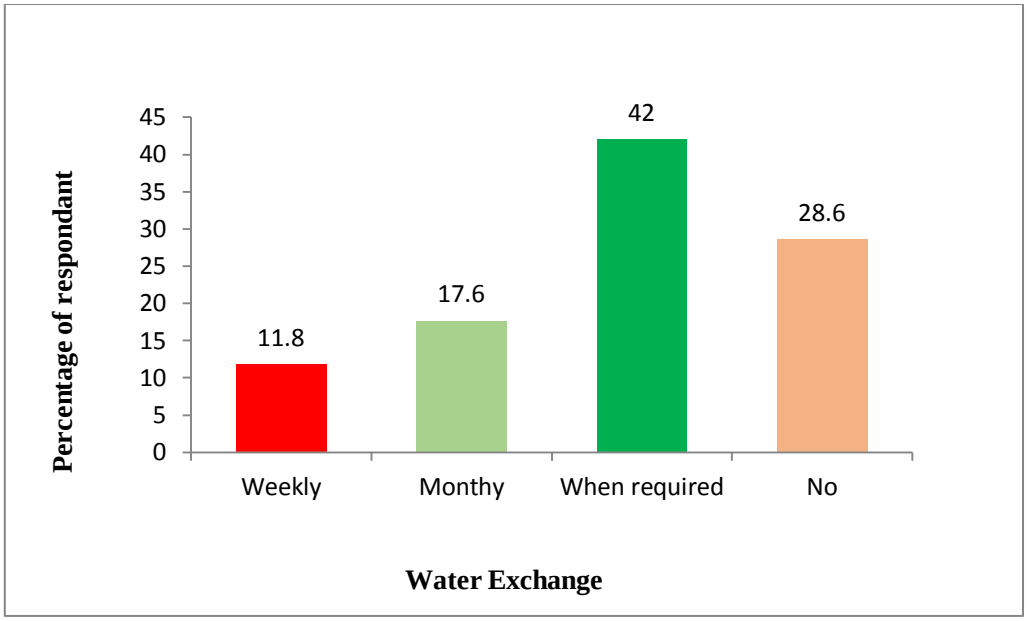

Figure 4.7: Water exchange by fish farmers of the selected area

4.3 Culture Related Information

This segment discusses the significant factors involved in carp fattening. Effective management was identified as crucial for successful carp fattening. Key aspects such as pond preparation, the application of fertilizers like T.S.P. and Urea, use of chemicals such as Lime and Salt, growth promotion techniques, disease management, species selection, and addressing potential problems were all taken into account during the culture process.

4.3.1 Pond Preparation

For the purpose of fattening carp, the selected farmers used a semi-intensive cultivation system. Sixty-five percent of farmers prepared their ponds before starting the cultivation process. Of them, 25.8% of farmers made dikes, and 92.4% cleaned weeds, employing liming in about 80% of cases and rotenone in 58.6% of cases. A minority, approximately 16.5%, chose to dry their ponds before to culture, whereas 34.4% did not make any preparations for their ponds (Table 4.5).

Table 4.5: Preparation of pond before carp fattening

Types of Preparation	Percentage (%)
Dike	25.8
Weed cleaning	92.4
Liming	80
Rotenone	58.6
Drying	16.5
No preparation	34.4

4.3.2 Use of Lime

Liming is widely recognized as a crucial step in pond preparation and treatment, playing a significant role in improving water quality. It is a commonly employed practice in aquaculture. In this study, all participant utilized lime, with the quantity applied varying depending on factors such as the duration and condition of water in the pond (Table 4.6).

Table 4.6: Use of lime in carp fattening ponds

Amount (kg/ha)	No of respondents	Respondents (%)
130	30	50
55.85	12	20
45	10	16.67
Required amount	8	13.34

4.3.3 Salt

Salt is a widely employed substance in aquaculture, often dubbed as the "aspirin of aquaculture" due to its versatility and effectiveness. It serves various purposes such as treating bacterial gill infections, managing external parasites, safeguarding against

fungus spores in water, and alleviating stress during handling and transportation of fish. Particularly during the winter season, it is utilized for these purposes. The application rate in this study was 130 kg per hectare at monthly intervals.

4.3.4 TSP

Phosphorus (P) stands out as the key nutrient in pond fertilizers, often resulting in a more significant boost in fish production compared to nitrogen or potassium. In this study, TSP (Triple Super Phosphate) was applied at rates ranging from 16 to 50 kg per hectare at seven-day intervals. To enhance its efficacy, TSP was combined with oilcake to aid in its dispersion in the water. Additionally, urea was applied prior to serving to further optimize nutrient availability for fish growth.

4.3.5 Urea

To enhance the carrying capacity of ponds for fish farming, the introduction of off-farm inputs like chemical fertilizers and supplementary feeds becomes essential. Urea particularly plays a vital role in this process, as it facilitates the rapid growth of fish within a short span. Farmers in the selected study areas administered urea at rates ranging from 10 to 70 kg per hectare at seven-day intervals. This strategic use of urea significantly contributes to maximizing fish productivity and optimizing the overall efficiency of pond management practices.

4.3.6 Growth Promoter

Growth promoters play a significant role in optimizing fish culture operations by promoting faster growth, improving feed efficiency, enhancing health and immunity, and ultimately increasing the economic viability of fish farming ventures. Fish treated with growth promoters may exhibit better resilience to environmental stressors such as fluctuations in water temperature or quality, thereby increasing their chances of survival

and growth. Different types of growth promoters were used by the fish farmers which are Growmix (15.8%), Aquamix (25.5%), Nutrigel (15.6%), Nutrimix (10%), Chemovit aqua (8%), Rapid grow (6.5%) whereas 12% of fish farmers did not use growth promoters (Figure 4.8).

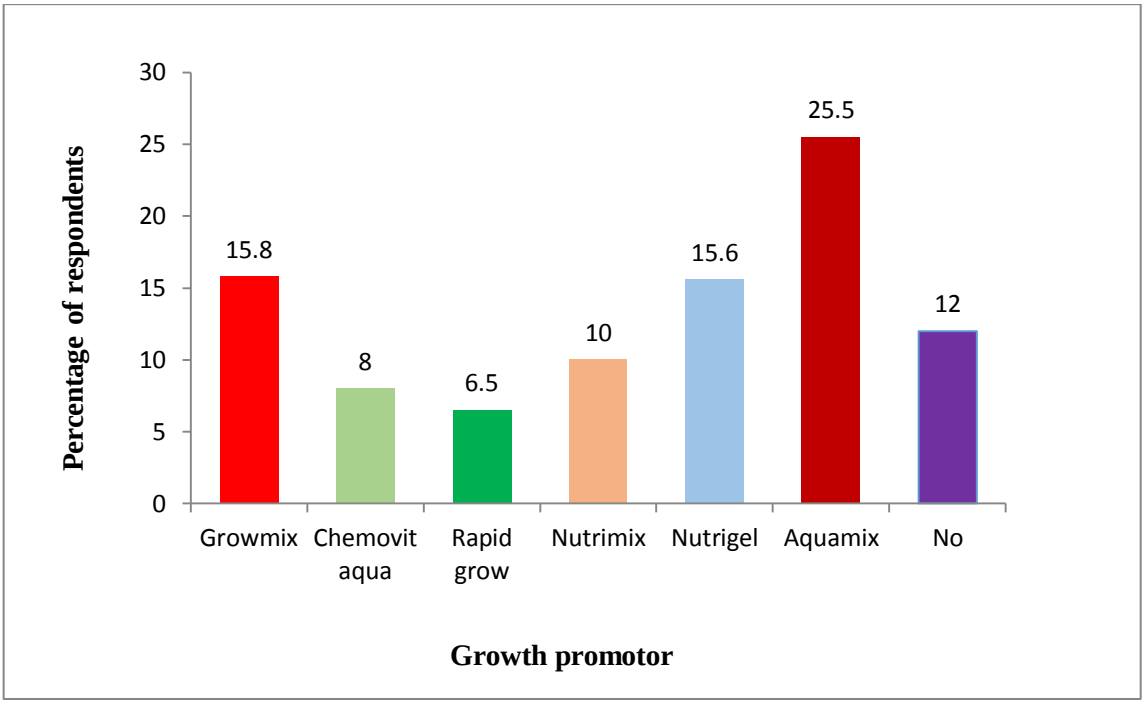

Figure 4.8: Growth promoter used by farmers of the selected area

4.3.7 Species

Species selection for carp fattening is based on a variety of feeding habits, encompassing surface, column, and bottom feeder fish species. The chosen species include Catla (*Catla catla*), Mrigal (*Cirrhinus cirrhosus*), Rui (*Labeo rohita*), Grass Carp (*Ctenopharyngodon idella*), Bighead (*Hypophthalmichthys nobilis*), Silver Carp (*Hypophthalmichthys molitrix*), and Mirror Carp (*Cyprinus carpio*). Additionally, some farmers also culture Tilapia (*Oreochromis niloticus*), Pangas (*Pangasius pangasius*), as well as Shing (*Heteropneustes fossilis*) species.

4.3.8 Stocking Density

Stocking density refers to the number of fish stocked in a given area of water, typically measured in terms of the number of individuals per unit area (such as per square meter or per hectare). It is an important consideration in aquaculture and fish farming because it directly impacts the growth, health, and overall productivity of the fish population. In the study area, farmers regulate fish density by ensuring an ample supply of natural food and enabling fish to move freely within the pond (Table 4.7).

Table 4.7: Stocking density of fish in the selected study area

Species	Density/ha
Rui	450-650
Catla	280-500
Silver	150-300
Mrigal	450-700
Bighead carp	150-250
Grass carp	250-450
Mirror carp	200-400

4.3.9 Weight of Fish Seed

Farmers take into account a range of fish seed sizes for culture, with the belief that larger-sized seeds exhibit faster growth compared to smaller ones (Table 4.8).

Table 4.8: Weight of fish species considered for culture

Species	wt.(g)
Rui	200-250
Catla	500-600
Silver	250-300
Mrigal	250-500
Bighead carp	300-500
Grass carp	350-500
Mirror carp	200-250

4.3.10 Price of Carp Seed

The cost of carp seed differs among farmers, typically fluctuating due to factors such as availability, seasonal variations, and geographic location (Table 4.9).

Table 4.9: The price of fattening carp seed

Species	Price of Seed (Tk/Kg)
Rui	300-350
Catla	250-300
Silver	100-120
Mrigal	300-350
Bighead carp	100-120
Grass carp	200-250
Mirror carp	200-250

4.3.11 Production Cycle

Carp fattening technology in the study area usually lasts nine to ten months, from the time the seed is stocked in the pond until it is harvested. Every farmer examined was found to have produced at least once a year.

4.3.12 Probiotics Used in the Study Area

Various types of probiotics were utilized by fish farmers in the study region as per the present investigation which are Safe gut, Navio plus, MI plus, Protox aqua, Aquaphoto and Dellomax. Probiotics play a pivotal role in fish culture, offering numerous benefits that contribute to the overall health, growth, and productivity of fish populations. Additionally, probiotics help to strengthen the immune system of fish, making them more resistant to various pathogens and diseases (Table 4.10).

Table 4.10: Probiotics used in fish culture in the study area

Probiotics	Recommended dose
Safe gut	1-2 g/kg feed
Navio plus	5g/kg feed
MI plus	60 g/33 decimal
Protox aqua	2-3 litre/acre
Aquaphoto	1 litre/33 decimal
Dellomax	200 g/50 decimal

4.3.13 Disease

In the survey conducted among 60 respondents, 40 reported encountering lice problems, while only four mentioned issues with bacterial and fungal diseases. To address bacterial infections, farmers used Chemistpro and Pond Care (S.K.F), while Thiovit (Syngenta) was employed for fungal infections. For lice control, farmers administered medicine at a

rate of 500ml per hectare every 15 days starting one month after stocking. Notably, 45.80% of farmers utilized Killer Argulouse, 30.60% used Deltrix (Fishtech), and 8.30% employed Sumithion (Figure 4.9).

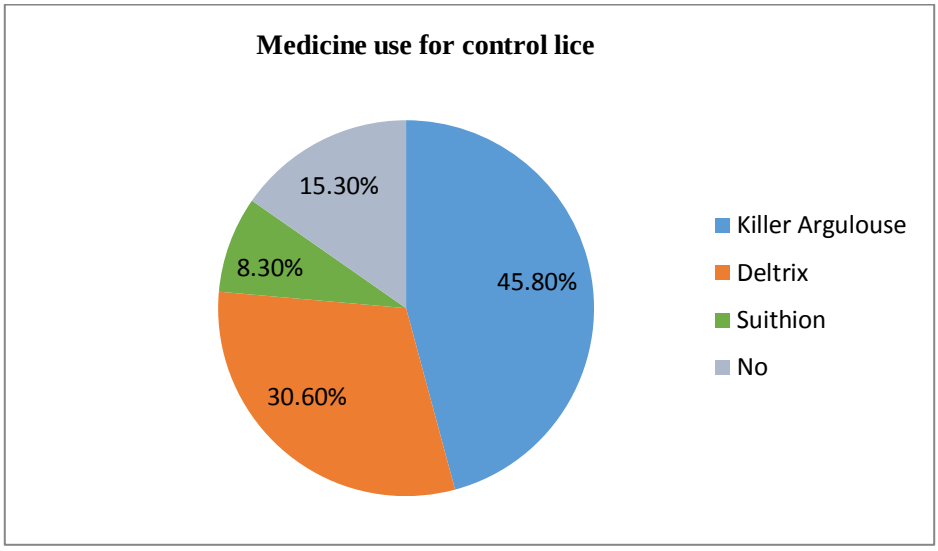

Figure 4.9: Lice control medicine use by farmers of the selected study area

4.3.14 Problems Faced By Fish Farmers

According to the present study, 50.60% farmers reported social problems as the single most important problem for aquaculture. While respondents were identified technical problems (30.75%), financial problems (41.03%), to be the most important problems in the study area while only 8.17% farmers had no problems. The social problems were theft, poisoning and multiple pond ownership. The technical problems might include lack of technical knowledge, lack of awareness of fish production technology among the fish farmers etc. Lack of money, higher production cost, lower market price all were the financial problem (Figure 4.10).

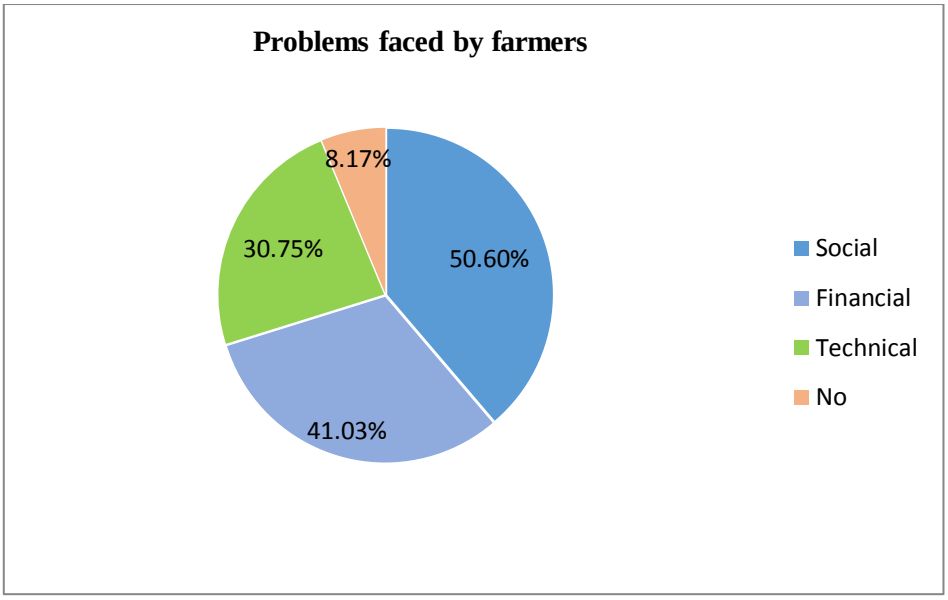

Figure 4.10: A graphical presentation of problems faced by farmers

4.4 Feed and Feeding Information

This section focuses on the observations regarding the feeds documented in the study. It encompasses various aspects such as the types of fish feed utilized by farmers, feeding frequencies, methods of feed application, availability of feed storage facilities, and the names of feed companies, among other relevant characteristics.

4.4.1 Use of Feed by Farmers

According to the present study, 100% fish farmers used different types of fish feed in their ponds in the selected areas.

4.4.2 Feed Types

In the study regions, farmers employed a mix of commercial feed, farm-made feed, and a combination of both. Notably, 63.33% relied solely on commercial feed, reflecting a predominant reliance on this type. Additionally, 13.33% of farmers utilized exclusively farm-made feed, while 23.34% opted for a blend of commercial and farm-made feed (Table 4.11).

Table 4.11: Fish Feed used by farmers of the selected area

Feed form category	No. of respondent	Respondent (%)
Commercial feed	38	63.33
Farm made feed	8	13.33
Both farm-made and commercial feed	14	23.34
Total	60	100

4.4.3 Commercial Feed Company

In the study region, farmers employed a variety of commercial feed options sourced from different companies. Among these, Mega, Aci Godrej, Quality, Nourish, Paragon, Aftab, CP, and Tongwei were the most prevalent. Mega feed emerged as the most popular choice, being utilized by 25% of the farmers in the area. (Table 4.12).

Table 4.12: Feed from different companies used by farmers

Companies Name	Respondents (No.)	Respondents (%)
Mega	15	25
Quality	13	21.67
Aci godrej	10	16.67
Nourish	7	11.56
Paragon	5	8.34
Aftab	4	6.76
CP	4	6.76
Tongwei	2	3.34

4.4.4 Feeding Frequency

Farmers used feed to their fish during different times of the day, including morning, noon, and afternoon. The majority, constituting 85% of the farmers, provided feed twice daily, specifically in the morning and afternoon. Conversely, 15% of farmers opted to feed their fish three times a day, during the morning, noon, and evening (Figure 4.11).

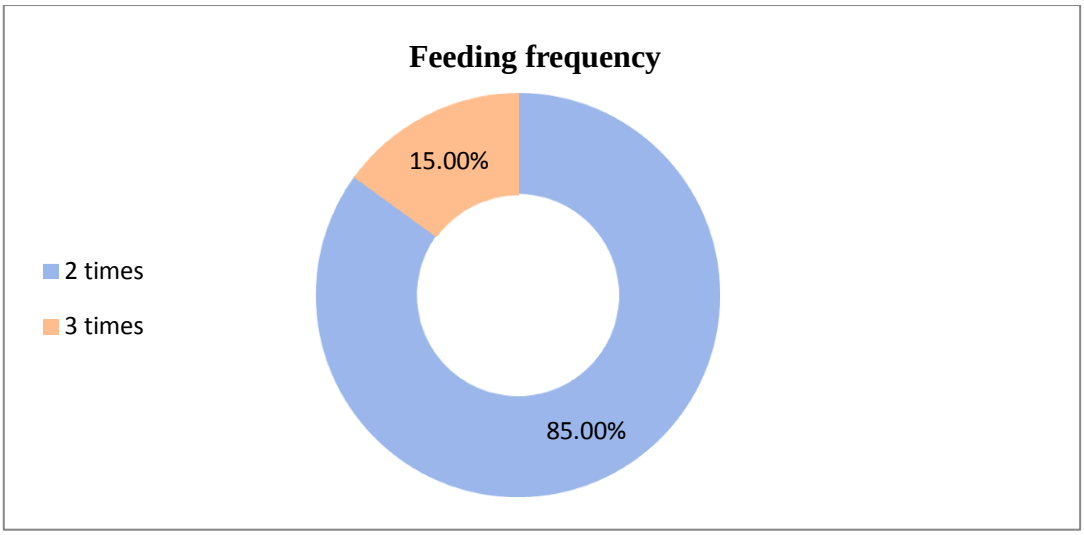

Figure 4.11: A graphical presentation of feeding frequency

4.4.5 Feeding Method

According to the report, 100% of the fish farmers employed manual methods for feed application. It denotes a typical cultural method in the research topic. It happens as a result of a lack of intense cultivation systems in the targeted locations (Table 4.13).

Table 4.13: Feed application method in the selected ponds

Feeding methods	No. of respondent	Respondent (%)
Manually	60	100
Mechanically	0	0
Total	60	100

4.4.6 Storage Facilities of Feed

In the chosen areas, 40.8% of the respondents on average had "semi paka" rooms for storing feed, compared to 30% who had "kacha" rooms, 20.56% who had "paka" rooms, and 8.64% who had no feed storage at all (Figure 4.12).

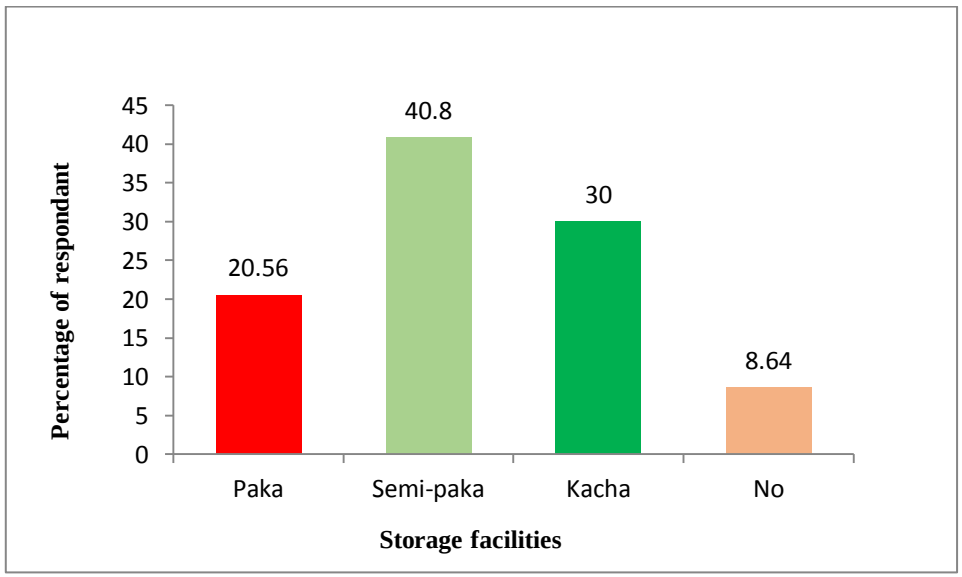

Figure 4.12: Storage facilities of feed in the selected study area

CHAPTER V

DISCUSSION

The practice of carp fattening has gained considerable attention in the aquaculture industry, particularly in three upazilas of Natore district of Bangladesh which were Natore Sadar Upazila, Singra Upazila, and Gurudaspur Upazila. Carp, being a staple fish in the local diet, presents a significant opportunity for improving food security and economic growth in this area. This discussion section aims to interpret and analyze the findings of this study in the context of existing knowledge and practices, highlighting both the successes and the areas needing improvement. The aim of this chapter is to analyze the findings and compare them with previous research outcomes. The following parameters were meticulously examined and are detailed in this chapter.

Five categories were created based on the respondents' ages. Approximately 40% of the farmers in the research region were between the ages of 41 and 50, whereas 35% of farmers were between the ages of 31 and 40, and just 15% were above 50 years. Jahan *et al.* (2018), 55.80% of fish farmers belong to the middle age group (41-60 years), and the majority of fish farmers are male, with only 10.80% being female. Kundu (2007) found that 40% of prawn farmers in Khulna area were 41-50 years old, 29% were 31-40 years old, and 19% were under 30 years old. Differential involvement of various age-group fishermen in the research locations was seen due to personal preference.

Education plays a crucial role in the modernization of farming operations. It equips individuals with current knowledge on contemporary methods and technological advancements across various production processes. The bulk of fish farmers (30%) have secondary educational level, followed by primary level (24%), higher secondary

(22.5%), graduate (9%) and 14.5% fish farmers were illiterate. Jahan *et al.* observed that 45.8% had primary level education, 17.5% had secondary level only 15% were graduates. Rahman (2001) stated that 68% fishermen were illiterate, 28% had education up to primary level, and 4% fishermen had secondary level of education in Baculiar haor areas.

Families owned by fish farmers were divided into two categories in the current study: nuclear families and joint families. 35% farmers lived in joint families, whereas 65% farmers lived in nuclear families. In the research area, nuclear families were the majority. The majority of water loading station owners (64%) had nuclear families, while the 39 rest (36%) had joint families, which is similar to the current study findings (Asif *et al*. 2017). Shahjahan *et al.* (2003) observed similar sorts of family structure among Jamuna river fishermen.

The fish farmers were divided into five income categories. Notably, the majority of the respondents fell into the second category ranged from 1,00,000-2,00,000 which comprised 33.34% of the farmers. In contrast, the fifth category had the smallest representation, with only 8.33% of the farmers which were greater than 4,00,000 lakh. Zafar *et al.* (2020) reported that 46% of farmers had an annual income between BDT 1.51 and 1.8 lakh, which corresponds with the findings of the current study.

In the survey area, it was revealed that all of the selected fish farmers had access to electricity. Rahman *et al.* (2014) observed that 62% of fish farmers in Panchagarh Sadar had access to electricity, which contradicts the findings of the present study. The current study revealed that 41.67% of the farmers were members of organizations like ASA and BRAC, while 58.33% were not affiliated with any organizations. Ali *et al*. (2008) found that around 30% of farmers acquired technical knowledge from peers, and 15% received

technical support from the Department of Fisheries (DoF) and non-governmental organizations. These findings are consistent with the present study. As per Saha *et al.* (1995), the size of the ponds ranged from 0.05 to 0.15 ha. To reduce the cost of fish farming production, a suitable pond size is required.

The findings of the current study indicate that most ponds (58.5%) in the selected area ranged from 0.5 to 1.0 acre in size. Additionally, 22% of the ponds measured between 1.1 and 2.0 acres, 11.5% ranged from 2.1 to 3.0 acres, and 21% were larger than 3 acres. According to Kundu *et al.* (2012), pond sizes ranged from 0.05 to 0.15 hectares. To minimize fish farming production costs, it is essential to have an appropriately sized pond. The study shows that 70% of the ponds used for fish culture were owned by the farmers, while the remaining 30% were leased. Hossain *et al*. (2002) reported that the majority (50.15%) of the ponds utilized for fish culture were owned by the farmers. The present analysis found that the average depth of the ponds in the selected sites was 1.5 meters, a result consistent with the findings of Kundu (2012) and Saha (2004).

In the selected study area, 78.00% of farmers used ground water and the rest of 22% used surface water. Ahmed (2003) observed that 55% of fish farmers utilized groundwater, while 35.80% predominantly depended on rainwater, with only 9.20% utilizing surface water. This proportion was lower compared to the findings of the present study. Maintaining good water quality is essential for achieving optimal production outcomes. One recommended practice for ensuring good water quality is regular exchange of pond water. The observation revealed that 42% of fish farmers exchanged water as needed, while 11.8% performed weekly exchanges and 17.6% did on a monthly basis. Ali *et al.* (2014) found that a mere 8% of farmers practiced pond water exchange, while the majority, constituting 92% of farmers, did not exchange pond water during the culture period.

In these study areas 50% of fish farmer was applied lime at a rate of 130 kg/ha in the current study areas whereas TSP and Urea were used at a rate of 16 to 50 kg/ha/7days and 10 to 70 kg/ha/7days respectively. Following the research conducted by Hossain (2011), a strategy to address low alkalinity and high turbidity in the ponds was executed through lime treatment. This involved applying a basal dose of 750 kg per hectare and periodic doses of 60 kg per hectare every fortnight. Hossain *et al.* (2022) discovered that organic manure was not utilized, with only sporadic application of inorganic fertilizers, such as urea at 120 kg per hectare per month and triple superphosphate (TSP) at 635 kg per hectare per month, aimed at augmenting natural feed. Additionally, regular supplementary feed was administered to enhance fish growth.

In the study areas, a crucial aspect of carp fattening was the use of growth promoters, with approximately 88% of farmers incorporating them into their culture systems. Among these, the majority favored Growmix (15.8%), Aquamix (25.5%), and Growmix (15.8%) as the most commonly used growth promoters. In the research area, farmer raised Rui, Catla, Mrigal, Silver Carp, Grass Carp, Mirror Carp, and Big Head Carp for fattening. Rahman (2014) found that almost all farmers engaged in polyculture practices. Additionally, it was observed that 60-70% of farmers in Panchagarh Sadar cultured Rui, Catla, and Mrigal.

In the research area, farmers manage fish density by maintaining a sufficient availability of natural food and allowing fish to move freely within the pond. The stocking densities per hectare were as follows: for surface feeders, Catla ranged from 280 to 500, Silver Carp from 150 to 300, and Bighead from 150 to 250; for column feeders, Rui ranged from 450 to 650; for bottom feeders, Mirror Carp ranged from 200 to 400, Mrigal from 450 to 700, and Grass Carp from 250 to 450, distributed across surface, column, and

marginal levels. Bhanu *et al.* (2018) recommend that aquaculture species combinations incorporate surface, column, and bottom feeder fish varieties.

Various types of probiotics were utilized by fish farmers in the study region as per the present investigation which are Safe gut, Navio plus, MI plus, Protox aqua, Aquaphoto and Dellomax. Probiotics play a pivotal role in fish culture, offering numerous benefits that contribute to the overall health, growth, and productivity of fish populations. Sultana *et al.* (2004) investigated the use of probiotics in aquaculture systems in several districts, highlighting its effectiveness in improving fish health and growth. Similarly, Uddin *et al.* (2017) explored the application of probiotics in fish farming practices in different regions, emphasizing its role in enhancing water quality and disease resistance.

In the study areas, farmers identified parasitic diseases as their primary concern. A significant 84.70% of farmers reported lice infestations. Among these, 45.80% utilized Killer Argulouse, 30.60% used Deltrix (Fishtech), and 8.30% employed Sumithion as treatments. Kibria *et al.* (2022) found a slightly higher prevalence of lice infestations, reported by 88.13% of farmers. The treatment method reported by Kibria *et al.(*2022) involved the use of Killer Argulouse at a rate of 500 mL per hectare at 15-day intervals, which was utilized by 55.93% of fish farmers.

According to the present study, 50.60% farmers reported social problems as the single most important problem for aquaculture. While respondents were identified technical problems (30.75%), financial problems (41.03%), to be the most important problems in the study area while only 8.17% farmers had no problems. As reported by Jahan *et al.* (2018), 35.80% of fish farmers experienced social issues. Respondents also mentioned technical issues (26.70%) and budgetary issues (30%). Islam (2010), on the other hand, discovered that the restrictions for sustainable pond fish farming in the selected study

location were a lack of technical expertise among fish farmers in the Maulvibazar district. Theft of fish and pollution of pond water, as well as a lack of cash and technical knowledge, were identified as key issues in Natore district by Saha (2003).

According to the report, all farmers supply feed on their farms. Most of the farmers (63.33%) relied solely on commercial feed of them. According to Rahman (2007), 80% of farmers used additional commercial feed made from rice bran and mustard oil cake. Rahman (2014) stated that farmers employed fish feed such as mustard oil cake, rice bran, wheat bran, fish meal, soyabean meal, and so on in their farms. Jahan *et al.* (2018) was found from the survey that 100% of the fish farmers supplied feeds to the cultured species manually, that is similar to the present study.

In the study area 13.33% farmers did not utilize feeds from companies in the selected locations. Of the farmers, 25% used Mega feeds; 21.67% used Quality feeds, 11.56% used Nourish feeds; 8.34% used Paragon feeds; 16.67% used ACI godrej feeds; 6.76% used Aftab feeds; 6.76% used CP feeds; and 3.34% used Tangwei feeds. Jahan *et al.* (2018) observed that fish farmers predominantly used Mega feeds (35%), followed by Nourish feeds (8%), Aftab feeds (3%), Eon feeds (3%), and only a small percentage utilized Provita feeds (3%), with approximately 30% of farmers opting not to use commercial feeds in the surveyed areas. In contrast, Alam *et al*. (2012) documented that farmers in Fulpur areas of Mymensingh district utilized a variety of commercial fish feeds, including ACI feed, Aftab feed, Nourish feed, CP fish feed, Mega fish feed, Saudi Bangle feed, and Quality fish feed.

In the chosen areas, 40.8% of the respondents on average had "semi paka" rooms for storing feed, compared to 30% who had "kacha" rooms, 20.56% who had "paka" rooms, and 8.64% who had no feed storage at all. As per Jahan *et al.* (2018), the vast majority of

fish farmers (97%) possessed feed storage facilities. Among them, more than half of the respondents (52.50%) utilized 'kacha' rooms for feed storage, while 25.50% utilized "paka" rooms, 18.30% had "semi paka' rooms, and only 3.30% lacked any feed storage facility.

CHAPTER VI

SUMMARY AND CONCLUSION

6.1 Summary

The study provides a comprehensive analysis of fish farming practices and the socio-economic status of fish farmers in the Natore district. This analysis spans various aspects, including personal information, farm-related details, cultural practices, and feed, feeding, and marketing information.The demographic analysis reveals a predominant age group of 41-50 years (40%) among fish farmers, highlighting the experience that comes with age in this sector. The gender distribution is significantly skewed, with 89.83% of the farmers being male. Education levels among farmers show diversity, with the majority having attained secondary education (30%), followed by higher secondary education (23.33%). This indicates a relatively educated group, which is beneficial for adopting modern farming techniques. Family structure analysis shows a preference for nuclear families (65%) over joint families (35%). When it comes to annual income, 33.34% of the farmers earn between BDT 1,00,001-2,00,000, and another 31.67% earn BDT 2,00,001-3,00,000, reflecting a moderate income range. Notably, all farmers have access to electricity, indicating a basic level of infrastructural development. However, only 41.67% are members of organizations like ASA and BRAC, suggesting limited engagement with formal farming communities or cooperatives.

The data on pond ownership and water sources indicate that most ponds (70%) are owned by the farmers themselves, which provides them with better control over their farming practices. The size of the ponds varies, with a majority (58.5%) being small to medium-sized (0.5-1.0 acre). Groundwater is the primary source of water (78%),

underscoring the reliance on natural resources. Effective water quality management practices are in place, with 80% of farmers using lime and regular water exchange to maintain optimal conditions. Pond preparation is thorough, involving the use of lime, fertilizers, and growth promoters, which are crucial for enhancing fish growth and health.

In terms of species cultivated, the study highlights the prevalence of various carp species, reflecting a focus on commercially viable and popular fish types. Farmers maintain specific stocking densities, balancing between maximizing production and ensuring fish health. Feeding practices show a reliance on both commercial and homemade feeds, with 63.33% of farmers opting for commercial feed and Mega being the most popular brand. Most farmers feed their fish twice daily using manual methods, which, while effective, could benefit from mechanization for greater efficiency. Feed storage facilities vary, with a significant number having semi-permanent structures (40.8%), indicating a need for better infrastructure to prevent feed spoilage and ensure consistent quality.

Feed and feeding practices are critical to fish farming success. The reliance on commercial feed (63.33%) indicates an awareness of the nutritional needs of fish and the benefits of formulated diets. However, the manual feeding methods prevalent among farmers suggest room for improvement in efficiency through automation. Storage practices also need enhancement, as a considerable number of farmers (40.8%) use semi-permanent storage facilities, which may not provide optimal conditions for preserving feed quality. Marketing practices reveal a predominantly local market orientation, with most farmers (70%) selling their produce within the district. This local focus, while beneficial for reducing transportation costs, may limit market reach and profitability.

Fish farmers in Natore face several challenges that impact their productivity and sustainability. Theft is a significant concern, with 65% of farmers reporting it as a major

issue. This not only affects their income but also adds to the operational stress. Technical knowledge is another critical area, with many farmers lacking the expertise needed to adopt advanced farming techniques and disease management practices. High production costs, particularly for feed and disease management, further strain their resources. Additionally, market fluctuations pose a risk, making it difficult for farmers to achieve consistent income levels.

6.2 Conclusion

The research project offers a detailed overview of fish farming practices and the socio-economic conditions of fish farmers in the Natore district. The findings indicate that the majority of fish farmers are middle-aged, educated males with a moderate income, suggesting a stable and experienced workforce essential for sustainable fish farming. However, the low participation of women and younger individuals points to the need for inclusive policies to encourage broader engagement in the sector. Farm-related data show that most farmers own their ponds, allowing them significant control over their operations. The reliance on groundwater emphasizes the necessity for sustainable water management practices to ensure long-term viability. Farmers are diligent in pond preparation and water quality management, reflecting their commitment to optimal fish growth and health. Cultural practices focus on commercially viable carp species, with farmers adopting specific stocking densities and feeding practices to maximize production. The preference for both commercial and homemade feeds, especially the Mega brand, indicates an understanding of fish nutritional needs. However, the manual feeding methods highlight the potential benefits of mechanization for improved efficiency. Farmers face several challenges, including theft, knowledge gaps, high production costs, and market fluctuations. These issues hinder productivity and sustainability, indicating the need for targeted interventions.

In conclusion, addressing the identified challenges with the recommended measures holds significant potential for growth in the fish farming sector. These improvements can enhance economic outcomes for farmers and contribute to the overall development of the region's agricultural economy, ensuring a sustainable future for fish farming in Natore.

6.3 Recommendations

- Improve access to information is needed on best practices, market trends, and new technologies through digital platforms and extension services.
- Investment should be needed in high-quality, nutritionally balanced feed specifically formulated for carp fattening and implementation of feeding schedules is necessary that maximize growth rates while minimizing waste.
- Collaboration between farmers, researchers, and policymakers should be increased to address the challenges faced by the fish farming industry comprehensively.
- Access to credit and financial support for farmers should be facilited to invest in better equipment and expand their operations.
- Implementation of policies and initiatives is required to encourage greater involvement of women and young people in fish farming.
- Provide regular training programs on advanced fish farming techniques to improve productivity and efficiency.

REFERENCES

Ahmed MNU. 2003. Fisheries sector in the economy of Bangladesh and it development prospects. Saranica: Matshwa Pakhha. Department of Fisheries, Ministry of Fisheries and Livestock, Bangladesh. 11-15.

Ahmed N. & Garnett S. T. 2011. Integrated rice-fish farming in Bangladesh: meeting the challenges of food security. Food Security, 3(1), 81-92.

Alam MK, Habib MA and Tahmid MS. 2012. A survey on commercial fish feed used at Fulpur area in Mymensingh district. Journal of the Bangladesh Agricultural University. 10(452-2016-35556): 175-178.

Ali MH, Hossain MD, Hasan ANGM and Bashar MA. 2008. Assessment of the livelihood status of the fish farmers in some selected areas of Bagmara upazilla under Rajshahi 47 district. Journal of the Bangladesh Agricultural University. 6(2): 367-374.

Ali MM, Hossain MB, Rahman M and Rahman S. 2014. Post stocking management practices by the pond fish farmers in Barisal district, Bangladesh. Global Veterinaria. 13(2): 196-201.

Asif A, Habib MA. 2017. Socio-economic condition of fish farmers of Jhikargachha upazila in Jessore district, Bangladesh. Asian Journal of Medical and Biological Research. 3(4): 462-475.

Belton B, Karim M, Thilsted SH, Murshed-E-Jahan K, Collis W & Phillips M. 2011. Review of aquaculture and fish consumption in Bangladesh. Studies and Reviews. pp. 53.

Bhanu, Prakash CH, Khairnar SO, Mandal A, Kumar A and Kumar B. 2018. Composite fish farming: A review on economic enterprise for rural empowerment and livelihood generation. International Journal of Fisheries and Aquatic Studies. 6(4): 545-550.

Bhuiyan MIA. 2002. Effects of different supplementary feeding methods on growth of fish in carp polyculture. MS Thesis. Department of Aquaculture, Bangladesh Agricultural University, Mymensingh. pp. 94.

Das, M., Khan, M. N. A., & Hasan, M. R. 2020. Status and challenges of carp aquaculture in Bangladesh: A review. Aquaculture Reports, 17, 100360.

DoF 2012. National fish week compendium (in Bengali). Department of Fisheries, Ministry of Fisheries and Livestock, Bangladesh

DoF 2022. Annual Report. Department of Fisheries, Ministry of Fisheries and Livestock. The Government of Peoples Republic of Bangladesh.

DoF 2023. Jatiyo Matsyo Saptaho Report. Department of Fisheries, Ministry of Fisheries and Livestock. The Government of Peoples Republic of Bangladesh.

FAO 2020. Fishery and Aquaculture Country Profiles: The People's Republic of Bangladesh.

Halim MA, Rayhan A, Sharmin S, Mondal DK. 2021. Status of pond fish farmers in some selected areas of Mithapukur upazila under Rangpur district, Bangladesh. SSRG International Journal of Agriculture & Environmental Science. 4(3): 13-17.

Hasan MR, Ahmed GU. 2002. Issues in carp hatcheries and nurseries in Bangladesh, with special reference to health management. Food and Agriculture Organization Fisheries Technical Paper. 6(2): 147-164.

Hossain MA, Alam MR, Haque MR and Mehbub MF. 2013. Study on present status of carpsis polyculture in Dinajpur district of Bangladesh. Bangladesh Research Publication Journal. 2: 123-130.

Hossain M. A. R. 2014. An overview of fisheries sector of Bangladesh. Research in Agriculture, Livestock and Fisheries. 1(1): 109-126.

Hossain ME, Khan MA, Saha SM and Dey MM. 2022. Economic assessment of freshwater carp polyculture in Bangladesh: Profit sensitivity, economies of scale and liquidity. Aquaculture. 548: 737552.

Hossain ZA. 2011. Effect of fertilization techniques on fish growth in ponds under red soil zone of northern Bangladesh. Bangladesh Journal of Progressive Science and Technology. 9 (2): 192-196.

Hossen MHA, Sarker K, Chhanda MS and Gupta N. 2019. Effects of water depth on growth performance of Indian major carps at a poly culture system in Bangladesh. International Journal of Aquaculture and Fishery Sciences. 5(3): 14-21.

Islam MR, Das M, Akter T, Kawser AQMR and Mondal MN. 2018. Present status, problems and prospect of fish farming at Gazipur Sadar upazila in Bangladesh. Progressive Agriculture. 29(1): 53-63.

Islam S. 2010. Studies on pond fish farming and livelihoods of rural farmers in some selected areas of Moulavibazar district. Ms Thesis. Department of Aquaculture, Bangladesh Agricultural University, Mymensingh. pp. 36.

Jahan H, Parvez I and Kibria ASM. 2018. Current aquaculture practices in Dinajpur District: Special emphasis on fish feeds. International Journal of Fisheries and Aquatic Research. 3(1): 35-42.

Kabir MS. 2009. Assessment of the livelihood status of the fish farmers in some selected areas of Trishal Upazila under Mymensingh district. MS Thesis. Department of Aquaculture, Bangladesh Agricultural University, Mymensingh. pp. 39.

Kawsar A. 2012. Quality Assessment of Some Commercial Fish Feeds Available in Mymensingh Sadar and Trishal Upazilla. Bangladesh Journal of Training and Development, Department of Aquaculture, Bangladesh Agricultural University, Mymensingh. pp. 62.

Khan MA, Hossain ME, Saha SM, Dey MM. 2020. Economic assessment of freshwater carp polyculture in Bangladesh: Profit sensitivity, economies of scale and liquidity. Aquaculture. 548: 737552.

Khan S, Hossain MS and Haque MM. 2009. Effects of feeding schedule on growth, production and economic of pangasiid catfish (Pangasius hypophthalmus) and silver carp (Hypophthalmichthys molitrix) polyculture. Journal of Bangladesh Agricultural University. 7(1): 175-181.

Kibria ASM, Rana MM, Khatun M. 2022. Carp Fattening and Socio-economic Status of Farmers of Dinajpur District, Bangladesh: An Expedient Overview. Asian Journal of Fisheries and Aquatic Research. 17(5):32-48.

Kunda M, Rishan ST, Shipra NT and Fagun IA, 2020. Present status of aquaculture and socio -economic condition of fish farmers in a rural setting in Bangladesh. Research in Agriculture Livestock and Fisheries. 7(2): 329-339.

Kundu D. 2007. Present Status of prawn farmers and Socio-economic Condition of the Fishermen in the Baculiarhaor, Itna, Keshoregang. Bangladesh Journal of Training and Development, Department of Fisheries Management, Bangladesh Agricultural University, Mymensingh. pp. 62.

Kundu P. 2012. Study on the socio economic aspects and livelihood of fisherman in Gopalpur upazila under Tangail district . MS Thesis . Department of Aquaculture, Bangladesh Agricultural University, Mymensingh. pp. 78.

Monir S, Bagum N, Rahman S, Ashaf-Ud-Doulah M, Bhadra A and Borty SC. 2015. Parasitic diseases and estimation of loss due to infestation of parasites in Indian major carp culture ponds in Bangladesh. International Journal of Fish Aquaculture Study. 2: 118-122.

Munguti JM, Musa S, Orina PS, Kyule DN, Opiyo MA, Charo-Karisa H and Ogello EO. 2014. An overview of current status of Kenyan fish feed industry and feed management practices, challenges and opportunities.

Rahman MH and Miah TH. 2001. Economics of pond fish culture in some selected areas of Bangladesh. Bangladesh Journal of Fisheries Research. 5(1): 95-100.

Rahman M. M, Hasan M. R & Rahman, M. A. 2019. Diseases and mortality in freshwater carp aquaculture in Bangladesh: a review. Reviews in Aquaculture, 11(1), 110-123.

Rahman MA, Toky MT, Islam MS and Mukta MA. 2020. Economic analysis of tilapia-carp polyculture in a selected area of Bangladesh. Archives of Agriculture and Environmental Science. 5(3): 354-362.

Rahman MA. 2007. An economic study of pond fish culturein some selected areas of Mymensingh district. MS Thesis. Department of Agricultural Economics, Bangladesh Agricultural University, Mymensingh. pp. 94.

Rahman MH, Zafar MA, Hossain MA and Kibria ASM. 2018. Present status of integrated aquaculture in some selected areas of Nilphamari District in Bangladesh. International Journal of Fisheries and Aquatic Studies. 6(2): 290-295.

Rahman MR. 2014. Aquaculture practices followed by the fish farmer in Panchagarh sadar upazila. MS Thesis. Department of Aquaculture. Bangladesh Agricultural University, Mymensingh. pp. 58.

Rahman MS, Kazal MMH, Rayhan SJ and Manjira S. 2021. In Press. Adoption determinants of improved management practices and productivity in pond polyculture of carp in Bangladesh. Aquaculture and Fisheries. https://doi.org/10.1016/j.aaf.2021.08.009.

Saha MK. 2003. A study on fish production technology in North-west Bangladesh. M.S. thesis, Department of Aquaculture, Bangladesh Agricultural University, Mymensingh. pp. 71.

Saha SK. 2004. Socio economic aspect of Aquaculture in Tangail Sadar Upazila, Ms. Thesis, Department of Aquaculture, Bangladesh Agricultural University, Mymensingh. pp. 77.

Saha SM, Hossain ME, Khan MA and Dey MM. 2022. Economic assessment of freshwater carp polyculture in Bangladesh: Profit sensitivity, economies of scale and liquidity. Aquaculture. 548: 737.

Saha, D., Das, P., & Hossain, M. Y. 2020. Water Quality Monitoring in Aquaculture Management in Bangladesh. Aquaculture and Fisheries. 5(3): 85-91.

Sarker, R., Rahman, M., & Hossain, M. A. 2018. Indigenous Fish Seed Production and Management in Bangladesh. Journal of Fisheries and Aquatic Science. 13(1): 1-8.

Sayeed MAB, Hossain GS, Mistry SK. and Haq K.A. 2008. Growth performance of Thai pangus (*Pangasias hypophthalmus*) in polyculture system using different supplementary feeds. University Journal of Zoology. Rajshahi University. 27: 59-62.

Shahjahan MM, Islam S, Bapary MAJ, MIAH MI. 2003. Study on the fisheries on socio economic conditions of fisherman of the Jamuna river. Bangladesh Journal of Fisheries Research. 26: 42-52.

Sultana N. 2004. Use of chemicals in aquaculture activities in Mymensing area. M.S. Thesis. Department of Aquaculture, Bangladesh Agricultural University, Mymensingh, Bangladesh. pp. 81.

Tanjeena Z, MAS Jewell and AS Bhuiyan, 2007. Preesent status of pond fishery resources and livelihood of the fish farmers of Mohanpur upazila in Rajshahi district. University Journal of Zoology. Rajshahi University. 25: 31-35.

Taylor S, Robertson-Andersson D, Moodley G and Adeleke B. 2021. Aquaculture in Africa: A comparative review of Egypt, Nigeria, and Uganda vis-a-vis South Africa. Reviews of Fisheries Science & Aquaculture. 29(2): 167-197.

Uddin S, Hossain MA, Ahamed S, Iqbal MM and Akter M. 2017. Status of medicines,chemicals and antibiotics usages in freshwater aquaculture activities at Jaintapurupazila of Sylhet, Bangladesh.Algerian Journal of Environmental Science and Technology. 3(2): 5-10.

Zafar MA, Mia MF, Parvez I, Kibria ASM and Roy KC. 2020. Present status of aquaculture practices in some selected areas of Dinajpur District. Research in Agriculture Livestock and Fisheries. 7(2): 341-349.

APPENDIX

Department of Aquaculture

Hajee Mohammad Danesh Science and Technology University, Dinajpur

An Interview schedule on

"An Investigation on Carp Fattening in Natore District"
Serial no……..

(Please answer the following questions)

Section-A: Personal Information

Name of the respondent…….Phone no……

Village……..Union……Upazila……Post office……

1. Age:

What is your age? ……..years

2. Gender:

○ Male	○ Female

3. Educational qualification:

○ No education	○ Primary (up to class five)	○ S.S.C
○ H.S.C	○ Graduate	○ Masters

4. Marital Status:

○ Married	○ Unmarried

5. Family type:

○ Nuclear	○ Joint

6. Annual family income……..

7. Are you a member of any organization?

○ Yes	○ No

8. Name of the organization……

Section-B: Farm Information

9. Area of your pond .....ha

10. Depth of the pond……...

11. Sources of water:

○ Surface water	○ Ground water	○ Rain water	○ Others

12. Do you have water exchange facilities?

○ Yes	○ No

13. Do you have electricity facilities?

○ Yes	○ No

14. Ownership type of pond:

○ Own	○ Lease	○ Multi ownership

15. Are you prepared your pond before culture?

○ Yes	○ No

16. Which of the flowing step do you follow during pond preparation:

○ Dike preparation	○ Weed Cleaning	○ Drying
○ Liming	○ Aeration	○ Rotenone

17. Do you use fertilizer in your farm?

o Yes	o No

18. Which type of fertilizer do you use?

Fertilizer use	kg /(dec/ha/acre)

19. Lime, Salt, Fertilizer use

Name	Time Interval	(gm/kg)/(dec/ha/acre)
Lime		
Salt		
Fertilizer		

20. Growth promoter: Silver meal/…….) ……gm/kg feed

21. In carp fattening, which species do you use?

Species	Pond no.	Stocking density (no./dec)	Size (cm/gm)	price /No/kg	Sources of seed

22. How many production cycles do you produce per year?.....

23. Have any disease problem in your pond?

○ Yes	○ No

24. Which types of disease occur?

○ Bacterial	○ Viral	○ Fungal	○ Others

25. Medicine use to control parasite and disease

Name of parasite/ disease	Medicine use	Time interval	Dose (ml/L)/dec

26. 4.Do you face any problem in carp fattening?

○ Yes				○ No
○ Technical	○ Financial	○ Physical	○ Social	

Section-D: Feed and Feeding

27**.** What are the feed types you use in the pond/farm?

○ Farm made	○ Commercial	○ Others

28. Which brands of feeds do you use?

Name of the company
1. Mega
2. Nourish
3. Eon
4. ACI
5. CP
6. Aftab
7. Quality fish feed
8. Paragon
9. Others

29. What is the feeding frequency?

○ Two times	○ Three times

30. Which system do you follow during feeding?

○ Manual	○ Mechanical

31. Feed storage facilities:

○ Paka room	○ Semi-Pakka room	○ Kacha room