Introduction

1.1 Background

Bangladesh is a downstream nation with numerous rivers passing through it. Around the river, its civilization has grown. Although some are in decline, it has the majority of 700 rivers that are essential to the nation's culture. About 230 rivers are now running in Bangladesh, according to records kept by the Bangladesh Water Development Board (BWDB) (during summer and winter). Our country's economy is significantly benefiting from rivers. The primary resources of a river or other body of water are fish and creatures that resemble fish. In economically troubled Bangladesh, the fishing industry is already well-known for producing employment and money, as well as cheap sources of wholesome food for the population (Hasan et al., 2016, Rahman et al. 2012, FRSS-2012).

In the foreseeable future, Bangladesh could benefit from the fishing industry. Bangladesh is currently ranked third for inland open water capture production and fifth for aquaculture production (Department of Fisheries). The fishing sector contributed to Bangladesh's overall production of 45.03 lakh MT of fish in 2019–20, with a target of 45.52 lakh MT in 2020–21, according to the Fiscal Yearbook of Fisheries of Bangladesh 2019–20. Production grew at a 2.72 percent annual pace. More than one-fourth (26.37 percent) of all agricultural GDP—or 3.52 percent—comes from the industry of fishing. 1.39 percent of all export revenues come from fish and fishery products, with a substantial portion is contributed by Hilsa. Bangladesh is leading Hilsa-producing country in the world. Indirect or direct involvement in a range of fisheries-related activities provides a living for more than 12% of the population, including women. With a per capita fish consumption of 62.58 g/day compared to a goal of 60 g/day, Bangladesh has achieved self-sufficiency in the production of fish.

Fishermen are individuals who mostly depend on capturing fish to provide for their daily needs. Due to their poor income, they are one of Bangladesh's most vulnerable communities (Alam and Bashar, 1995; Kabir et al., 2012). Rivers offer a huge opportunity and promise for increasing fish output and the socio-economic security of the local population (Ali et al. 2014). A significant portion of rural families participates in part-time river and *beel* (open water large monsoonal water bodies) fishing (Haque et al.1991).

A method of subsisting is established by the skills, pursuits, and possessions (including both material and social resources). Fisheries resources are the only source of income for fishermen. A livelihood is everlasting when it can handle stresses and shocks, recover from them, and preserve or improve its capabilities and assets both now and in the future, all without compromising the natural resource base set up to build a whole picture of socioeconomic conditions (Chambers and Conway, 1992).

Individual techniques have been employed to eradicate poverty and continue rural development, and the sustainable livelihood strategy has gradually expanded with its own fundamental values and guiding principles for poverty-focused development efforts (Paul et al. 2013).

Fish are the main resource of the river; those are providing income source of the fisherman. As most of the fishermen are live under poverty and are accustomed to other work so they mainly rely on the river, estuary, or the other water adjacent sources. But the fisherman cannot full fill necessary commodities by catching fish for the constraint such as economic, social, and technical etc.Bangladesh's water and water sources are constantly being contaminated by industrial, metalloid, and other causes. (Arefin and Mallik, 2018; Islam et al., 2018; Faroque and South, 2022) Due to various sorts of pollution, fish production in the river estuary and other water resources has been declining day by day (Jolly et al. 2021).

The largest and most significant river in the Chattogram district and Chattogram hill tracts is the 'Karnafuli' River. It comes from the Lushai highlands in the Indian state of Mizoram. It flows 270 kilometers through Lushai hills to the south-west through Chittagong Hill Tracts and Chittagong into the Bay of Bengal (BOB) after traversing 180 kilometers of mountainous wilderness, making a narrow loop at Rangamati, and then continuing on a zigzag path before forming two other notable loops, the Dhuliachhhari and the kaptai (Miah, 2012).It is contaminated in several ways, most notably by sewage and industrial waste dumping. Raised anthropogenic activity has increased the risk of river pollution, particularly from heavy metal contaminants that may be hazardous to both people and aquatic life.

The presence of heavy metals in river water has a hazardous effect on aquatic life. In most of the sites, the concentration of heavy metals showed seasonal change and was higher in the winter than in the wet season (Dey et al. 2015). Salinity concentration of various sampling locations (SL) in the middle section of the Karnaphuli river (KR) water during two seasons (Roy et al. 2020).

Because of this, the number of fish in the river was dwindling, and the fisherman was having trouble catching any. So, the socioeconomic circumstances of fishermen are not good. They are unable to make the necessary income to cover their fundamental demands (Alam, 2005). Many facilities are unavailable to a sizable portion of fishermen. The fishing community's livelihood situation is not adequate; they must constantly strive to exist (Rahman et al. 2015).

A Rivers fishery resource is extremely important for alleviating rural poverty and providing food for the underprivileged fishing community (Minar et al. 2012). The seasonal richness of fish species in the Karnaphuli River directly affects the socioeconomic situation of fishermen. The average yearly income of a fisherman is BDT 2,442, which is around 70% less than the average income per capita for the entire nation (Minar et al. 2012, Mahmud et al. 2015, Alam, 1995). Therefore, it suggests that the fishermen's socioeconomic situation is inadequate.

To understand the socio-economic situation of the Karnaphuli River fishermen and an overview of the distribution of fish species in the fishing area, this study was carried out in these areas while taking into account these facts.

1.2 Objectives of the study

1. To know the socio-economic and livelihood status of fishermen of Karnaphuli River.
2. To find out the causes of declining fish resources and an overview of fish species distribution in this fishing area.

Review of literature

Prior to undertaking any experiment, it is crucial to be aware of relevant information from earlier study. This chapter's goal is to evaluate earlier research that has been done in the area by various researchers. The information that was previously completed and pertinent to the investigation was briefly discussed below in support of the current study.

Alam et al. (2009) stated that the majority of fisherman drank water from tube wells, but sanitary conditions and economic conditions (daily income of 100-150Tk per day) were not good. Fishermen were 44.4% illiterate, the nuclear family was prevalent, and 75% relied on the local doctor.

Hasan et al. (2011) in their study stated that most of the fishermen were lived in kancha house (78%), 34% illiterate and 46% can only sign. 75% had pure drinking water facility and sanitation condition was not good. Also stated that most of them had income ranged between 30000Tk to 38000Tk annually.

Kabir et al. (2012) found that many fishermen (88 percent) were uneducated, and that fishing was their primary source of income (70 percent). Muslim fishermen dominated that region (95 percent). They only had *"Kacha"* latrines (30%) and no other form of sanitation (60 percent). Most people have unhealthy living circumstances. The government did not provide them with a VGA (Vulnerable Group Feeding) card facility. Also argued that the government should give them access to educational institutions and resources to improve their economic and educational circumstances. Government assistance in the form of educational institutions and provision is required.

Minar et al. (2012) reported that most of fishermen were Muslim and had joint family. 80% fisherman was illiterate and no one can reached secondary level. Their sanitation situation was not good whereas around 74% had kacha and 16% had no latrines. They were not getting any kind of VGA form government.

Das et al. (2015) investigated that much fishermen were in the age group of 16 to 30 (45%), and dominant by hindu fisher flock (62%). Their education (75% illiterate), sanitation (59% kacha), housing (kacha 61%) and electricity (77% had no electricity) condition was not good. Some were used pond and river water for drinking purpose and got treatment from village doctor (78%). Also stated that the fishermen were not getting VGA card from Govt.

Ali et al. (2014) revealed that, more than half (60%) of the individuals in the fishing village were illiterate. Although 60% were semi-pakka, just 15% had *"Kacha"* sanitary latrines and 3% had none. Majority about 60% of the population drank water from the government school tube well.

Faruque and Ahsan (2014) stated that, most fishermen were Muslims while the majority of the population in other areas was Hindu. Since few Hilsa fishermen had any formal schooling, 67.54 % of them could only sign. Most residents drank and cleaned their houses with river water, and the dwelling conditions were not made of concrete locally known as "*Kacha*" (90 %). They made less money each day. The conflict between fishermen and non-fishers, animosity between Hindu and Muslim fishermen, extortion, issues with finance facilities, and issues with preservation facilities were their main obstacles.

Hossain et al. (2015) in their study stated that 90% of those were Muslims, and the rest were followers of Hinduism. Fishing communities had 50% illiteracy rate, 36% had no electricity, and 36% of the children did not attend school. Additionally, claimed that 45% of fishermen's revenue came from fishing and the fishermen suggested that the development of sanctuaries, the restriction of harmful fishing gear, and the prohibition of mother fish catches may enhance fish productivity, which was on the decline.

Trina et al. (2016) stated that majority of the fishermen were engaged with fishing (70%) there 55% were 10 to 30 aged groups. Housing condition 90% bamboo made wall with tin roof, majority had sanitation except 5%. Education condition was not good (57% can sign only, 7% illiterate).74% fisherman had annual income ranged between 40000-60000 BDT.

In their survey, Kamruzzaman and Hakim (2016) noted that the majority of fishermen were illiterate (65.71%) and that their economic, housing, and latrine conditions were not excellent.

Billah (2018) revealed that maximum fishermen were belongs to Muslim (96%) rest of them were Hindu and Buddhist. There had no illiterate person but 78% up to primary level.100% had Sanitary facility but most of semi pacca (88%), 59% children were out of education. Majority (26%) fisher's annual income was 30000 to 40000 BDT and treatment facility from village doctor (67%).

Hossen et al. (2018) stated that majority fishermen were belongs to Muslim and joint family (81%). Their sanitation situation was poor 18% had no sanitary facility. 59% were illiterate 71% lived in roof shed house, 73% had no electricity connection, 77% used govt. school area tube well. Most of them were poor (85%) had no alternative income source except fishing in their area.

Afrad et al. (2019) revealed that 75% fisherman had no particular own water body, illiterate percentage 26 and can sign only was 41.3%. Also stated that they were lived in kacha house (55%), their income was lower than the Govt. lower payment. And resource (fish) of the river was decreasing.

Hossain et al. (2014) investigated that 70% of fishermen were illiterate. Fishermen children drop out at a rate of 54 percent male and 46 percent female, 88 percent lived in kacha houses, and there was 100 percent electricity. They earn between 6000 and 15000 BDT per month. The majority (55%) of them took out loans from money lenders.

Sufian et al. (2017) revealed that highest percentage (72.5%) of fishermen were under poor income level (40000 to 60000 BDT), 57% were illiterate, 11.98% children dropped out earlier completing primary education, and their housing and sanitation condition was not good enough. They mainly got their health treatment form village doctor. They wanted to change their occupation for better livelihood.

Hossen et al. (2020) stated that, fishing was practiced by 60 percent of illiterate fishermen and 3.33 percent of children involved in fishing. They had poor sanitation (70 percent used kacha and 15 percent had no latrine) and poor power use (35 percent had no electricity). Additionally, stated that overfishing was caused by their low economic and educational conditions, a lack of other income sources during the ban period. And gender discrimination in their children's schooling and other subjects.

According to Uddin et al. (2020), the majority of fishermen were Hindu (66 percent), while the remaining fishermen were Muslims. Only 18 percent of fishermen were literate, 90 percent of them lived in tin sheds, 80 percent had their won tube wells, 56 percent had access to sanitation facilities, and 60 percent earned between 50,000 and 70,000 BDT annually. The village doctor and kabiraj treated the poor fisherman. They engaged in prohibited fishing-related activity throughout that time.

Islam et al. (2017) noted that this region's fishermen were predominately Muslim (94%) and only 32% could read and write. Their sanitary quality was just about 64% satisfactory. Approximately 71% of homes had mud walls and tin roofs. In peak season, 200-300 BDT per day was earned by the 70% of fishermen who possessed less than 50 decimal acres of land. People, there were more interested in domestic cow farming and mango business than in fishing.

Rishan and Fagun (2019) revealed that most of the fisherman used tube-well water except 3% (pond water), 75% had electricity, kacha house (19%), kacha latrine (29%), education was not good 7.25% illiterate and 65% can sign only. Also added that many of them wanted to change their occupation for off season scarcity.

Siddiqui (2018) found that kattoli and kumia region socioeconomic condition uplift 2005 in 2018 in many areas fisherman age group 20-30 was doniment (55% and 58%) in 2005 which was replaced by the 30-40 age group (50% and 46%) in 2018. Their housing, sanitary, health treatment condition, use of electricity, television, phone, and secondary education holder percentage also increase from 2005 in 2018. Muslim religion people and female number also uplift in this profession.

Momi et al. (2021) discovered that the river's biodiversity decreased as a result of dryness or a lack of water in a particular section, which led to siltation and illicit fishing. Due to their decreased revenue, they had an impact on the fishermen's way of life. They received no training or financial assistance from NGOs or GOs.

Rahman et al. (2012) found his study fishermen were chosen alternative livelihood generating activities such as poultry, livestock, small business, handicraft, crop farming, boatman, crab catching and fish farming for fish biodiversity decreasing in the river.

Abdullah-Bin-Farid et al. (2013) pointed out that in his study area majority fishermen were lived in kancha house (78%) and used kancha latrine (74%). Only 18% fisherman can complete their primary education. Also stated fish and other fish related fauna reduced drastically for siltation, overfishing and used of banned gear.

Hasan et al. (2016) reported that in survey fish farmer condition was better than the fisher man any point of view among them one was income fishermen 45000 to 100000 BDT where fish farmer income 70000 to 680000 BDT annually.

Rashed et al. (2016) reported the majority of fisherman (91 percent) were Muslims while the remainder were Hindus, only 67 percent had any formal education, and their yearly income ranged from 50,000 to 100,000 BDT. Age groups 21–30 and 31–40, which were represented by the 31 percentage, comprised the bulk of fisherman. They lost access to their neighborhood. Eighty percent of their money is spent on food and caring for their family (10 percent) after that, there may not be any savings left.

Akhtar et al. (2017) stated that fishermen were spent their maximum income for food, cloth and other necessary needs rather than education because of their low income.

Materials and Methods

3.1 Study Area and Study period:

Two areas were chosen to conduct this survey. One was North Mohara and the other was South Mohara, both of which were located along the Karnaphuli River in the Chattogram district under the chandgaon thana (Figure 1). That location was near the Kalur Ghat Bridge and located in between 22.3766104° N and 91.8757422° E. On the western side of this region, the rivers Karnaphuli and Halda converge. From July to December 2021, the survey
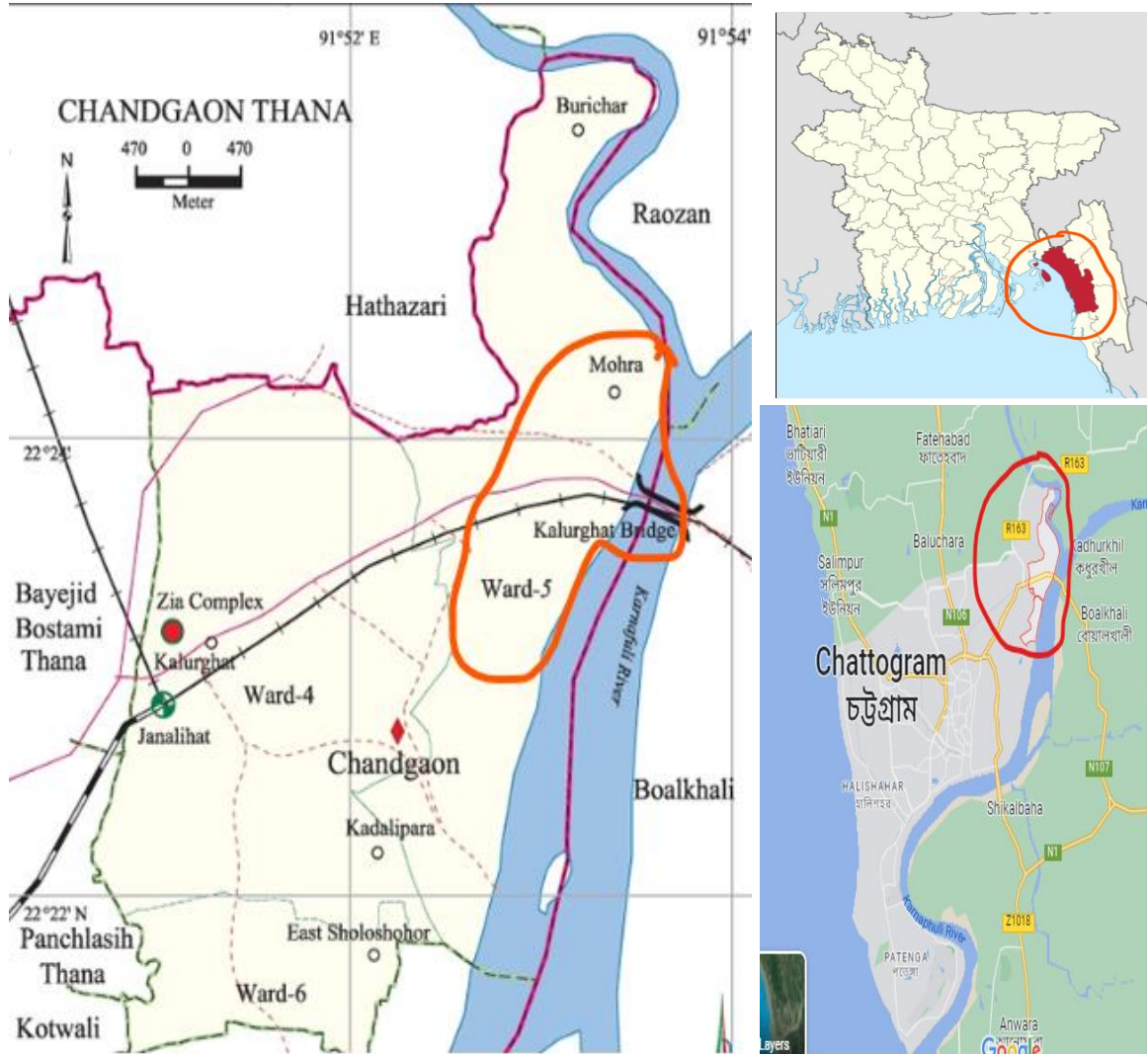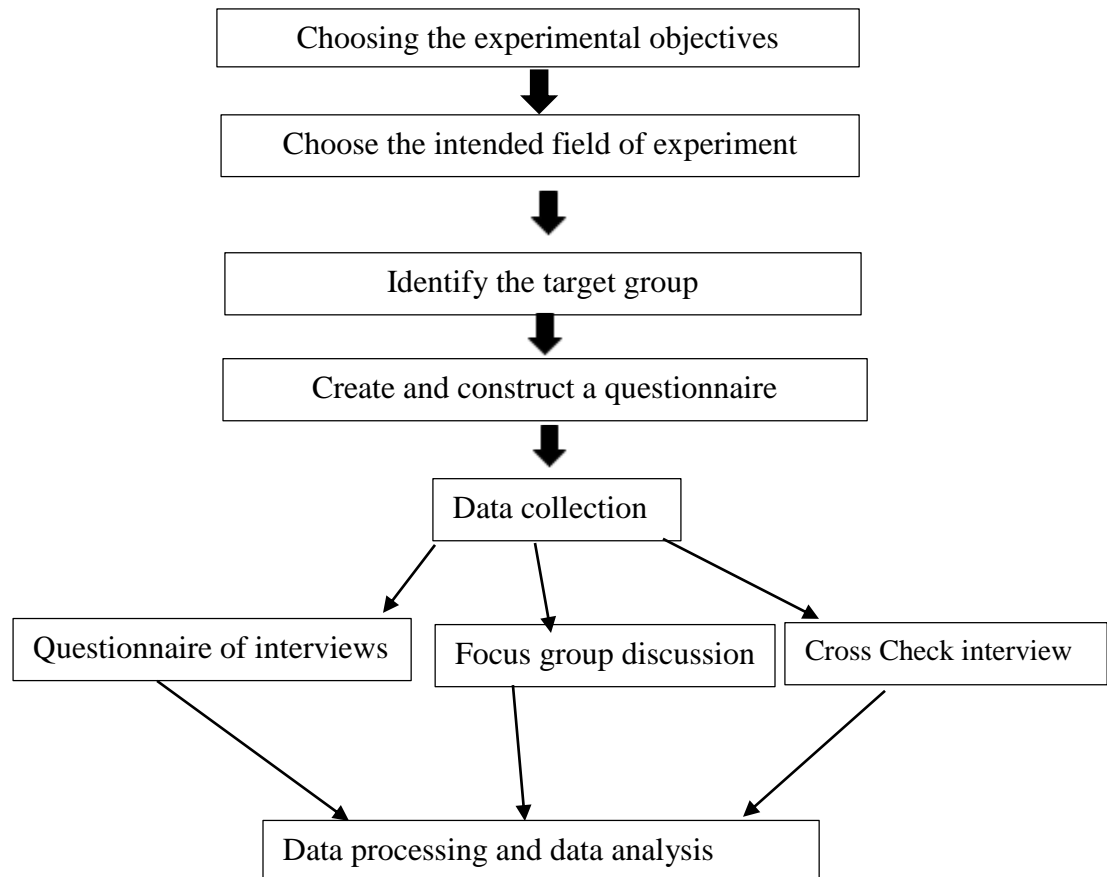

was conducted.

Figure 1: Mohra, Candgaon Thana, and Chattogram District are shown on the study area map of Bangladesh. The location of the Karnaphuli River sampling locations is indicated by the circle.

3.2 Experimental Design:

Experimental design is a part of research activity. An experimental design can be used to do research more successfully (Figure 2).

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│      Choose the intended field of experiment  │
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│            Identify the target group          │
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│       Create and construct a questionnaire    │
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Figure 2: Flow chart of investigation design

3.3 Data collection technique:

The primary method used to gather data for the study was a survey using a semi-structured questionnaire and in-person interviews with local fishermen. The alternative methods for using participatory tools in Participatory rural appraisal (PRA), like as Focus Group Discussions (FGD), key informant interviews, etc.

3.3.1 Personal interviews:

To conduct the interviews for this survey, 43 peoples were chosen at random (Figure 3). At their home, tea shop, and places of employment, the interview was done. The interview took place in the afternoon when they had free time. Interview data from both males and females were gathered in this area.

Figure 3: Personal interview

3.3.2 Focus group discussion:

In this study, focus groups were conducted to gather information from fishermen about the issues contributing to the depletion of fishing resources and potential solutions (Figure 4). This discussion also includes information on the general distribution of fish in their fishing region. Three focus groups were set up to conduct a conversation about various issues and potential solutions. Various folks provide various information.

Figure 4: Focus group discussion

3.3.3 Key informant interviews:

Key informant interviews were employed in the current investigation to learn more about all the material and to double-check the facts. The operator of the tea stand assisted in the selection of those who were knowledgeable with the community. These conversations took place at their home and a nearby tea shop. This led to the gathering of some fresh information regarding the region and its fishing resources. These section was also done in the district fisheries office with the fisheries officer (Figure 5). In this interview, familiar with the list of qualified professional fishermen from Mohra Ward. The list comprises the names of 195 fishermen who currently have fishing licenses and aids in cross-referencing the identities of fishermen who were gathered for the current study.

**Figure 5:** Key informant interviews

3.4 Data analysis:

Before the actual tabulation, the acquired data were carefully examined and summarized. Some of the information (fish name) was gathered in local units and then transformed to use in international units. Following data entry, SPSS Software 25 (Participant Gender, Religion, Marital status, occupation, Educational background, Family type, Housing condition, income, Working person in family, Economic condition, Sanitation type, Potable water source, Net type and Engaged time) and Microsoft Office Excel 2019 (Age group of fishermen, Children education condition of fishers' community, Catch composition, Stockholder's conflict, Regularly faced shock, Common problem faced, Crises faced in last 12 months, Fish resources decreasing factors and Initiative measure to arise fish production) were used to evaluate the data.

Results

4.1 Gender:

The fishermen gender was recorded in this survey area. From the recorded data there were 93.18% male and 6.82% female fishers found in this present study (Figure 6). The female fisher was doing mainly net making and line fishing.
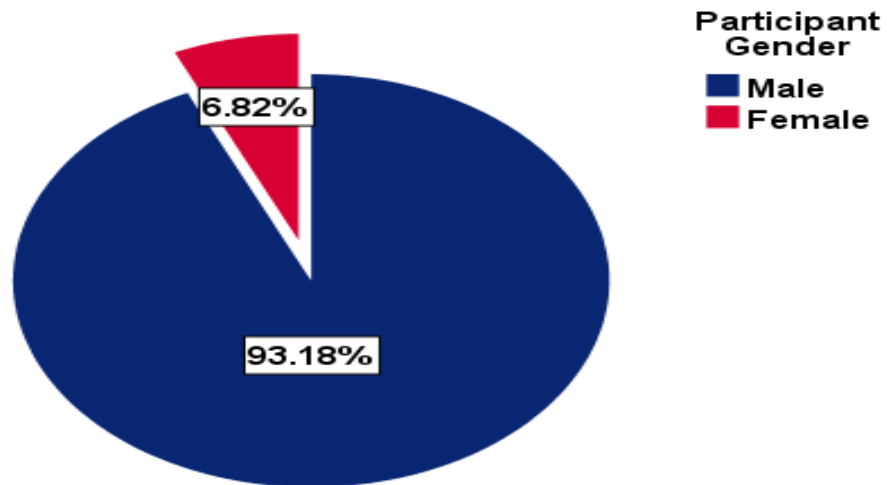
Figure 6: Gender distribution of fishermen in Chandgaon

4.2 Participant religion:

In this survey area fishermen were dominated by Hindu. About 95.45% were of the Hindu and the rest of them were Muslim (Figure 7). The area in which Hindu fishermen are dominant is called "Koiborta Para".
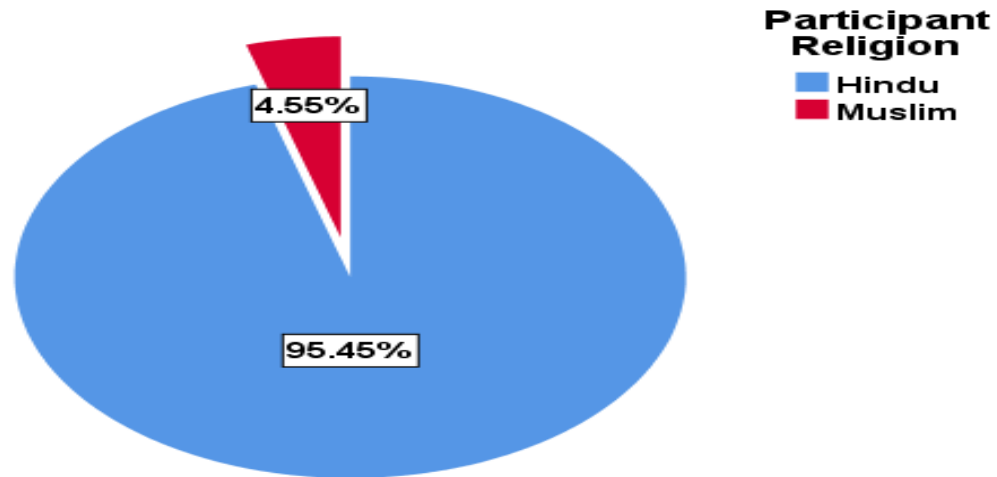
Figure 7. Religion status of participant of fishers' community

4.3 Marital status of fisherman:

In this present survey, found most of the fishermen were married, where around 97.73% were married fishermen, and 2.27% were unmarried (Figure 8).
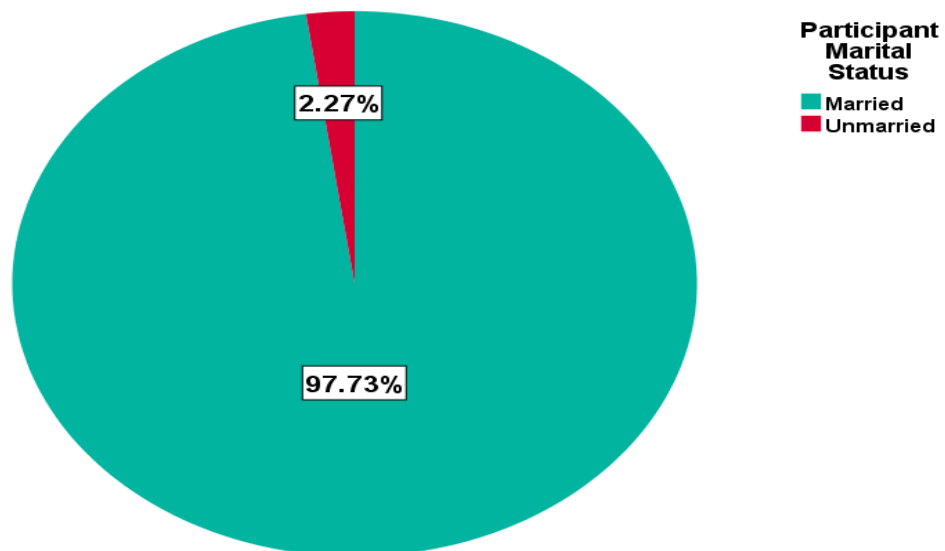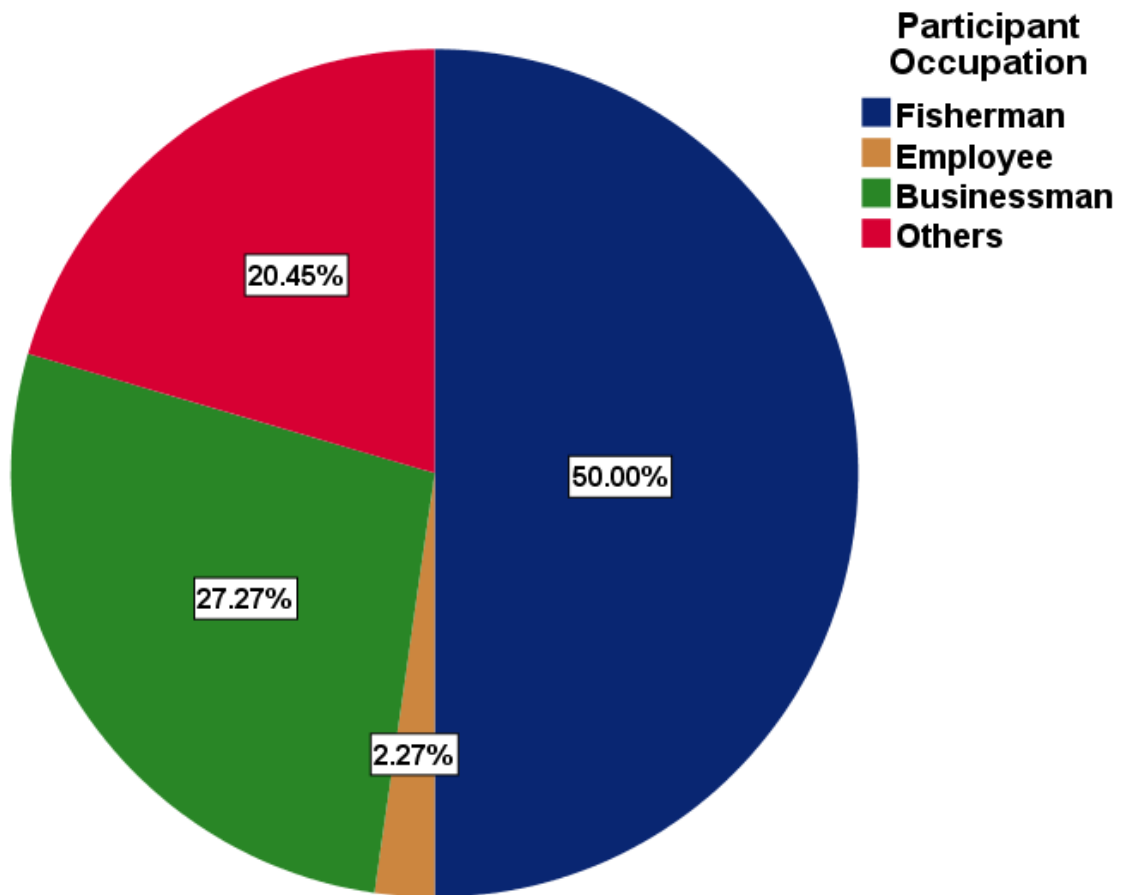
Figure 8: Marital status of fisherman

4.4 Participant occupation of the fishermen community:

In this fisher's community, various occupations people were lived. In this collected data, the majority were fishermen (50%), followed by small-scale businessmen (27.27%), employees (2.27%), and the rest of all others (20.45%) (Figure 9).

Figure 9: Participant occupation of the fishermen community

4.5 Educational background of all participants in fisher's community:

In this survey area of the fisher's community, some were Hons completed people. All participants' education conditions were classified as: can sign only (27.27%), up to class five (9.091%), class 6-8 (27.27%), and Class 9-10 (15.91%), HSC (6.818%), Hons (9.091%), and Illiterate (4.545%) (Figure 10). Illiterates had the lowest proportion, while classes 6-8 and can sign only had the same and highest proportion.
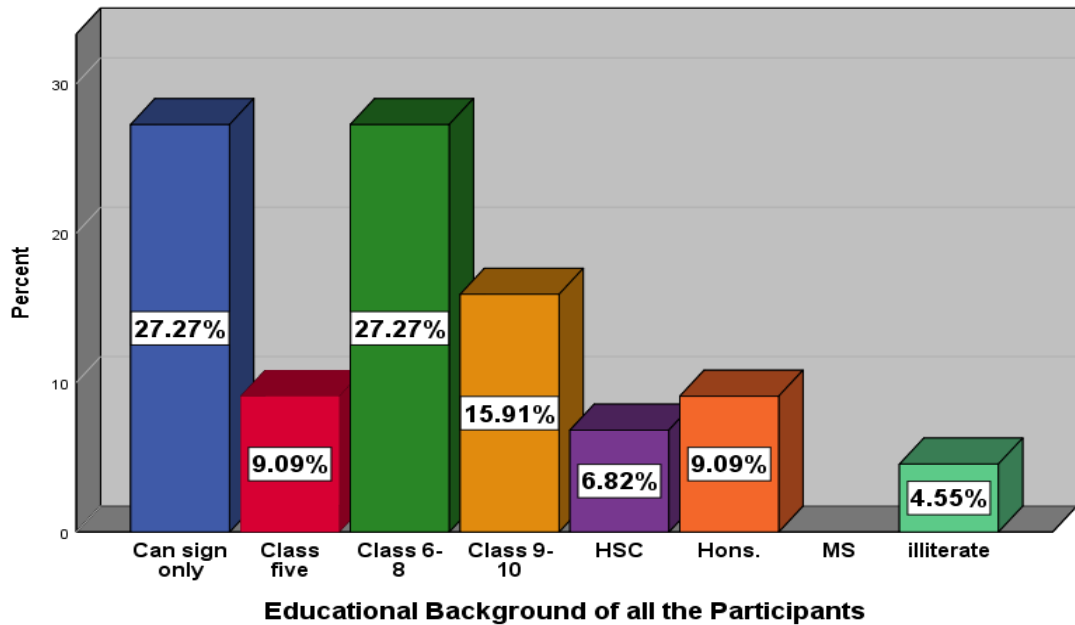
Figure 10: Educational background of all the participants

4.6 Education background of fisherman:

In this investigated area, found professional and occasional fishermen's educational qualifications were up to class10. Professional fishermen and occasionally fishermen's education backgrounds were categorized into: can sign only (54.55%), up to class five (13.64%), class 6-8 (4.55%), and class 9-10 (4.55%), and illiterate (9.09%) (Figure 11). The greatest number of fishermen (54.6%) were able to sign only one stage, with the lowest in classes 6-8 and 9-10.
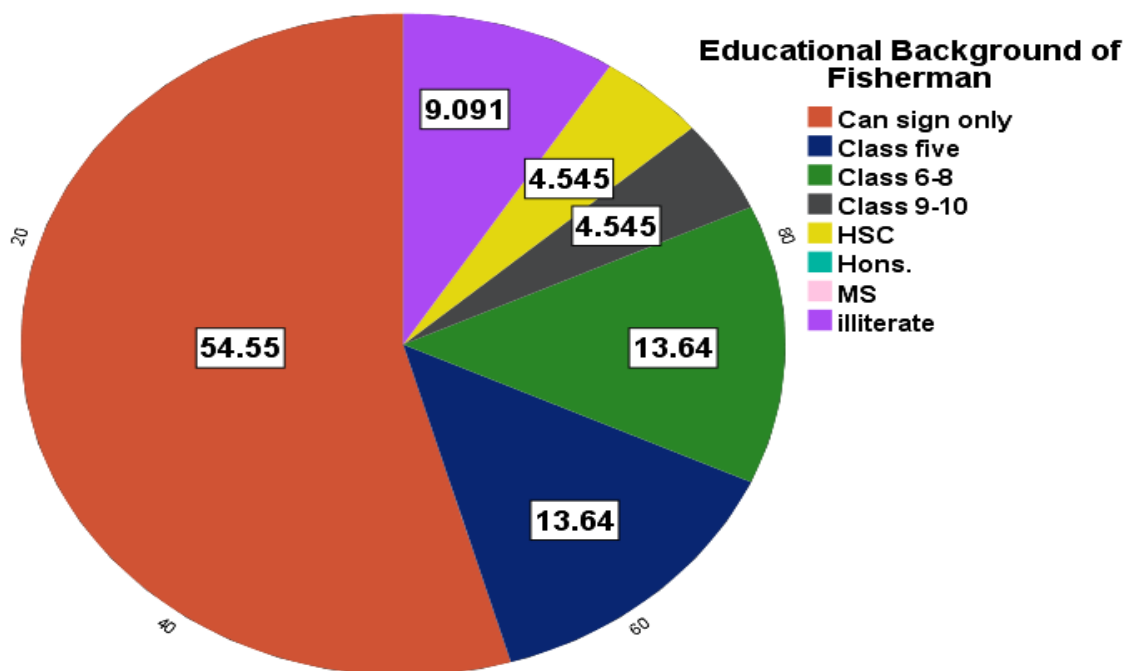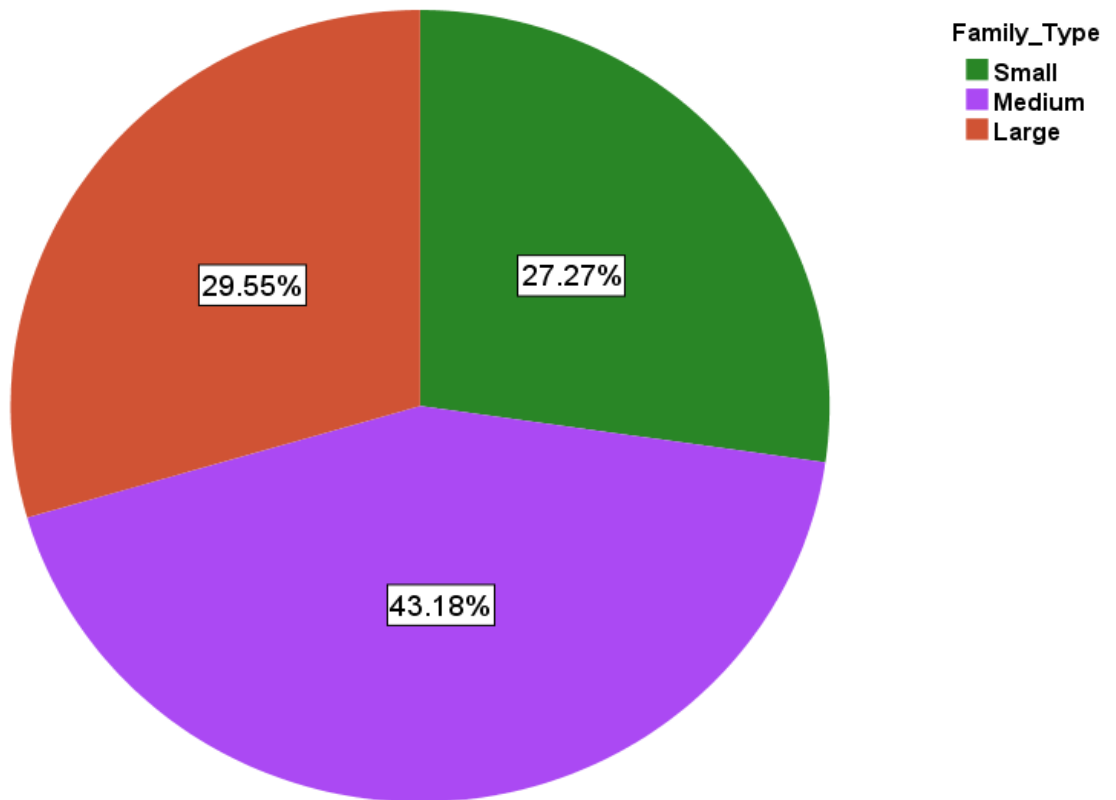

**Figure 11:** Education background of fisherman

4.7 Family Type:

The community type of Fishermen was inquired about and recorded. Most families were of average size. There were 43.18% medium-sized families (5-6 persons), 29.55% large families (> 7 persons), and 27.27% small families (2-4 persons) (Figure 12).

Figure 12: Family type of fishermen community

4.8 Age group of fishermen:

In this survey, the age of fishermen recorded by asking them. The recorded age of the participants ranged from 15 to more than 50. The age group of the fishermen was categorized as: below 15 years, 15-30 years, 31-40 years, 41-50 years, and > 50 years. The maximum proportion was aged 31–40 years (48%) and the lowest was aged 41–50 years. No one was aged below 15 years (Figure 13).
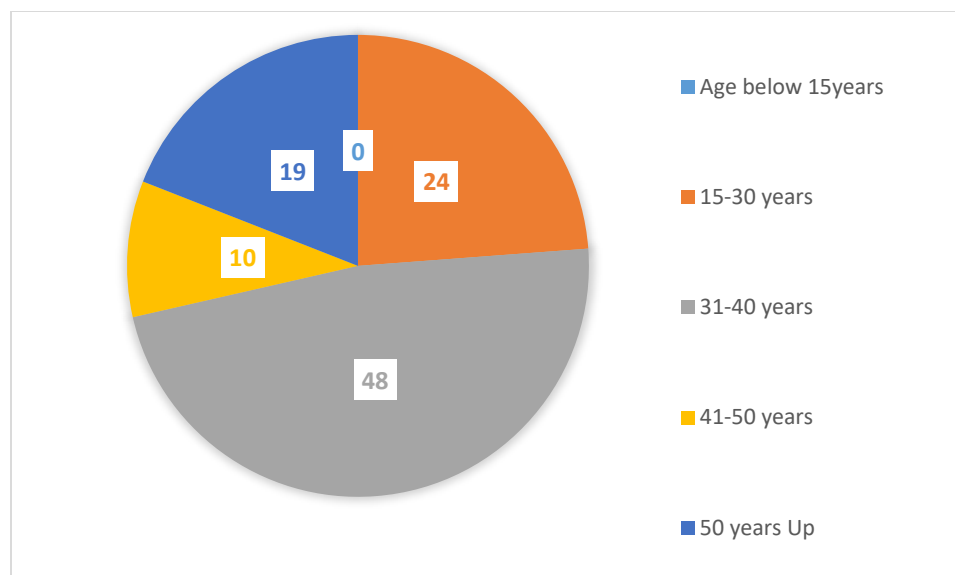
Figure 13: Age group percentage of fishermen

4.9 Children education condition of Fishers' community:

Schooling indicates the education facilities and awareness of the people in this area. In this present survey, 97% of fishermen's children attended school, with 3% dropping out due to family income problems (Figure 14).
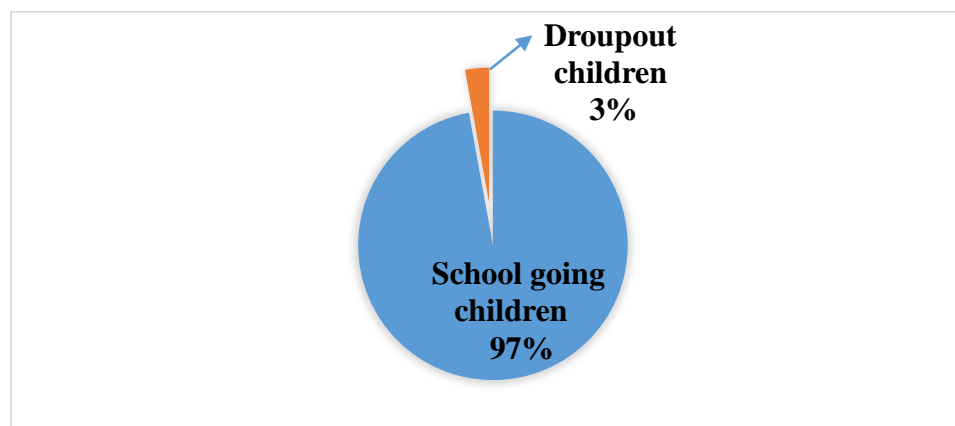
Figure 14: Children education condition of Fishers' community

4.10 Housing condition of the participants:

In a person's socioeconomic analysis, their housing condition is crucial. According to survey data, most people (37.21%) lived in the roof and tin-wall houses, while a smaller percentage lived in tin-roof with bamboo fence wall houses (13.95%), and others lived in semi-concrete (30.23%) and concrete houses (18.60%) (Figure 15).
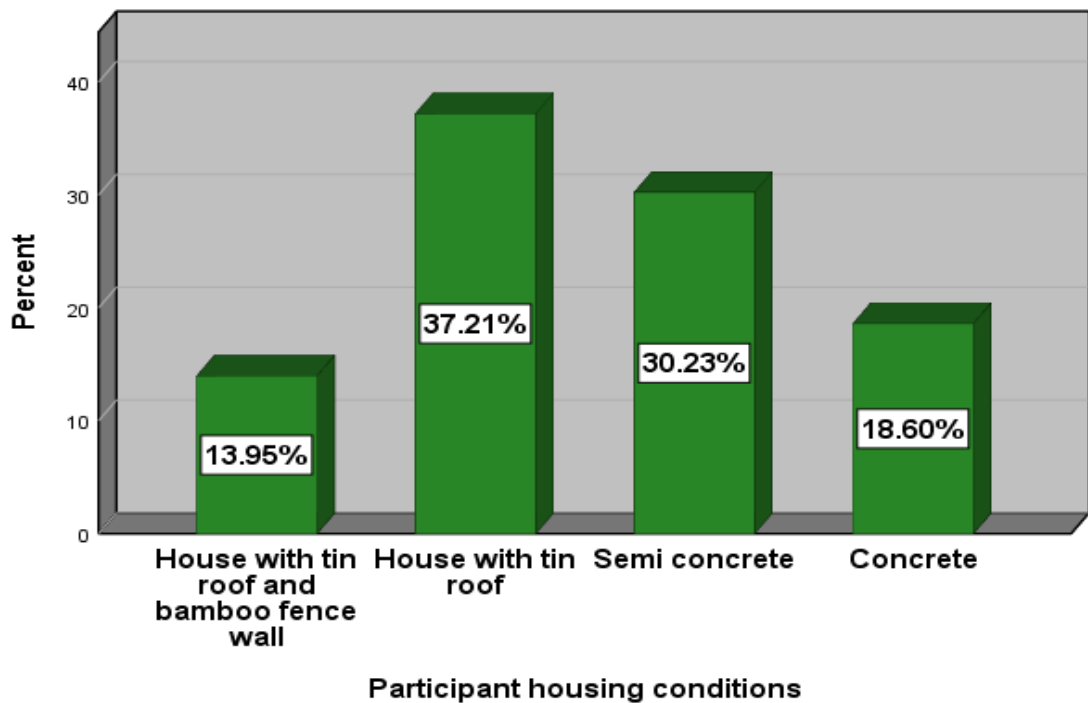
Figure 15: Housing condition of the participants

4.11 Income of fisherman:

Income determines many things in life. The present recorded survey data indicates that for fishermen in this region, daily income was not good enough. 38.10% below 100tk, 33.33% (100-200tk), 19.05% (200-300tk), 9.52% (300-400) (Figure 16).
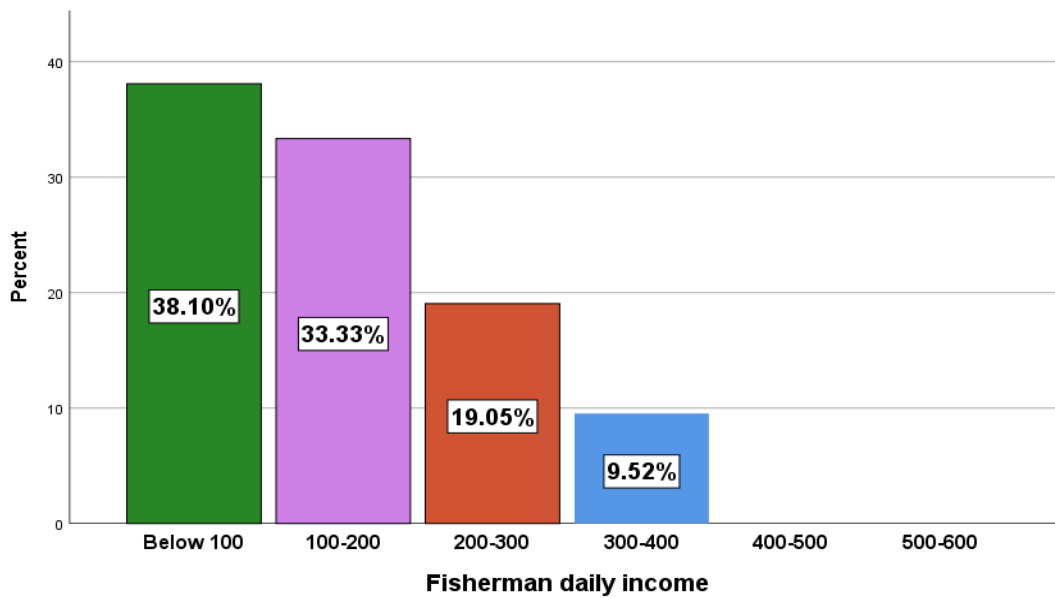

Figure 16: Fisherman daily income

4.12 Electricity use: Electricity accessibility is a crucial component of support for living. In the present investigation of this fisher's community, found 100% of the fishermen got the electricity facility and used it. It was because this area was under city coverage.

4.13 Working person in the participant family:

Economic conditions are determined by the working member of a family. More working people can contribute more to the family. In this present investigation, the maximum number of working people was 5, with a minimum of 1 person per family.

	N	Minimum	Maximum	Mean	Std. Deviation
Working Capable Person in the participant family	43	1.00	5.00	1.9535	1.04548
Valid N (listwise)	43				

4.14 Economic condition of the participant family:

In the present survey, the economic condition of the fishermen was determined by direct observation, asking, and their income. The fishing community was made up of 55.81 percent lower middle class people, 20.93 percent middle class people, 11.63 percent rich people, and 11.63 percent poor people (Figure 18).
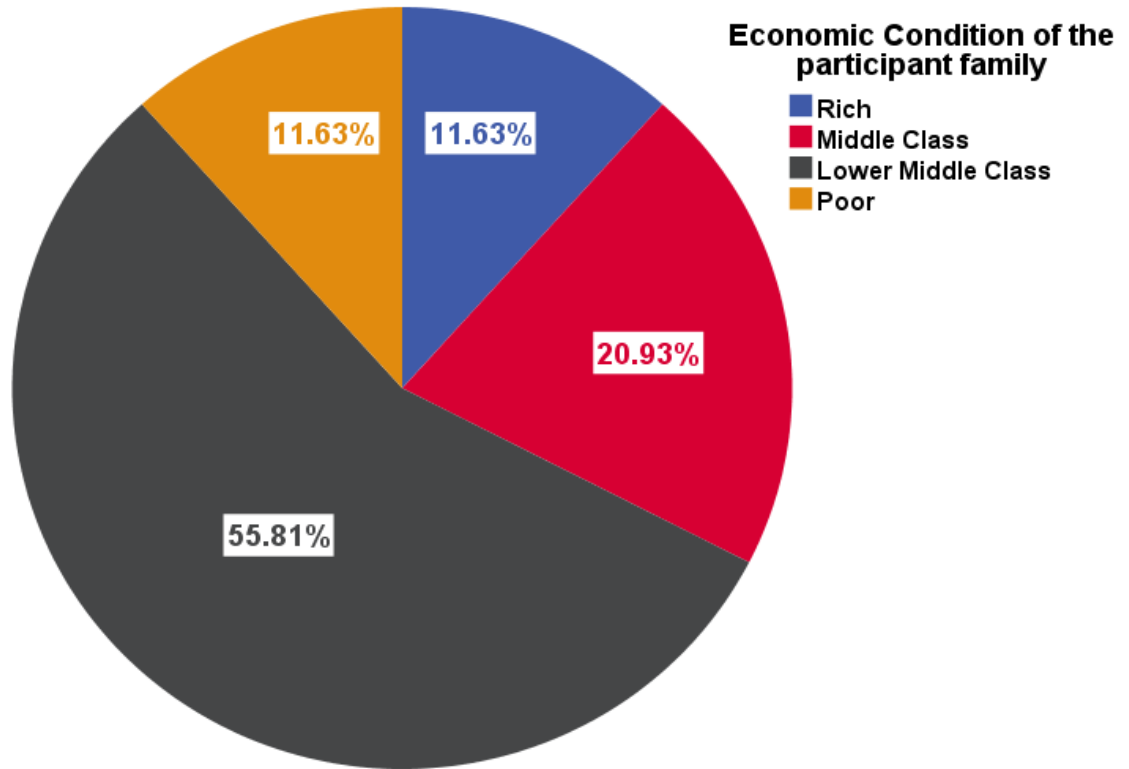
Figure 17: Economic condition of the participant family

4.15 Sanitation type:

To maintain excellent health and encourage a long life, sanitation is essential. Lack of proper sanitary facilities mean there are a variety of illnesses, including cholera and diarrhea. There were two types of sanitation found in present study: semi-pacca and pacca. The majority of the latrine was semi-pacca (68.18%), rest of them were pacca (31.82%) (Figure 19).
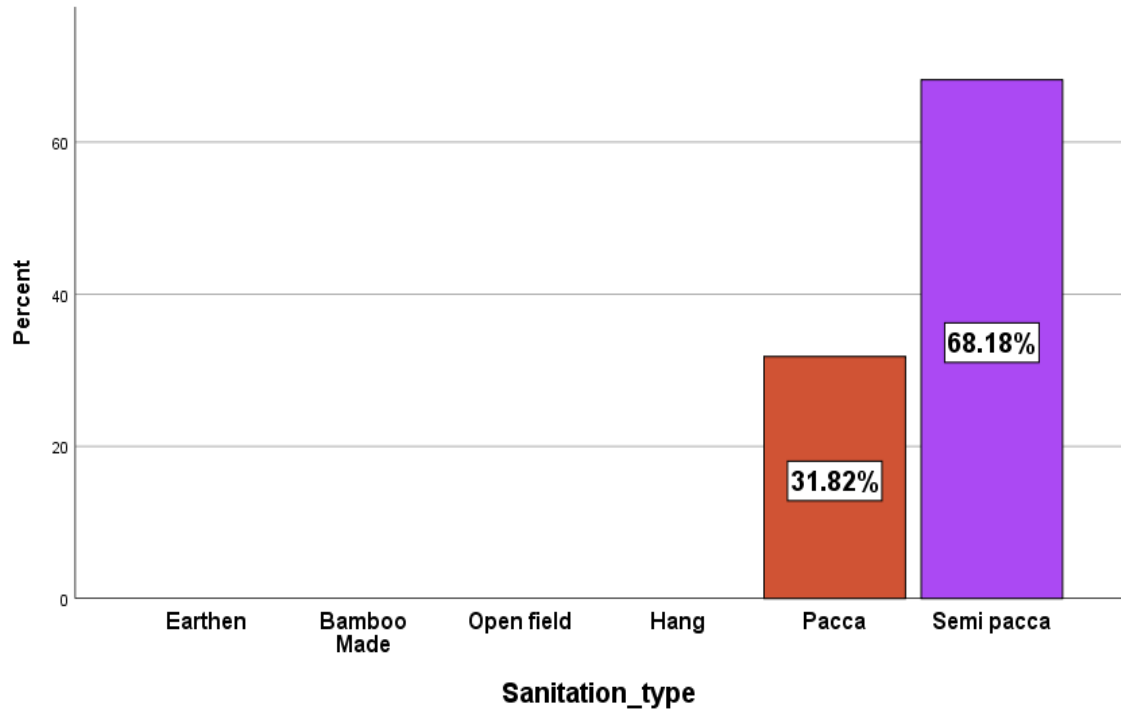

Figure 18: Sanitation type

4.16 Potable water source:

Life cannot exist without water. A valuable resource in civilization is clean, safe drinking water. In the present investigation, found the majority of people used tube well water (48.84%) for drinking purposes, the rest of them were using tank tap water (27.91%), and supply water (23.26%) (Figure 20).
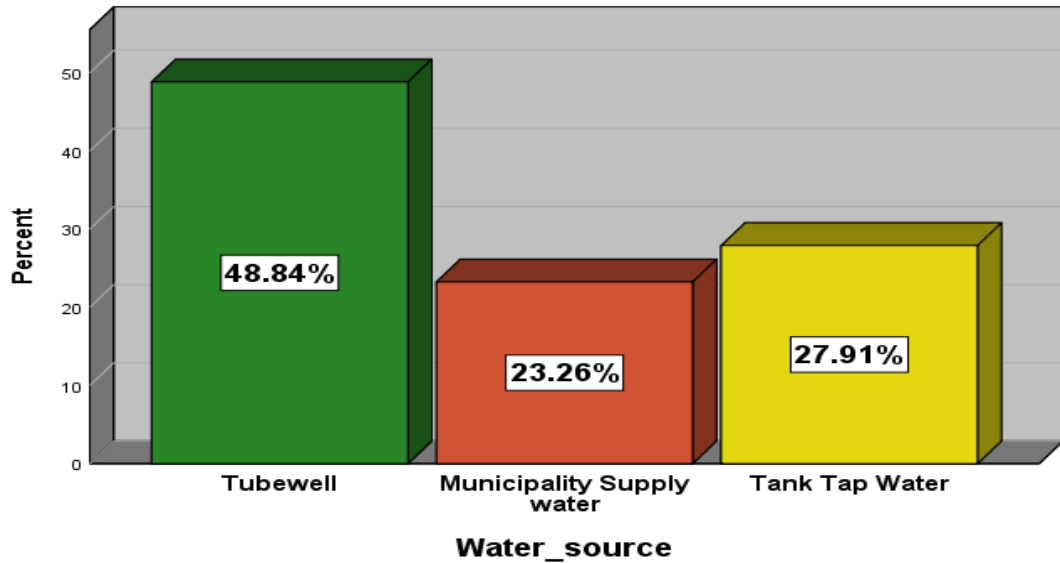

Figure 19: Potable water source

4.17 Net types:

Nets are the most important tool for fishermen. The net type depends on the fish type, operator, region, and the water body. The Gill net (94.74%) and cast net (5.26%) were most commonly used by fishermen in the current study area (Figure 21).
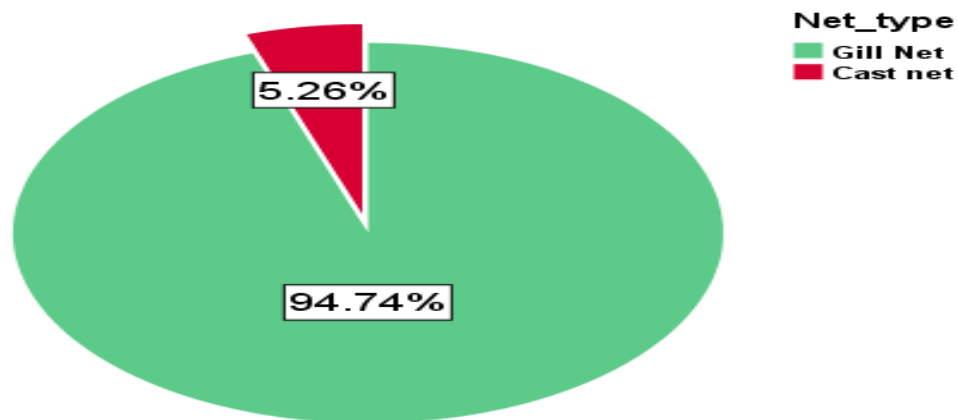
Figure 20: Net Types they use

4.18 Catch composition Size:

Catch composition data was recorded by asking the fishermen and by observing the local fish market. The catch composition provides information about the fishing method, fishing gear used, and resource availability. In the current survey, most of the fish they caught were medium size (72%), the rest were small size (18%), large size (9%), and very large size (1%) (Figure 22).
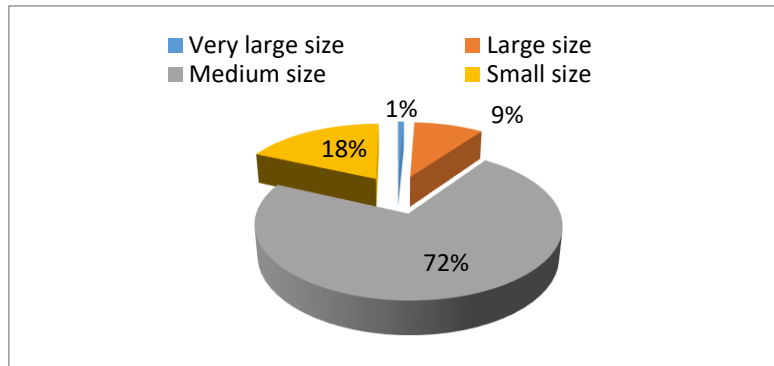
Figure 21: Catch composition size in percentage

4.19 Engaged Time:

The amount of engaged time refers to the duration of the action. The majority of the fishermen in the current study have been fishing for a very long period. The percentages of engaged time fishing were more than 20 years (43.75%), 10-20 years (31.25%), 5-10 years (18.75%), and 1-5 years (6.25%) (Figure 23).
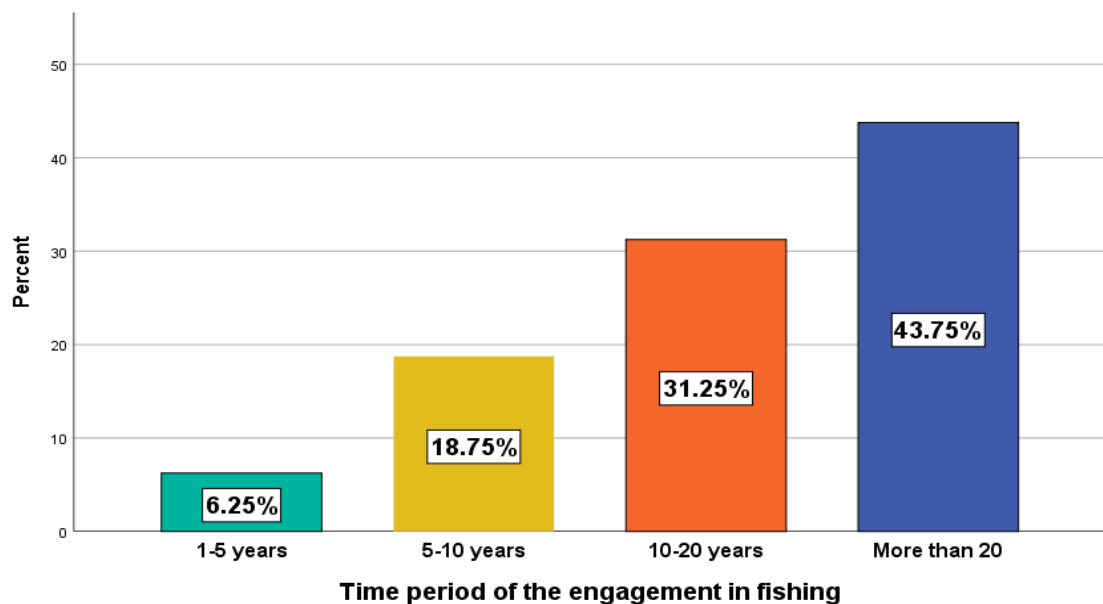
Figure 22: Engaged time of fishing of fisherman

4.20 Stockholder's Conflict:

Some conflict has a negative impact on fishing and the water bodies. When fishermen were fishing in a body of water, they first selected the area where fish were caught most. The fishermen always want to occupy this area or side. When many fishermen choose the same side, conflict arises between them. This conflict can sometimes lead to poisoning-related activities in the body of water. The fishermen and fish traders' conflict occurs over bargaining for a fish price. There were two types of conflict that occurred in the current study: one was fisherman-fisherman (87.5%) and the other was fisherman-dealer (12.5%) (Figure 24). Most of the time, there was a conflict between fishermen.
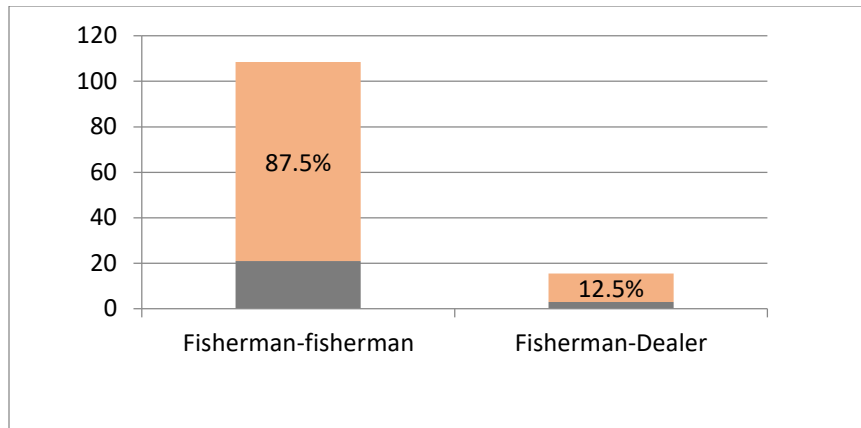
Figure 23: Stockholder's conflict

4.21 Shocks those they regularly faced:

In this present study, two types of shocks were identified in the fishing community. One was a flood (54.05%), and the other was a fisherman's illness (45.95%) (Figure 25).
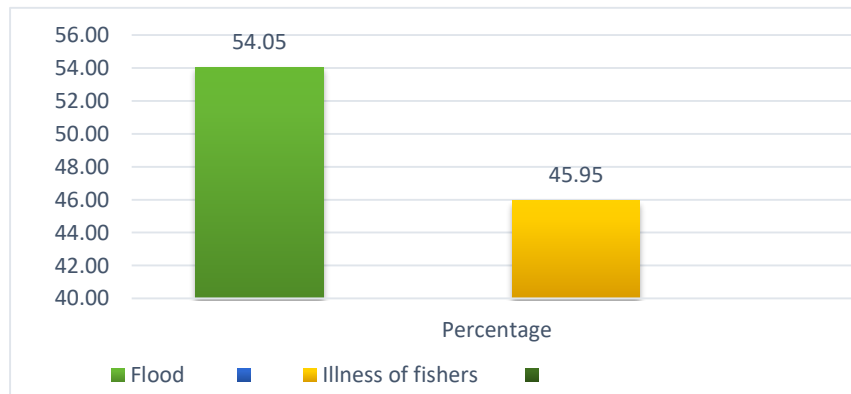
Figure 24: Regularly faced shock

4.22 Common problem faced:

This area's fishing flock was usually confronted with insufficient government facilities (26.19%), natural disasters (26.19%), scarcity of drinking water (16.67%), fewer working facilities (14.29%), insufficient health facilities (4.76%), social conflict (4.76%), and the power of musclemen (2.38%) in the current study (Figure 26).
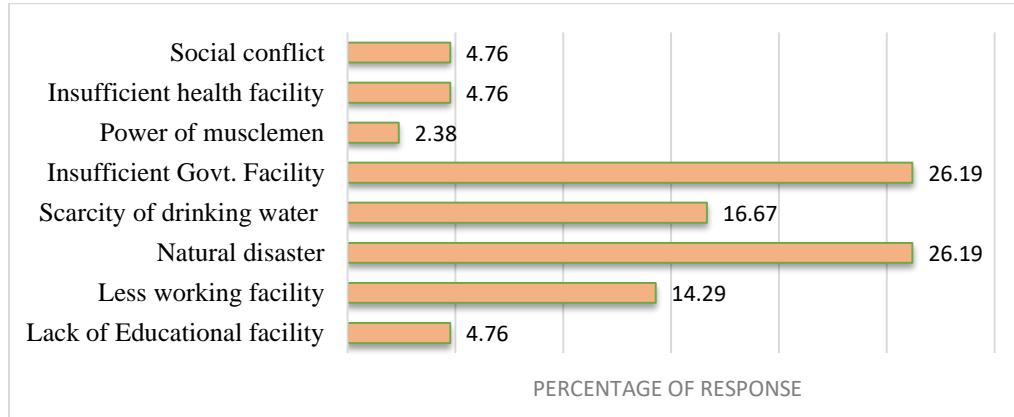
Figure 25: Common problem they faced

4.23 Crises faced in last 12 months:

In this study, fishermen blamed three major crises in the last 12 months: fewer caught fish (38%), flood problems (30%), diseases (22%), and other less severe crises such as road damage (2%), lost jobs (2%), social conflict (2%), and salinity (2%) (Figure 27).
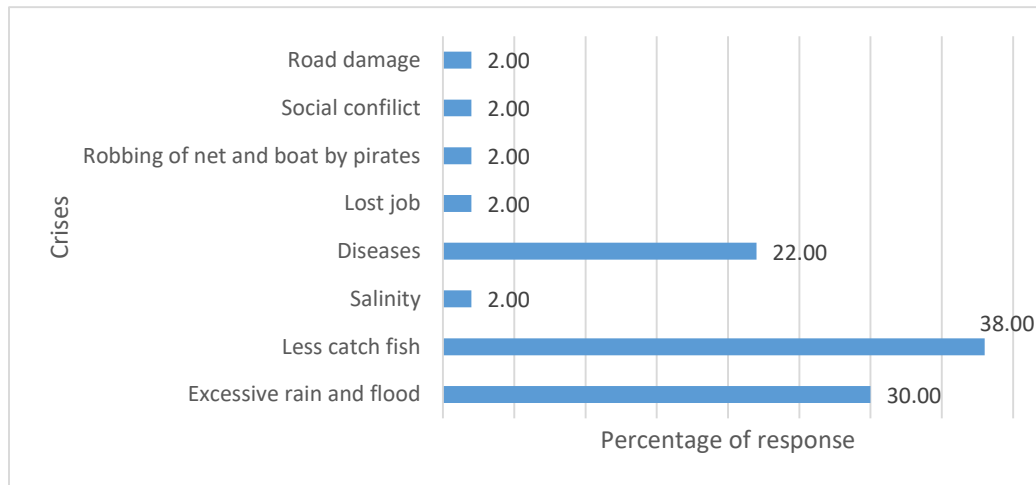
Figure 26: Crises they faced in last 12 months

4.24 Fish resources decreasing factors:

Fish resources were decreasing in the river. Some factors were identified by the fisherman's observations in this study. They mainly emphasized 7 to 8 factors. Water pollution (24.47%), overfishing (14.89%), municipal sewage (14.89%), use of destructive fishing gear (6.38), waste dump from boats (6.38%), change of rainfall pattern (5.32%), tide pattern change (5.32%), bottom topography change (4.26%), basin size change (4.26%), and other factors such as bridge/dam construction, water flowing direction change, and depth change all had an impact on fish resource declines (Figure 28).
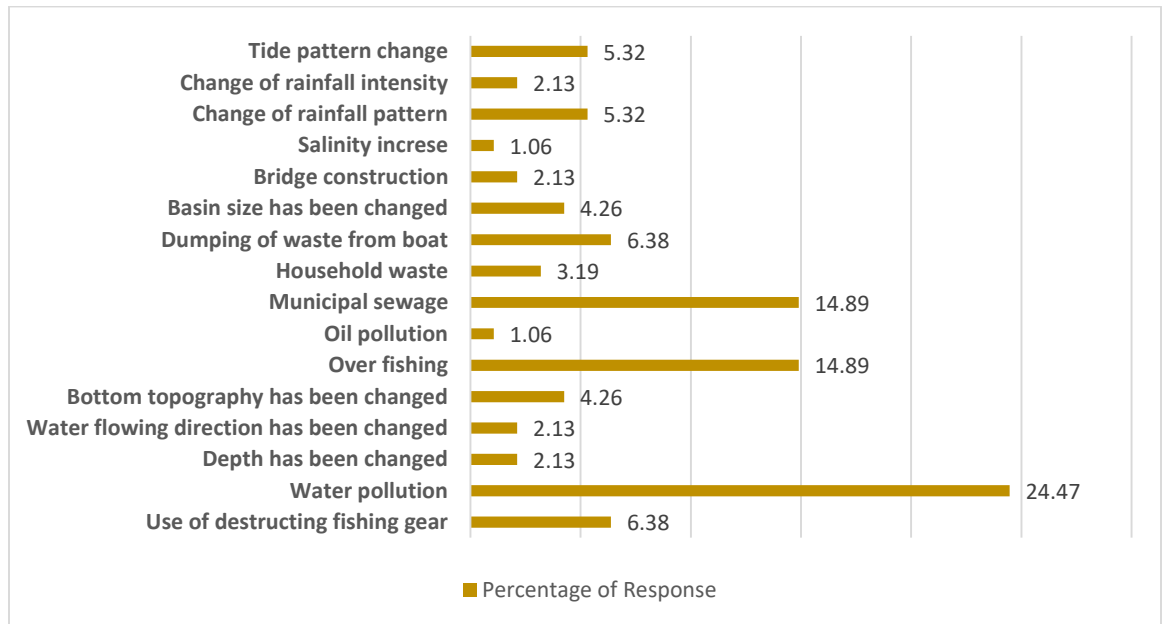
Figure 27: Fish resources decreasing factors

4.25 **Initiative measure to arise fish production:**

To increase fish production, fishermen suggested controlling all kinds of pollution (36.59%), reducing fishing (31.71%), banning destructive gear (14.63%), and enforcement of the fish act (9.76%) and habitat restoration (7.32%) (Figure 29).
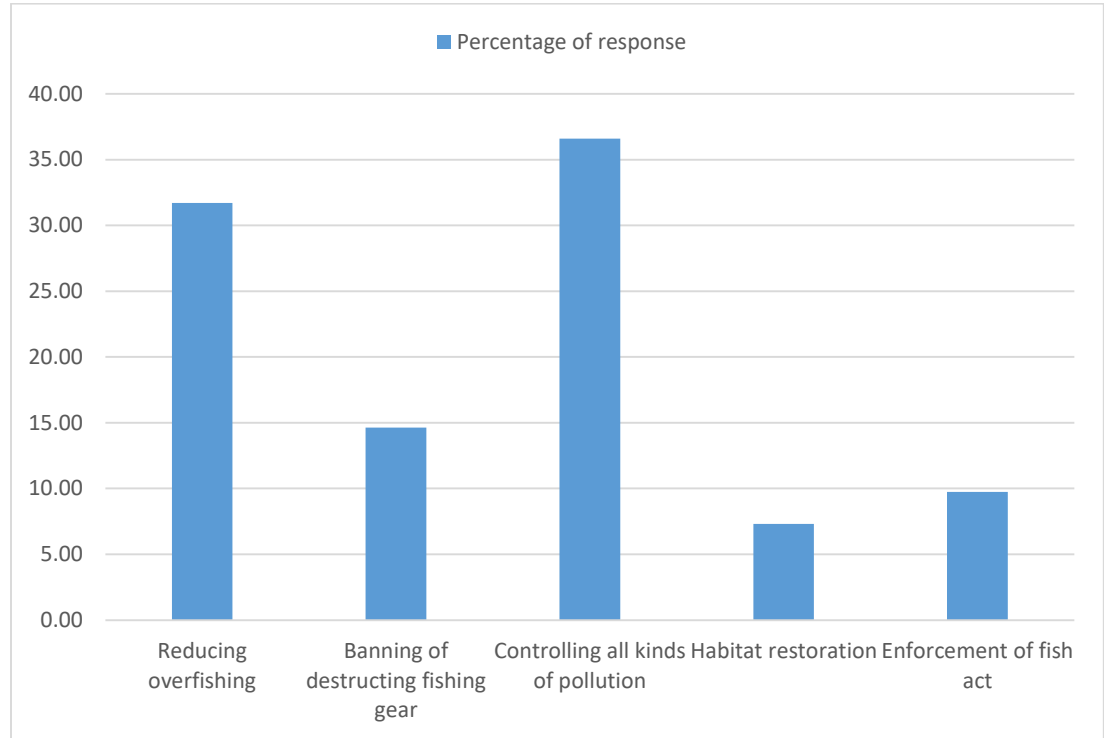
Figure 28: Initiative measure to arise fish production

4.26 List of fish species distribution in this fishing areas:

Overview of fish species distribution in this fishing areas			
Fishes usually caught by the gear	Fishes were abundant in the past but not so common at this moment	Fishes that were not caught in the past, but are now frequently available	Fishes were less available at past but are more available at present
Pama pama	*Labeo rohita*		*Pama pama*
Setipinna phasa	*Catla catla*		
Macrobrachium rosenbergii	*Labeo calbasu*		
Polynemus paradiseus	*Glossagobius aureus*		
Tenualosa ilisa	*Corica soborna*		
Cynoglossus sp	*Tenualosa ilisa*		
Amblyphayngodon mola	*Setipinna phasa*		
Corica soborna	*Mystus vitatus*		
Lates calcarifer	*Pangasius bocourty*		
Peneaus indicus	*Pangasius pangasius*		
Peneaus japonicus	*Chitla chitla*		
Nibea soldado	*Mystus aor/ Sperata aor*		
Glossagobius aureus	*Macrobrachium rosenbergii*		
Mystus vittatus			
Mystus aor/ Sperata aor			
Harpodon nehereus			
Mastacembelus armatus			
Gudusia chapra			
Pangasius bocourty			
Pangasius pangasius			
Oxudercinae			
Coilia dussumieri			

Discussion

This present survey observed that fishing-related activities were mainly done by the male fisher. Its percentage was male fisher 93.18% and female 6.82%. Almost the same result was found by Hossain et al, 2014 whereas male fishers were 94% and female fishers 6%. But 100% male fisher was found by Uddin et al, 2020. This study area was Hindu dominated fisherman community. Hindu religion 95.45% and Muslim religion 4.55% no Buddhist and Christian found. Other studies found also Hindus are dominant, Hindu (88%) and Muslim (12%) (Hossain et al, 2014) and Hindu (66%), and Muslim (34%) (Uddin et al, 2020) but the Muslim percentage was higher from our study. The opposite scenario was found by Hossain et al, 2015 (Muslim 90% and Hindu 10%). It's indicated that this varies from area to area. Where the Hindu-inhabited fishing community more, it indicates that it is the occupation of their ancestors but now a days many people leave their ancestor's occupation and Muslim involvement is increasing in many areas.

In this inquiry, most fishermen (97.73 %) were married, while the remaining individuals were single (2.27 %). According to the research by Uddin et al. (2020), Hossain et al. (2014), and Rishan and Fagun (2019), married fishermen controlled the fishing industry in respective amounts of 94%, 84 % and 85%. In this investigation, found that the majority of people were fishermen (50 %). According to the survey results from Kabir et al. (2012), 70% of the population in his research region worked as fishermen. Education conditions among the community of fishermen in this study area were superior to those in other areas. Therefore, divided it into two categories: one for the fisherman alone, and the other for all participants.

All participants were from the fisher community, and among them were those with completed HSCs (6.818 %) and Honours (9.091 %) but only able to sign for classes 6 to 8, where the highest percentage (27.27 %) and lowest percentage illiterate (4.545 %). The education status of fishermen, who were primarily engaged in fishing, had slightly improved, but the majority of them were can sign only persons (54.55 %), followed by fishers who had completed primary school (9.09 %), and the completion rates for classes for grades 6 through 10 were equal (4.55 %). People who can only sign also qualify as illiterate. Therefore, 63.64 percent or more of the fishermen were illiterate (including can sign only person). It suggested that fisherman education condition was insufficient. According to observations by Islam et al. (2017) and Hossain et al. (2014), there were 12 percent and 70 percent of illiterate fishermen, respectively. In Islam, the 2017 results show that only fishermen made up 32%. The results of Hossin et al. (2014) study were somewhat comparable to those of this one.

The majority of the medium-sized families (43.18 percent) were found in this study, followed by large-sized (29.55) and small-sized families. According to the studies by Islam et al. (2017) and Hossain et al. (2015), the majority of families were established with 4-6 people (72%) and 5-6 members (60%) respectively. The current survey's findings were consistent with the Hossain et al.

In this investigation, 48 % of fishermen were in the 31–40 age range, which is almost similar to Ali et al. (2014). However, the majority in Islam et al. (2017) belonged to the 21–30 age range (36 %). In this study area, 97 % of the children of fishermen attend school, with a 3 percent dropout rate. Sufian et al. (2017) reported that in their survey, 11.98% of respondents dropped out, while Hossain et al. (2015) reported that 36% of respondents did not attend school. Their lack of knowledge and limited family income were the causes. Because of awareness and the proximity to the city, the percentage of school-going children in our research area was higher than in other areas, yet some dropped out due to financial difficulties.

This present research area's housing situation was inadequate. Most people (37%) lived in homes with mud floors and tin roofs, while 13.95% had bamboo fence walls with tin roofs. In studies by Rishan and Fagun (2019) and Islam et al. (2017), the proportion of mud walls with tin shed houses was determined to be at its highest (76 percent).This present survey revealed that all fishermen had access to electricity because the research region was located underneath a city. In their study, Rishan and Fagun (2019) found that 72% had electricity. Each family had a maximum of five working-capable members, a mean of two, and a minimum of one. According to this survey, a fisherman's family typically consists of 5 to 6 people. In large and medium-sized families, there were often two to five working-capable individuals, but in tiny families, there was typically just one. Some modest households with two working adults included both the wife and the husband in the household's income.

Sanitation facilities were present in every fisher community. The majority were semi-paccas (68.18%), with the remainder being paccas. Due to NGOs' provision of ring-shaped slabs, there was no kacha sanitation. In Habiganj Sadar, Rishan and Fagun (2019) found 65 percent semi-pacca latrines in his study, which was close to this present investigation but also contained some Kacha latrines (29 percent). That suggests that the cleanliness in this present research region was superior to their's.

In this survey, discovered that the majority (48%) of people use tube well water, although some (23.26%) also use government-supplied water and 23.26% use tap water (which was picked up with the help of peas). The majority used a neighbor's tube well because they lacked their own. A government-provided water supply tap was located in the area's center. Because of flood (tide) and poor communication, some fishermen cannot enter. Sufian et al. (2017) revealed that while most people did not have their own, 100% of them used tube well water. Uddin et al. (2020) discovered that no one used river water for drinking; instead, everyone used tube well water (80% own and 20% neighbour).

The fishermen primarily utilized two types of net. Gill nets were used by nearly all fishermen (94.74%) when fishing for large and medium-sized fish. They typically captured medium-sized fish (72 %) since they utilized gill nets, whose mesh was established by the current fish act for this region. Fishermen utilized Jhaki jal, Dharma jal, Current jal, Moiya jal, Ber jal, Thella jal, Bair and Chandi bair jal, according to Kabir et al. (2012). The Net used by the fisherman varies to region, catch type etc.

The majority of fishermen in this observation (43.75%) have been fishing for more than 20 years; the lowest percentage belonged to the 1–5 year group (6.25%). This study showed that the local fishing population was no longer interested in fishing for low catches. Due to the area's predominance of Hindus and the fact that fishing was their ancestral vocation, many people who once belonged to this profession were now in their middle years.

The study area's annual income ranged from 36000 to 144000 tk, however the biggest share was between 36000 and 72000 tk (71.4 %). That was less than the lowest government wages. In order to support their family's income, several children of fishermen leave school and engaged in fishing or other work. The female members of many families provide support by working in the apparel industry, raising livestock, etc. According to Uddin et al. (2020), the annual revenue of fishermen was in the range of 50,000–75,000 tk. For the gear operating area, stockholders generally noticed friction between fishermen (87 %). There were often tides in this area. They experienced two different sorts of shocks: flooding (54.05 %) and fisherman's illness (45.95 %).

In this present study, found that although while respondents reported a wide range of issues, they placed the heaviest focus on ineffective government facilities (26.5%), natural disasters (26.5%), a lack of drinking water, and underperforming facilities in general. During the time of the prohibition, the government gave them incentives, but they no longer receive any. Some fishermen struggled for work throughout that period because they lacked the skills for other jobs. They nearly were drowned because this area was susceptible to tides. Because of the damage caused by flooding to their route, they have struggled to obtain drinking water. They mostly saw a decrease in fish capture (38 %), flooding issues (30 %), sickness (22 %), and an employment crisis over the past year.

The amount of fish caught in the river was low due to pollution and overfishing. Because of the corona virus epidemic during this time, some people lost their jobs and had illnesses. They mostly attributed the dwindling fish population in the river to salinity, overfishing, the use of damaging gear, and pollution. Around this river area, a number of industries were developed, and their discharges and other waste products contaminated the river.

Many fishermen travel to the higher region to fish, which leads to overfishing. During the fishing prohibition, some people turned to illicit fishing to support their families. Additionally, they proposed that reducing pollution (36%), overfishing, and outlawing illicit fishing might boost the number of fish in the river. In this present study, found that some resources were once available but are now less so due to saline water intrusion and a decline in the area's freshwater supply.

They found that the main reason for the overall decline in fish resources was pollution (Ali et al. 2016). The amount of saltwater Poa fish, however, has increased while there has historically been less harvest.

There was a linkage among the common problems they faced, the crises in the last 12 months, and the resources decreasing.For instance, in the past year, their key crises have included decreased fish harvest, severe rain and flooding, and decreased job opportunities. At that time, their common problems were insufficient government facilities and natural disasters. These were used to enforce the use of illicit fishing gear and throughout the ban period. Additionally, the river's resources are being depleted for these reasons.

Conclusion

From all the findings of the present survey, it appears that the fishing communities of the Karnaphuli River fisherman's socioeconomic and livelihood conditions are not good enough. They are deprived of any facilities that were provided by the government in the past during the time of the ban on fishing. They have faced many problems that exists tremendously even at the present time. They are not trained with skill development activities that can support them in the ban period. Pollution is the main cause of declining fish biodiversity in this area. Their education and economic condition are not being improved by the fishing profession; so many fishermen in this fishing community change their profession. So, the government and NGOs should take the necessary steps to improve their socioeconomic and livelihood conditions.

Recommendations:

The following actions are suggested based on this research:

- ❖ For industrial pollution and other types of pollution control, the government should provide a pollution control act and force them to use filtration processes before discharging.
- ❖ Allowances should be paid during the ban period, and job opportunities should be created for actual fishermen.

- ❖ NGOs can give them soft loans and educational facilities like sanitation, which were done by them in the past.
- ❖ The government should train them and increase their skills in fishing and other sectors, mainly fishers.
- ❖ The government should build a concrete dam around this area for flood control where it is necessary.
- ❖ Fisheries graduate and scientists should more research to protect the fish resources and fisher's community

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Appendices:

Appendix 1: Questionnaire used in this field survey

Date: Time:

Area: Karnaphuli River bank Fisher's community.

General information

1. Name of the interviewee:
2. Address:

Village	
P/O	
P/S	
District	

3. NID OR Birth Certificate No:

4. Gender/Sex:

5. Age:

Male (1)	Female (2)

6. Religion:

Hindu (1)	Muslim (2)	Buddhist (3)	Christian (4)	Others (5)

7. Maritial status:

Married (1)	Unmarried (2)	Divorcee (3)

8. Occupation:

fisherman (1)	Employee (2)	Businessman (3)	Others (4)

9. Educational background:

Can sign only (1)	Up to class Five (2)	Up to class Eight (3)	Up to S.S.C (4)	H.S.C (5)	Hons. (6)	Masters (7)	Illiterate (8)

(Up to class Five = Class 1-5) # (Up to class Eight = Class 6-8) # (Up to class S.S.C = 9-S.S.C)

10. Number of Family Member:

11. Family structure:

Small Family (1)	Medium Family (2)	Large Family(3)

#(Small Family=(2-4)) #(Medium Family=(5-6)) #(Large Family = 7 to above)

Family members	
Father	
Mother	
Wife/Husband	
Son	
Sister	
Brother	
Grand father	
Grand mother	
Father in-law	
Mother in-law	
Sister in-law	
Brother in-law	

12. Children education condition:

School going children(1)	Dropout children (2)

Socio-economic condition

1. Housing condition:

House with bamboo fence and tin roof (1)	House with tin roof (2)	Sami-pacca house (3)	Pacca house (4)

2. Daily income of fisherman (BDT)

below100 (1)	100-200 (2)	200-300 (3)	300-400 (4)	400-500 (5)	500 or Above (6)

3. Total earning member of the family:

One (1)	Two (2)	Three (3)	Four (4)	More than four (5)

4. Economic condition

Rich (1)	Middle (2)	Lower middle (3)	Poor (4)	Extreme poor (5)

5. Do you have latrine/sanitation in your house?

Yes	No

If yes, types or condition of sanitation/ latrine

Earthen(1)	Bush(2)	Open field(3)	Hung latrine(4)	Pacca sanitary latrine (5)	Semi-Pacca sanitary latrine (6)

6. Electricity use/accessibility

Yes (1)	No (2)

7. Potable water source:

Tube well	Supply	Tap water	River	Pond	Washa	others

8. Common problem you faced:

Lack of Electricity facility	
Lack of educational facility	
Less working facility	
Natural disaster	
Lack of sanitary facility	
Scarcity of drinking water	
Insufficient Govt. facility	
Power of musclemen	
Insufficient health facility	
Social conflict	
Scarcity of cooking fuel	

9. Get any training program facility or other facilities for fish production:

Yes (1)	No (2)

If yes, what kinds of facilities provided by the Government: (Put the tick)

Education	Electricity	Health	Latrine	Govt. support	Support from NGOs	Support during calamities	Drinking water facility

10. According to your opinion, who is responsible for managing risks associated with ecological and socio-economic challenges?

Authorities	Rank			
Government	1	2	3	4
Local community	1	2	3	4
NGOs	1	2	3	4
Scientist	1	2	3	4
Voluntary organization	1	2	3	4

*1=higher responsible

*2= moderate responsible

*3=lower responsible

*4=no responsible

11. Are there any conflicts among the stakeholders?

Yes	No

If yes, mention the degree of conflict-

Stakeholders	Rank			
Fisherman-fisherman	1	2	3	4
Fisherman-traders	1	2	3	4
Fisherman-dealer	1	2	3	4
Fisherman-boat owner	1	2	3	4
Fisherman-gear owner	1	2	3	4
Fisherman-farmer	1	2	3	4
Fisherman-creditor	1	2	3	4

*1=Strong conflict

*2= medium conflict

*3=less conflict

*4=no conflict

12. What kinds of shocks the people of your area faced regularly?

Types of shocks	1	2	3
Flood	1	2	3
Drought	1	2	3
Illness of fishers	1	2	3
Others	1	2	3

1= strongly faced

2= moderately faced

3= less faced

13. Crisis and coping strategies?

What sort of crisis you faced in last 12 months					
Flood, excessive rain	1	2	3	4	5
Drought	1	2	3	4	5
Landslides/erosion	1	2	3	4	5
Less fish catch	1	2	3	4	5
Salinity	1	2	3	4	5
Diseases	1	2	3	4	5
Accident	1	2	3	4	5
Death of earner	1	2	3	4	5
Death of family member	1	2	3	4	5
Divorce	1	2	3	4	5
Lost job	1	2	3	4	5
Theft	1	2	3	4	5
Robbing of net and boat by pirates	1	2	3	4	5
Social conflicts	1	2	3	4	5
Religious conflicts	1	2	3	4	5
Dowry	1	2	3	4	5
Child/women trafficking	1	2	3	4	5
Physical/mental torture	1	2	3	4	5
Boat sunk	1	2	3	4	5
Political conflicts	1	2	3	4	5
Others	1	2	3	4	5

*5=maximum occurrence

*4=medium occurrence

*3=minimum occurrence

*2=rarely occurred

*1=no occurrence

14. How did you tackle those crises?

How did you tackle those crises	1	2	3	4	5
Loan from neighbor	1	2	3	4	5
Loan from money lender	1	2	3	4	5
Loan from NGOs	1	2	3	4	5
Loan from others	1	2	3	4	5
Taking less food	1	2	3	4	5
Food stuff on loan	1	2	3	4	5
Land sale	1	2	3	4	5
Land lease	1	2	3	4	5
Fishing equipment lease	1	2	3	4	5
Fishing equipment sold	1	2	3	4	5
Big tree sold	1	2	3	4	5
Livestock/poultry sold	1	2	3	4	5
Excessive physical labor	1	2	3	4	5
Gold or other valuable sale	1	2	3	4	5

*1=no use

*2=rarely use

*3=less use

*4=moderate use

*5=mostly use

Begging	1	2	3	4	5
Child labor	1	2	3	4	5
Homestead land sale	1	2	3	4	5
Use of savings	1	2	3	4	5
Displacement/migration	1	2	3	4	5
Change of profession	1	2	3	4	5
Others	1	2	3	4	5

Fishing Program Related Question

1. Where the fish is sold?

In local Market (1)	Export to metros (2)	Export to other cities (3)

2. How the fish is transported?

In ice boxes (1)	In open bags(Tokaries) (2)	In heat insulted boxes with ice layering (3)

3. Is there regular record of catch?

Yes (1)	No (2)

4. If yes then who keeps stock of it?

Fisherman (1)	Owner/ contractor (2)	Others (3)

5. Which types of gear or net are used for fishing?

Gill net (1)	Cast net(2)	Others (3)

6. Is the net provided to you?

Yes (1)	No (2)	Made by yourself (4)	Buy (5)

7. Which types of fish usually caught by the gear?

Local Name	Scientific Name

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8. What fishes were abundant in the past but not so common at this moment?

Local Name	Scientific Name

9. Are there any fishes that were not caught in the past, but are now frequently available?

Local Name	Scientific Name

10. What kinds of fishes were less available at past but are available at present?

Local Name	Scientific Name

11. What you're thinking about decrees of fish resources in the river?

Factors	Ranking					
Use of destructing fishing gear	0	1	2	3	4	5
Water pollution	0	1	2	3	4	5
Depth has been changed	0	1	2	3	4	5
Water flowing direction has been changed	0	1	2	3	4	5
Bottom topography has been changed	0	1	2	3	4	5
Over fishing	0	1	2	3	4	5
Oil pollution	0	1	2	3	4	5
Municipal sewage	0	1	2	3	4	5
Household waste	0	1	2	3	4	5
Dumping from boat	0	1	2	3	4	5
Temperature increase	0	1	2	3	4	5
Basin size has been changed	0	1	2	3	4	5
Basin size has been changed	0	1	2	3	4	5
Street drainage	0	1	2	3	4	5
Bridge construction	0	1	2	3	4	5
Salinity increase	0	1	2	3	4	5
Change of rainfall pattern	0	1	2	3	4	5

Change of rainfall intensity	0	1	2	3	4	5
Water level rise	0	1	2	3	4	5
Tide pattern change	0	1	2	3	4	5

- 0= no impact   *3= moderate impact
- 1= very little impact   *4=high impact
- 2=little impact   *5=very high impact

12. Do you think, this is the high time to take initiative to mitigate these impacts?

Yes	No

If yes, what are the initiative measures should be taken?

Initiative measures	0	1	2	3	4	5
Reducing overfishing	0	1	2	3	4	5
Banning of destructing fishing	0	1	2	3	4	5
Controlling all kinds of pollution	0	1	2	3	4	5
Habitat restoration	0	1	2	3	4	5
Enforcement of fish act	0	1	2	3	4	5

- 0= no impact   *3= moderate impact
- 1= very little impact   *4=high impact
- 2=little impact   *5=very high impact

13. Catch composition according to the size (percentage)-

Present catch composition			
Very large size	Large size	Medium size	Small size

14. Total cost in each trip-(Put the tick)

No cost	500-1000tk.	1000-2000tk.	2000-300tk.	3000-5000tk.	More than 5000tk.

15. How long have you been engaged in fishing?

1-5 years(1)	5-10 years(2)	10-20 years(3)	More than 20 years(4)

16. What the amount you catch daily?

10-20 kg(1)	20-40kg (2)	40-60kg (3)	60-100 kg(4)

17. What are the alternative income sources during off season?

Day laboring	
Rickshaw pulling	
Boatman for transport and tourism	
Working in agriculture field	
Small business	
Work in grocer shop	
Fry collection	
Fuel wood collection	
Boat making	

18. What is your expectation from the GOVT/NGOs to improve your situation/condition?

Expectations	Ranks				
Allowance	1	2	3	4	5
Creation Job facilities	1	2	3	4	5
Rehabilitation	1	2	3	4	5
Salvation	1	2	3	4	5
Health facility	1	2	3	4	5
Education facility	1	2	3	4	5
Sanitation facility	1	2	3	4	5
Drinking water facility	1	2	3	4	5
Security	1	2	3	4	5
Govt. loan facility	1	2	3	4	5

*5=highly expectation

*4=medium expectation

*3=least expectation

*2=occasional expectation

*1=no expectation

19.

…………………………..   …………………………………

Signature of the interviewee   Tip bond of the interviewee

Photo gallery

Appendix 2: **Study area fishermen activities**

Appendix 3: Study area fisher' community environment

Appendix 4: Study area Local fish market

BRIEF BIOGRAPHY OF THE AUTHOR

This is Palash Chandra Das, son of Rabindra Chandra Das and Jholan Rani Das Who came from Brahman-para under Cumilla District. He passed Secondary School Certificate examination in 2010 from Madhab pur High School and Higher Secondary Certificate examination in 2012 from Sonar Bangla College, Cumilla. He achieved his B. Sc. Fisheries (Hons.) Degree in 2018 from Faculty of Fisheries, Chattogram Veterinary and Animal Sciences University (CVASU). Now, he is a candidate for the degree of MS in Fisheries Resource Management under the Department of Fisheries Resource Management, Faculty of Fisheries, Chattogram Veterinary and Animal Sciences University, Chattogram, Bangladesh.