FINAL REPORT

Next Steps for Environmental Protection of Halda River in Bangladesh

Supported by

University of Chittagong

Palli Karma Sahayak Foundation

Halda River Research Laboratory

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Executive Summary

Palli Karma-Sahayak Foundation (PKSF) has taken the initiative to prepare a policy paper reviewing existing policies relating to Halda river along with the perception of local people from adjacent areas to identify major obstacles in conserving the ecosystem of Halda. The policy paper aims to suggest roles and responsibilities of different stakeholders including Govt. institutions and private sector organizations to conserve the environment of the unique natural fish spawning ground of Halda river. The study also determines the implementation strategy of those comprehensive and integrated policy interventions effectively.

The paper made policy recommendations by analyzing an assortment of qualitative and quantitative data from both primary (stakeholders) and secondary (policy documents) sources. The primary data was collected through field visits, face-to-face and telephone interviews with various stakeholders and key informants including Halda-dependent communities, researchers and relevant professionals from government and non-government institutions. A total of 132 people from the communities on the banks of Halda river in different upstream and downstream areas of Manikchari, Fatickchari, Hathazari and Raozan upazilas were purposively selected for interviewing. Secondary information was obtained from published journal articles, policy documents and newspaper reports.

By analyzing the data, the study has adequately identified the major problems of the river basin, such as indiscriminate catching of brood fish, use of illegal or banned fishing gears, destroyed and displaced egg releasing grounds and fish habitats by straightening the ox-bow bend of the river to make easy water transportation, protection of the riverbank houses and properties, unscientific extraction of soil and sand from the river, industrial pollution, sewage contamination, introduction of unplanned construction of sluice gates and rubber dam, river bank erosion, oil leakage from motorized boats, water withdrawal from the river and various unplanned development projects violating the ecosystem of the natural fish spawning ground. The study has also noted a substantial change in fish population of Halda river. It has discovered that 26 out of 76 species of fish are no longer found in the natural breeding ground. The presence of a high quantity of Total Dissolve Solids (TDS) and low Dissolve Oxygen (DO) in the river has also been identified which indicates a high level of water pollution. High salinity intrusion due to climate change, reducing river length through straitening of oxbow band and water withdrawal has also been discussed. The study has also discussed about the annual egg and fry production from Halda river.

To conserve and development of the natural breeding ground of Halda river, PKSF has been implementing a value chain sub-project under its IFAD supported “Promoting Agricultural Commercialization and Enterprises (PACE)” project titled “Conservation and development of natural fish breeding ground in Halda river” through its Partner Organization (PO) named “Integrated Development Foundation (IDF)” since 2016. The notable activities of this initiative

includes monitoring and surveillance of the declared sanctuaries, establishment of ‘Halda River Research Laboratory’ at University of Chittagong, arrangement of community awareness building programs, facilitation of alternative livelihood options for egg collectors and tobacco farmers, adoption of advanced technologies for carp egg and fry management in earthen ponds, facilitation of value chain establishment to strengthen carp seed market, arrangement of workshops for raising awareness regarding safe navigation along with legislative and regulatory issues related with responsible fisheries, etc. A number of government initiatives has also been undertaken to improve the environment of Halda river. The Department of Environment regularly monitors the factories to prevent waste discharge into Halda river. Administrator of Hathazari and Raozan upazila are taking appropriate measures to protect the brood fish of Halda. The Department of Fisheries has set up 6 hatcheries on Halda bank so that egg collectors can easily produce fish fry from the collected egg. A special team of Bangladesh river Police has installed high-powered close circuit (CC) cameras around the river adjacent areas to protect this natural fish breeding ground along with its brood fishes and endangered dolphins and to prevent illegal sand extraction. A 19 member committee was constituted under the leadership of the Chief Secretary in the Prime Minister's Office to maintain the genetic purity and preservation of the natural breeding ground of carp fishes and to coordinate the activities of various organizations related to Halda river. The Ministry of Environment and Forest has formed a committee to protect the unique features of Halda river, to preserve the ecosystem of carp fish breeding grounds, and primarily to keep the water flow unaffected and to prevent river water pollution. Ministry of Fisheries and Livestock declared Halda river as 'Bangabandhu Fisheries Heritage' on the occasion of the birth centenary of Father of the Nation Bangabandhu Sheikh Mujibur Rahman. A gazette was published in this regard effective from 21st December 2020 as per Section 32 of the Bangladesh Biodiversity Act, 2017.

The value chain sub-project being implemented by PKSF and its partner organization has been instrumental in the recent success on increasing the spawning trend of fish. The active participation of local administration, government and non-government stakeholders in PKSF's efforts to improve the environment and increase productivity in the natural fish breeding sector has accelerated the expected success. Although Halda's natural environment has improved tremendously in recent times, there are still some challenges. Rubber dam and concrete dams in the upstream region, 18 sluice gates in 19 branch canals, illegal brood fish and dolphin hunting, cutting of river bends, lower navigability of Karnafuli river, lack of ETP structure of nearby factories, unplanned populist development project implementation centering Halda, and other issues still pose a threat to Halda’s development initiatives.

This study has proposed an Integrated Halda river Management Plan for better management of the river in line with all the local needs and aspirations to conserve Halda as the “Bangabandhu Fisheries Heritage". Major suggestions made by the river management plan include: (i) formulate a designated ‘Halda Heritage Preservation Committee’ for proper management of Halda river and avoid setting up various committees, this committee will determine integrated strategies for development of Halda river to solve the problem, and responsible of overseeing river

biodiversity conservation, riverine development work, waste disposal and pollution; ii) conduct proper Environmental Impact Assessment (EIA) taking into account all physical and biological criteria before infrastructural development; iii) formation of groups, technical assistance in production of safe agricultural products, taking action to increase health awareness including market connectivity for alternative livelihoods of fishermen and tobacco growers; iii) capacity development of Halda river resource users and iv) recommended action on river zoning etc. The paper has outlined key activities against the recommended interventions, responsible department for execution, possible barriers and its solutions. The study paper has also suggested to increase the involvement of local community and strict enactment of law in the safeguarding of brood stock, removal of rubber dam and scientifically renovation of sluice gate, conservation of riverbank, taking necessary steps for controlling pollution, creating awareness and collective efforts for conserving the breeding ground. This policy paper will help the policy makers to adopt integrated strategies to ensure better management of Halda for its restoration and conservation without compromising the expectations of the local people and related public authorities.

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1. Introduction

1.1 Background

Rivers play a pivotal role in the development of a country and economy by producing a wide array of services such as supply of fresh water, fish, means of transportation, tourism, waste assimilation capacity, scenic beauty, place of rituals, provision of scientific and educational research, enhancement of the quality of local environment etc. (Sultana et al., 2019). Halda is a resourceful river with additional distinctive values. It is also the only tidal river of Bangladesh which houses the breeding of major Indian carps (Kabir et al., 2015). This river is one of the effectors of economic development of Chittagong region as well as the whole country by becoming the means of production and services such as drinking water supply, fish production, transportation, waste assimilation, recreation and tourism options etc. (Kabir, 2011) A large number of people are dependent on this river directly or indirectly by means of egg and fry collection, irrigational water extraction, fishing, boating, sand collection, transportation etc. For the unlimited ecosystem services produced by the Halda, the government considered announcing this river as an Ecologically Critical Area (ECA) for its conservation purpose. (Kabir, 2011). Moreover, Bangladesh is a signatory to the Ramsar Convention (1971) and the World Heritage Convention (1972), which are the principal instruments ensuring the conservation of natural heritages worldwide. Meanwhile, the Government of Bangladesh declared a 40 km area (Nazirhat Bridge to Kalurghat Bridge) (The Daily Star, 2009) of the river as a sanctuary and also as Bangabandhu Fisheries Heritage (The Financial Express, 2020; Halda Gazette, 2020). Besides, there are a number of laws and regulations that have connection with the river ecosystem conservation.

1.2 Problem statement

To date, some appreciable studies have been conducted to estimate the direct (tangible) & indirect (intangible) value derived from the Halda (Kabir, 2011) with focusing on some environmental problems (Saimon et al., 2016; Azadi and Alam, 2015). Study reveals that Halda River is being polluted due to industrial waste (53%), sewage contamination (20%), tobacco farming (13%), rubber dam (8%) and sand extraction (6%) (Islam et al., 2017; Saha et al., 2019). Moreover, some poultry farms built along the river are contributing to the pollution too. (Khan, 2019). Recently, deforestation, blockage of the Halda river sources, development of Mango garden instead of natural forest at the Halda source, water withdrwal for different purposes have become major problems that need to be addressed with high priority (Kibria, 2021c). Along with these issues, no significant research has been found to know about people's perception and institutional responsibilities towards the integrated approach of Halda River conservation. Before formulating any policy regarding pollution prevention of the Halda, it is necessary to evaluate the perception of the Halda related people and the existing management practices by relevant stakeholders to make all the initiatives sustainable. In this context, Palli Karma-Sohayak Foundation (PKSF) has taken the initiative to prepare a policy paper reviewing existing policies

relating to the Halda River and Halda river bank people's perception to identify significant problems in conserving the ecosystem of the Halda. This can be achieved by gathering qualitative and quantitative data sources involving relevant stakeholders and analyzing the data for policy recommendations and grounds for the way forward.

1.3 Objectives

PKSF has aimed for three objectives: to identify major constraints in conserving the environment of the Halda River, to suggest integrated interventions along with responsible authorities and stakeholders and to develop strategies for implementing policy interventions suggested by the paper.

In line with all these objectives, this policy paper has been written based on primary and secondary data sources. Primary data has been collected with a combination of field visits; face-to-face interview; telephonic interview and key informant interview with the adjacent communities of the Halda River; officials of government and non government institutions; researchers and relevant professionals. Besides, published journal articles, newspaper reports have been used as a source of secondary information to correlate the Halda community in terms of economic and resource dependency so that integrated and sustainable management of Halda can be ensured. For interviewing the adjacent communities, different areas of three upazilas on the bank of the Halda River, namely Manikchari, Hathazari and Raojan, have been selected purposively from upstream to downstream. A total of 132 respondents have been selected by using random and purposive sampling methods for face to face interviews along with telephone interviews during this pandemic. For this purpose, different groups of professionals related to the Halda such as Egg and Fry collector, Tobacco farmer, and the people living upstream and downstream of Bhujpur rubber dam have been surveyed to identify their views and suggestion relating to the river environment; to learn about their observations regarding the river conditions; its production capability and other related things. Integrated Development Foundation (IDF) as non-government organization; and authories of the government like Upazila administration; Fisheries office; Local politicians; River police; Department of Environment; Water Development Board; Forest Department related with Halda River management have been interviewed either face to face or over the phone to identify their opinion on existing problems of the Halda and way forward to solve the issues. In addition, the opinions of researchers and professionals have been taken into consideration who are involved in activities relating to bringing back the environment of the river. This policy paper suggests roles and responsibilities of different stakeholders with probable barriers and solutions in an integrated way to conserve the environment of the only natural fish spawning ground of Bangladesh.

A number of suggestions have come out from Halda adjacent communities who are solely dependent on this river for their livelihood; administrative bodies who are continuously giving their effort for sustenance of the River Halda based on their real-world field level experiences. Among the stakeholders, the egg collectors emphasized on increasing monitoring of all the adjacent areas of Halda with stopping illegal catch of brood fish with nets. Besides, most

tobacco farmers have urged for training on cultivation methods and techniques, requested for providing hybrid seeds, funding for cultivation market expansion, providing knowledge on technology, providing modern equipment, insurance on cultivation, loan facilities etc. Moreover, recommendations have been made by the rubber dam users for the proper management of drainage systems in irrigation areas through the concrete drain or underground pipes, establishment of deep tube wells etc. Besides, suggestions for proper surveillance surrounding the Halda river, creating awareness, collective working effort, taking necessary steps for controlling pollution, conservation of the riverbank, tree plantation on the riverside, and focusing on Halda development projects have come out from the administrative sides. On the other hand, research professionals have focused on Sewerage Treatment Plant for waste management in Ananya residential area, fulfil the water demand of the industrial city located in the Mirsarai-Feni region from the nearest, simplest and economically viable source as a replacement of the Halda River, rehabilitation of 18 sluice gates and 19 branch canals, increasing navigability of Karnafuli River, more research on dolphin population, local community involvement in safeguarding process etc. This policy paper can help policy makers to find out the integrated strategies on priority basis based on the stakeholders' recommendations for ensuring better management of Halda.

2. Literature review

2.1 Overview of the Halda River with its source

The Halda river (22° 28.130´N and 091° 52.412´E) is the 3rd main river of Chittagong after Karnafuli and Sangu which originates from the Haldachora (হালদা ছড়া) at the Hasukparha area (22° 55.914´N and 091° 46.327´E) of 2 no. Patachora union in Ramgarh Upazila under Khagrachari District (Former Chittagong Hill Tracts), Bangladesh. It flows through Manikchari, Fatikchhari, Hathazari, Raozan Upazila and Chandgaon thana of Chittagong before falling into the Karnaphuli River (22° 24.398´N and 091° 53.494´E). The river, Halda, is a unique inimitable natural heritage of Bangladesh by being the only tidal river of the world that serves as a natural breeding ground for major Indian carps (Rui, Katla, Mrigel, Kalibaush etc.). The 98 km long river has a turbulent tributary in Dhurung, which joins it 48km downstream from the source (Kabir et al., 2015). But, at present deforestation, blockage of the Halda river sources, development of Mango garden instead of natural forest linked to Halda source are major problems that need to be addressed with high priority (Kibria, 2021c). Bangladesh government already declared the Halda as 'Bangabandhu Fisheries Heritage' on 21st December, 2020. The proposed heritage area starts from the Halda source - Hahusk para to the confluence of Karnafuli river, Mohora.(22°. 55´ 39.79´´North and 91°. 46´ 17.32´´ East to 22°. 26.667´ North and 91°. 50.470´ East) (Halda gazette, 2020). In addition, the source needs to be conserved with native tree plantation and removing the impediments of natural water flow from the source to ensure sustainability of the Halda (Kibria, 2021c).

2.2 Socio-cultural perspective

Social and cultural values of rivers are rarely considered in the decision making process. (Hossain, 2015). The nearby communities of Halda River are more or less dependent on this river. Varieties of profession are found in these communities, such as boatmen, fishermen, boat builder, farmer, egg collector, jolodas (fisherman cum net maker), sand quarer etc. Many businesses have been developed based on the fishing gears that are required for egg collection and fishing (Arshad-Ul-Alam and Azadi, 2015). There are 4,253 fishermen and 588 fish egg collectors dependent on Halda (Khan, 2019). People from Muslim, Hindu and Buddhist religious communities are involved in fishing and fry collection (Arshad-Ul-Alam and Azadi, 2015; Kabir Saim et al., 2016). Besides fishing, large numbers of people are engaged in farming. Aquaculture has developed largely in the Halda watershed area for the last two decades because of good environmental conditions and presence of natural fry from the river (Siddique et al., 2012). The adjacent communities use their indigenous knowledge for fertilized egg collection and hatching (Alam et al., 2013; Kibria et al., 2018). This knowledge has been developed through the local people's historical knowledge and religious spirit. (Kabir et al., 2014). Halda also has a large cultural significance. It is well known for an exceptional boat called "Sampan " that has had great influence on the creation of *HaldaFada* songs which is famous in the whole country (Kabir et al., 2015).

2.3 Socio-economic stance

Unlike other rivers the Halda greatly contributes to our national economy by becoming the means of production and services such as fresh water supply, fish production, transportation, waste assimilation, recreation and tourism options etc. Total 988 households in the vicinity of Halda are directly or indirectly involved for their livelihood. Some appreciable studies have been conducted to estimate the direct (tangible) & indirect (intangible) value derived from Halda (Kabir, 2011). In study it is found that the total value of tangible resources is 20.5 million US$. Segmented contributions of fishing, fish fry, irrigation, drinking water, water transportation and sand extraction respectively were 0.07, 0.005, 15.78, 1.33, 0.12, 2.51 (US$) (Kabir et al., 2013). In another study total indirect use value was found Tk. 29.50 million per year (Kabir et al., 2015). Again, it contributes to the national economy by catching prawn, prawn post larvae catching, irrigation & industrial uses. It is also found that the total value of this river is about 2971.85 US$ (Kabir, 2011). Hatched fries have a complex market chain that can be described in four ways i.e., firstly from fry sellers to local fish consumers via local fish farmers and pond owners; secondly from fry sellers to nationwide fish farmers via hatchery owners and technicians; thirdly from fry sellers to renowned public fish hatchery in order to produce mother fish and finally from fry sellers to government Halda brood restoration project in order to enrich Halda River with more brood fish (Saimon et al, 2016).

2.4 Halda resources

2.4.1 Fish & Dolphin

Contribution of our fisheries sector to the GDP is about 3.61 percent. 11 percent of the total population of Bangladesh is engaged in the fisheries sector on a full or part-time basis (The Daily Star, 2020) where Halda fish plays a great role in the local and national economy of the country. The tidal river, Halda is the renowned breeding ground in the world from where naturally fertilized eggs of major Indian carps i.e., Catla (*Catlacatla*), Mrigal (*Cirrhimusmrigela*), Rui*(Labeorohita*) and Kali Baush*(Labeocalbasu*) (Kabir et al., 2015b) are culled and hatched by the local egg collectors and fishermen. Moreover, it is one of the major sources of plants, fish, freshwater shrimp and crab, freshwater turtle, dolphins (shushuk) and other organisms; (Alam et al., 2013; Zaman, 2014). However, the use of different types of nets and fixed gears across rivers has affected the capture fishery.

Some appreciable research works on fish fauna of the rivers of Chittagong including Halda were conducted like biodiversity and field sites of fish (Azadi and Arshad-ul-Alam, 2011), fishing intensity (Arshad-Ul-Alam, 2013), Ichthyofauna in the upper Halda and their status (Alam et al., 2013), finfish and shellfish species of Halda and their present conditions (Azadi and Alam, 2015), marketing channels of Indian carp fry collected from the Halda River and livelihood of the fry traders (Saimon et al., 2016).

The Ganges river dolphin, or shushuk (*Platanista gangetica*) is one of our country's most important fauna and endangered freshwater animal. It was historically distributed throughout the Ganges/ Brahmaputra/ Megna and Karnaphuli river systems of India, Nepal, and Bangladesh (Halda, Karnaphuli, and Sangu rivers). The Halda River is one of the major sources of Ganges River Dolphin or South Asian River Dolphin. According to the Halda River Research Laboratory findings, currently 250 dolphins are found in the Halda River. The official status of the river dolphins, locally known as Shushuk is "critically endangered" as per the International Union for Conservation of Nature (IUCN) Red List. (DhakaTribune, 2020). Once there were 167 dolphins in Halda but now the number is 126. From 20 September 2017 to 01 February 2018, 18 dead dolphins were reported in Halda River (Khan, 2019). In the last three years since September 2017, 29 dolphins have died in this river. (The Business Standard, 2021a).

2.4.2 Sand

Halda is the major supplier of sand in Chittagong city. From this river, local leaders and businessmen collect sand from sand mining stations. Through competitive bidding, legal Balumohal is leased to people. Few studies were conducted to show the impact of sand mining on local society, fish, water quality and so on. Study shows that the number of legal Balumohals was less than illegal sand selling stations. Due to which, the whole ecosystem is disturbed along with the river basin and the situation is worsening day by day. Study also indicates that sand

mining is the main reason for the bank erosion at the Halda (Kabir et al., 2014). According to a report of DhakaTribune, it also has a negative impact on the sustainability of natural resources because of the mismanagement of sand mining stations (DhakaTribune, 2020).

2.5 Intervention of Rubber Dam on the Halda River

A rubber dam was built on Halda River in 2012 at the location of Bhujpur under Fatikchari Upazilla of Chittagong district. The dam is situated about 35 km upstream from Sattarghat. Having 55 m length, 8.5m width and 4.5m height, the damcan retain at least 16 ft water in its reservoir. A study was conducted in Bangladesh about performance evaluation of rubber dam projects in irrigation development focusing on financial viability of the rubber dam projects. This study used socio-economic indicators as a tool for analysis (Saleh and Mondal, 2001). However, the study lacks the environmental perspective of a rubber dam where policymakers and agencies can make better decisions about which interventions should be undertaken, and how to pre-identify potential social and environmental impacts before starting the project (Tilt et al., 2009). Another study on the Halda was found to show the overall mismanagement of engineering structures in this river. According to the study, the rubber dam is hampering the natural flow of Halda River due to blockage. As a result, siltation is occurring which consequently reduces the water holding capacity of the river due to lower depth (Kabir et al., 2014). Besides, a study of Akhter (2015) reveals that implementation of a rubber dam is causing 17.41% reduction of flow on an average due to lack of proper maintenance and management; many of these structures became nonfunctional. Along with the constructed water control structures, local people also built earthen dams across the hilly streams. Therefore the natural flow in the river was affected which has had adverse impact on the spawning activity in the river.

2.6 Present political condition

Halda created lots of political interest as the Prime minister showed her generous motive to save this river from being deteriorated. Prime Minister also emphasized on protection of natural breeding grounds of fishes and declared Halda as a ‘Sanctuary of Fish’ (DhakaTribune, 2013). The Department of Environment (DoE) also organized a view exchange meeting on the matter of declaring the Halda as an Ecologically Critical Area (ECA). Meanwhile, the Ministry of Fisheries declared the river Halda and 23,422 acres of adjoining land of river banks as Bangabandhu Fisheires Heritage (The Financial Express, 2020). Recently, the High Court has constituted a committee titled “Halda river dolphin killing prevention, natural environment, biodiversity and all types of mother fish protection committee” headed by Chittagong Deputy Commissioner to protect the biodiversity of Halda river, carp, mother fish and dolphins. (bdnews24.com, 2020)

2.7 Technological

At present, modern technology of egg collection and hatching has partly replaced the traditional one which is not welcomed by many Halda experts. Besides, the government initiative of protecting the river bank by covering it with concrete blocks, local people are also found to use

sand stack for river bank management using their traditional knowledge (Kabir et al., 2014). Moreover, currently there are 12 sluice gates installed at different points of the Halda River for irrigation purposes, most of which are unplanned and unsuitable for irrigation and drainage systems (The Daily Star, 2020).

Communication system has also changed a lot now compared to the past. Motor boats have largely replaced traditional boats. Water transportation has been reduced by the construction of bridges, culvert etc. Unfortunately, a total number of 22 brick fields were found very close to the river bank which provide a bad example of technological activity at Halda. Using dredgers for sand extraction is another such example. Cutting the oxbow band has reduced the length of the river by about 25 km. This activity has subsequent consequences towards the river and lives of adjacent people. During the rainy season, overflowed water hits the river bank with great velocity causing severe bank erosion (Kabir et al., 2014).

2.8 Environmental

2.8.1 Source of water

The Halda is one of the major sources of fresh water of Chittagong city. A proposed project of Chittagong Water Supply and Sewerage Authority (CWASA) has been set to withdraw 14 crore litres of water from the Halda river daily for an economic zone which will pose a serious threat to the unique breeding ground for natural spawning of carp fish in South Asia. CWASA has already been extracting 18 crore litres of water daily from the river for the use of city dwellers since 2018 (The Daily Star, 2020).

2.8.2 Industrial use

Halda River acts as a way of water transportation for collection of soil for brickfields. At the same time, brick kilns on both sides of the river (total 22) (Khan, 2019) use the water of this river as a raw material for brick processing (Kabir et al., 2014). Moreover, CWASA is now planning to withdraw a further 14 crore litres from Halda a day for factories in the Bangabandhu Sheikh Mujib Shilpa Nagar at Mirsarai, Chattogram. If the project is implemented, the total withdrawal will stand at around one third of total water flow in the dry season. For this reason, Halda experts and environmentalists have warned about a radical impact on the biodiversity of the river, which has been experiencing severe salinity since 2016 due to decline in its water flow (The Daily Star, 2020).

2.8.3 Change in water quality

Dissolve oxygen (DO) concentrations were found < 4 in Halda river. (Uddin & Jeong, 2021) According the report of UNDP, relatively high quantity of total dissolved solids (TDS) indicates high level of pollution, which was supported by the visible pollutants and sources of water pollution (e.g., industries, markets and residential areas) along the river and riverbanks. The pH values along the river indicate that in general the water is slightly alkaline but is not a big problem. The pollution would have been terrible if the river was not tidal. (Khan, 2019)

2.8.4 Change in fish population

There was a record of 93 species of Ichthyofauna i.e., fish, shrimp and crab from the river during seven years (2004-2011) of investigation. But 3 species were under critically endangered, 9 endangered and 8 vulnerable categories out of the 93 species (Azadi and Arshad-Ul-Alam, 2011). Another study says 26 species lost in 7 years due to pollution. The study carried out between March 2015 and February 2016 found at least 26 fish species have disappeared from the Halda. Currently, 26 out of 76 species of fish are not available in the natural breeding ground because of water pollution through indiscriminate dumping of industrial and solid waste into the river, salinity, sand extraction, sluice gates and dikes built on riverbanks and others. (The Business Standard, 2021a). Some of the species that are no longer found are Goni Chapila, Iisha, Telipasha, Chital, Foli, Mrigal, Koksa, Ghor Poia, Guijja Ayre, Meni, Dhela, Chep Chela, Teri Punti, Baleetora, Pabda, Madhu Pabda, Tengra, and Shilong. Other lost species include Dhain, Batasi, Pangwash, Ghajal, Koitor Poa, Poa, Baila and Nuna Baila (The Daily Star, 2017).

2.8.5 Pollution

River pollution has become a great warning for the ecosystem and biodiversity of river Halda. Once main sources of pollution were Asian Paper Mill, Madina Tannery, Hathazari 100 MW peaking power plant, that are sealed off now (The Daily Star, 2019; DhakaTribune, 2019; Dhaka Tribune, 2018).

Study showed that Halda River is being polluted due to industrial waste (53%), sewage contamination (20%), tobacco farming (13%), rubber dam (8%) and sand extraction (6%) (Islam et al., 2017; Saha, 2019). Moreover, some poultry farms built along the river are contributing to the pollution. As a consequence the dissolved oxygen and food production rate have gone down (Khan, 2019). However, Chittagong Development Authority (CDA) has established a residential area named Annanya Residential Area whose sewerage system is opened at Halda, which can be a great hygiene issue.

2.8.6 River Bank Erosion

River bank erosion is severe in some parts of the locality situated beside the river Halda. Areas like Madarsha, Transferbazar, Kochukhain, Shundarpur, Shuoabil etc. are at risk of this threat. Bangladesh Water Development Board (BWDB) has provided cemented or concrete blocks at some areas which are at high risk of erosion. By doing so, they are able to protect around 1.5 km of river bank (Kabir et al., 2014). As government support and management is not adequate and satisfactory, local communities have started to practice some traditional knowledge at a very small scale to save their lives and properties from erosion.

2.8.7 Destruction of spawning ground by straightening oxbow-bend from Halda River

Oxbow-bends are the spawning ground of major Indian carps in the Halda River (Tsai et al., 1981) of which 11 oxbow-bends (Annex IV) of Halda River were cut down from the beginning

of the 19th century and eight out of eleven is at lower Halda and the rest at upper stream (Kabir et al., 2014). Due to this, the total length of the river is reduced from 123 km to 98 km. In 2002, the Kagotia char oxbow bend near Gorduara was cut short by digging a 10 feet wide canal and it was subsequently cut again in 2004, 2007 and 2009 which substantially hampered the natural flow of this river. As a result, heavy water flow during rainy season hits the adjacent banks. Since the length of the river is shrunken by about 25 km, the saline water is entering easily into the river from Bay-of-Bengal and the water holding capacity also reduced leading to water overflow with a great velocity during rain causing severe erosion to river banks of Halda. River Biologists stated that all the oxbow bends of this river act as main habitat for carp spawning. Due to heavy flow of water and strong water turbulence, *Kum* (natural shallow hole for spawning) is created naturally at this bend of river. As this natural flow is disrupted through cutting of oxbow bends, this *Kum* is filled up by siltation. Besides, the physiochemical properties of the river ecosystem are also hampered. Consequently, the unique environmental set up for spawning is disturbed and amount of egg collection was also gradually going down (Kibria, 2021c).

2.8.8 Unscientific sand extraction by changing the river morphology and hydrodynamics

At present, there are 13 legal and 20 illegal Balu Mohals (sand querying stations) in the Halda River (The Daily star, 2017). Every day, a huge amount of sand is extracted from the river. As a result, the river basin is damaged and the whole ecosystem has been disrupted including noise pollution. This immense sand quarrying also acts as a main factor of river erosion at Halda.

2.8.9 Impact of mechanized water boat

The motor based water transport has an inverse impact on fish reproduction and spawning area in Halda. Oil leakage into the water environment hinders the natural movement and growth of carp fishes. On the other hand, sound derived from those motor vehicles frightens mother fishes, which are too sensitive during egg release period. The motors of those vehicles create turbulence on water level which can be a reason for river bank erosion. (DhakaTribune, 2019). The Department of Fisheries has banned movement of motor operated vehicles during egg release season.

2.9 Legal

2.9.1 Environmental policy, 1992

Section 5 discusses how to ensure environmentally sound utilization of all water resources. To ensure that all steps taken for flood control, including construction of embankment, dredging of rivers, digging of canals etc. to be environmentally sound at the local, zonal and national levels.

Section 8 discusses prevention of activities which diminish the wetlands, natural habitats of fish and encourage rehabilitative measures in this area. Besides, section 11 discusses how to ensure that road, rail and inland water transport systems do not pollute the environment or degrade the

resources. Policy also addresses the conduct of Environmental Impact Assessment (EIA) before undertaking related projects.

2.9.2 Environmental Conservation Act (ECA) (amendment), 2010

According to section 5 of the Act, after declaring an area as ecologically critical area, the government will take management plans for certain areas where subsection (1) specifies the activities or processes that cannot be initiated or continued in an ecologically critical area.

2.9.3 Fisheries Protection and Conservation Act, 1950; Fish Inspection and Quality Control Ordinance, 1983 and New Fisheries Management Policy, 1986

The main objective of all these fisheries laws and regulations is to provide the framework and mechanism for the systematic, efficient and rational utilization, development and management of the country's fisheries sector and the aquatic resources it contains.

2.9.4 National Fisheries Policy, 1998

This policy discusses conserving fish habitats from damage. Appropriate care should be taken during the implementation of all developmental activities such as flood control, irrigation and drainage projects, agriculture, industries, road and urban development projects. Breeding grounds of fish and freshwater massive prawn will be conserved. In subsection (6.6) it is mentioned that action will be taken to utilize the Fish Conservation Acts perfectly in order to prevent capture of banned size of different fishes. Moreover, in subsection (6.8) import, manufacture, sale, storage and use of current net (monofilament net) and other such nets harmful for the fisheries resources are mentioned to be banned. Again in subsection (6.9) it is pointed out that the fishermen societies along with the local government will be engaged in the execution of the fish conservation acts besides the authorities presently engaged for the same purposes.

2.9.5 National Water policy, 2012

This policy focuses on ensuring adequate upland flow in water channels to preserve the coastal estuary eco-system threatened by intrusion of salinity from the sea. And also a suggestion of developing a central database and management information system (MIS) consolidating information from various data collection and research agencies on the existing hydrological systems, supply and use of national water resources, water quality, and the eco-system. According to this policy, different suitable measures would be undertaken, wherever needed, to maintain navigational capability of designated waterways. But water development plans will not interrupt fish movement and will make adequate provisions in control structures for allowing fish migration and breeding. Moreover, measures will be taken to minimize disruption to the natural aquatic environment in streams and water channels.

2.9.6 The Embankment and Drainage Act, 1952

The Act consolidates the laws relating to make better provision for the construction, maintenance, management, removal and control of embankments and water courses for the better drainage of land and for their protection from floods, erosion or other damage by water.

2.9.7 National River Protection Commission Act, 2013

This act discusses encroachment of rivers, environmental pollution, and river pollution due to the different industrial activities. To prohibit illegal infrastructure and irregularities of different issues, this act also focuses on reclaiming natural flow of river and proper management of river.

2.9.8 Environmental Conservation Act, 1995

In this act subsection 5 of section 6 outlines that the place selected as a reservoir cannot be filled or altered.

2.9.9 Bangladesh Water Act, 2013

Section 20 outlines ensuring normal flow of water courses. Without permission of appropriate authority no person or organization cannot stop or divert natural flow of water.

2.9.10 Brick Manufacturing and Brick Kilns Establishment (Control) act, 2013

Section 5(2) of this act outlines that no person can collect soil from khal, beel, haor, baor, pond, stream and river without due permission from responsible authority. Section 8(5) of this act strictly prohibits establishment of brickfields in the Ecologically Critical Area (ECA).

2.10 Discrepancy

Bangladesh Water Development Board (BWDB) took on a number of projects over the years in the Halda river basin. These include the Halda Unit of Karnafuli Irrigation Project, Halda Irrigation Extension Sub-Project and Halda Parallel Khal Project (Akhter, 2015). There have also been several other smaller projects in which many of the hill streams have been blocked by water control structures (e.g. regulators, sluice gates and weirs) in the mouth of the streams for dry season irrigation. This has hampered the flow from the hilly region downstream, which has been exacerbated by the fact that many water control structures are not functioning properly (Kibria et al., 2009). This has also increased the potential of increased salt water intrusion in the Halda River. The Government undertook a five-year project in 2007 named “Halda Restoration Project”. The objectives of the project included river dredging, repairing existing sluice gates, establishment of a fish sanctuary in a certain river, and preserving the brood (mother) fish. However, the role of some of the proposed components in improving the situation was not very clear (Kibria et al., 2009; Akhter, 2015). In 2018, Bangladesh Water Development Board initiated a project on Halda which included building up roads and embankments on both sides of

the river, repair of embankments and dams on 39 points across 12-kilometers belonging to Hathazari and Raozan upazilas. The project dumped sandbags at those places to reduce the depth and later built embankments with concrete blocks (BWDB, 2021) which might have adverse effects on fish breeding grounds. A study titled “Impact assessment on upstream water withdrawal to conserve natural breeding habitat of major carps in the Halda river” jointly conducted by Department of Fisheries (DOF) and Bangladesh Fisheries Research Institute (BFRI) also addressed the above-mentioned issues. Social activists and environmentalists make efforts to protect and improve the environment and to preserve and safeguard the natural resources, bio-diversity, wetlands and aquatic life of the river. Bangladesh is a signatory to the Ramsar Convention (1971) and the World Heritage Convention (1972). These are the principal instruments safeguarding the natural heritages worldwide. Meanwhile, the Government of Bangladesh declared a 40 km area (Nazirhat Bridge to Kalurghat Bridge) of the river as sanctuary not mentioning any policy guideline for the fisherman (The Daily Star, 2009). But both the government and private sector have to act accordingly and in an integrated way to prevent pollution and unplanned infrastructural development on the banks of Halda River by ensuring Halda river bank peoples’ interest to make all the initiatives sustainable.

2.11 Scope of work

The principal legislations that safeguard Ecologically Critical Areas (ECA)s in Bangladesh are the Environment Conservation Act (1995), Environment Conservation Rules (1997), and the Constitution of Bangladesh. The significance of conserving the ECAs has been addressed by few esteemed decisions of the Bangladesh Supreme Court. There are some other legislations which address environmental concerns. The Playground, Open Spaces, Gardens, and Water Bodies Conservation Act 2000; Environment Court Act 2010; Wildlife (Conservation and Security) Act 2012; Brick Manufacturing and Brick Kilns Establishment (Control) Act 2013; Bangladesh Biodiversity Act 2017; Bangladesh Water Act 2013 etc. Besides, all other acts and regulations that have connection with the river ecosystem conservation along with govt. and non-govt. institutional rules and regulations with the opinion of people residing on the bank of the Halda River will create pathways to determine required integrated policy interventions.

3. Method

3.1 Sample selection

This draft policy paper has been written based on primary and secondary data sources. Primary data has been collected with a combination of field visit; face to face interview; telephonic interview and key informant interview with the adjacent communities of the Halda River, officials of govt. and non govt. institutions, researchers and relevant professionals. Besides, published journal article, newspaper reports have been used as sources of secondary information. It is actually aimed to correlate the Halda community in terms of economic and resource dependency so that integrated and sustainable management of Halda can be ensured. Categories of stakeholders and work plan have been mentioned in table 2 and table 3.

For interview of the adjacent communities, different areas of three upazilas on the bank of the Halda River have been selected purposively from upstream to downstream are Manikchari, Hathazari and Raojan. According to expert opinion, at present number of egg collectors; tobacco farmers (ex) and rubber dam users are around 600 (directly and indirectly); 100 and 40-50 respectively who depend on Halda for their livelihood (Kibria, 2020a). However, among the 600 egg collectors, 300 are directly involved. Considering this population, during this pandemic situation in total 132 respondents have been selected by using random sampling and a purposive method for face to face interview along with telephone interview during this pandemic situation. For this purpose, different groups of professionals related to the Halda such as Egg & Fry collector (62; from Hathazari: 43, from Raozan: 19), Tobacco farmer (58), and the people (12) living up & downstream of Bhujpur rubber dam have been surveyed to identify their views and suggestion relating to the river environment, to learn about their observations regarding the river conditions, its production capability and other related things. Authorities of the government like Upazila administration; Fisheries office; Integrated Development Foundation (IDF) as non-govt. organization; Local politicians; River police; Department of Environment; Water Development Board; Forest Department, Chittagong Development Authority, Journalist related with Halda River management have been interviewed either face to face or over the phone to identify their opinion on existing problems of the Halda and way forward to solve the issue (Annex I). Besides, some researchers and professionals' opinions have been taken into consideration who are involved in activities relating to bringing back the environment of the river (Annex I). Most of this discussion has been covered over the phone amidst this pandemic situation.

3.2 Study area

This draft policy report has been written based on visits to IDF's project areas - Khagrachari, Hathazari and Raozan as shown in figure 1.

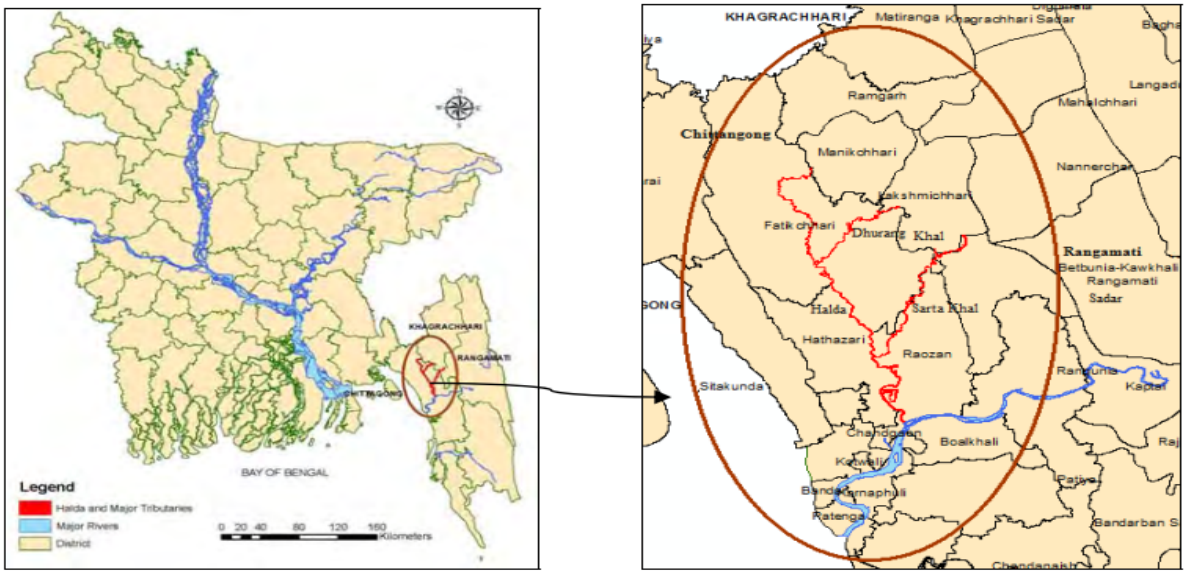

Figure1: Location of the study area Source: Akhter, F (2015).

3.3 Data sources, collection tools, procedures, cleansing and quality control

Primary data has been collected from field surveys following the safety measures during this pandemic period along with telephone interviews and some face to face interviews using semi-structured questionnaires. Prior to the interview, the questionnaires have been reviewed by PKSF professionals (Annex II). For better understanding, a research planning matrix is included in Table 1. For interview purposes, a group of survey team has been formed with proper guidance who were continuously involved with the survey (Annex III).

Table 1: Research planning matrix of the study

Objectives of the study	Relevant indicators/issues	Important variables	Sources of Data
1. To identify major constraints in conserving the environment of the Halda River	• Status with profit • Status of Kum	Egg amount	• Primary data • Secondary data (Previous research)
	• Status of practice • Status of embryonic, larval and fry development	Hatching technique	• Primary data • Secondary data (Previous research)
	• Status of brood fish	Brood fish amount	• Primary data
	• Status of dolphin	Dolphin	• Secondary data (Previous research)
	• Current status	Fish breeding environment	• Primary data
	• Govt. initiative • CWASA project • Perception of stakeholders	Water withdrawal	• Primary data • Secondary data (Previous research, consultancy report)
	• Status of industries	Industrial pollution	• Secondary data (Previous

Objectives of the study	Relevant indicators/issues	Important variables	Sources of Data
	• Pysico chemical parameters		research, consultancy report)
	• Status of tobacco cultivation • Status of yield and profit • Perception of tobacco farmers • Tobacco effect on Halda	Tobacco cultivation	• Primary data • Secondary data (Previous research, consultancy report)
	• Status of rubber dam user • Rubber dam and fish spawning relationship • Perception of rubber dam user	Infrastructural development	• Primary data • Secondary data (Previous research, consultancy report)
	• Perception of stakeholders • Problems identified by administrative bodies	Institutional efficiency	• Primary data
2. To suggest integrated interventions along with responsible authorities and stakeholders	• Recommendations from previous research • Opinion of Halda river bank people • Opinion of Halda administrative bodies	• Research • Local intervention • Administrative	• Primary data • (Discussion with stakeholders)

Objectives of the study	Relevant indicators/issues	Important variables	Sources of Data
		intervention	
3. To develop strategies for implementing policy interventions suggested by the paper	• Major focused interventions identified by stakeholders and responsible authorities	Co-ordination among stakeholders	• Primary data Discussion with stakeholders

Sources of secondary data have been gathered by consulting with the Halda experts, concerned government. and non-government organizations, resource persons, and also from published articles, policy reports, newspapers, different blogs and websites etc. to best describe the policy issues. Prior analysis, data have been undertaken by several processing activities aiming for cleansing and quality control. Collected data have been clearly inspected to remove data related errors such as whether there is any missing value or any repeat of data, misallocation of data under wrong column, unusual value of data, change in data type etc. Before starting the analysis of data, data have been formatted into desired structures that serve the purpose of study objectives. Finally, the analysis has been done with Microsoft excel.

3.4 List of Stakeholders

Table 2: Breakdown of relevant stakeholder categories for consultation

Stakeholder Categories	Identified relevant stakeholder	Corresponding issues
Local people	Egg collector, tobacco farmer, people involved with rubber dam, people living up & downstream of rubber dam	Views and suggestions related to river environment, observations regarding river conditions, its production capability and dependency on river.
Key Informant	Upazila administration, Fisheries office, Integrated Development Foundation (IDF), Local politicians, River police, Department of Environment, Water Development Board, Forest Department, Chittagong Development Authority, Journalist	Current policies roles and responsibilities, barriers, way to overcome, future plan regarding river management through integrated approach, Major issues need to address at the earliest
Professional &	Chittagong University faculty	Research outcome relating to bringing

Researcher	member, researcher from Halda research lab	back sustainable river environment

3.5 Works detail

Table 3: Detail timetable of work

Activity	**Location**	**Time frame: April, 2021 to July, 2021**												
		April (in week)				**May (in week)**				**June (in week)**				**July (in week)**
		1st	**2nd**	**3rd**	**4th**	**1st**	**2nd**	**3rd**	**4th**	**1st**	**2nd**	**3rd**	**4th**	**1st**
Contract signature	--													
Literature review	Home base													
Background analysis	Home base													
Methodology design	Home base													
Final planning	Home base													
Submission of inception report	--													
Preparation of questionnaire	Home base													
Interview of tobacco farmers	Field													
Interview of rubber dam users	Field													

Activity	Location	Time frame: April, 2021 to July, 2021												
		April (in week)				May (in week)				June (in week)				July (in week)
		1st	2nd	3rd	4th	1st	2nd	3rd	4th	1st	2nd	3rd	4th	1st
Interview of egg collectors	Field													
Interview of key informants	Field													
Data input	Home base													
Data analysis	Home base													
Report writing	Home base													
Submission of draft policy paper	--													
Presentation on draft policy paper	Home base													
Revision of draft policy paper	Home base													
Submission of final policy paper	--													

4. Results and Discussion

4.1 Status of Egg collector

To identify the views, observations and suggestions relating to the river environment and other related things total 62 egg collectors were interviewed face to face both from Hathazari and Raozan upazilas of Chittagong district.

4.1.1 Age distribution

Among the respondents, 28% were in the age of between 51 to 60 years while 23% were in between 41 to 50 years (Fig. 2). Only 5% of them were at the age of 71 to 80 years. However, all of them were male respondents.

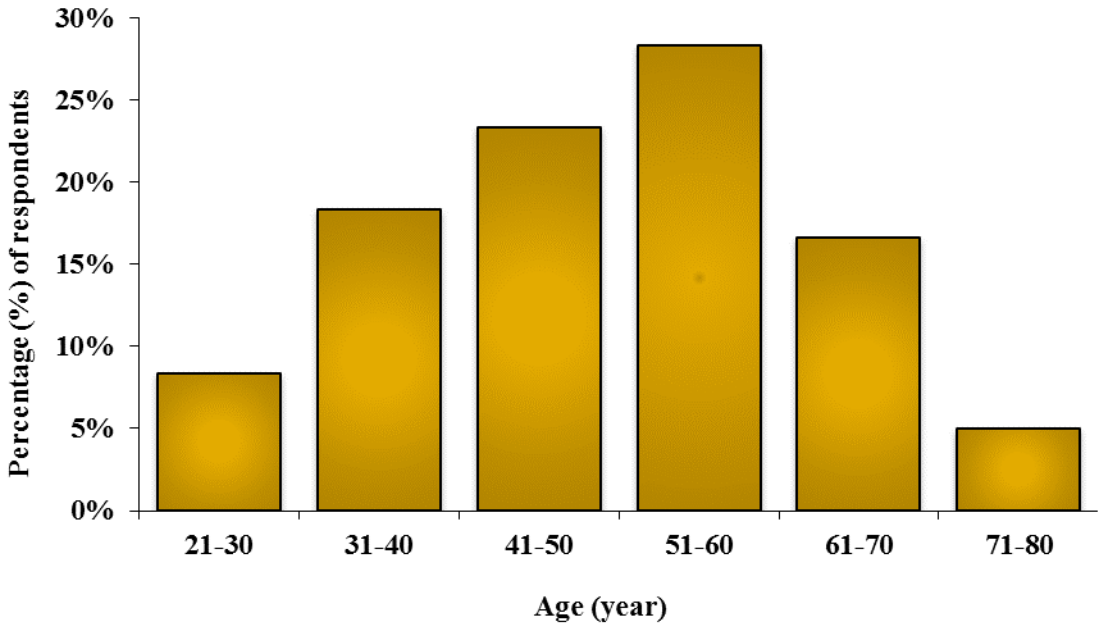

Figure 2: Age distribution of egg collector

4.1.2 Involvement with egg collection

Among the respondents, around 8% were involved with egg collection for 51 to 60 years which was the highest time of involvement for the respondents (Fig. 3). Respondents who were involved with this occupation for around 41 to 50 years, the percentage for them was 18%. Besides, 27% of the respondents were involved for around 21 to 30 years.

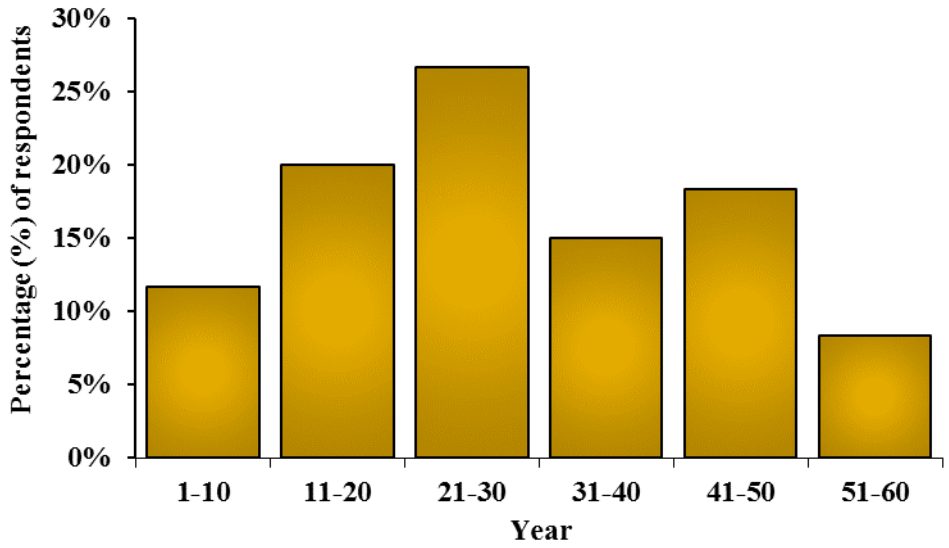

Figure 3: Involvement of respondents with egg collection

4.1.3 Egg collection trend from 2001 to 2021

Figure 4 represents the amount (kg) of egg collected by the egg collectors from 2001 to 2021. Highest 47,700 kg of eggs were collected by the egg collectors in 2001. Upto 2004 there was a sharp decrease in the amount which had increased after 2005. But upto 2014 the trend was fluctualing following both increase and decrease. Again, in the year 2015 there was a sharp decrease in the amount of eggs compared to the previous year and in 2020 the amount of collected eggs (25536 kg) was the highest compared to previous 13 years. Again the amount has dropped in 2021 from 25,536 kg to 8,580 kg.

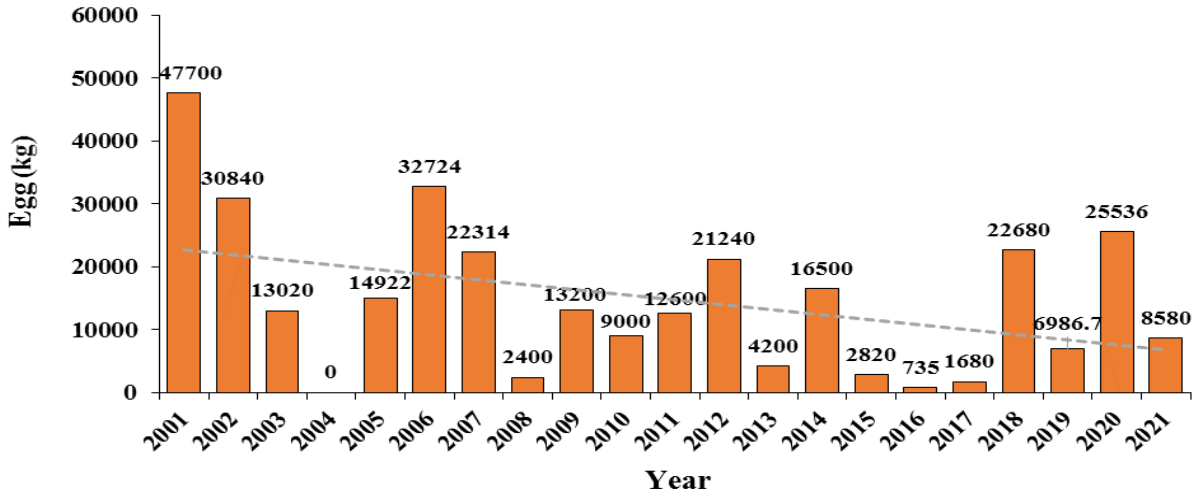

Figure 4: Egg collection trend (year basis) and amount (kg) from 2001 to 2021

4.1.4 Fry production trend from 2001 to 2021

Figure 5 represents the amount (kg) of fries produced from eggs from 2001 to 2021. Highest 795 kg of fries were produced from the eggs in 2001. Upto 2004 there was a sharp decrease in the amount which had increased after 2005. But upto 2014 the trend was fluctualing following both increase and decrease. Again, in the year 2015 there was a sharp decrease in the amount of fries compared to the previous year and in 2020 the amount of fries (393.74 kg) was the highest compared to previous 13 years. Again, the amount has dropped in 2021 from 393.73 kg to 105.73 kg.

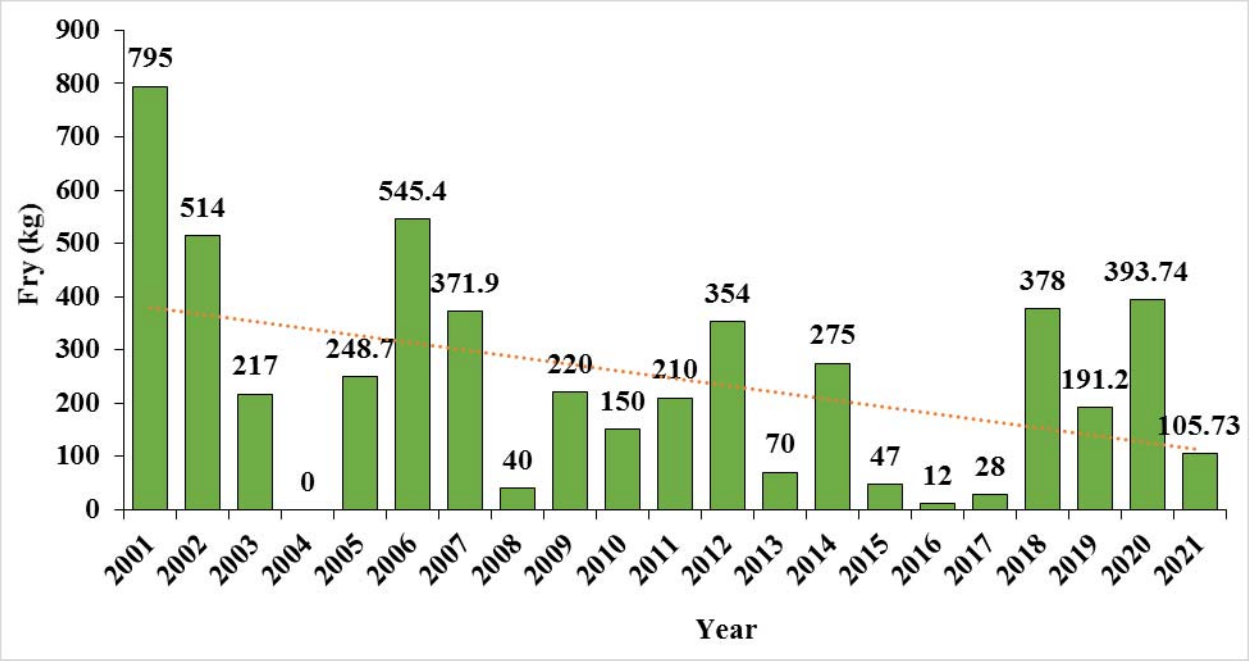

Figure 5: Fry production (kg) status from 2001 to 2021

4.1.5 Change in egg amount in last five years

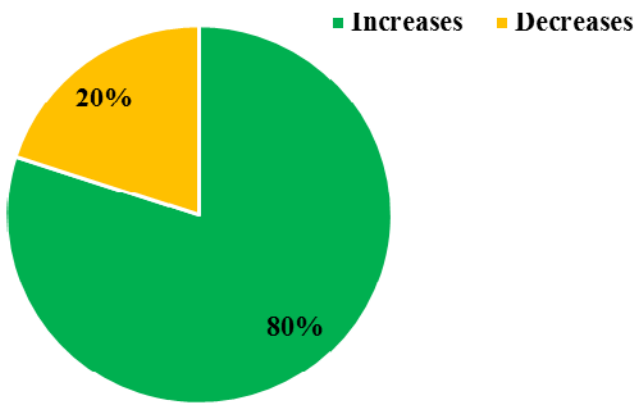

Figure 6: Perception on change in egg amount in last five years

Respondents were asked about their opinion on any change in the amount of egg in the last five years. 80% of them opined that the amount of egg has been increased in the last five years (Fig. 6). But the rest of them opined that it has been decreased.

4.1.5.1 Causes behind increase in egg amount in last five years

Respondents who believed that egg amount has increased in the last five years, among them 79% mentioned that saving brood fish was one of the key factors regarding this issue (Fig. 7). While 67% and 60% opined that prevention of pollution and stopping the motor boat pass played role for the increase in egg amount respectively. Moreover, 10% opined that lockdown might be a cause of increase in egg amount.

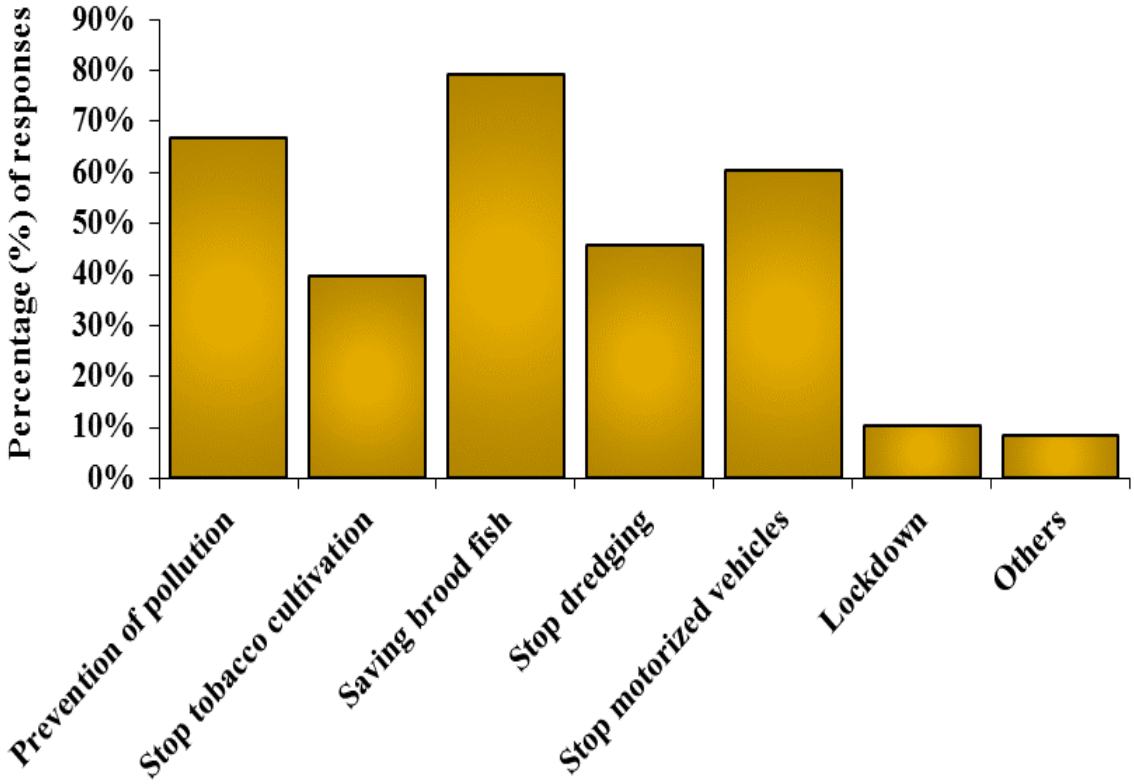

Figure 7: Perception on reason of increase in egg amount in last five years

4.1.5.2 Causes behind decrease in egg amount in last five years

Respondents who believed that egg amount has decreased in the last five years, among them 75% made pollution responsible for this decrease (Fig. 8). Moreover, killing of brood fish (58%), cutting of oxbow bend (50%), destroying kum (42%), less water flow (42%), less rainfall etc. were also mentioned by them.

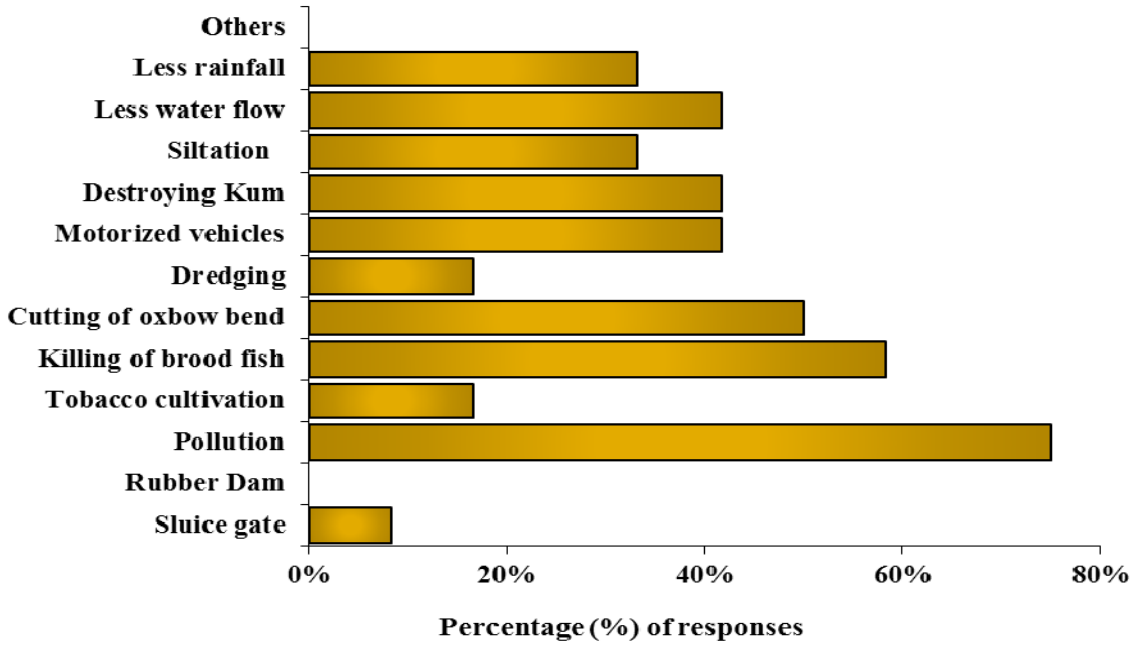

Figure 8: Perception on reason of decrease in egg amount in last five years

4.1.6 Preferences on method of hatching

Respondents were asked about their preferences on hatching methods. Among them 87% mentioned that they prefer earthen well over cemented well (Fig. 9). Rest of them showed their interest in cemented well for hatching of eggs.

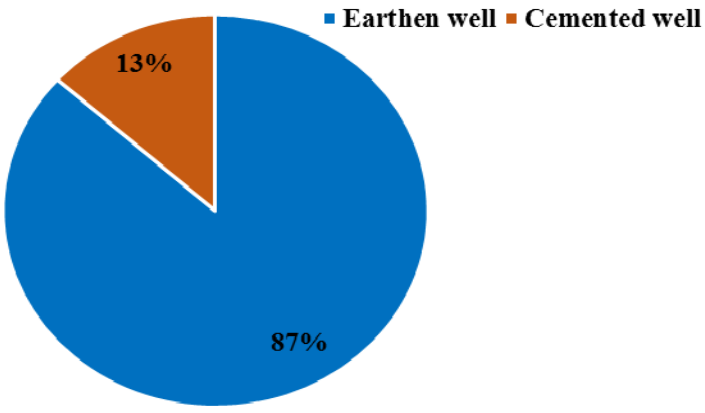

Figure 9: Opinion on preferences of hatching method

4.1.6.1 Reasons behind preference of earthen well

Respondents who preferred earthen well for hatching among them 48% believed that it is healthy practice (Fig. 10). Besides, 40% believe that in earthen wells fries get nutrients from the mud,

25% opined that it creates a cool environment which is helpful for fry development. High oxygen (6%), easy maintenance (6%) etc. were also identified reasons by the respondents.

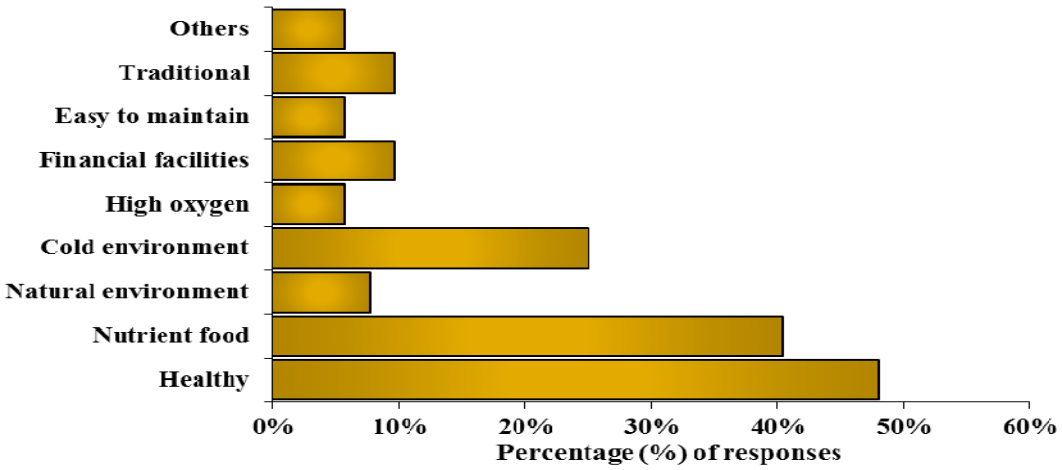

Figure 10: Perception on liking of earthen well

4.1.6.2 Reasons behind preference of cemented well

Respondents who preferred cemented well for hatching among them 63% opined that fries damage is less in cemented well compared to earthen well (Fig. 11) . Another 25% mentioned that it is less labor intensive. High growth (13%), fresh water facilities (13%) etc. are some other reasons for the preference of cemented well remarked by the egg collectors.

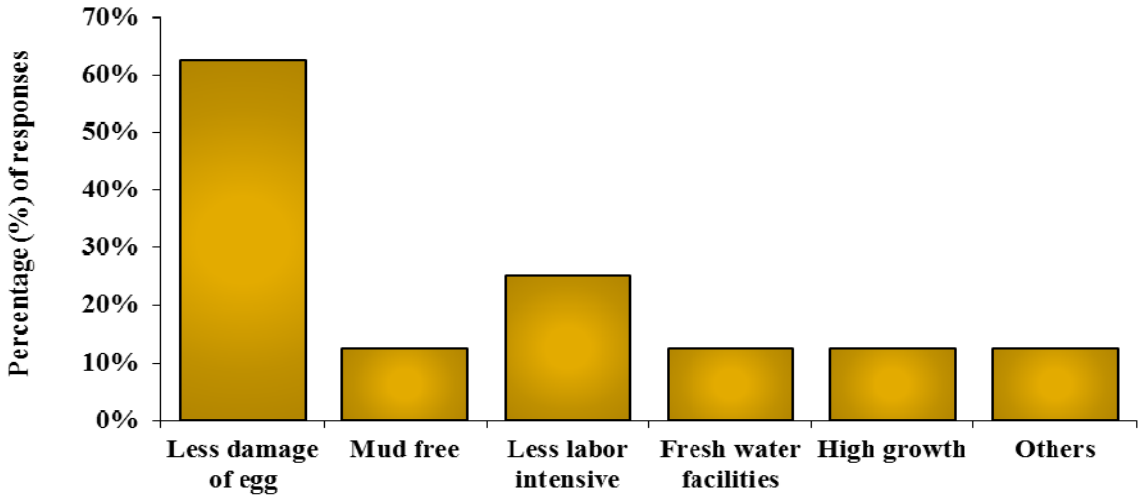

Figure 11: Perception on liking of cemented well

4.1.7 Opinion on increase of brood fish in Halda

70% of the respondents believed that the amount of brood fish of Halda had increased while 30% denied on this issue (Fig. 12).

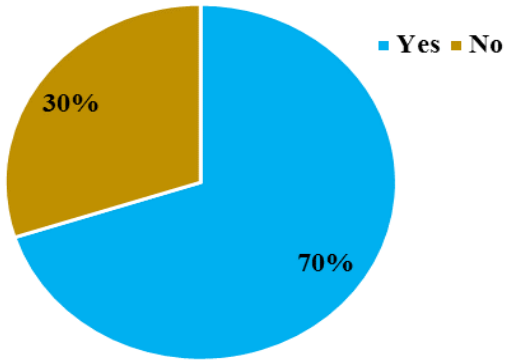

Figure 12: Perception on increase of brood fish in Halda

4.1.7.1 Reasons of increase in brood fish amount

Respondents who opined that the amount of brood fish has been increased among them 95% mentioned that taking initiatives for saving brood fish make this happen (Fig. 13). While another 88% identified conducting mobile courts could be the reason for the increase in the amount of brood fish of Halda. Moreover, 69% respondents also mentioned the pollution free environment as one of the factors. No other reasons had come out from their responses.

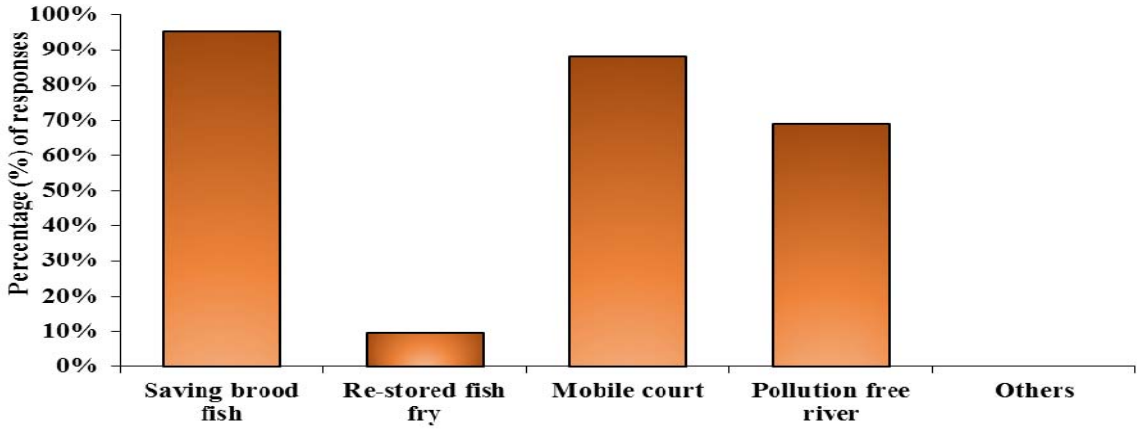

Figure 13: Perception on reason behind increase in brood fish amount

4.1.7.2 Reasons of decrease in brood fish amount

Figure 14 represents the decrease in Halda brood fish amount, among them 83% respondents identified salinity intrusion and killing of brood fish as reasons respectively. Besides, industrial

pollution (78%), tobacco cultivation (44%), siltation (33%) and dredging (22%) etc. were also addressed by them.

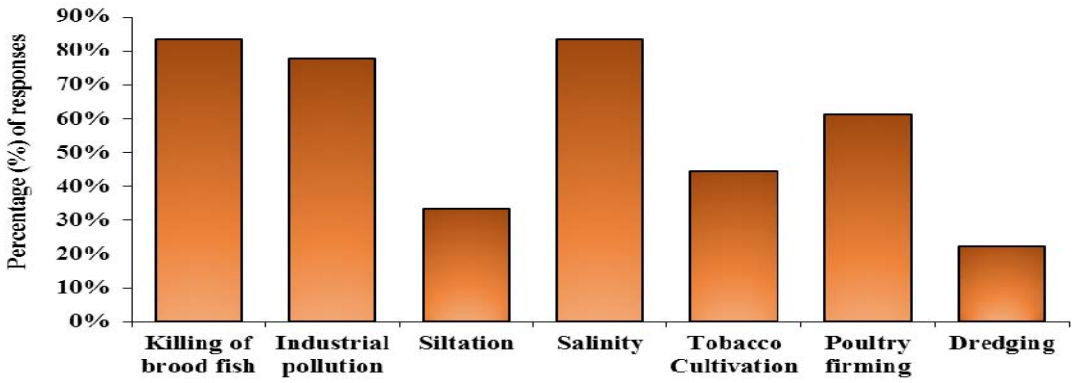

Figure 14: Perception on reason behind decrease in brood fish amount

4.1.8 Opinion on dolphin status in Halda

While asked about dolphin status in Halda, 54% opined that the amount of dolphins has decreased so far but rest of them believed that the amount has been increased (Fig. 15).

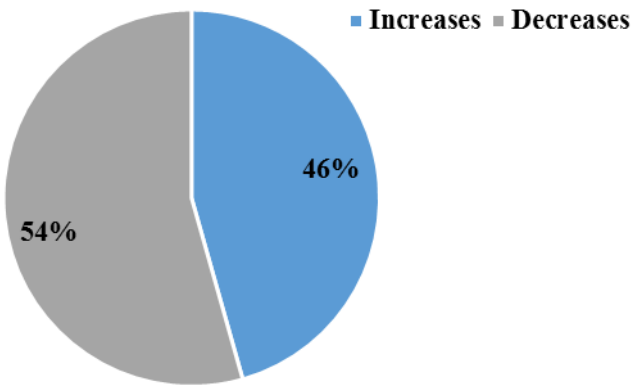

Figure 15: Perception on dolphin status in Halda

4.1.8.1 Reasons of increase in dolphin amount

Those who believed that the dolphin amount had increased among them 41% mentioned that administrative activities played a crucial role in this case (Fig. 16). Besides, controlling the use of pesticides and illegal fishing with nets could be another factor mentioned by 35% of the respondents. 24% mentioned some other reasons for which dolphin amount might increase.

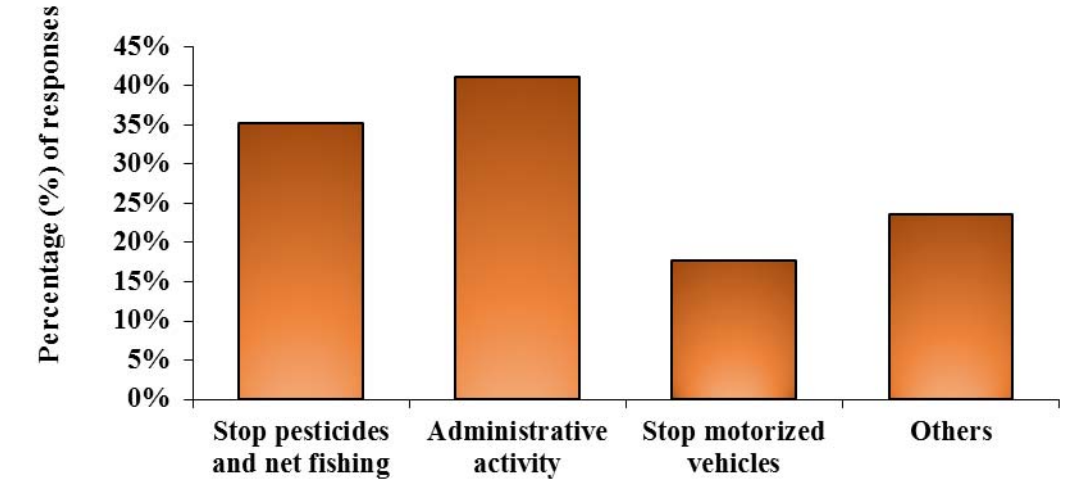

Figure 16: Perception on reason behind increase in dolphin amount

4.1.8.2 Reasons of decrease in dolphin amount

Those who believed that dolphin amount has been decreased among them 40% opined that pollution and dredging play a significant role in this regard (Fig. 17). Besides, net fishing, scarcity of food, decrease of fresh water and river flow etc. were also marked by 33%, 20% and 7% respondents respectively.

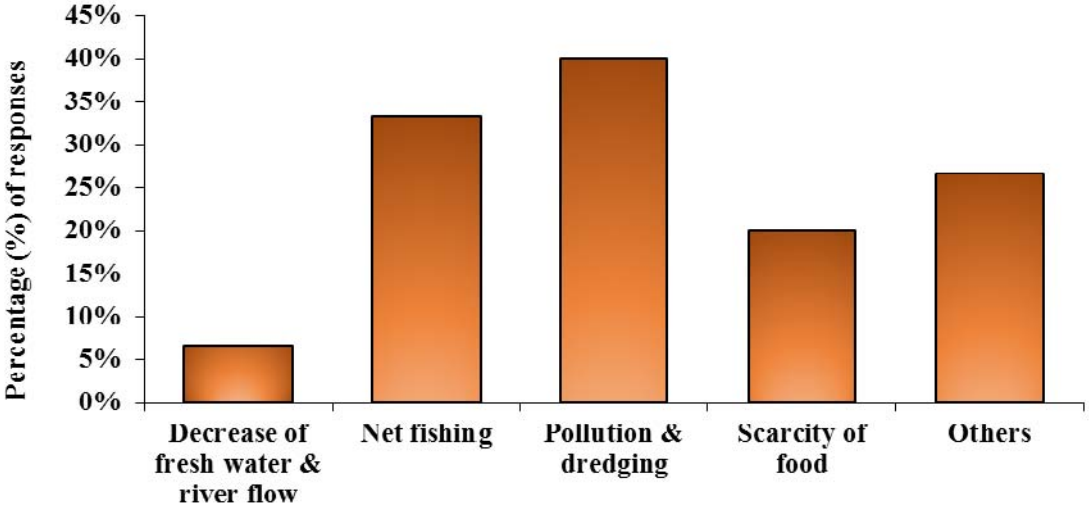

Figure 17: Perception on reason behind decrease in dolphin amount

4.1.9 Obstacles for fish breeding environment in Halda

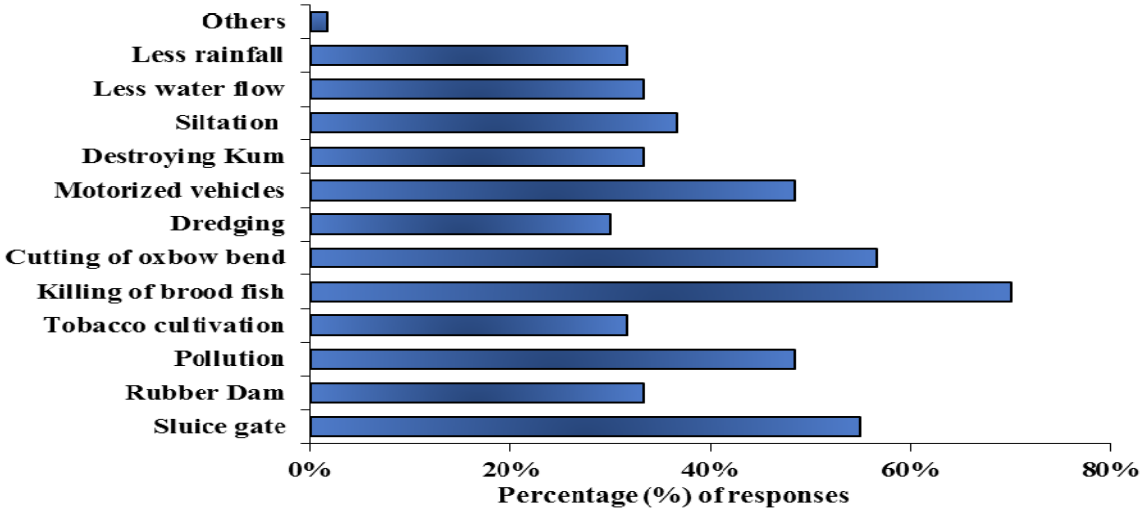

Figure 18: Opinion on obstacles for fish breeding environment in Halda

Among the respondents, 70% opined that killing of brood fish is one of the major obstacles for fish breeding in Halda (Fig. 18). Another 57% believed that cutting of oxbow bend and 55% answered that establishment of sluice gates are also significant impediments for fish breeding. Not only these, but also pollution, presence of motor boats, siltation problem etc. were mentioned by 48%, 48% and 37% of the respondents individually.

4.1.10 Perception on harmful effect of water extraction from Halda for Mirsarai Economic Zone

Almost 90% respondents believed that if water is extracted from the Halda for Mirsarai economic zone then it will create a detrimental effect on Halda. But 10% of them completely denied this negative effect (Fig. 19).

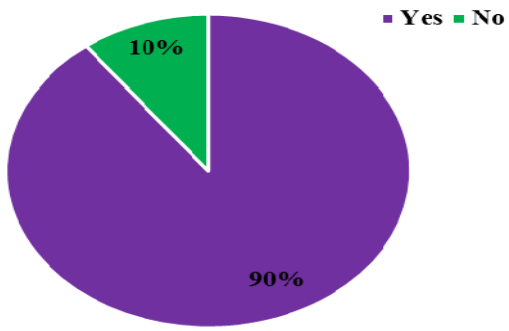

Figure 19: Opinion on harmful effect of water extraction from Halda for Mirsarai economic zone

4.1.10.1 Types of harmful effect due to water extraction

Figure 20 illustrates that 67% of the respondents who mentioned the negative impact upon water extraction from Halda identified salinity intrusion as one of the negative impacts. Besides, decrease of freshwater (33%) and destruction of breeding ground (4%) were also identified effects from the respondents' opinion.

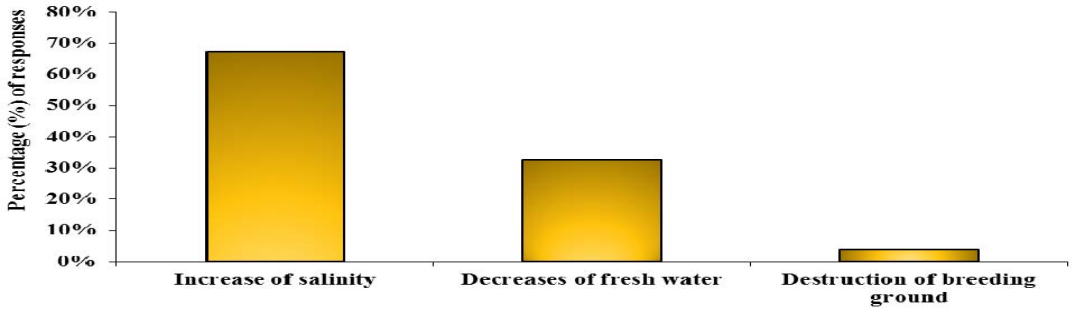

Figure 20: Opinion on types of harmful effects on Halda due to water extraction for Mirsarai Economic Zone

4.1.11 Recommendations for betterment of Halda

Suggestions for betterment of Halda have been addressed by the egg collectors during their interview. 62% of the respondents believe that it is necessary to increase monitoring of all the adjacent areas of Halda while 38% opined for stopping illegal brood fish catch with nets. (Fig. 21) Besides, controlling pollution, installing close circuit (CC) cameras, stopping use of pesticides, saving kum of fish etc. were recommended by 15%, 13%, 8% and 5% respondents respectively.

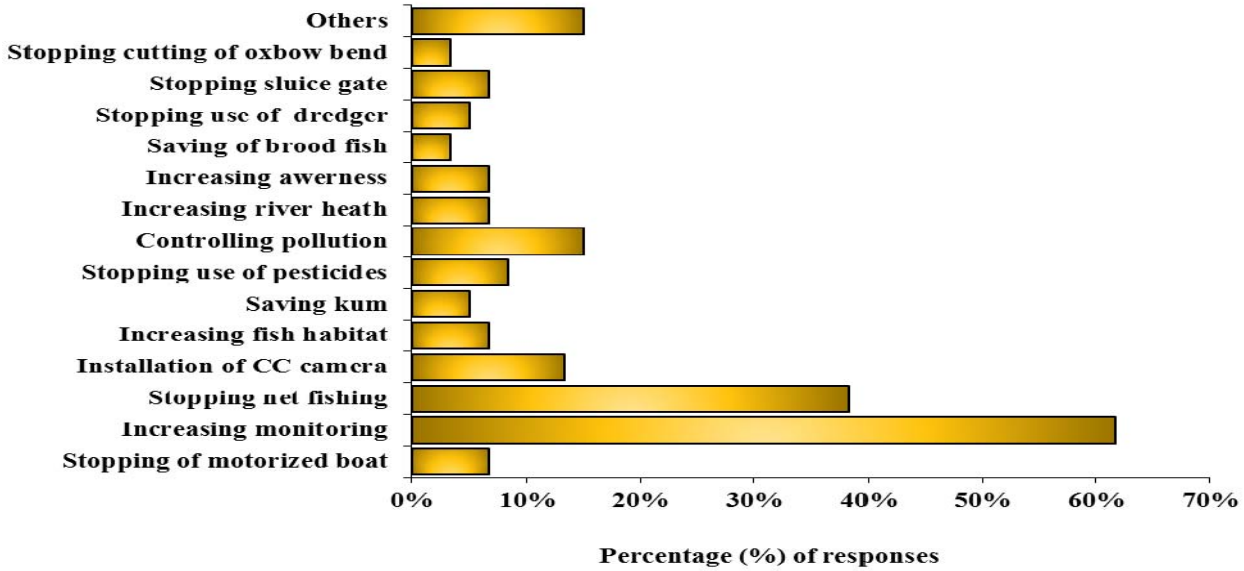

Figure 21: Recommendations from egg collectors for betterment of Halda

4.1.12 Opinion on effectively working institutions

Respondents were asked about their opinion on among Upazila administration, Department of Fisheries, Department of Environment, Water Development Board, Integrated Development foundation (IDF)/others who are working effectively for betterment of Halda. 65% of the respondents believed that Upazila administration is the most efficiently working institution among all others (Fig. 22). 48% of the respondents mentioned the name of the Department of Fisheries for their activities. However, another 8% stated that IDF/other similar organizations are working for Halda. Though it is showing less efficacy of IDF compared to Upazila administration and Department of Fisheries as of respondents' perception, the ideal scenario is Upazila administration is getting continuous assistance from IDF by means of logistics, speed boat facilities, fuel cost and volunteers' support. But no one mentioned the Department of Environment.

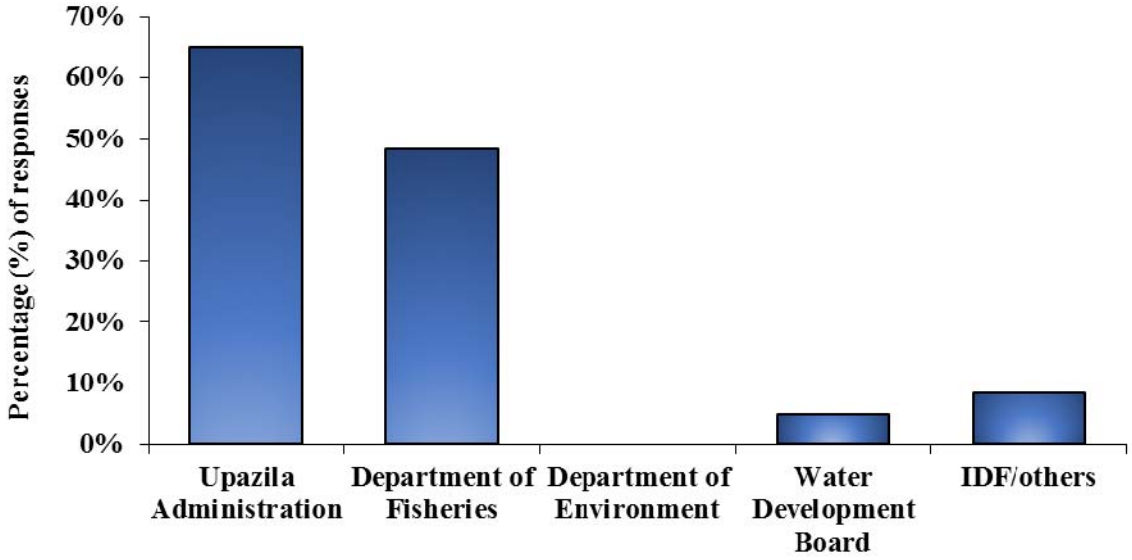

Figure 22: Egg collectors' perception on effectively working institutions at Halda

4.2 Status of Tobacco farmer

To identify the views, observations and suggestions relating to the river environment and other related things, a total of 58 tobacco farmers were interviewed face to face. All of them were from Manikchari upazila of Khagrachari district.

4.2.1 Age distribution

Figure 23 illustrates that among the respondents, 32% were at the age of 40 to 49 years and 23% of them were 30 to 39 years old. Only 4% of the respondents were found with an age of more than 70 years.

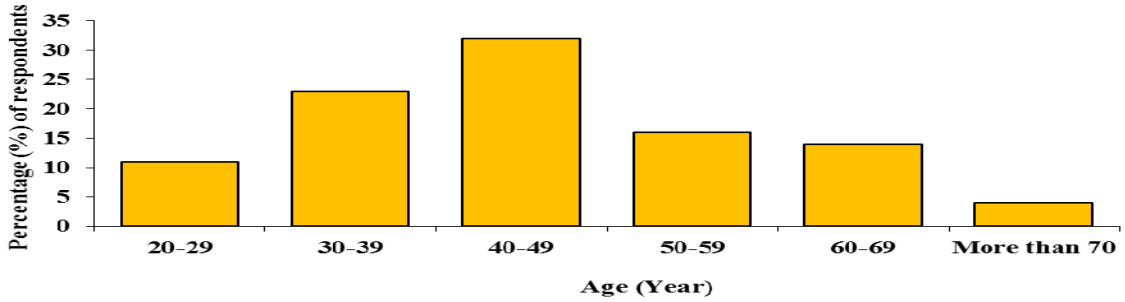

Figure 23: Age distribution of tobacco farmer

4.2.2 Gender distribution

83% of the respondents were male while another 17% were female who were engaged with tobacco cultivation once upon a time (Fig. 24).

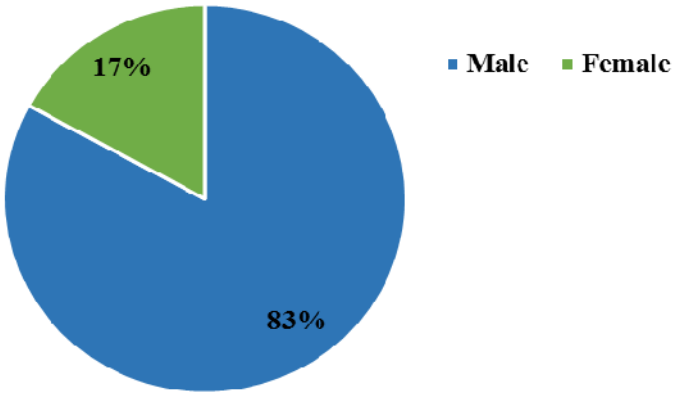

Figure 24: Gender distribution of tobacco farmer

4.2.3 Status of tobacco cultivation

Respondents were asked about their involvement period with tobacco cultivation. More than half (65%) of the respondents mentioned that they were involved with tobacco cultivation for 0 to 5 years while another 10% were involved with more than 11 years (Fig. 25 left).

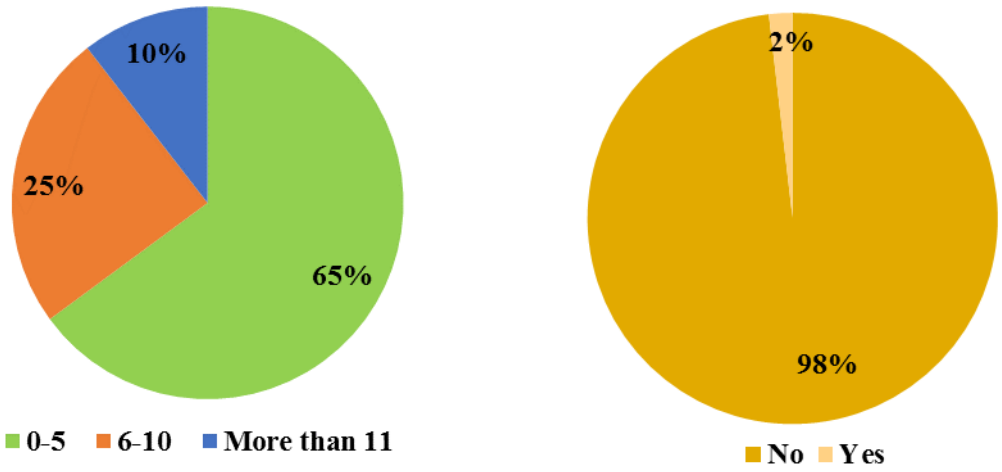

Figure 25: Involvement years of tobacco cultivation (left) and present status of involvement (right)

They were also asked about their present status of involvement. Figure 25 (right) revealed that 98% of the respondents are now-a-days not involved with tobacco cultivation which is a positive indication for Halda River environment while only 2% are in practice yet.

4.2.4 Cultivable land ownership

93% of the respondents opined that they had their own cultivable land where the rest of the 7% took lease for cultivation (Fig. 26).

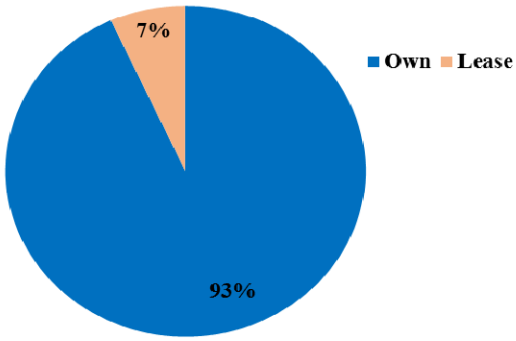

Figure 26: Responses on type of cultivable land ownership

4.2.5 Status of land, yield and profit of the farmers

Respondents were asked about the amount of land, yield and profit came from the yield where they cultivated various types of crops and vegetables like radish, bitter melon, spiny gourd, squash, potato, eggplant, rice, bean, cucumber, nuts, banana etc in 2020 and 2021 but only tobacco in 2017.

4.2.5.1 Status of land

Table 4 indicates that the median land amount (1.2 acre) for 2020 and 2021 was higher than the amount (0.9 acre) of 2017.

Table 4: Year wise amount of land

Land amount (acre)	2020 (Land except tobacco)	2021 (Land except tobacco)	2017 (Land for tobacco)
Mean	1.529056604	1.484815	1.092632
Standard Error	0.131964685	0.129969	0.109207
Median	1.2	1.2	0.9
Mode	0.8	0.8	2
Standard Deviation	0.960717409	0.955073	0.6732
Sample Variance	0.922977939	0.912165	0.453198
Count	53	54	38

4.2.5.2 Status of Yield

It is very clear from table 5 that median yield was highest (1500 kg) in 2020 compared to 2017 (482.5 kg) and 2021 (1150 kg). Yield amount might be a reason for tobacco farmers to increase their dependency on other crops and vegetables over tobacco after 2017.

Table 5: Year wise amount of yield

Yield amount (kg)	2020 (Yield except tobacco)	2021 (Yield except tobacco)	2017 (Yield of tobacco)
Mean	2599.722222	1327.083	659.3889
Standard Error	1093.981234	140.2269	85.43762
Median	1500	1150	482.5
Mode	1600	1600	1200
Standard Deviation	8039.087436	971.5205	512.6257
Sample Variance	64626926.81	943852.1	262785.2
Count	54	48	36

4.2.5.3 Profit from yield

Table 6 shows the median profit came from tobacco cultivation in 2017 and from crops and other vegetables in 2020 and 2021. In case of profit from the yield, highest (BDT 63300) profit came from tobacco cultivation in 2017 compared to profit from 2020 (BDT 32500) and 2021 (BDT 28750). This profit scenario is a responsible factor of depression of the ex-tobacco farmers although they are not in practice with tobacco cultivation now.

Table 6: Year wise profit from yield

Profit (BDT)	**2020 (Profit from other yield)**	**2021 (Profit from other yield)**	**2017 (Profit from tobacco)**
Mean	61813.46154	39139.32	97617.94
Standard Error	17494.59678	4874.225	14933.89
Median	32500	28750	63300
Mode	10000	12000	186000
Standard Deviation	126155.3315	33769.62	87078.78
Sample Variance	15915167658	1.14E+09	7.58E+09
Count	52	48	34

4.2.6 Opinion on pros and cons of tobacco cultivation

Respondents were asked about their opinion on the merits and demerits of tobacco cultivation.

4.2.6.1 Opinion on merits of tobacco cultivation

Figure 27 describes the perception of the respondents on the merits of tobacco cultivation. 64% of the respondents found it as profitable for them while another 47% mentioned the facility of loan availability when needed. Besides, 31% said that they get fertilizers, seeds and pesticides for tobacco cultivation from the company. Another 10% of respondents opined that tobacco is easy to sell compared to other crops. Moreover 10% of respondents identified the benefits as company aids, double profit than rice cultivation, required less investment etc. However, 2% of the respondents did not give any comment on the merits of tobacco cultivation.

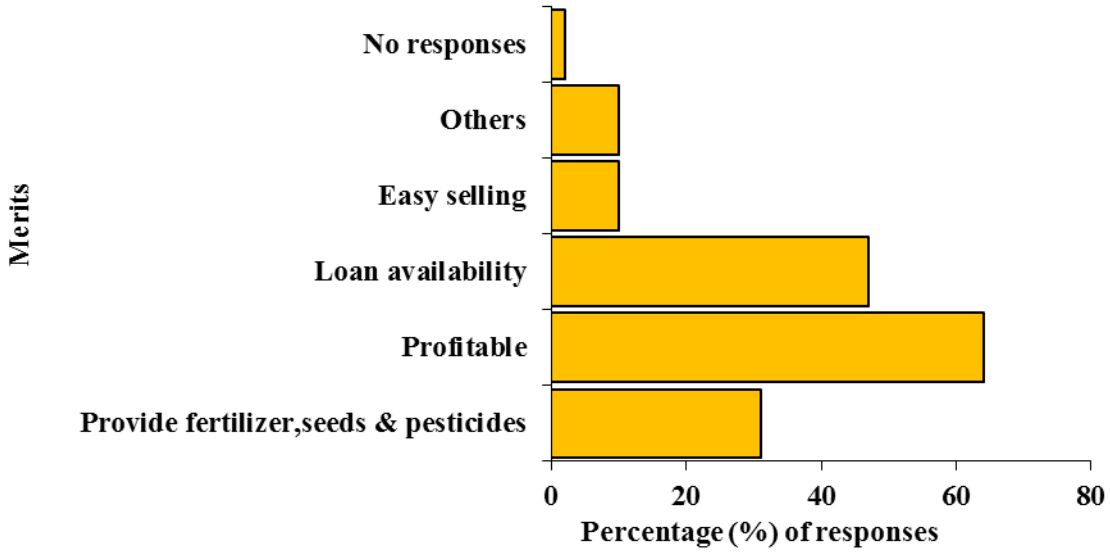

Figure 27: Perception on merits of tobacco cultivation

4.2.6.2 Opinion on demerits of tobacco cultivation

Figure 28 describes the perception of the respondents on the demerits of tobacco cultivation. 31% of the respondents mentioned that during tobacco cultivation gas is produced which is injurious to health and environment. Another 29% opined that there is no fair selling price of tobacco. Prohibition of govt. is also creating problems for the tobacco farmers mentioned by 16% of the respondents. Bitterness of hand and some other reasons like harvest amount not up to expectation were mentioned by 12% and 5% of the respondents respectively. However, 17% of the respondents did not give any comment on the demerits of tobacco cultivation.

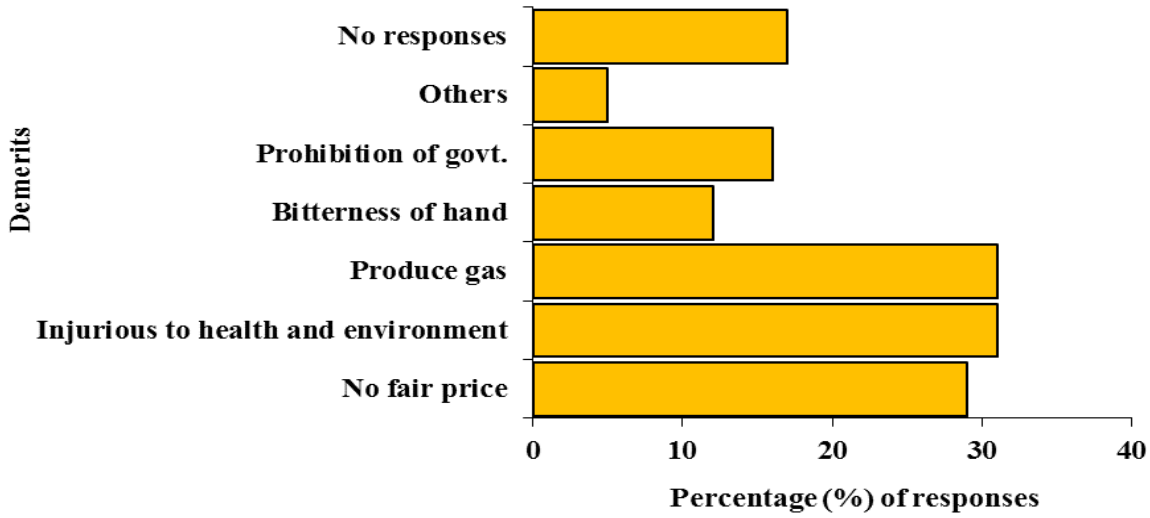

Figure 28: Perception on demerits of tobacco cultivation

4.2.7 Impact of tobacco cultivation on Halda

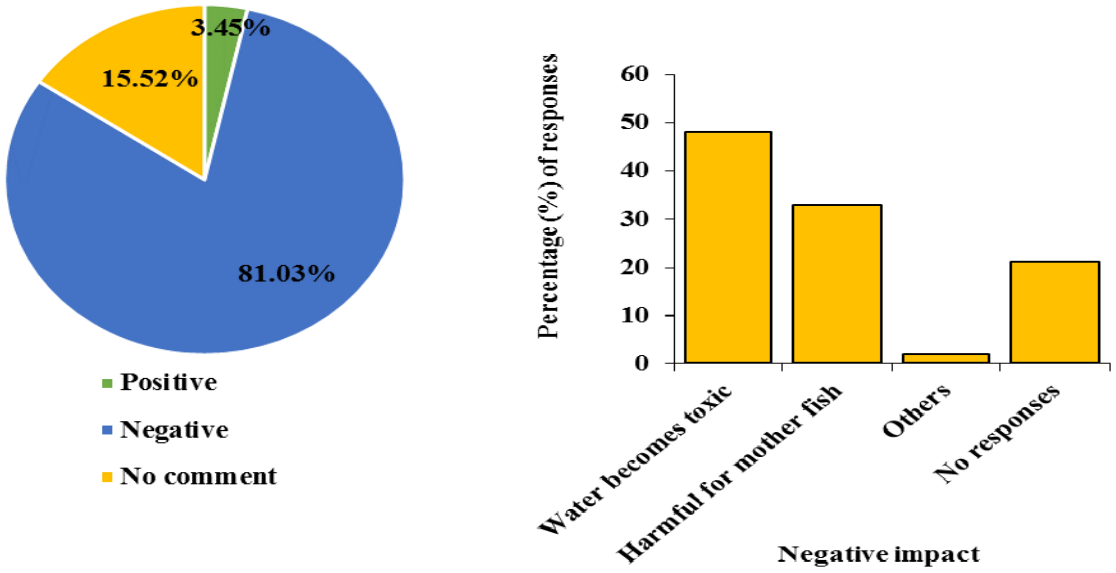

Figure 29: Perception on impacts of tobacco cultivation (left) and types of negative impact (right)

Around 81% of the respondents believed that tobacco cultivation created a negative impact on Halda while almost 4% opined for positive impact (Fig. 29 left). Rest of the respondents had no comment on this issue. Respondents who opined for the negative impact of tobacco cultivation, among them 48% believed that water became toxic as a result of tobacco farming (Fig. 29 right). Besides, 33% identified tobacco farming as harmful for mother fish of the Halda. However, 21% did not provide any specific comment on the reason behind the negative effect of tobacco farming.

4.2.8 Overall opinion on tobacco cultivation

Overall 81% of the respondents opined that tobacco cultivation should be stopped (Fig. 30). Besides, 34% believed that there should be alternative livelihood options for the tobacco farmers. But 3% stated that tobacco farming should not be stopped while another 5% of the respondents had no comment regarding this issue.

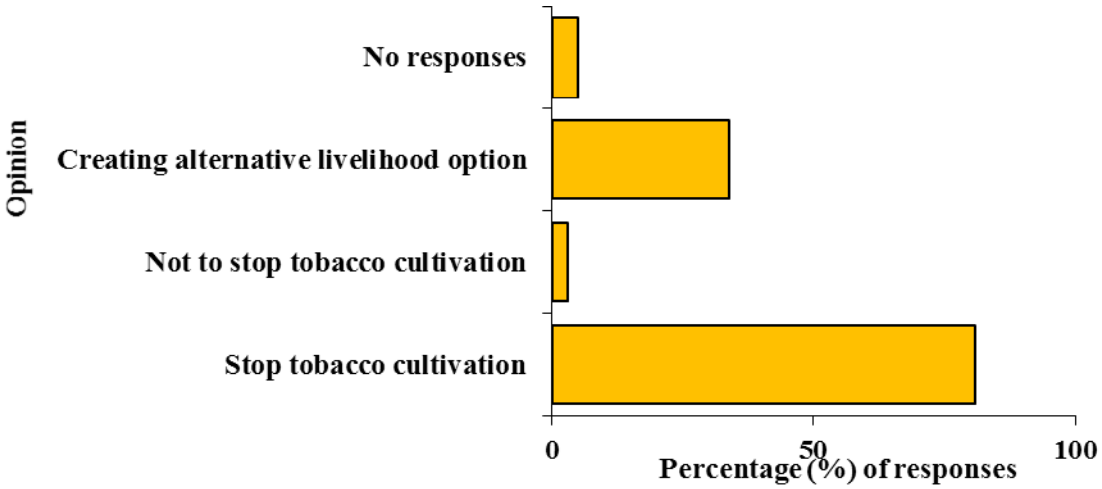

Figure 30: Opinion on tobacco cultivation

4.2.9 Assistance required prior to banning tobacco cultivation

The respondents addressed some assistance prior to banning tobacco cultivation. 89% of the respondents urged for training on cultivation methods and techniques while 88% requested for providing hybrid seeds (Fig. 31). Funding for cultivation was also mentioned by 77% of the respondents. Besides, market expansion, knowledge on technology, providing modern equipment, insurance on cultivation, loan facilities etc. were recommended by 44%, 42%, 33%, 28%, 23% of the respondents respectively. However, providing improved seedlings, arranging awareness campaigns, meeting with tobacco farmers etc. were identified by other 14% of the respondents.

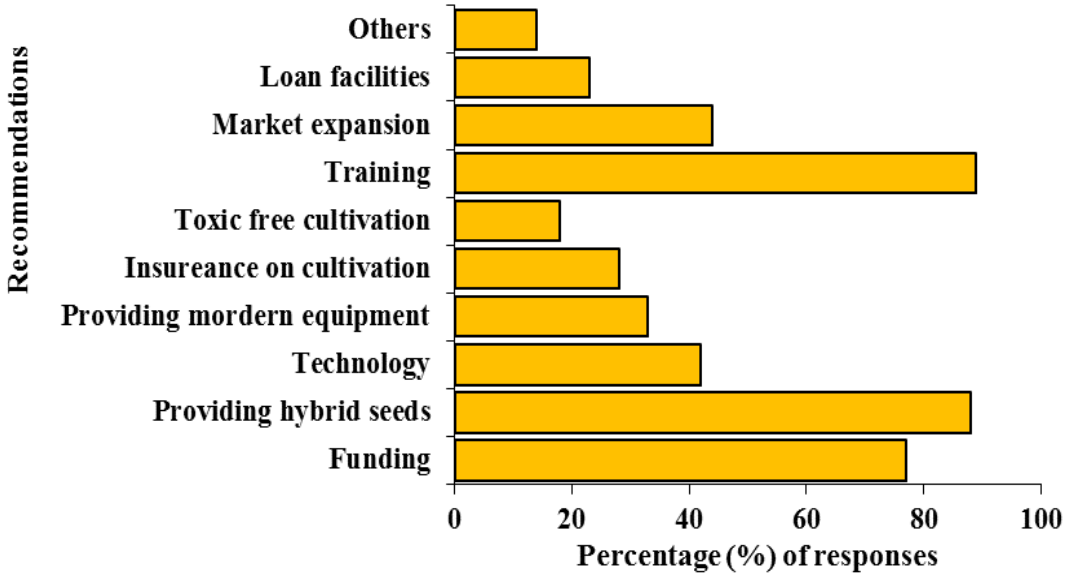

Figure 31: Recommendations on banning tobacco cultivation

4.3 Status of Rubber dam users

To identify the views, observations and suggestions relating to the river environment and other related things, a total 12 respondents were interviewed face to face. All of them are from East Vujpur village of Fatikchari Upazila where the rubber dam has been built. Their occupation is mainly cultivation and all of them were male respondents.

4.3.1 Age distribution

Among the respondents, half of them were 50 years old. Rest of them were between 40 to 49 years (25%) and 30 to 39 years (25%) respectively (Fig. 32).

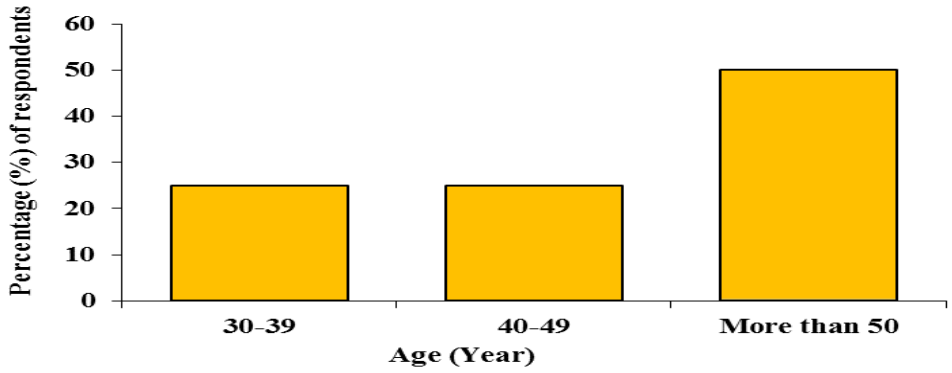

Figure 32: Age distribution of Rubber dam users

4.3.2 Educational status

During the interview the rubber dam users were asked about their schooling numbers. According to them, half of the respondents had reached primary education level and around 42% got secondary education (Fig. 33). Rest of them did not get the light of learning.

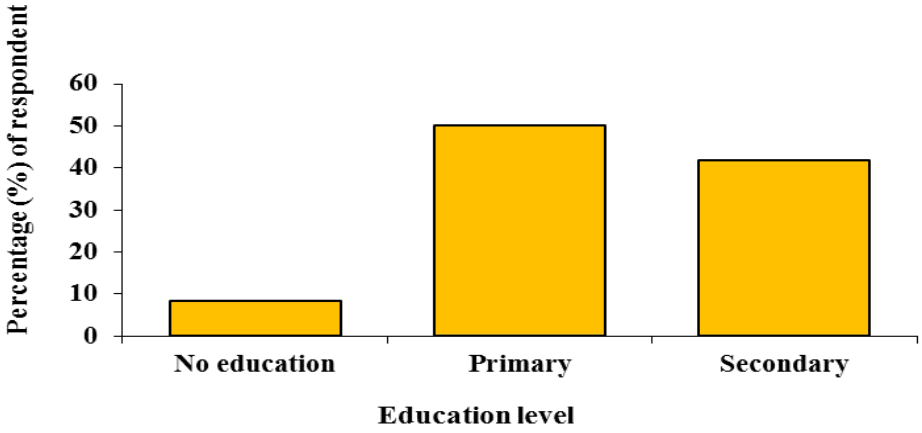

Figure 33: Education level of Rubber dam users

4.3.3 Impact of Rubber dam

All of the respondents are well known for their rubber dams. Their main purpose was to utilize the dam for irrigation and cultivation purposes and they all found the dam very useful to the local communities. Only 8% of the respondents opined that this rubber dam has a negative impact on environment while rest of them denied for this negative impact (Fig. 34).

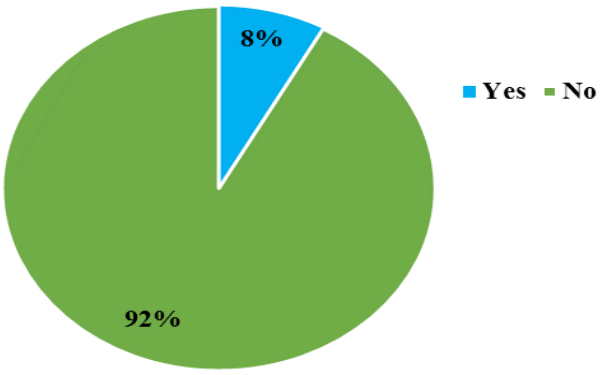

Figure 34: Perception on negative impact of Rubber dam

4.3.4 Opinion on depletion of spawning in the Halda

During the interview, the perception on causes of depletion of spawning in the Halda was estimated by mentioning four factors – fishing with net, cutting of oxbow bends, establishment of rubber dam and environmental pollution. Figure 35 describes that 50% of the respondents believed that environmental pollution is the leading cause of depletion of spawning in the river. Another 42% opined for fishing with net and establishment of rubber dams respectively. While no one mentioned that cutting of oxbow bend could be a cause of spawning depletion.

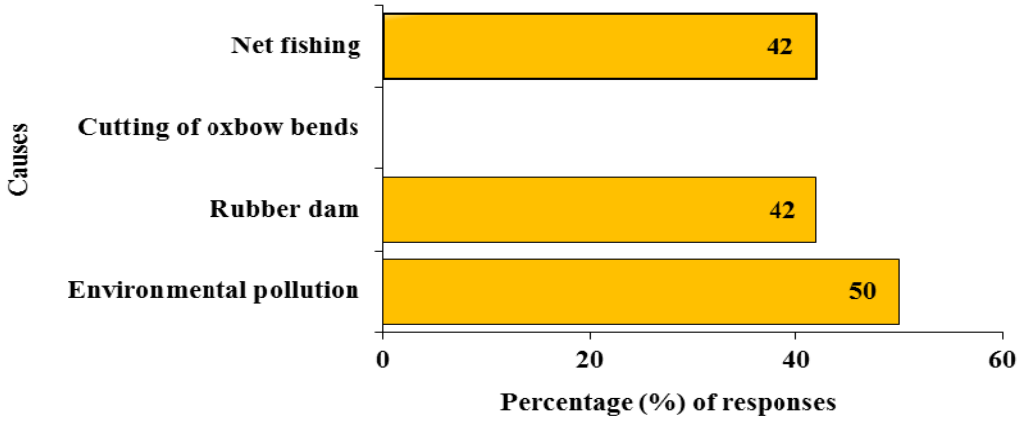

Figure 35: Perception on causes of depletion of spawning in Halda

4.3.5 Driving reasons of Halda importance

All of the respondents believed that as their livelihood is based on agriculture and their dependency on Halda for agricultural activities made Halda as an important river to them. Besides, 92% of them emphasized on fisheries resources available from this river while 50% of them opined for Halda's importance as a source of water to them (Fig. 36).

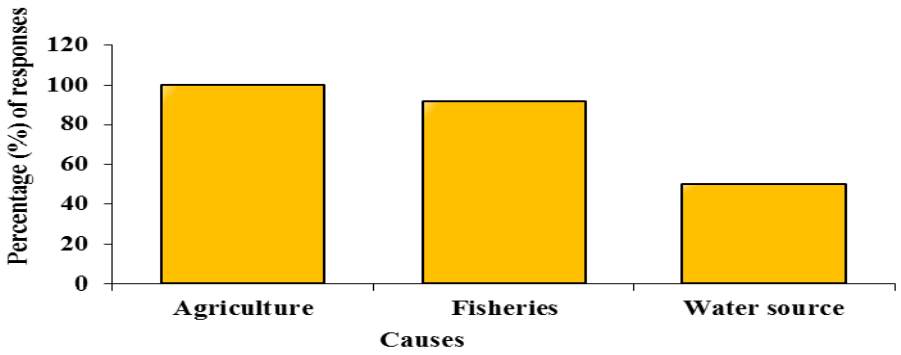

Figure 36: Perception on causes behind importance of Halda

4.3.6 Recommendations from Rubber dam users

Respondents were asked about their opinion on alternatives to the rubber dam. 33% of them recommended management of drainage systems in irrigation areas through concrete drain or underground pipes (Fig. 37). Another 33% of them opted for the establishment of deep tube wells. Besides, the arrangement of electric pump irrigation by the government and by forsaking the electricity bill were other two alternatives came from 25% and 8% respondents respectively.

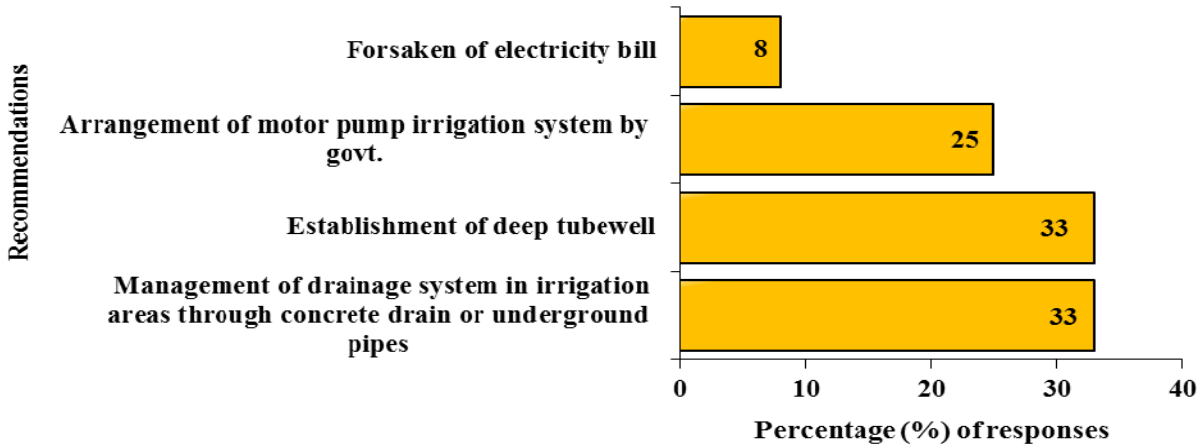

Figure 37: Recommendations from rubber dam users

4.4 Status of Halda River: Views of Administrative bodies

To understand the existing problems, to identify a way to overcome and for making future plan regarding Halda river management through integrated approach, authorities relevant to Upazila administration, Fisheries officer, people of Integrated Development Foundation (IDF), Local politician, River police, representatives from the Department of Environment (DoE), Bangladesh Water Development Board (BWDB) and Forest Department (BFD), Chittagong Development Authority (CDA) and journalist have interviewed.

4.4.1 Role of Administrative Bodies

4.4.1.1 CDA

a) To supervise whether any damage is being done to Halda due to any development project.

b) Approving industries that have ETP.

4.4.1.2 Journalist

a) Promoting Halda as a news worker.

b) Creating social awareness.

c) Creating Social awareness meetings, gatherings.

d) Vice-Chairman of Halda River Conservation Committee.

e) Member of Halda Heritage Committee.

f) Member of the committee constituted by the Department of Environment.

g) Member of District River Protection Committee.

4.4.1.3 Fisheries Office

a) As a member secretary of each committee related to Halda, to inform the higher authorities about the overall views of the members of these committees and take steps to resolve them on the basis of their views.

b) Conduct regular raids.

c) To make people aware.

d) Regular monitoring.

e) To take appropriate measures so that industrial and household wastes do not mix with Halda.

f) To conduct regular mobile courts / campaigns for the implementation of Fisheries Protection and Conservation Act.

g) Seize and destroy illegal fencing nets, floating nets, current nets, zaki nets.

h) Seize and destroy engine driven sand collection boats and dredgers.

i) Involve local people's representatives and upazila administration in all activities undertaken for the development and protection of the environment of Halda River.

j) Brood-fish guard during the breeding season from Samitir Hat to the mouth of Dhurung-Nazirhat canal.

h) Bhujpur Rubber Dam Monitoring.

4.4.1.4 Forest Department

A) Performed all kinds of responsibilities as the Member Secretary of the Committee for Prevention of Dolphin Killing, Natural Environment, Biodiversity and Protection of brood fish of Halda River as per the directions of Honorable High Court.

B) Organizing awareness workshops including distribution of leaflets and posters to increase public awareness on dolphin conservation.

C) Continue patrol activities to prevent poaching of dolphins.

4.4.1.5 Water Development Board

A) Implementation of river bank protection works to prevent river erosion;

b) Operation / Maintenance of sluice gates constructed in Halda river canals.

c) Informing the Department of Environment / Local Administration about River pollution.

B) Use of CC block and GEO bag to prevent river erosion.

C) Karnaphuli River basin (including Halda) study.

4.4.1.6 Department of Environment

A) Active participation in the conservation of biodiversity of Halda.

B) Regular monitoring to reduce pollution.

C) To take action so that no industrial waste flows in Halda river.

D) Overall monitoring of waste disposal through ETP of all industries located in a remote area from Halda.

4.4.1.7 River Police

A) Illegal net rescues.

B) Prevention of illegal sand extraction.

C) Prevention of engine boat navigation.

D) Work to prevent the killing of dolphins, brood-fish etc.

4.4.1.8 Local Politicians

A) Increase public awareness.

B) Inclusion in the Development Project Proposal (DPP) to increase the production of fish farming by cultivating the Halda's fry of Hathazari.

4.4.1.9 Upazila Administration

A) Operation of mobile court, fines and imprisonment.

B) Illegal net rescues.

C) Closure of engine driven boat

D) Stop illegal dredging.

E) Dredger destruction

F) Strengthening patrols through village police.

G) Involving of public representatives.

H) Conducting awareness activities through meetings and rallies.

I) conducting regular campaigns to protect brood-fish, dolphins and other biodiversity.

J) Seizure of illegally extracted sand.

K) Seizure of boats used for illegal nets in Halda River.

L) Destruction of pipes used for sand extraction.

M) Destruction of tractor used for cutting soil from the Halda River bank.

N) Destruction of engine driven boats used for dredging.

O) Due to pollution, in a joint venture of Hathazari Upazila Administration and Department of Environment, Chittagong; 100 MW power picking plant and Asian Paper Mill have been shut down.

P) Awareness activities to keep the river free from pollution.

Q) Administrative activities to protect the biodiversity of Halda River.

4.4.1.10 IDF

A) Distribution of leaflets, making posters, making and displaying documentaries to increase public awareness on environmental protection.

B) Promote using pheromone traps and organic pesticides instead of toxic pesticides in land near Halda River to create a fish friendly environment.

C) To protect the environment of Halda river from various toxic wastes.

D) Arrangements of alternative livelihood to stop tobacco cultivation in Manikchhari upazila: the source of Halda River.

E) Stop illegal nets, engine driven boats and dredging.

F) To create awareness among the students of schools / madrasas on the banks of Halda river about Halda river.

f) Raising awareness through imams of mosques and other religious leaders.

4.4.2 Problems identified

Figure 38 illustrates the existing problems identified by the associated Halda River management administrative bodies.

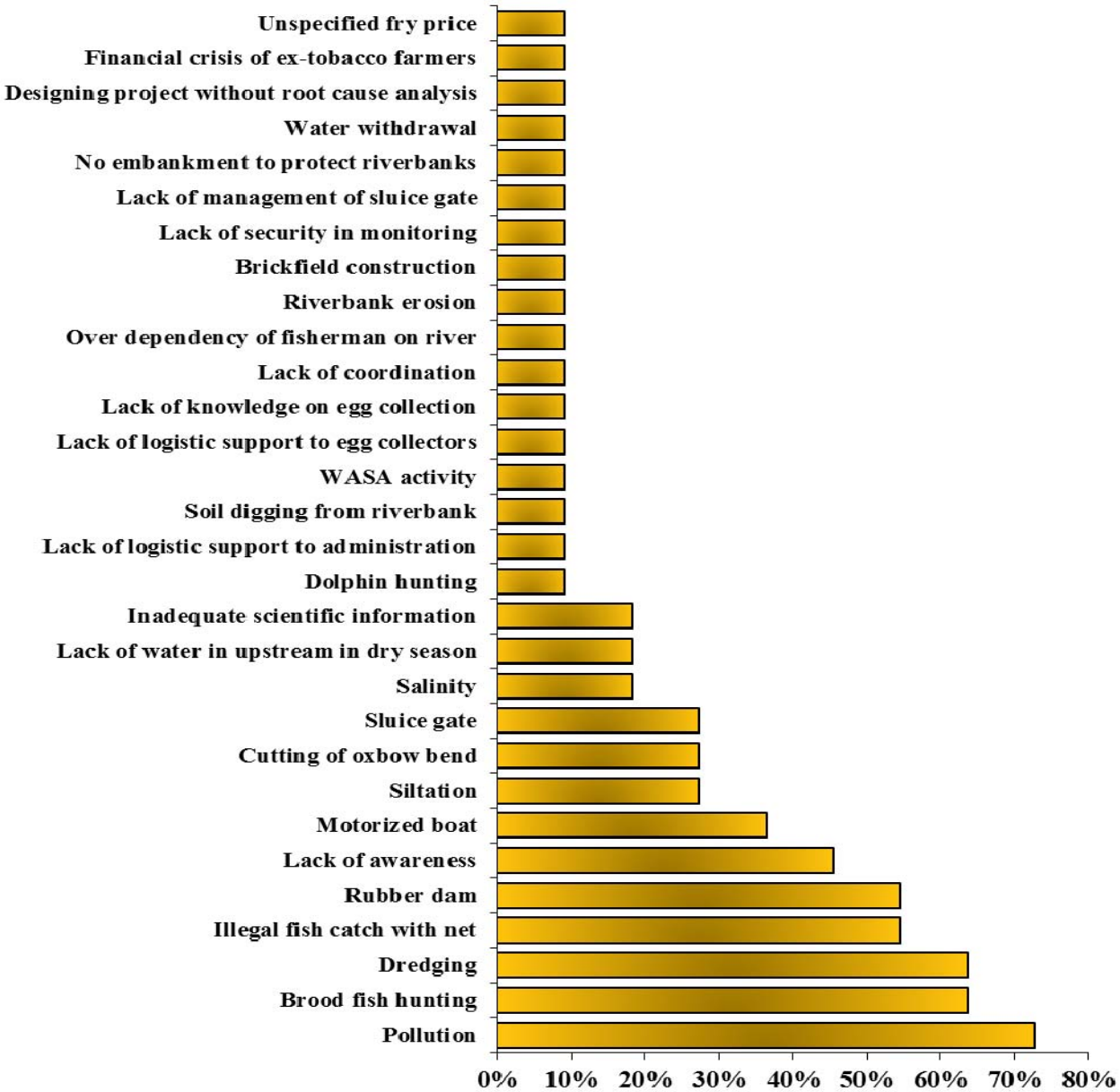

Figure 38: Current problems of Halda River identified by administrative bodies

According to 73% of the respondents, pollution from different sources is the most detrimental problem in Halda nowadays. Besides, dredging and brood fish hunting were identified as problems by 64% of the respondents. Illegal fish cash with net and establishment of rubber dam have been mentioned by 55% of the respondents individually as current problems in Halda. Another 45% believed that lack of awareness and 36% opined for engine boat are acting as the reasons of problems in Halda. Not only these issues but also establishment of sluice gate, siltation problem and cutting of oxbow bend were mentioned by 27% respondents respectively that are acting as the reasons of problems in Halda. Moreover, 18% of the interviewee opined that salinity intrusion, lack of scientific information and lack of water in the upstream during dry season are also causes of creating problems for Halda River. Besides all of these some other issues have been come out from 9% of the interviewees respectively i.e. dolphin hunting, construction of brickfield, water scarcity in the upstream in dry season, poor management system of sluice gates, river bank erosion, lack of coordination and logistic support to administration, designing project without root cause analysis etc

4.4.3 Solution identified

The respondents were asked about the solutions to the identified problems existing in Halda. A number of way outs have been marked by them.

Among the solutions, 73% of the respondents urged for proper surveillance surrounding the river, Halda (Fig. 39). Besides, creating awareness, collective working effort, and enforcement of law have been mentioned by 64% and 55% of the respondents individually. However, another 45% of the interviewees highlighted for rehabilitation of fisherman dependent on Halda River. Again, building up individual authority for Halda River management, modern waste management systems and necessary steps for river pollution control had been identified as solutions by 36% of the respondents while 27% emphasized on establishment of a river police station, conservation of the riverbank through tree plantation and focusing on reconstruction of hatchery and building up new hatcheries. Moreover, exclusive guideline for politicians, subsidy to egg collectors, collaboration between politician, academician, researcher and local administration, training for alternative livelihood for local people etc. had been addressed by 18% of the respondents. Besides, management and modernization of sluice gates, community involvement for Halda conservation, training on alternative livelihoods, increasing logistics for authority, dolphin survey and conservation, conservation of Halda source, education for fisherman and their kids, media involvement were mentioned by 9% of the interviewees.

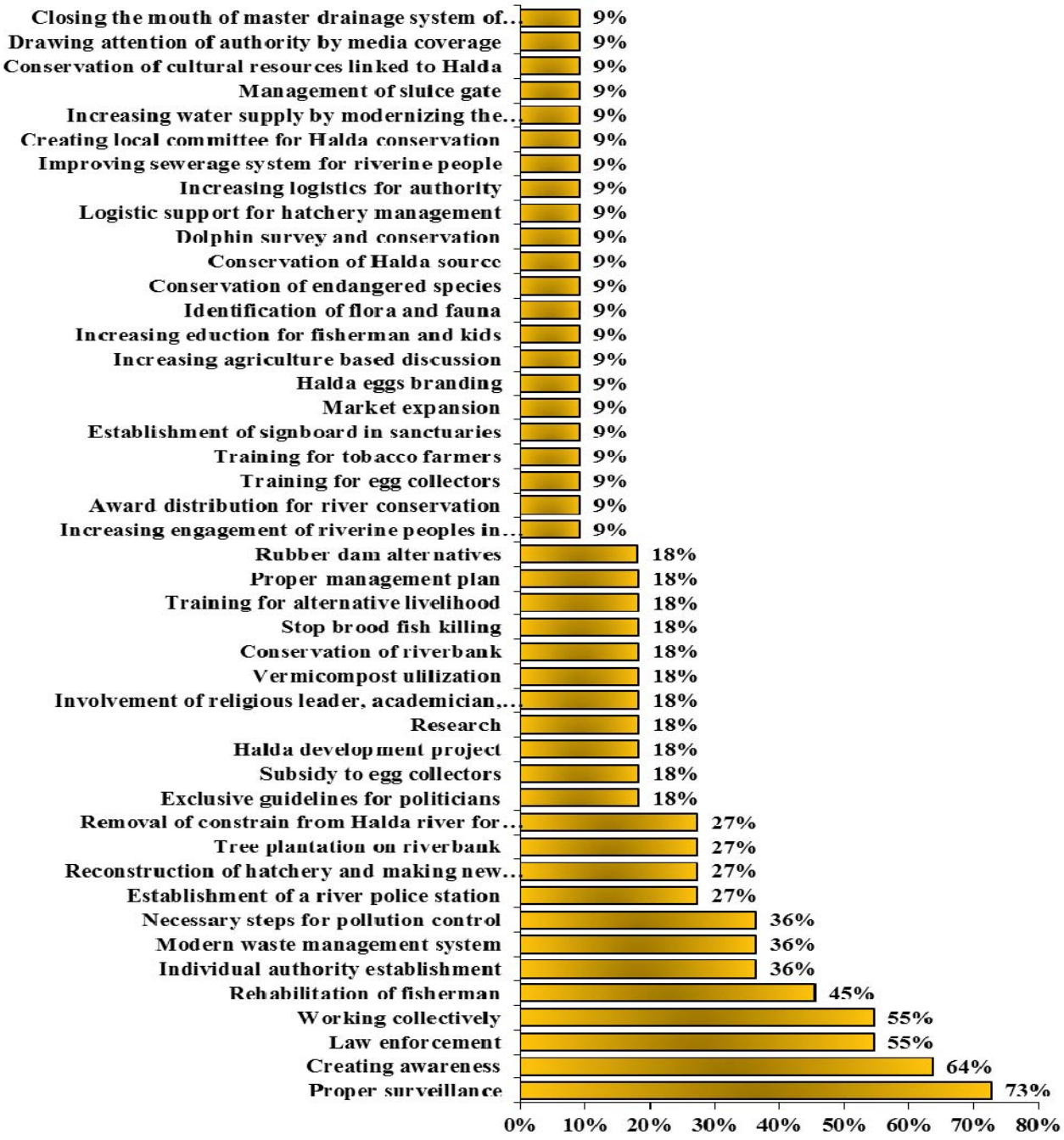

Figure 39: Solutions identified by administrative bodies

4.5 Status of Halda River: Views of resource persons

To understand the existing problems, to identify a way to overcome and for making future plan regarding Halda river management through integrated approach, Chittagong University faculty members (04) (Professor, Associate Professor, Assistant Professor and Lecturer) have been interviewed based on their experience relevant to the Halda.

4.5.1 Role of resource persons

a) Research

b) Awareness Building

c) Collaboration

d) While teaching in the university, always try to inform the students about the importance of Halda and encourage research work on rivers

e) They try to share the aspects of different environmental harms of Halda through different social media

f) Dissemination information through teaching

g) As a faculty member it's very usual to make students aware on importance of Halda explaining its uniqueness

h) Plan to conduct research on future to enrich the knowledge base and contribute in policy making process for Halda conservation

4.5.2 Problems identified

- Salinity increase
- **I**nflow of Agrochemicals
- Lack of Awareness
- Inadequate scientific information
- Too many stakeholders and interest to harvest more water from the river
- Designing project without root cause analysis
- Man-made environment such as water quality is being degraded by setting up industrial plants on the banks of Haldar which is threatening fish and other biodiversity.
- The professional and social life of the Halda-centric professional community is at risk.
- There is frustration and change of attitude and professional change among them as the quantity of eggs is not available as expected.
- Industrial pollution
- Illegal fishing
- Destruction of aquatic biodiversity (eg. Dolphin)
- Sand extraction
- Excessive sediment load

- Insufficient water flow
- Improper planning of water withdrawal for Mirsarai Economic zone
- Financial crisis of ex-tobacco farmers
- Impact of rubber dam on Halda
- Unspecified fry price

4.5.3 Solution identified

- Extensive forest restoration in the upper watersheds of Halda and its feeder canals
- Continuous monitoring and vigilance
- Promotion of organic farming and integrated pest management
- Addressing the root problems
- Involving local people through conservation-focused livelihood
- Extensive research to learn about the river, its ecosystem, hydrology, biology, morphology and its contribution more objectively
- Intensification of efforts to produce more awareness building materials – video documentary, reports, social media engagements etc.
- Upper watershed restoration
- Permanent regulation of illegal fishing and boating
- Conservation of cultural resources linked to Halda
- Short and Long term planning
- Medium-term plan for the Halda-centric professional community, especially the professional community attitude, needs to be developed which will play a helpful role in preserving the Halda environment.
- In addition to providing alternative work during the breeding season, it is possible to build river-based manpower structures for the younger generation by providing them with interest in the profession and training in scientific concepts related to modern fish production and institutional zoology conservation and production.
- To plan the relevant development by giving priority to the special natural features of Halda
- Nationalization of Heritage Conditions, with more research on Haldar Water and Health
- Integrated river basin management
- Halda river protection task force

- Coordination among the all stakeholders
- Enforcement of associated laws and rules strictly
- No further establishment of industry alongside of river
- Stopping illegal fish catch
- Generating alternative livelihood options for fisherman during off season and for tobacco farmers
- Ensuring coordination among ministry, local administration and Halda river bank people
- Ensuring regular monitoring of Halda river environment (including waste management)
- Increasing manpower for monitoring with local people and administration
- Proper selection of tree species for plantation by ensuring control of river bank erosion
- Identify alternative of rubber dam
- Taking proper steps for implementing the already identified solutions
- Political good will starting from top tire must be ensured
- No water withdrawal for Mirsarai Economic Zone from Halda rather identify alternative water sources from nearby areas.

4.6 Status of Halda River Research

4.6.1 Halda River pollution: HRRL-DoE Joint Research

A study report has been prepared by Halda River Research laboratory (HRRL) jointly with Department of Environment (DoE) on 2nd July 2018 on "Field investigation report on the identification of sources of pollution disaster and massive death of fishes in Halda River" (Kibria, 2018a).

4.6.1.1 Study findings

- The wastes from the Hathazari 100 MegaWatt Peaking Power Plant are dumped into the Halda River near the Ankuri Ghona area by the plant's adjacent Chara on its north side via Chan khali. On June 23-24 it was observed that the plant discharged furnace oil into the surrounding canal by the Chara located on its north side through an underground pipeline. Inside the power plant, oil-mixed water was found to be released by the lowest layer of a three-layered drainage system that connects to the underground pipeline.
- Residents of Hathazari Upazila have been complaining about the Halda River being polluted by Asian Paper Mills for a long time. Although they have recently set up an ETP, the small canal called Mara Chara, which flows along the south-eastern side of the factory, was noticed to have turned into a dumping station of the factory. Hence, it

appears that factory authorities do not use their ETP regularly. About 2-2.5 kilometres of the canal have accumulated wastes creating around a 1-1.5 feet thick layer of wastes above the canal. Due to water pressure, the wastes overflow and accumulate in Halda and the surrounding waterbody during heavy rains. The wastes decompose in the water and cause oxygen depletion. It also appears to be one of the sources of ammonia. In Madarikhal, which is connected with the Halda River, the average amount of dissolved oxygen was found to be about below **0.5 ml/litre.**

- Many illegal poultry farms have been built in the eastern part of Chowdhury Hat and in the adjoining areas of Fatehabad, Baradighi, Nandirhat and Madan Hat in Hathazari upazila. The wastes of these poultry farms are being dumped in the surrounding areas, which are ultimately falling into the Halda river through small canals and streams from this dumping station. As a result of poultry wastes, the amount of dissolved oxygen is declining, and there is an increased amount of ammonia.
- Before CDA built the Ananya residential area, residential wastes and industrial wastes from the northern side of Oxygen to Kulgaon were dumped into the Karnafuli River by the local Bamanshahi canal. Due to the construction of the Ananya residential area, the Bamanshahi canal adjacent to the west side of the Ananya border was closed. As a result, about 2-2.5 km of the canal area has now turned into land, obstructing the area's drainage system. Due to heavy rainfall this season, the water flow from this area gets obstructed in Ananya residential area and Bamanshahi canal causing the water to flow in the opposite direction. As a result, the agro lands and ponds are getting polluted by the wastes at Shikarpur union and adjacent lands in Hathazari upazila. This polluted water containing industrial wastes ultimately get mixed with the Halda River by flowing through Khandakia and Katakhali of Modunaghat area of Hathazari.

4.6.1.2 Recommendations

- ✔ Effluent Treatment Plant (ETP) must be built and used in factories located in Oxygen to Kulgaon area, including Hathazari peaking power plant.
- ✔ To take adequate measures to permanently stop the dumping of waste in the local Mara Chhara canal at Nandir Hat in Hathazari.
- ✔ To take necessary measures to prevent the release of wastes from scattered illegal poultry farms.
- ✔ The dried Bamanshahi canal near the Ananya residential area must be re-excavated to bring it back to its original condition.
- ✔ To disconnect the master drainage system of the Ananya residential area from the Bamanshahi canal and Kuwaish canal.
- ✔ To establish a Sewerage Treatment Plant for waste management in Ananya residential area.

- ✔ To clear water flow by digging small canals and streams in Shikarpur and Madarsha areas.
- ✔ To form the Halda River Commission to coordinate Halda River management.
- ✔ Above all, to take extraordinary measures to protect the Halda River by declaring it a "National River".

4.6.2 Halda River pollution: CDA Report

A report has been prepared by a committee formed by Chittagong Development Authority (CDA) on the pollution of Halda River in 2020 with inspection of the sites in 2019 (Kibria et al., 2020).

4.6.2.1 Problems identified

- Change in the water flow of Bamanshahi canal
- Decrease in the navigability
- The polluted water of Bamanshahi canal is flowing into Halda River and polluting it.
- The construction of a master drain by CDA in Ananya Residential project has become another cause for Halda river pollution.

4.6.2.2 Study Findings

- At the source of the Bamanshahi canal, especially from the industries located in Oxygen and Kulgaon area, untreated industrial effluents are flowing directly into the canal.
- According to R. S. mouza map, the fixed width of Bamanshahi canal has decreased due to illegal occupants.
- People living on both sides of the canal are dumping all of their wastes, including human waste directly into the canal.
- As the Bamanshahi canal has not been reformed for a long time, the navigability of the canal has been reduced, due to which the normal flow of water is being disrupted.
- Due to the Bamanshahi canal fill up in the Shahidullah Para area of western Kuwaish, the course of the canal changed because of which the polluted water now flows over the Kuwaish and Chandra Beel and falls into the Halda River through Hamidia Canal, Kuwaish Canal and Khandakia Canal.
- The navigability of the canal has decreased in many places, starting from the downstream of Bamanshahi canal, i.e. from the southern part of Ananya residential project, till the end of the canal i.e. Karnafuli River. In addition, the alignment of the canal on the west side of the Ananya residential project is not specific. As a result of the navigability crisis of the canal and lack of precision in the alignment, contaminated water in the canal is overflowing and falling into the adjacent lands. Some of this polluted water is flowing

through the Ananya Residential project into the Halda River via the CDA constructed master drain in the Kuwaish canal and Krishnakali canal.

4.6.2.3 Recommendations

- ✔ Polluting industries need to be identified on an urgent basis. If necessary, this identification process should be done jointly by the Department of Environment and the Authorized Department of the CDA in collaboration with the Executive Magistrate.
- ✔ Factories that are discharging untreated waste directly into canals or flowing streams should close down until they have their own waste disposal system.
- ✔ In order to restore the navigability of Bamanshahi canal, it is necessary to reform and excavate the canal urgently.
- ✔ Illegal structures on both sides of the Bamanshahi canal must be removed to bring back its original width as per R.S. mouza map.
- ✔ The parts where the flow of water of the canal has changed, the obstacles that changed the course of the canal have to be removed, or dams have to be constructed if deemed necessary. It is pertinent to mention here that a dam should be constructed on the bank of the canal adjacent to the culvert of Bamanshahi canal in the area called Shahidullah Para so that the polluted water of the canal does not flow on the adjoining land and into the Halda River.
- ✔ After re-excavation of Bamanshahi canal, a dam needs to be constructed at the front of the master drain of Ananya residential project, i.e. at the junction of Bamanshahi canal and drain.
- ✔ STP (Sewerage Treatment Plant) should be set up for waste management of Ananya residential project.
- ✔ ETP (Effluent Treatment Plant) system should be made mandatory in all the factories which produce polluted waste.

4.6.3 Chattogram Water and Sewerage Authority (CWASA) water extraction from Halda

A review and recommendations on the environmental feasibility study report prepared by Institute of Water Modeling (IWM) for water supply from the Halda River ("Bangabandhu Fisheries Heritage") to the industrial city located in the Mirsarai-Feni region has been prepared from Halda River research laboratory (HRRL) on 28 November, 2020 (Kibria, 2020b). The report has been reviewed by the coordinator of HRRL from the field level experience of working on the Halda River for the last 20 years, from an academic perspective and a sense of social responsibility.

4.6.3.1 Study findings

The Halda River is located about 65-70 km from the Bangabandhu Sheikh Mujib Industrial City in the Mirsarai-Feni area. The Institute of Water Modeling (IWM) has prepared an environmental feasibility study report to extract 14 crore litres (total of 54.50 crore litres daily approximate) of water daily from this river through Phase II project at WASA Mohra Water Treatment Plant in Chittagong.

- This report is not based on any scientific study. The water extraction is shown to be valid based on false information. For example, even after withdrawing 54.5 crore litres of water per day from the river, including the project proposed by Chittagong WASA, the report has shown that only 2.05% water will be extracted. On 16th October (year missing), the Managing Director of WASA said in an interview in Daily Purbakon that 3.5% of water will be extracted every day. However, the report does not contain any factual data nor any systematic measurements. According to the report provided by the Institute of Water Modeling (IWM), the lowest tide of Halda during the February to March period is shown to be 1600-2150 MLD, with an average of 165 MLD. At the same time, the daily water demand of WASA from the river is 545 MLD. If calculated, the total water extraction from the river is about 29.06%.
- January to March is the pre-spawning season in the Halda River. The abundance of food, quantity and quality of water is vital for the maturation of fish gonads in the river during this period. Also, there is no water in about 20 km of Bhujpur Rubber Dam upstream of the Halda River from January to March. That means there is no chance of water coming from upstream. During the same time, by 18 sluice gates, Halda Parallel Project (225 MLD), two running water treatment plants of WASA (180 MLD), and by the Proposed project (140 MLD), a total of 545 MLD (excluding rubber dam and sluice gate) water will be withdrawn from Halda.
- During the same period (January to March), almost all the Hydro Power turbines were shut down due to the depletion of Kaptai Lake in the Karnafuli River. Therefore, there is no discharge in the upstream of Karnafuli River. In this situation, the Rangunia Water Treatment Plant project is extracting 140 MLD, Vandaljuri Project is pumping 80 MLD of water. This water gap will be filled with salt water from the sea and polluted water from the Karnafuli River.
- From January till March, pollution in the Chittagong City area becomes unbelievably severe through the Khandakiya canal at Madunaghat on the Halda River. At low tide (12 hours), if 545 MLD (about 54.5 crore litres) of water is extracted from the Halda river, it will severely decrease the water volume of Halda, which will cause an increase in river pollution through the Khandakiya canal. At high tide (12 hours), salt water and polluted water of the Karnafuli river will enter at the entrance of the Halda River. With the reduced amount of river water, the abundance of plankton and benthos will also decrease.

- Thus, the increasing pollution and salinity, decreasing the amount of water and decreasing the abundance of fish food will inevitably have a negative impact on the river ecosystem, dolphins and other aquatic biodiversity. Simultaneously, the daily water demand of the people of Chittagong city is also likely to be threatened due to the infiltration of saline water from the Karnafuli River into the Halda River.
- One of the main stakeholders of the Halda River is the local fishermen, egg collectors and farmers. In addition, those who work to protect the Halda River, such as the Halda River Protection Committee, researchers, NGOs, and local people's representatives are also important stakeholders. This report has been made in great secrecy without consulting them. For this reason, the report did not portray the views of the beneficiaries.
- In the report, the socio-economic impact of the project, which is worth around three thousand six hundred crore taka is not clear. The report did not answer regarding how much land would have to be acquired to place a pipeline with a diameter of around 4 feet at a distance of about 100 km from Mohra to Mirsarai-Feni? How many people will be affected? What will be their alternative employment? What will be the cost of the project? In addition, the price per litre of water collected from Halda compared to the price collected from the nearest source, its economic justification and socio-economic impact were not assessed.
- The abundance of food for aquatic biodiversity depends on the amount of water in the river. The Environmental Impact Assessment Report does not provide any estimate on the number of phytoplankton, zooplankton, micro and macro benthic organisms that will be affected for drawing 32 crore litres of water per day (9 crores + 9 crores + 14 crores) from the proposed project including the two ongoing water treatment projects of Chittagong WASA. The non-disclosure of such an estimate might cause extensive damage to Halda River's ecosystem through a shortage of food for brood fishes, dolphins and other biodiversity.
- Bangladesh is rich in biodiversity. Therefore, Bangladesh is a signatory of the United Nations Biodiversity Charter or Convention on Biological Diversity (CBD) 1992. Hence, environment, biodiversity conservation and development has been included as a principle in Article 18 (a) of the Constitution of the People's Republic of Bangladesh. It states that "*The State shall endeavour to protect and improve the environment and to preserve and safeguard the natural resources, bio-diversity, wetlands, forests and wildlife for the present and future citizens.*" However, the report prepared by the Institute of Water Modelling (IWM) and the withdrawal of water from the Halda River through the Chittagong WASA Phase II project is endangering the only field for the collection of fertilized eggs of the Rui fish, which is a clear violation of the UN Biodiversity Charter and the Constitution of People's Republic of Bangladesh.

4.6.3.2 Recommendations

- ✔ If water is withdrawn in an unplanned way from such a unique and essential river based on an unscientific report containing false and inaccurate information, it will pose a threat to the ecosystem of the Halda River if the following is not determined:
    - How much water is discharged from the Halda River;
    - How much water is extracted by the projects, namely Chittagong WASA's Madunaghat, Mohra Water Treatment Plant projects, Bhojpur Rubber Dam, Harualchhari Rubber Dam, Dhurang Concrete Dam, Halda Parallel Canal in Hathazari to draw water for cultivation in 7 unions and 18 sluice gates, and
    - E-flow of the river
- ✔ Instead of using the Halda River, the water demand of Bangabandhu Industrial City can be met through the availability of affordable, economic and alternative natural resources and technology. For example, the nearest rivers such as Feni River / Silonia / Muhuri, Dakatiya / Chhota Feni River, Kaptai Lake, Mahamaya Lake, Meghna River, and other natural sources can meet the demand of water.
- ✔ In addition, as an alternative to the Halda River it is possible to meet the water demand of Bangabandhu Industrial city in Mirasharai by using several other options. In particular, Mountain centric canal reservoir (Shahasradhara Jharna, Kaiya Chhara, Napityachhara, Bara Kamaldaha Jharna, Bawachhara Lake), water recycling process, reverse osmosis process (De-salination), rainwater harvesting and water vapour condensation process.
- ✔ To fulfil the water demand of the industrial city located in the Mirsarai-Feni region from the nearest, simplest and economically viable source as a replacement of the Halda River.

4.6.4 Carp fish breeding status of Halda River, 2021

A report has been prepared under Halda River Research Laboratory on Halda River (Bangabandhu Fisheries Heritage) Carp Fish Breeding in 2021 and relevant analysis (Kibria, 2021a).

4.6.4.1 Study findings

On 25th May 2021, the carp fish laid its first egg (sample egg) of the season in the Halda River at midnight. From the same day, from 1 am, the Chittagong University Halda River Research Laboratory team has been collecting and monitoring various Halda river fish breeding data from the field level, including water quality tests. On 26th May, around noon (12 pm), the fish laid sample eggs for the second time. Local fishermen and egg collectors started collecting eggs from 11:30 pm on 26th May. In 2020-21, the joint efforts of all to protect the Halda River, especially the active participation of the local administration in the protection of the Halda River brood fish; the versatile activities of the Integrated Development Foundation (IDF) and Palli Karma

Sahayak Foundation (PKSF); the establishment of naval police outposts; the installation of close circuit (CCTV) cameras; due to the active involvement of the Fisheries, Environment and Forest Department the brood fish was almost safe. At the same time, since the Asian Paper Mill and Hathazari Peaking Power Plant were shut down for a while and tobacco cultivation in the Manikchari area was halted, it was possible to keep the river pollution-free. The declaration of Halda River as 'Bangabandhu Fisheries Heritage' on 22nd December 2020 on the centenary of Bangabandhu's birth has created different expectations regarding this breeding ground. In the last 21 years, the highest efforts have been made this time to protect the environment and breeding fish of the Halda River. Despite such success and protection, two environmental parameters have caused the carp fish to not lay the expected amount of eggs in the Halda River.

Following are the two reasons:

1. April to June is the breeding season of carp fish in Halda. During these three months, if there is heavy rain on the new moon or full moon of each month, the fish will lay eggs in the river. However, this year even though two months (April–May) have already passed, there was no expected level of rain upstream of the Halda River. As a result, the hill slope did not create a suitable environment for spawning in the river.

2. 23rd to 29th May was the date for the fourth full moon. If there is a small amount of rain at this time, the fish is ready to lay eggs due to the maturation of the fish gonads. However, due to cyclone Yaas, the sea was rough, and the sea-water level rose. Since Halda is a tidal river, the water level increases to a great extent during high tide, causing saltwater intrusion from the sea into the river. Concurrently, the lack of water pressure due to the lack of rainfall in the upstream areas of the river has further affected the tendency of salinity increase in the breeding areas. As a result, the salinity level was found much higher than normal levels.

These two environmental barriers have hindered the formation of a suitable environment for fish breeding in the Halda River. However, due to the maturation of the fish gonads, the slightly favorable environment has forced the fish to lay eggs. Although there were many fish in the pollution-free river, the carp fish did not spawn as expected. However, removing saline water from Halda and the anticipated rainfall in the upstream, might make it possible for the fish to lay eggs for the second time.

The research team of Chittagong University Halda River Research Laboratory collected the following preliminary data on fish breeding in the Halda River.

- This year around 250 boats were involved in collecting eggs, which is higher than last year. Similarly, the number of people collecting eggs directly from the river was also higher than the previous year.
- Around 800 egg collectors took part in collecting eggs directly from the river.

- According to Chittagong University Halda River Research Laboratory data, the total amount of eggs collected this year is about 8500 kg, despite the unfavorable environment.

4.6.4.2 Recommendations

- ✔ A long-term planning is required for reducing the salinity of Halda River and Karnafuli River.
- ✔ Additionally, rubber dam and concrete dams in the upstream region of Halda will have to be removed.
- ✔ The 18 sluice gates of 19 branch canals need to be rehabilitated in an environmentally friendly manner to increase water flow in the upstream areas of the river.
- ✔ The navigability of the Karnafuli River needs to be increased.
- ✔ The public needs to be encouraged to plant trees extensively in the Halda river basin.
- ✔ Further water extraction from Halda River has to be stopped.

4.6.5 Historical spawning data (HRRL, 2021a)

Table 7: Year wise egg collection and fish fry production

Year	1st Spawning Date	2nd Spawning Date	Fry (Kg)	Egg (Kg)	Data Source
2021	26 May	2 June	(85.35+20.38)105.73	(6360+2220) 8580	HRRL+DoF+BFRI
2020	22 May	20 June	(393.74+4.48) 398.22	(25536+235.4) 25771.4	
2019	25 May		191.2	6986.7	
2018	20 April		378	22680	
2017	22 April		28	1680	HRRL
2016	20 May		12.25	735	
2015	21 April	12 June	(17 + 30) 47	(1000+1800) 2800	
2014	13 May		275	16500	
2013	05 May		(70+80) =150	4200+4800 9000	

2012	08 April		334	21240	
2011	22 May		210	12600	

4.6.5.1 Findings for Historical egg collection and fish fry production

For the historical egg collection record analysis, both primary and secondary data were collected. Egg collection records from 1946 to 2002 were collected from the Department of Fisheries, Chittagong Divisional Office. Again, egg collection data from 2003 to 2015 was recorded through intensive field visits. Although there is no established scientific method for egg collection from the Halda River, face to face interview during the spawning days was a reliable process of data collection. It is worth noting that after transferring the collected eggs from the river to hatchery, the exact amount of collected eggs was not accounted. Besides, the egg collectors were reluctant to share the exact amount of eggs in the hatchery due to fear of falling of selling price of fish fry in the market. Moreover, accounting of fertilized eggs after the 2-3days of spawning also misled the records. Therefore, on-spot data collection in the spawning day through direct field observation was used as method of data collection from 2003-2015. Boats along with fishermen were selected randomly. The total amount of eggs in each randomly selected boat was multiplied by the total number of boats used for egg collection. By this process, the total amount of collected fertilized eggs was recorded in each spawning season. It is important to mention that, sometimes, spawning occurs twice a year. Similar procedure was followed in each spawning season to collect data. On the other hand, there is a very old and established indigenous calculation that, from a mixture of 60 liter of eggs (50% of which is water), only one kg of fish fry is produced. The professional egg collectors use this calculation for a long time. To validate this calculation, an experiment was set up with 4 plastic buckets, each of which contained 15 liter of water (50% water, 50% eggs). After hatching, the experiments result shows that, from these buckets, around 1kg fish fry was produced. That is, the traditional knowledge on fry calculation is more or less scientific. According to the traditional practice, within 4 days of collected eggs, the fish fry is ready for sale in the market. But, if the fish fry production is calculated after the 4 days (96 hours), the amount of the fish fry will be almost double which again misleads the total amount of fish fry production from the collected fertilized eggs. Therefore, for this research, fish fry production data was recorded within 96 hours/4 days from the egg collection time.

4.6.5.2 Comparative egg collection and fry production data

Table 8: Comparative egg collection and fry production data of Department of Fisheries and Kibria from 2003-2015. (Kibria, 2015)

Year	Egg (kg) (Kibria)	Fry (kg) (Kibria)	Egg (kg) (DoF)	Fry (kg) (DoF)	Expected Fry Production (DoF)

Year	Egg (kg) (Kibria)	Fry (kg) (Kibria)	Egg (kg) (DoF)	Fry (kg) (DoF)	Expected Fry Production (DoF)
2003	13020	217	5000	199	83
2004	0	0	780	20	13
2007	22314	371.9	12700	307	212
2008	2400	40	5000	120	83
2009	13200	220	7500	180	125
2010	9000	150	5700	138	95
2011	12600	210	13040	326	217
2012	21240	354	31000	1569	517
2013	4200	70	13500	625	225
2014	16500	275	30480	508	--
2015	2800	47	6360	106	--

Secondary data from DoF, news items from different national dailies, and direct field observations data clearly indicates the amount of both egg collection and fish fry production from the Halda River has been decreasing gradually. Now, it is a burning question that whether withdrawal of water from this river through rubber dam and irrigation project has any negative impact on biological community or not? At Bhujpur of Halda River, a rubber dam was constructed in 2012 and another dam was in operation at Harualchori in 2013. According to the DoF statistics, after the year of 1977, the relatively higher amount of fish fry (1559kgs) was recorded in 2012. A survey on rubber dam users and beneficiaries also shows that, due to rubber dam construction, the amount of fertilized eggs and fish fry production has increased. Direct field investigation's also confirmed that in 2012, after the year of 2007, the fish fry production was relatively higher. Field visits during this year urged that the main reason of this increased fish fry production was the favorable environmental condition for spawning, relatively low water turbulence in the river and full preparedness of egg collectors. If rubber dam had positive impact on the increased number of brood fish and amount of fish fry production, it is expected that it will continue for the next several years. But, surprisingly, after 2012, the amount of fish fry production has decreased gradually. It is important to mention here that a government project called 'Halda River spawning ground restoration project' from July 2007 to June 2012 has successfully completed. From this big budget (Tk.13 crore 84 lakh) project, great efforts towards increasing the brood fish, hatchery installation, fish sanctuary declaration, banning of fishing throughout the year, alternative livelihood options for fishermen and egg collectors, and micro-

credit facilities for fishermen were publicly praiseworthy. Despite these development activities from the 5 year long restoration project, the gradual decrease of fish fry production from this river clearly indicates that rubber dam operation, from 2013 till now, may have negative impact on fishery resources of Halda River.

4.6.5.3 Newspaper highlights on egg and fry production

Reasons for dramatic reduction of the amount of fish egg were highlighted in different local and national newspapers following the instant opinions of stakeholder. **The Business Standard (2021b)** reported: "Local villagers have changed the flow of the Halda by destroying at least 11 oxbow bends of the river between 1905 and 2002. A study conducted by the Bangladesh Fisheries Research Institute identified the destruction of 11 oxbow bends over the last 100 years as one of the 10 human interventions to the destruction of the Halda's biodiversity as a consequence the river's length has decreased by 25.25km to 97.75km from 123km. Thus human pressure has hurt the river's ecology forever with the ultimate result of fish egg production falling steeply in the only natural carp breeding ground of the country. According to the Department of Fisheries and the Chattogram University Halda River Research Laboratory, the number of eggs collected from Halda in 1945 was over 1.36 lakh kg, which dropped to 47,000kg in 2001, 21,000kg in 2012 and only 8,000kg in 2021. This year, the spawning was very poor in the absence of natural phenomena like downpours, hilly torrents and thunderstorms. On top of that, the eggs were spoiled because of increased salinity and high temperature. According to Chattogram Wasa, the maximum salinity found in Halda was 400 ppm (parts per million) in 2004, which gradually increased to 4,000 ppm in May 2021. Moreover, the uncoordinated development projects of various government agencies such as rubber dams, dumping of sandbags and blocks, and sluice gates have brought this river to its death throes. Three upstream dams are holding one-third of the river water among which rubber dam in Bhujpur holds 20% of Halda river water. Besides, about 15% more water is unable to flow downstream through Harwalchhari and Dhurung canals. Due to the dam, the presence of benthos, the staple food of carp fishes like Rui and Kalbaush, has almost vanished from a 20km area of the river. As a result, the presence of Kalbaush is only 3%, Rui 6%, Mrigel 20%, and Catla 70% in the river." (14 July, 2021b)

The Daily Star reported: 'For the drastic drop in spawn production, the expert blamed disposal of tannery and chemical waste into the river, illegal netting of mother fish, and the cross-rubber dam built at Bhujpur in 2011 for irrigation, obstructing the natural flow of water'. (13 June, 2015).

Similarly, the English daily newspaper **The Independent** reported that: "Construction of rubber dams and unplanned sluice gates for irrigation, discharge of industrial wastes and catching of brood fishes are destroying the environment for spawning in the river," (13 June, 2015).

The local leading newspaper the **Dainik Purbakone** reported that: 'Although spawning has occurred in the Halda River within the time interval of two months, the amount of collected eggs

are not satisfactory at all. But, only about couple of kilograms of eggs per boat were collected by the egg collectors. As the egg collectors were able to collect the fertilized eggs below their expectation, they are now hopeless' (13 June 2015). The newspaper mentioned that: 'Despite of having all the natural conditions for spawning, the reasons of the poor spawning were river water pollution, withdrawn of water through rubber dam, catching of brood fish etc.'

4.6.6 Status of water quality, precipitation, temperature and humidity (HRRL, 2021b)

4.6.6.1 Status of water quality

Table 9: Water quality of five places of Halda River Date: 11/04/2021 Dark Moon (High Tide (12.00 am)

Place	DO (mg/ lt)	pH	Resistivity (Kohm-cm)	Conductivity	Salinity (%)	TDS (mg/ l)	BOD	COD	Turbidity (NTU)
Mohra	4.89	7.05	5.26	208.80	0.09	89.60			82.30
Maduna Ghat	5.24	7.10	6.35	172.90	0.07	74.70			117.00
Ramdash Hat	5.62	7.14	6.05	178.90	0.08	78.40			64.10
Gorduara	6.25	7.21	5.23	204.80	0.09	90.90	6.60	34.00	121.00
Sattar Ghat	7.24	7.28	5.01	213.00	0.09	94.90			179.00

Table 10: Water quality of five places of Halda River Date: 29/04/2021 Full Moon (Low Tide (9.00 am)

Place	DO (mg/ lt)	pH	Resistivity (Kohm-cm)	Conductivity	Salinity (%)	TDS (mg/l)	BOD	COD	Turbidity (NTU)

Place	DO (mg/ lt)	pH	Resistivity (Kohm-cm)	Conductivity	Salinity (%)	TDS (mg/l)	BOD	COD	Turbidity (NTU)
Mohra									
Maduna Ghat	4.53	7.01	2.57	390.00	0.19	187.40			98.30
Ramdash Hat									
Gorduara	5.33	7.04	3.95	253.00	0.12	120.80	8.00	36.00	44.80
Sattar Ghat	5.54	6.82	4.04	248.00	0.12	118.20			70.80

Table 11: Water quality of five places of Halda River Date: 11/05/2021 Dark Moon (High Tide (11.30 am)

Place	DO (mg/ lt)	pH	Resistivity (Kohm-cm)	Conductivity	Salinity (%)	TDS (mg/l)	BOD	COD	Turbidity (NTU)
Mohra									
Maduna Ghat	5.73	7.12	2.50	400.00	0.19	192.00			366.00
Ramdash Hat	5.31	7.11	3.11	325.00	0.15	153.90			228.00
Gorduara	5.75	7.06	3.56	283.00	0.13	134.50	15.00	75.00	175.00
Sattar Ghat	7.71	7.01	3.78	266.00	0.12	126.30			183.00

Table 12: Water quality of five places of Halda River Date: 25/05/2021 Full Moon (High Tide (Night)

Place	DO (mg/lt)	pH	Resistivity (Kohm-cm)	Conductivity	Salinity (%)	TDS (mg/l)	BOD	COD	Turbidity (NTU)
Mohra									
Maduna Ghat									
Ramdash Hat									
Gorduara	5.56	6.74	1370	811	0.35	356			60.9
Sattar Ghat									

Table 13: Water quality of five places of Halda River Date: 25/05/2021 Full Moon (High Tide (Day)

Place	DO (mg/lt)	pH	Resistivity (Kohm-cm)	Conductivity	Salinity (%)	TDS (mg/l)	BOD	COD	Turbidity (NTU)
Mohra									
Maduna Ghat	4.02	6.67	148	7.24	3.69	3.61			38.1
Ramdash Hat									
Gorduara	5.65	6.84	2.47	405	0.19	195.2			60
Sattar Ghat									

Table 14: Water quality of five places of Halda River Date: 26/05/2021 Full Moon (High Tide (11.30 am)

Place	DO (mg/lt)	pH	Resistivity (Kohm-cm)	Conductivity	Salinity (%)	TDS (mg/l)	BOD	COD	Turbidity (NTU)
Mohra	5.03	6.83	775.00	1293.00	0.64	640.00			255.00
Maduna Ghat	4.00	7.04	657.00	1653.00	0.77	761.00			28.00
Ramdash Hat	4.19	7.11	1482.00	737.00	0.33	329.00			461.00
Gorduara	5.09	6.44	2.83	396.00	0.17	169.40	8.30	31.00	84.90
Sattar Ghat	5.39	7.08	3.56	281.00	0.13	133.60			220.00

Table 15: Water quality of five places of Halda River Date: 27/05/2021 Full Moon (Low Tide (9.30 am)

Place	DO (mg/lt)	pH	Resistivity (Kohm-cm)	Conductivity	Salinity (%)	TDS (mg/l)	BOD	COD	Turbidity (NTU)
Mohra									
Maduna Ghat									
Ramdash Hat									
Gorduara	4.09	6.99	2.45	451	0.2	197			
Sattar Ghat									

Table 16: Water quality of five places of Halda River Date: 27/05/2021 Full Moon (High Tide (1.30 am)

Place	DO (mg/lt)	pH	Resistivity (Kohm-cm)	Conductivity	Salinity (%)	TDS (mg/l)	BOD	COD	Turbidity (NTU)
Mohra									
Maduna Ghat									
Ramdash Hat									
Gorduara	4.6	6.88	1196	933	0.41	409			
Sattar Ghat									

Table 17: Water quality of five places of Halda River Date: 27/05/2021 Full Moon (Low Tide (5.30 am)

Place	DO (mg/lt)	pH	Resistivity (Kohm-cm)	Conductivity	Salinity (%)	TDS (mg/l)	BOD	COD	Turbidity (NTU)
Mohra									
Maduna Ghat									
Ramdash Hat									
Gorduara	4.91	6.79	1163	948	0.42	422			
Sattar Ghat									

Table 18: Water quality of five places of Halda River Date: 29/05/2021 Full Moon (Low Tide)

Place	DO (mg/lt)	pH	Resistivity (Kohm-cm)	Conductivity	Salinity (%)	TDS (mg/l)	BOD	COD	Turbidity (NTU)
ShahMadari	4.36	6.9	351	2.85	1.49	1459			
Maduna Ghat									
Ramdash Hat									
Gorduara									
Sattar Ghat									

Table 19: Water quality of five places of Halda River Date: 29/05/2021 Full Moon (High Tide (1.30 am)

Place	DO (mg/lt)	pH	Resistivity (Kohm-cm)	Conductivity	Salinity (%)	TDS (mg/l)	BOD	COD	Turbidity (NTU)
Mohra									
Maduna Ghat									
Ramdash Hat									
Gorduara	3.98	6.67	10.36	966	0.47	475			
Sattar Ghat									

Table 20: Water quality of five places of Halda River Date: 30/05/2021 Full Moon (Low Tide (12.00 pm)

Place	DO (mg/lt)	pH	Resistivity (Kohm-cm)	Conductivity	Salinity (%)	TDS (mg/l)	BOD	COD	Turbidity (NTU)
Mohra									
Maduna Ghat									
Ramdash Hat									
Gorduara	4.63	7.23	1930	519	0.25	251			
Sattar Ghat									

Table 21: Water quality of five places of Halda River Date: 30/05/2021 Full Moon (High Tide (3.45 pm)

Place	DO (mg/lt)	pH	Resistivity (Kohm-cm)	Conductivity	Salinity (%)	TDS (mg/l)	BOD	COD	Turbidity (NTU)
Mohra									
Maduna Ghat									
Ramdash Hat									
Gorduara	3.93	6.93	822	1277	0.6	603			
Sattar Ghat									

Table 22: Water quality of five places of Halda River Date: 30/05/2021 Full Moon (High Tide (8.15pm)

Place	DO (mg/lt)	pH	Resistivity (Kohm-cm)	Conductivity	Salinity (%)	TDS (mg/l)	BOD	COD	Turbidity (NTU)
Mohra									
Maduna Ghat	5.27	6.78	668	1497	0.75	6.78			
Ramdash Hat									
Gorduara									
Sattar Ghat									

Table 23: Water quality of five places of Halda River Date: 08/06/2021 Dark Moon (High Tide (11.30 pm)

Place	DO (mg/lt)	pH	Resistivity (Kohm-cm)	Conductivity	Salinity (%)	TDS (mg/l)	BOD	COD	Turbidity (NTU)
Mohra	5.05	6.82	5.47	191.70	0.09	87.20			184.00
Maduna Ghat	5.81	6.75	6.81	146.80	0.07	69.50			223.00
Ramdash Hat	4.79	6.63	8.22	121.60	0.06	57.50			248.00
Gorduara	4.81	6.66	10.05	99.50	0.05	46.90		68.00	169.00
Sattar Ghat	5.54	6.99	10.94	91.40	0.04	43.10			143.00

4.6.6.2 Status of precipitation, temperature and humidity (HRRL, 2021)

Table 24: Precipitation, relative humidity and earth skin temperature of Halda from 2015 to 2021

Date	Precipitation (mm day-1)	Average	Relative Humidity at 2 Meters (%)	Average	Earth Skin Temperature (C)	Average
2015-04-20	0.37	3.3	70.63	75.14	29.79	29.34
2015-04-21	0.91		76.06		29.45	
2015-04-22	8.62		78.73		28.79	
2016-05-19	47.85	88.75	88.58	91.91	27.64	27.12
2016-05-20	112.6		93.27		26.62	
2016-05-21	105.79		93.9		27.11	
2017-04-21	127.36	94.72	92.2	90.86	26.23	26.32
2017-04-22	107.51		91.1		26.1	
2017-04-23	49.3		89.28		26.62	
2018-04-19	55.87	35.83	86.43	85.9	26.93	27.34
2018-04-20	32.96		85.32		27.31	
2018-04-21	18.66		85.96		27.77	
2019-05-24	54.43	51.89	86.45	86.53	28.7	28.48
2019-05-25	71.03		86.74		28.19	
2019-05-26	30.22		86.39		28.54	
2020-05-21	43.43	35.94	85.63	85.2	27.94	28.66
2020-05-22	43.16		85.46		28.89	
2020-05-23	21.24		84.5		29.14	
2021-05-25	29.89	12.56	76.79	72.58	30.58	30.78
2021-05-26	6.61		73.83		30.23	
2021-05-27	1.18		67.12		31.52	

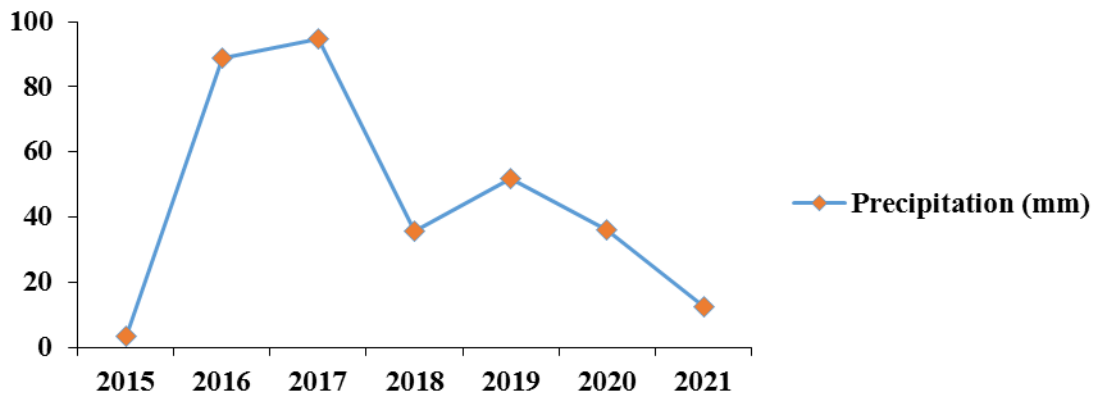

Figure 40: Precipitation status from 2015 to 2021

Data information is taken from POWER Data Access Viewer by NASA.

Location:

Gorduara: Latitude: 22.50, Longitude: 91.87

Manikchari: Latitude: 22.84, Longitude: 91.84

*Got Same Data for both location.

DEFINITION: (Source: NASA)

Precipitation:

Climatology: The monthly average of precipitation at the surface of the earth for a given month, averaged for that month over the 30-year period (Jan. 1984 - Dec. 2013).

Interannual: The monthly average daily rain rate.

Daily: The daily average rain rate.

Relative Humidity at 2 Meters:

Climatology: Ratio of actual partial press of water vapor to the partial pressure at saturation, expressed in percent. The monthly average of relative humidity at 2 meters above the surface of the earth for a given month, averaged for that month over the 30-year period (Jan. 1984 - Dec. 2013).

Interannual: Ratio of actual partial press of water vapor to the partial pressure at saturation, expressed in percent. The monthly average of the relative humidity at 2 meters above the surface of the earth.

Daily: Ratio of actual partial press of water vapor to the partial pressure at saturation, expressed in percent. The daily average of relative humidity at 2 meters above the surface of the earth.

Earth Skin Temperature:

Climatology: The Earth skin temperature is meant to approximate the temperature right at the surface including the vegetated ground coverage. Thus, surfaces with less vegetation will warm in the sunlight than vegetated surfaces and cool more at night. The monthly average of earth skin temperature for a given month, averaged for that month over the 30-year period (Jan. 1984 - Dec. 2013).

Interannual: The Earth skin temperature is meant to approximate the temperature right at the surface including the vegetated ground coverage. Thus, surfaces with less vegetation will warm in the sunlight than vegetated surfaces and cool more at night. The monthly average of earth skin temperature at the surface of the earth.

Daily: The Earth skin temperature is meant to approximate the temperature right at the surface including the vegetated ground coverage. Thus, surfaces with less vegetation will warm in the sunlight than vegetated surfaces and cool more at night. The daily average of earth skin temperature.

4.6.7 Status of Kum in Halda River

A study has been done under Halda river research lab (HRRL) on "Identification of kum (deeper area of river) of Halda River by using echo-sounder" in 2020 (Shaha, 2020). The objective of this research work was to identify Kum of Halda River based on local people's interviews and analyze their statements in a scientific way as identification of Kum with proper scientific instruments did not take place before.

4.6.7.1 Study findings

The names of the Kum were justified by comparing the local names, which were found from interviews, with the names given on the map. Additionally, the unnamed Kums were given new names. List of the names of Kum found by local interview is presented in table 25. Depth was measured with the help of echo-sounder. Its digital screen showed water depth clearly. GPS tracker was used for identifying the location which is represented in the chart.

Table 25: List of Kum of Halda River (Shaha, 2020)

Kum no.	Local name	Depth range (m)	Highest depth (m)	Location, GPS
Kum- 1	Karnafuli confluence	10-18	18	N22°40.478 E91°89.274
Kum- 2	WASA (Mohora)	10-13.5	13.5	N22°39.763 E91°88.937
Kum- 3	Kalakkharhat	10-20.1	20.1	N22°24.957 E091°53.075
Kum- 4	Chayar char	10-19.5	19.5	N22°25.622 E091°53.495
Kum- 5	Khandakia	10-16.5	16.5	N22°26.063

Kum no.	Local name	Depth range (m)	Highest depth (m)	Location, GPS
				E091°52.348
Kum- 6	Ramdas Munshir Hat	10-18	18	N22°27.905 E091°51.303
Kum- 7	Turning of Harekrisna Mohajon	< 10	8.25	N22°27.905 E091°51.400
Kum- 8	Amburaghat	10-14.3	14.3	N22°28.357 E091°51.942
Kum- 9	Napiter Ghat	10-20.1	20.1	N22°28.095 E091°52.359
Kum- 10	Azimer ghat	10-13.3	13.3	N22°28.988 E091°52.908
Kum- 11	Porakopali	10-16.8	16.8	N22°29.229 E091°52.531
Kum- 12	Kagotia	10-12.2	12.2	N22°29.604 E091°52.617
Kum- 13	Sipahir ghat	10 – 15	15	N22°30.090 E091°52.325
Kum- 14	Noyahat	10-10.7	10.7	N22°30.028 E091°51.926
Kum- 15	Keramtalir Band	10-15.2	15.2	N22°30.234 E091°51.724
Kum- 16	Kamdar Ali Chy ghat	10-15.9	15.9	N22°30.066 E091°51.214
Kum- 17	Ankurighona Band	10-13	13	N22°30.725 E091°51.021
Kum- 18	Moghasashsri Band	10-14.6	14.6	N22°30.897 E091°50.556
Kum- 19	Boaliakhal Opening	10-10.6	10.6	N22°31.179 E091°50.922
Kum- 20	Sarta Khal Opening	10-12.4	12.4	N22° E091° E091°50.855
Kum- 21	Annapurna Ghat	10-11.9	11.9	N22°31.688 E091°50.800
Kum- 22	Terpali Opening	10-13.2	13.2	N22°32.355 E091°50.448
Kum- 23	Peshkar Hat	10-12.2	12.2	N22°32.440 E091°50.718
Kum- 24	Alamma's Opening	10-13.5	13.5	N22°32.987 E091°50.697

4.6.7.2 Recommendations

- ✔ Bangladesh Water Development Board (BWDB) took on a project to protect river banks by using cement blocks however it is disturbing the natural ecology of the river causing a decrease in Kum depth. Massive quarrying of sands from river bed illegally, by a section of unscrupulous traders by using dredgers is also disturbing the river's biological ecosystem. Unplanned construction of a good number of sluice gates and rubber dam for irrigation purposes caused the decline of the natural flow of the river. Therefore, it is recommended that fewer dams and sluice gates be built in order to maintain a river-friendly environment.
- ✔ Due to deforestation and Jhum cultivation, sands and muds are moving towards the river with rainwater from hilly areas. This causes a decrease in river depth. So it is important to plant more trees and build a green riverbank area for conservation of biodiversity of the Halda River.

4.6.8 Status of Dolphin in Halda River

A study has been done under Halda River research lab (HRRL) on "Present status of Gangetic river dolphin (*Platanista gangetica*) and habitat identification from Halda River by using echo-sounder" in 2020 (Nahian, 2020**)**. The objective of the study was to update existing information on the Ganges River Dolphin and contribute knowledge on its status and threats in the Halda River.

4.6.8.1 Study findings

Table 26: Distribution of Dolphins in different sites by direct counting

No of sites	Places	GPS Coordinate	No. of dolphins			Site wise Mean
			Jul	Aug	Sep	
1	Confluence of Karnaphuli	22°23.622'N 91°51.945'E	12	6	6	8
2	Chayar Char	22°25.622'N 91°52.945'E	27	20	14	20.33
3	Khandakiakhal	22°27.905'N 91°51.303'E	5	2	10	5.6

No of sites	Places	GPS Coordinate	No. of dolphins			Site wise
4	Katakhali	22°28.357'N 91°51.342'E	10	11	6	9
5	Madarikhal	22°28.095'N 91°52.359'E	3	7	8	6
6	Barighona	22°30.066'N 91°51.214'E	16	18	4	12.66
7	Nafiterghona	22°30.897'N 91°50.556'E	9	6	3	6
8	Porakopali	22°29'1"N 91°51'35"E	8	7	10	8.33
9	Khagatiakhal	22°32.355'N 91°50.488'E	13	7	12	10.66
10	Sonai char	22°32.440'N 91°50.718' E	12	3	6	7
11	Keramtali	22°32.440'N 91°50.718' E	8	7	3	6
12	Sattarghat	22°32.987'N 91°50.697'E	14	8	14	12
Total			137	102	96	111.58 ±112
Monthly mean of total			11.41	8.5	8	

Table 27: Distribution of Dolphins in different sites by echo-sounder

No of sites	Places	GPS Coordinate	No. of dolphins			Site wise Mean
			Jul	Aug	Sep	
1	Confluence of Karnaphuli	22°23.622'N 91°51.945'E	14	6	4	8

No of sites	Places	GPS Coordinates	No. of dolphins			Site wise Mean
2	Chayar Char	22°25.622'N 91°52.945'E	28	22	14	21.33
3	Khandakiakhal	22°27.905'N 91°51.303'E	9	3	6	6
4	Katakhali	22°28.357'N 91°51.342'E	9	15	6	10
5	Madarikhal	22°28.095'N 91°52.359'E	6	10	8	8
6	Barighona	22°30.066'N 91°51.214'E	16	22	6	14.66
7	Nafiterghona	22°30.897'N 91°50.556'E	10	6	6	7.33
8	Porakopali	22°29'1"N 91°51'35"E	10	10	12	10.66
9	Khagatia khal	22°32.355'N 91°50.488'E	14	8	10	10.66
10	Sonai char	22°32.440'N 91°50.718' E	10	5	9	8
11	Keramtali	22°32.440'N 91°50.718' E	6	8	6	6
12	Sattar Ghat	22°32.987'N 91°50.697'E	15	12	10	12.33
Total			147	127	97	123.66 ±124
Monthly mean of total			12.16	10.58	8	

4.6.8.2 Dolphin population

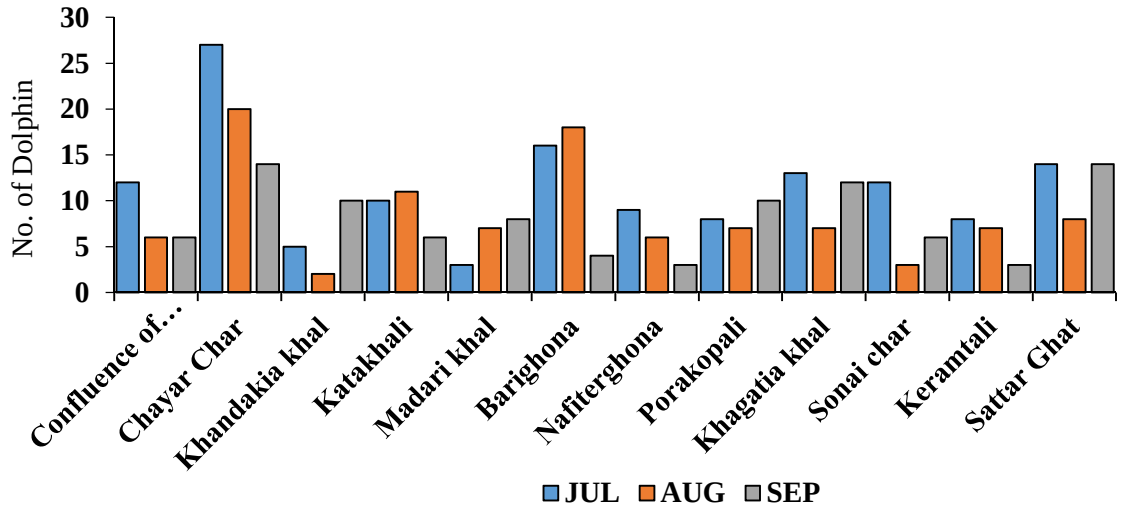

Figure 41: Site wise number of dolphins by direct counting

In Halda River, highest number of dolphin was recorded in July (137 individuals of Dolphin by direct count and 146 by echo sounder) and lowest in September (96 individuals of Dolphin by direct count method and 96 by using echo sounder) in 2019 (Fig. 41).Water depth varied monthly in the river during study period. Water began to increase in May due to pre-monsoon rain.

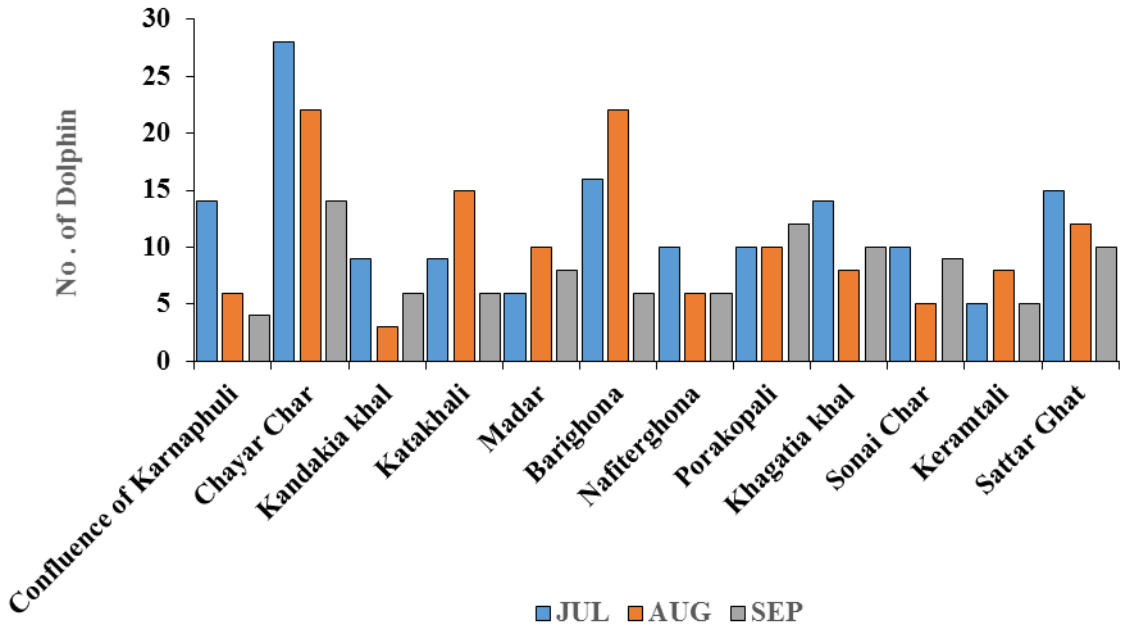

Figure 42: Site wise number of dolphins by Echo Sounder

- Study revealed that the Chayar Char and Sattar Ghat area is the most important stretch of the Halda River in terms of the Dolphin abundance.
- Although river dolphins prefer to travel alone or in small groups, the group of 3-5 individuals is a common group size observed in this study. Group of 5-10 individuals has also been seen. However, if the current situation continues for a long time, there is a possibility that the Dolphin would face eradication from this river.
- The threats to the river dolphins in the Halda River were pointed out through interviews, inspection and discussion with the boatman, fishers and the locals.
- The habitat degradation due to dams, embankment of Water Development Board for river erosion, excessive motor vehicles due to sand extraction, intensive fishing gear are major threats. Ineffective law enforcement and inadequate conservation efforts from conservation organizations are another major cause of the decrease in the number of dolphins.
- Observation during the study showed high fishing activities occur in the areas where dolphins were reported by the local communities. The traditional fishers and the increased involvement of the immigrants from nearby areas have increased fishing activities in the Halda River as fishing is the basis of their livelihood. The riverine environment of the Halda River is degraded with the increasing trend of fishing occupation among other people of the area.
- During study, activities like washing of clothes, bathing and waste dumping were observed very often. House-hold waste materials were also dumped in the river water.

4.6.8.2.1 Recommendations

Based on the findings of this study, the number of dolphins is decreasing day by day. Further detailed studies are necessary to identify the limiting factors.

4.6.8.3 Investigation report on the post mortem of dead Dolphins in Halda River and causes of death

Due to the recent deaths of Dolphins in Halda River, for a post-mortem of dead dolphins, finding out its causes, and for recommendations, the Ministry of Fisheries and Livestock formed a committee based on the propaganda dated 22-02-2018 {numbered 33.00.0000.127.22.003.07-63(7)}. The committee members formed by the Ministry visited the Halda River Research Laboratory of Chittagong University on 07/03/2018 at 10.00 am to collect the post-mortem and samples of the dead dolphins and carried out the post-mortem on the dead dolphins that were kept in the laboratory. After that, the members exchanged views with the local people by visiting the probable places where the dolphins died in the Halda River.

✔ The dolphins found in the Halda River belong to the Gangetic species (*Platanista gangetica*). In the local language, it is called hutum or shushuk. According to the IUCN, this dolphin is listed as an endangered species. According to the data, 18 dolphins died from September 2017 to February 2018 - out of which five dolphins were found to be dead from different places of Halda River from 20 December 2017 till 1 February 2018. Out of 18 dolphins, 17 were full-grown, and one was underage. The dolphin found dead on 1 February 2018 was preserved at the Halda River Research Laboratory.

Table 28: List of dead dolphins (HRRL, 2017-2020**)**

Sl	Date	Location	Causes	Number
1	03/09/2017	Domkhali	Rotten	1
2	10/09/2017	Kagotia Breakfield	Rotten	1
3	19/09/2017	Gettakhali mouth	Mechanical Trauma	1
4	29/09/2017	Azimar Ghat	Mechanical Trauma	1
5	01/10/2017	Napiter Ghat	Mechanical Trauma	1
6	07/10/2017	Kagotia	Rotten	2
7	15/10/2017	Kasem nagar	Rotten	1
8	28/10/2017	Maduna Ghat	Mechanical Trauma	1
9	06/11/2017	Kagotia	Mechanical Trauma	1
10	12/11/2017	Ramdashat	Mechanical Trauma	1
11	25/11/2017	Azimar Ghat	Mechanical Trauma	1
12	08/12/2017	Azimar Ghat	Mechanical Trauma	1
13	02/01/2018	Gorduara	Mechanical Trauma	1
14	05/01/2018	Sarta Khal Mouth	Mechanical Trauma	1
15	20/01/2018	Kanthor Ali Sluice Gate	Mechanical Trauma	1
16	21/01/2018	Chipatali	Mechanical Trauma	1
17	01/02/2018	Domkhali	Mechanical Trauma	1

Sl	Date	Location	Causes	Number
18	14/11/2018	Azimer Ghat	Mechanical Trauma	1
19	26/03/2019	Madunaghat	Rotten	1
20	05/11/2019	Akboria, Madarsha	Rotten	1
21	05/12/2019	Akboria, Madarsha	Mechanical Trauma	1
22	21/03/2020	Azimer Ghat	Rotten	1
23	08/05/2020	Urkir Char	Killed	1
24	24/05/2020	Madunaghat	Trapped	1
25	14/08/2020	Mohora, Wasa area	Rotten	1
26	13/10/2020	Azimer Ghat, Kagotia	Killed	1
Total (From September 2017 to October 2020)				**27**

4.6.8.3.1 Causes of death

1. Mechanical Trauma
2. Trapped
3. Killed
4. Natural death

4.6.8.3.2 Recommendations

- ✔ Stopped Dredger and Motor Boat (Local Administration)
- ✔ Stopped Illegal Net and gears to save Dolphin and Brood fish (Department of Fisheries)
- ✔ Monitoring by local community (NGO and HRRL)
- ✔ Remove rubber dam (LGED and WRM)
- ✔ Stop Pollution and enforcement of strict law (DoE)
- ✔ Local Awareness (NGO)
- ✔ Digital Monitoring with CC Camera (Naval Police)
- ✔ Study of Habitat and Population, Safe Migration of Dolphin (HRRL)
- ✔ Implementation of Wildlife and Fisheries act (Forest Department and Department of Fisheries)

- ✔ Amendment of laws regarding conservation of fish to protect dolphins and other aquatic animals (Kibria, 2018b)

4.6.9 Status of embryonic, larval and fry development of carps spawn from Halda River

A study have been conducted on "Embryonic, larval and fry development of carps spawn from Halda River and comparative growth rate and water quality analysis between traditional mud scoop and cemented hatchery methods" under Halda River Research Laboratory (HRRL) in 2019 with the support of IDF and PKSF (Asek, 2020). The main objectives were to know the embryological feature of Halda Carp; different stages of embryo; fry and larva at natural condition, not of artificial; to know the differences between the eggs of cemented hatcheries and mud scoop; to know the facts of water quality that influences the life stages of Halda fry; to explore the sectors of embryo that can help in the transparency in the selling market of Halda fry.

4.6.9.1 Study findings

- Mud scoop spawn grew rapidly than the spawn of cemented hatchery after 10 hour. This was for increased amount of dissolved oxygen, tolerable salinity and increased amount of turbidity and biological food provided by the mud surface. So, mud scoop is better in rearing the early stages of Halda spawn.
- Both the spawn shows the similar growth up to 10 hour as the direct dependence on water quality was unnecessary till then.

4.6.9.2 Recommendations

- ✔ To understand the growth, a more specific long term study is recommended.
- ✔ Both the spawn of mud scoop and cemented hatchery is needed to rear in separate large ponds after early fry stages.

4.6.10 Livelihood status of egg collector

A study had been conducted on Livelihood status of egg collector and traditional knowledge of Carps Egg collection in the Halda River: A natural fish spawning heritage in Bangladesh in 2018 to To know the present egg collection status of the Halda River To know the socio-economic condition of the egg collectors of the Halda river and To assess present number of egg collection boat, comparative status with previous data and identify the causes (Kibria et al., 2018).

4.6.10.1 Study findings

- The living condition of the egg collectors in the Halda River is below the standard.
- They cannot meet their daily needs as their ancestors did.
- But the light of expectation is found from the present study. Record breaking amount of eggs was collected from the river this year. This amount is higher than the previous year.

- Indigenous knowledge helps a lot to fertilize the collected egg of the Halda River (A natural fish spawning heritage in Bangladesh).

4.6.10.2 Recommendations

- ✔ To stop illegal catch of brood stock, different stakeholders (e.g. police, coastguard, army, local folk etc.) should work together and raising awareness among the fishermen will be the effective measurement.
- ✔ Involvement of the local community in the safeguarding of brood stock must be increased.
- ✔ Strict enactment of law is key to protect the carp broodstock that is the main source of egg.
- ✔ Reducing the illegal influence of local politicians in the hatcheries.
- ✔ Cutting of river bends must be banned which is largely liable for erosion and devastation of the breeding grounds.
- ✔ Pollution from the industrial sector, domestic sector and agricultural sector must be controlled.
- ✔ Redesign of existing sluice gate and removal of rubber dam as well as concrete dam from the river to ensure normal flow pattern of water.
- ✔ Government owned hatcheries should be renovated, provided with suitable facilities and skilled technicians to help the spawn fishers in successful hatching of spawn. The authority of the hatcheries should provide required information to the fishermen during hatching to get strong and healthy fry.
- ✔ Government khas (bare) land should be allotted to those who have lost their households and properties by river erosion. It will help to increase the resilience of the spawn fishing community.
- ✔ Loan with low interest must be provided to the fishermen both from Govt. and local NGO to increase boat number.
- ✔ Alternative sources of income must be created and monthly allowance (e.g. rice, money etc.) should be provided to the fishermen during lean season to secure their livelihood.
- ✔ Traditional mud scoop technique should be encouraged beside the cemented cistern to sustainably increase egg collection through proper training and logistic support of respective government departments and NGOs.
- ✔ Finally, an integrated approach is needed to address the threats associated with egg collection activities and all the stakeholders should come forward to safeguard and withstand this exclusive resource of the Halda River.

4.6.11 Status of Industrial Pollution: Chittagong Asian Paper Mills (PVT)

A report has been prepared by a committee of eight members after inspection of Chittagong Asian Paper Mills (Pvt.) on 25th February in 2021 (DoE, 2021).

4.6.11.1 Findings

The inspection report provided that most of the guidelines issued by the Department of Environment on 03/10/2019 have not been appropriately implemented.

The directions are given as follows:

A. Different pipelines, including five pipelines of raw material mixing pulp, should be marked with different colours. Flowmeter should be connected with the underground pipeline, and the numbers must be recorded. It will help determine how much underground water and recycled water have been used in the production process.

B. Existing ETP must be reformed, or a new ETP needs to be constructed to keep the various parameters of ETP purified water within acceptable standards as mentioned in the Environment Conservation Rules, 1997.

C. RCC wall or guide wall should be constructed on both sides of the channel flowing through the factory.

D. The removal of sludge and its record must be kept following the sludge guidelines of the Department of Environment.

E. Separate meters for ETP management and a register for all the chemicals used in ETP management should be maintained.

F. A boundary wall must be constructed on the northwest side of the factory.

G. ETP should be maintained at all times under the supervision of a skilled chemical engineer.

- Although instructions were given in 2019, the guide wall construction on both sides of the Chara was not completed as of 25/02/2021.
- There is no boundary wall on the northwest side of the establishment.
- Sludge has been dumped inside the organization without following the sludge management guidelines.
- After reviewing the documents, it was found out that the liquid wastes of the paper mill have never been within the acceptable standards since the Mill started its operation.
- Legal action has been taken by the Department of Environment at various times, and instructions have been given to operate the factory in an environmentally friendly manner through the development of environmental management. However, the factory authorities have not taken any noticeable action.

- Samples were collected from the purified liquid waste stored in the pond inside the factory for reuse by the Department of Environment at various times. The results were found to be beyond acceptable standards. There are allegations that the water of this pond flows through the surrounding Chara during the rainy season and pollutes the water of the canal and Halda River. On 10/06/2019, the Director of Chittagong Region penalized the factory to pay 20 lakh taka as compensation for the damage done to the environment by the liquid waste and instructed not to store the purified liquid waste in the pond inside the factory. During the inspection, the factory authorities said they would store the excess water in the pond, which will be reused in the production process. As a result, there is a high chance of this incident to repeat in future.
- Volume and retention time in the units of ETP, especially the chemical dosing unit, settling tank, biological treatment unit, were not done based on any calculation. As a result, it does not appear that it will be possible to maintain the statutory standards by using such inefficient ETP for purifying liquid wastes.
- Although sludge management has been developed earlier, it is inadequate compared to the size of sludge.
- Upazila Fisheries Officer of Hathazari said that the production of carp fishes has increased in Halda after the paper mill's closure.
- The drainage layout of the factory was not found during the inspection. As a result, there is no specific information regarding the separate management of rainwater and liquid wastes generated in the factory. However, there are allegations that untreated liquid waste is discharged from the factory through drains during heavy rains. The allegation was found to be valid during the inspection of the paper mill on 10th June 2019 by the Upazila Nirbahi Officer. As a result, there is a risk of similar mismanagement in future.

4.6.11.2 Overall Comment

- Based on the information obtained during the inspection and reviewing the documents submitted to the Department of Environment, it is evident that the Chittagong Asian Paper Mill is not suitable for operating in a pollution-free manner with its existing waste management system.
- The design of each unit of ETP and its retention time has not been adjusted according to the factory's estimated liquid flow. As a result, it is not advisable to restart the factory until the ETP and other pollution control measures are correctly designed and implemented.
- It was observed during the inspection that purified water would be stored in the pond inside the factory. This might result in the rainwater to mix with the liquid waste during the rainy season and is likely spread in the environment or Chara.

- Last year it was possible to collect more eggs due to the closure of the paper mill. If the paper mill is commenced, egg production may be reduced due to the pollution of the Halda River.
- The Halda River has already been declared as a Bangabandhu Fisheries Heritage as it is rich in biodiversity. Therefore, such improper activities of the factory can have a negative effect on the biodiversity of the Halda River.

4.6.11.3 Recommendations

- ✔ Re-starting the Chittagong Asian Paper Mill's production process will not be an appropriate step considering the defective liquid waste treatment system of the factory, which is causing pollution of the Halda River.
- ✔ In this context, instructions may be given to re-locate the Chittagong Asian Paper Mills (Pvt) Ltd. to an economic zone in Mirsharai located in Bangabandhu Sheikh Mujib Industrial City.

4.6.12 Status of Industrial Pollution: Hathazari Peaking Power Plant

The Halda River, the only natural breeding ground for carp fishes in Asia, is located 5 km east of the Hathazari Peaking Power Plant. Considering the situation, a report has been prepared by a committee composed of eight members after inspection of Hathazari Peaking Power Plant on 25th February in 2021 (DoE, 2021).

4.6.12.1 Findings

- The design of the various units of the newly constructed ETP of Hathazari 100 MW Peaking Power Plant has been constructed following the design of the liquid waste floor. However, it was found that the oil will be separated manually in Oil Water Separator, and the sludge storage system is not suitable.
- During the inspection, the production process was closed; hence no liquid waste was generated. Therefore, the effectiveness of ETP could not be tested by collecting and analyzing the purified liquid waste.
- Manager of the Power Plant, said that routine repairs of the engines and other vital units could not be carried out since they had been shut down for a long time, leading to spare parts of various devices, including engines to become useless.
- In consultation with the engineers involved in power generation, it was found that both Heavy Fuel Oil (HFO) and diesel can be used as fuel in these power plant engines. If HFO is used, pre-heating and water separation are required. Whereas, if diesel is used, the engine can be used directly.

- It was learned during the inspection, the power plant has fuel reserves worth around 30 crore taka.
- Inside the factory, there are eight oil trap pits constructed around the engine house. In addition, a three-stage oil trapping water separator has been constructed at the front of the drain so that the liquid wastes go through the separator before it falls into Marachara.

4.6.12.2 Recommendations

- ✔ The environmental impact of heavy fuel oil is more significant than that of light fuel (petrol, diesel and kerosene). It is unknown as to what effect this HFO based power plant will have on the environment in the long run, even after ETP treats oil mixed liquid wastes before it goes to the Halda River. In this regard, the precautionary principle can be followed.
- ✔ Since the engines of this particular power plant are dual fuel (HFO & Diesel) engines, therefore it can be operated using diesel instead of HFO.
- ✔ As its liquid wastes fall into the river through the Marachara therefore, it is imperative to keep the liquid waste management as low as possible in this case. Oil-water drainage can be stopped if doable.
- ✔ In the light of the information obtained during the inspection and from the Department of Environment, it can be said that the design and retention time of the newly constructed ETP of the power plant has been done in accordance with the liquid waste floor. However, the oil-water separator's oil collection system and sludge preservation system needs further improvement.
- ✔ The power plant’s engines and other equipment need routine repairs, and they cannot be repaired without starting the engine. Since starting the engine with diesel will not create any liquid wastes, it is possible to start experimental power generation with diesel.

4.6.13 Physico chemical parameters and plankton population: PKSF report

A study has been conducted in 2017 by HRRL supported by PKSF on Physico chemical parameters and plankton population of the Halda River under PACE project in 2017 (Kibria, 2017)

4.6.13.1 Findings

- The diversity of zooplanktons are high but abundance of zooplankton communities are not sufficient for maintaining sustainable conditions in the Halda River.
- The zooplankton communities’ abundance is decreasing at an alarming rate due to different types of natural and anthropogenic disturbances, withdrawal of water from the

upstream, global climate change and excessive intrusion of saline water in the Halda River.

- Besides, the fluctuation of various physical and chemical factors reveals a sign of serious threat to destroy the natural ecosystem in the Halda River.

4.6.13.2 Recommendations

- ✔ There is an urgent need to take proper actions for stopping all types of industrial pollution in Halda River. Particularly, the master plan of Ananna R/A project under CDA should change accordingly. Discharge of wastewater through Khondokia canal should also be stopped. Besides, the old canals should be re-excavated.
- ✔ Over extraction of sand, both by legal and illegal extractors should be regulated by implementing existing law strictly to maintain the ecosystem of the river. The unplanned extraction of sand, to our view, is the most important factor contributing to river bank erosion which causes a huge economic and social damage.
- ✔ For stopping all types of destructive activities along the two banks of this river, the declaration of this river as ECA is urgently needed.
- ✔ For the protection of brood fish, it is urgently needed to involve the beneficiaries of this river. '*Public Patrolling Committee'* can be formed to save this spawning heritage.
- ✔ The study also recommends formulation of 'Halda River Conservation Commission' involving the local people and researchers for better management of Halda River ecosystem.
- ✔ Halda River is the only fish spawning ground in Bangladesh from where fertilized carp eggs collected by the local people from the time immemorial and whose origin and ending point is within the country. Due to this unique feature the river can be declared as "the National River" of Bangladesh.
- ✔ Halda River can also be declared as a 'Ramsar Site' due to its unique wetland ecosystem. Consequently, international collaboration will enhance the conservation activities of this river.
- ✔ Long term (multi-decadal) intensive research analysis of physico-chemical parameters' influence on planktonic communities in the Halda River, must be run to assess the exact interaction between physico-chemical parameters and the planktonic communities because only short-term analyses of these parameters have been accomplished so far. In addition, the relative importance of physico-chemical parameters and planktons is necessary to explain the present condition of this river, even though such knowledge will be important in planning of the Halda River restoration.
- ✔ An important research perspective for the river management is needed to determine fish faunal diversities that are threatened and endangered to extinction. One exclusive

approach is needed to meet a challenge for assessing the present status, distribution and diversity of fish fauna in the River Halda. Because many species of fishes are near extinction from the river.

- ✔ The signs of climate change impact on the flow of the Halda River are very prominent, like bank erosion, fluctuation of water level, siltation on the river bed, increasing salinity, high level of turbidity, increasing alarming rate of water temperature, extinction of different fish species, decreasing rate of spawn of native major carps etc. It is the demand of time to make an individual financial climate change fund for the Halda River. This fund will be used to river management for ecosystem and create self-livelihood and alternative livelihood opportunity for egg collectors, fishermen, fish cultivators, farmers who live near to the banks of the Halda River.
- ✔ Tobacco farming in the Manikchari area of Halda River should be stopped through appropriate government actions.
- ✔ Local administrative authorities should come forward and take appropriate actions against illegal oxbow cutting of this river.
- ✔ Re-running of *'Halda Parallel project'* under Bangladesh Water Development Board should be investigated for its scientific feasibility. Otherwise, saline water intrusion may be a serious threat for the spawning ground of this river and a health hazard for 6 million people of Chittagong city who are drinking the treated water from this river.
- ✔ Use of agro-chemicals including pesticides in agricultural lands along both the banks of this river and tea gardens in the upstream should be avoided. Besides, actions should be taken to encourage the farmers to use organic fertilizers.
- ✔ A proper management plan is necessary to conserve wild stock of carp fish species, to supply inbreeding free quality brood fish to the owner of the hatchery and to encourage farming of high growth carp fish. PKSF can play an important role in this regard. As an example: By collecting eggs from the river and hatching fry through their traditional mud scoop technology, brood fish can be produced and supplied to the hatchery owners. The whole process will be controlled with a strong monitoring and management system. This process will not only bring back the confidence of hatchery owners and fish farmers on carp fish farming; it will also help in the conservation of carp's wild stock of Halda River through ex-situ conservation methods and fulfill our national animal protein demand by producing quality fish.

4.6.14 Integrated initiatives to restore river ecosystem: Halda River (Bangabandhu Fisheries Heritage) is a successful example (Kibria, 2021b)

Bangladesh, which became independent in 1971 under the slogan 'Tomar amar thikana, Padma Meghna Jamuna', is geo-naturally formed from a river; hence it is called a riverine Bangladesh. Halda is one of the 776 rivers of the country. It is the only tidal river in the world from which

the fertilized eggs of the carp fishes are directly collected. For this reason, the Halda River is also a global heritage for Bangladesh. In addition to being a unique natural resource, it also contributes to the country's economy; hence it is our natural breeding heritage.

Halda River was declared a 'Bangabandhu Fisheries Heritage' on the occasion of the birth centenary of Father of the Nation Bangabandhu. A gazette was published to that effect on 21st December 2020 as per Section 32 of the Bangladesh Biodiversity Act, 2017. This announcement is a landmark step for the protection of rivers in Bangladesh.

Halda deserves recognition as a national heritage and an international heritage due to its several notable features. The Halda River is the only natural breeding ground for the pure natural gene bank of carp fish (Rui, Katla, Mrigel, and Kaligani) in Bangladesh and the only tidal river in the world from where fertilized eggs are collected directly. Currently, the growth of fish is severely hampered due to inbreeding. Therefore, conserving this natural gene bank of the Halda River is vital to overcome this situation. The process of extracting eggs from this river, producing hatchlings from it, and taking care of them are unique and have been followed by generation after generation by the locals. From time immemorial, this technique has been used to combine religious sentiments and technical knowledge to collect eggs and produce hatchlings from extracted eggs. The above conditions meet the 9th and 10th conditions of UNESCO World Natural Heritage. In order to be qualified to be the World Natural Heritage, any one of the four conditions set by UNESCO (No. 7-10) has to be fulfilled.

Halda River is also particularly significant for endangered biodiversity. Dolphins are listed as endangered aquatic mammals according to the IUCN Red List. In 2018, there were about 167 dolphins in the Halda River, which dropped to around 127 in 2020. From September 2017 to 2020, 28 dolphins have died. Most of these dolphins died due to injuries. Despite the alarming decline in the number of dolphins due to environmental pollution, killing, and overfishing, this Halda River is home to the most significant number of dolphins.

Although the Halda River has traditionally played an essential role as a natural fish breeding ground in the last century, since the establishment of the Kaptai Hydroelectric Power Station on the Karnafuli River in the 1960s, the fish breeding in this river has been steadily declining. Before constructing the dam for the Kaptai Hydroelectric Power Plant, brood fish used to come to the Halda River from the rivers associated with the present Kaptai Lake to lay eggs during the breeding season. Since 1964, this number has declined rapidly. Due to pollution, catching of brood fish, cutting of river bends, not knowing about Halda River, and lack of proper conservation measures, the number of eggs started to decrease. As a result, the river started losing its inherent characteristics. The continuous decline of the river ecosystem that started in 2001 saw its extreme in 2016. In 2016 no fish laid eggs in the Halda River, which has never happened in the past hundred years.

While finding the answer as to why the incident happened that year, several anti-environmental activities of the Halda River surfaced, most of which were caused by humans. The Halda Research Team of Chittagong University and the Halda River Protection Committee jointly

identified several factors. Notable among them are large-scale tobacco cultivation in upstream Manikchhari area, construction of rubber dam in Bhojpur area, contamination by Hathazari peaking power plant, contamination by Asian Paper Mill in Nandirhat, and the killing of brood fish.

2020 is the year of change for the Halda River. This year, 25,538 kg of eggs were collected from the river. A record amount of eggs were collected in 14 years after 2007. The relentless efforts of some river-friendly individuals and government and non-government organizations from 2016 to 2020 have caused the river to revive. The commitment and dedicated joint efforts of all have made it possible to improve the river environment.

4.6.14.1 Stoppage of Tobacco cultivation in Manikchhari

For the first time in 2016, no fish laid eggs in the Halda River. This unprecedented incident surprised all the egg collectors. After waiting for three months, everyone gave up, which resulted in a substantial financial loss and frustration. While searching for the reason for the incident, it was found that tobacco cultivation has started on a large scale in the Manikchhari area upstream of Halda. Although it started 7/8 years ago, with the particular encouragement of a few tobacco companies, tobacco cultivation has spread widely among the local farmers. This practice is deadly for the river because, during the breeding season, the muddy water slope of the hill is required for the fish to lay eggs. If this muddy water contains the toxicity of tobacco, the brood fish will not release eggs. That is what happened in 2016.

Suppose the farmers of Halda's Char in the Manikchhari area do not return to mainstream agriculture from tobacco cultivation. In that case, it would disrupt the natural fish breeding ground of the Halda River; hence, it requires alternative livelihood and awareness. The University of Chittagong's Halda River Research Laboratory conducted a baseline study, made a list of tobacco growers, and formulated some recommendations. IDF and PKSF came forward in collaboration with the Manikchhari Upazila administration based on these recommendations. Since 2018, considering the environment of the Manikchhari area and based on the demand of the farmers, about 150 tobacco farmers have been provided with high-yielding vegetable seeds, fertilizers, fruit trees for creating orchards, and fish fry for fish farming in Halda. In collaboration with the Halda River Research Laboratory of Chittagong University, it was possible to give an alternative livelihood to the farmers after having many awareness programs. After two years, in 2020, almost all tobacco growers back to mainstream agriculture.

4.6.14.2 Closure of Hathazari peaking power plant

The Hathazari 100 MW Peaking Power Plant was established under Bangladesh Power Development Board in 2012 at Hathazari Upazila Sadar. Since its establishment, the Peaking Power Plant has been operating without environmental clearance and with no ETP construction. Every day around 25 cubic meters of liquid waste is generated from the red-listed power plant. The use of HFO (Heavy Fuel Oil) for power generation activities results in the creation of crude oil-mixed liquid wastes, which drain into the nearby Mara Chara Canal with the help of

rainwater and finally fall into the Halda River, causing severe pollution. Following the complaints of everyone related to Halda, the power plant was fined multiple times by the Department of Environment with particular directions to make sure it does not create any pollution.

On 20th May 2012, the plant was penalized with BDT 10,00,000 (Ten Lakh taka only) as damages by the Department of Environment for conducting power generation activities with HFO without establishing ETP and polluting the Halda river.

Even after this, the company continued its activities without paying attention to any environmental pollution. Due to the massive death of fish in the Halda River on 14th July 2019, a committee was formed by the Department of Environment to inspect the site. According to their report, no ETP was found to be constructed, the oil-water separator was not working, and the outcome of internal drainage was beyond the acceptable standards under the Environmental Protection Rules, 1997. Therefore, the power plant was imposed for the second time to pay BDT 20,00,000 (Twenty Lakhs taka only) along with directions to halt its activities till the construction of ETP was completed and the oil-water separator was operational. As of 2020, due to the non-fulfillment of the above conditions, the power plant is now completely shut down; hence the Halda River is free from Furnace Oil pollution.

4.6.14.3 The shutdown of Asian paper mills due to pollution

The Asian Paper Mills, located at Hathazari in Chittagong District, was established in 2004 in a densely populated area called Nandirhat. From this mill, around 25 tons of media paper and 15 tons of newspaper are produced daily from recycled papers. Approximately 450 cubic meters of liquid waste is generated daily from the said production activities. Since the establishment of the factory, the liquid waste and the resulting sludge mixed with the rainwater has been falling into the Halda River through the surrounding Chara and causing severe pollution to the river environment.

On 19th June 2018, the Halda River faced massive pollution aggression. From 20-21st June, many fish died in the beels of the river and its basin. In this context, the Halda River Protection Laboratory, in collaboration with the Department of Environment, Chittagong University Halda River Research Laboratory, and river specialists, tested water samples from different parts of Halda River, identified dead fish, and concluded Hathazari Peaking Power Plant and Asian Paper Mills as sources of river pollution. The Department of Environment has taken various steps, including imposing fines multiple times for polluting the water body, land, and Halda River without complying with the environmental clearance conditions. Notably, on 25th July 2013, it imposed compensation worth Taka 2,00,000 (Two Lakhs taka only) for causing severe damage to the environment and surroundings of Halda river. The Paper Mill was penalized on 03/03/2014 with Tk. 1,15,63,200 (One crore fifteen lakhs sixty-three thousand two hundred taka only) by the enforcement team of the environmental headquarters after finding on 25/02/2014 that untreated liquid wastes are discharged from the said mill to Halda river. In the same year, on

18th November of 2014, the mill was fined with Tk. 7,98,710 (Seven lakhs ninety-eight thousand seven hundred and ten taka only) by the Enforcement Team of the Department of Environment for polluting the river.

On 18th February 2016, the Department of Environment imposed Tk. 7,36,000 (Seven lakhs thirty-six thousand taka only), by Chittagong Metropolitan Office, for not using ETP and discharging the untreated wastes into the surrounding. In the same year, on 8th November, the mill was fined with Tk. 1,96,000 (One lakh ninety-six thousand taka only) for the same reason. Chittagong Laboratory tested the samples of refined liquid wastes and found the results beyond the acceptable standard. Therefore, on 28/05/2018, a compensation of Tk. 57600 (Fifty-seven thousand six hundred taka only 57,600) was imposed. A year later, on 10/06/2019, the Chittagong Metropolitan Office imposed a fine of Tk. 20,00,000 (Twenty lakhs taka only) for pollution due to environmental management errors.

Lastly, on 14/08/2019, during the spot inspection, Hathazari Upazila Nirbahi Officer reported that the factory was discharging the liquid wastes through bypass; hence on 18/08/2019, the Department of Environment ordered the factory to be closed and gave direction to develop environmental management of the factory. Since then, the factory has remained closed due to the factory authorities' inability to develop environmental management as per the directions of the Department of Environment. As a result, the pollution of the Halda River reduced to a great extent in 2020, proving that the closure of the Asian Paper Mill improves the environment of the Halda River, increases the number of fish eggs, and at the same time makes the living for the locals more liveable.

4.6.14.4 Taking effective measures to prevent the killing of brood fish

Many years back, carp fishes used to lay plenty of eggs here in the Halda river. In 1945, around 148,000 kg of eggs were collected, which reduced to 47,700 kg in 2001. Unfortunately, due to various human-made impediments, the productivity of the river decreased to such an extent that the brood fish did not lay any eggs in the year 2016 (only 735 kg sample eggs were found).

In this context, the government organization Palli Karma-Sahayak Foundation (PKSF), funded by the non-governmental organization Integrated Development Foundation (IDF), has come forward to conserve and develop the natural breeding ground of fish in the Halda River. Therefore, from 2015-2016, a project titled "Conservation and Development of Natural Breeding Fish in Halda River" was initiated by IDF.

To aid the Fisheries Department and the local administration to take appropriate measures to protect the brood fish of Halda and conserve its environment and biodiversity through law enforcement, under the said project, forty volunteers, one speed boat, one engine boat, and one solar boat is kept on both banks of the river (Hathazari and Raozan).

It is worth mentioning the cooperation of the local administration in protecting the Halda River for the last 2/3 years. Especially the Hathazari and Raozan Upazila administrations. The

Department of Environment in Chittagong has sincerely cooperated with them. The primary responsibility of the Fisheries Department is to protect the fish of Halda.

According to the Hathazari Upazila administration, from September 2018 to February 2021, they have seized 268 km long various nets only by conducting raids in the river, which is more than two and a half times the length of the entire Halda River. During that time, mobile court conducted 158 raids and destroyed 50 engine boats used for sand extraction, and seized 115,000 cubic feet of sand. In addition, the raids destroyed three-and-a-half kilometers of pipes used for sand extraction and seized five boats used for setting nets. Simultaneously, various individuals and organizations were fined (Tk. 1 lakh 66 thousand) by the mobile court, and three people were given one-month imprisonment.

Due to the sincere efforts of the local (Hathazari and Raozan) Upazila administration, the intentness of the Department of Fisheries and Environment, the cooperation of volunteers, and the logistical support of IDF-PKSF, a record amount of 25,536 kg of eggs were collected in 2020.

4.6.14.5 Activities of IDF and PKSF

Among the projects under implementation by the Palli Karma-Sahayak Foundation (PKSF) and the Integrated Development Foundation (IDF), a project titled "Conservation and Development of Natural Breeding Fish in Halda River" was initiated to aid the Fisheries Department and the local administration to take appropriate measures to protect the brood fish of Halda and conserve its environment and biodiversity through law enforcement. Under the said project, forty volunteers, one speed boat, one engine boat, and one solar boat are kept on both river banks (Hathazari and Raozan).

In 2018, about 1800 kg of fish (Rui, Katla, Mrigel, and Kalibaus) were released in the Halda River near Sarta Ghat to increase the number of brood fish. Concurrently, an awareness campaign was carried out under this project to make the riverside schools' and madrasas' students aware of the importance of the Halda river. Furthermore, awareness activities are being conducted with the imams of the mosques located on both banks of the river to make the people aware of the importance of the Halda River and the government's instructions to protect the river and warn the people to stop fishing.

Since the beginning of the project, it has been working on developing earthen wells used for the local production of hatchlings from eggs. Since 2017, materials and financial assistance have been provided to 157 hatchling producers, who use earthen wells on both sides of Halda.

In addition, the Halda River Research Lab (the only single river-based laboratory in Bangladesh) has been set up at the University of Chittagong to conduct research on the Halda River. Fish poacher's school-going children have been given education assistance through scholarships. Initially, 50 children of fishers from both the banks of the river were selected and give scholarships. The number of hatcheries is less than the number of egg collectors on both banks of

the Halda River. Therefore, the work of setting up a complete hatchery with modern facilities is now at the final stage where egg collectors can use it to hatch eggs and produce brood fish.

4.6.14.6 River police activities and installation of CCTV cameras

A special team of Bangladesh Police River Police has installed high-powered close circuit (CC) cameras in the Halda River to protect this natural fish breeding ground and its brood fishes, endangered dolphins and stop illegal sand extraction. A temporary outpost has been set up on the banks of Halda by the naval police. As a result, for the first time in the country, a river is being monitored by CCTV cameras to protect its biodiversity. Six high-powered cameras have been set up to monitor the area from Madunaghat to Amtua. As a result, an area of about six kilometers of the river has come under constant surveillance.

There are several benefits to installing these cameras. First, the river can be monitored from any place, even during nighttime, to see if someone is setting a net in the river, extracting sand, killing dolphins, or doing something illegal. Second, this monitoring will create fear amongst the fish poachers and those who extract sand.

The declaration of Halda River as 'Bangabandhu Fisheries Heritage' is a unique example of river protection in Bangladesh. The river will get special status and importance as a result of such declaration. Initiatives for the conservation and management of this river (Bangabandhu Fisheries Heritage) can become a national river protection and management model in Bangladesh. The local people (volunteers), NGOs, administration, and technology will play an effective role in conserving biodiversity, including brood fish and dolphins, in the Halda River. It will help bring back the life of other dying rivers of Bangladesh. By protecting the rivers of our beautiful country, Bangladesh will go ahead to achieve the targets of SDG 2030, Vision 2041, and Delta Plan 2100.

4.7 Halda Gazettes: Requires some corrections

4.7.1 Gazette, 2007

The Government of Bangladesh first published a gazette on 02 July 2007 on the conservation and management of the Halda River. About 20 km from Sattarghat to Madhunaghat was declared as a fish sanctuary in the gazette, banning fishing in that area from January to December. Similarly, fishing has also been banned in about 40 km ranging from Nazirhat to Kalurghat, in Hathazari, Raozan and Boalkhali areas from February to July. Besides, fishing in the branch canals or tributaries of Halda, namely Sarta, Boalia, Chengkhali, Sonai, Kagotia, Porakopali, Domkhali, Mugdhai, Kumar Khali, Barighona, Madari, Boijjakhali, Katakhali, Khandakia, Krishnakhali and Sakarda, have been prohibited from February to July. Furthermore, fishing in Karnaphuli, Sikalbaha, Chandkhali and Sangu rivers adjacent to Halda has been banned from March to July. Moreover, according to the gazette, during the spawning period, i.e. from March to June, engine and machine-driven boats have been banned.

4.7.2 Gazette, 2010

Subsequently, on 12 August 2010, the gazette was further amended at the demand of the locals residing near the banks of Halda. In the revised gazette, the fish sanctuary area was increased from 20 km to 40 km. According to the latest data, the area from Nazirhat to Kalurghat has been declared as a fish sanctuary. Dhurang canal has been newly added to the list of tributaries where fishing has been banned from February to July. No new changes were made to the directions regarding the rivers adjoining Halda. However, the time has been extended from March to July (previously, March to June) regarding banning the engine and machine-powered vessels in Halda.

4.7.3 Gazette, 2020

The third gazette on the Halda River was published on 21 December 2020. According to the Gazette, Ramgarh and Manikchhari Upazilas of Khagrachhari district, Fatikchhari, Raozan, Hathazari Upazilas of Chittagong district, and 23,422.28059 acres of land along the Halda's riverbank (93,612 plots) have been declared as 'Bangabandhu Fisheries Heritage'. Declaration of Halda as Bangabandhu Fisheries Heritage has fulfilled the long-awaited demand of the people. However, this gazette also needs some amendments.

4.7.3.1 Corrections required

The gazette, 2020 - published by the Ministry of Fisheries and Animal Resources on Bangabandhu Fisheries Heritage (33.00.0000.127.23) requires ammendments (Kibria, 2021c).

1. In the 1st and 2nd paragraph of the first page of the gazette, next to the term carp fish, *Rui, Katla, Mrigel, Kalibaus* is necessary to be mentioned without which the identity of the species of fish in the river Halda remains unclear.

2. In the 2nd and 3rd paragraphs (points 2 and 3) of the first page of the gazette, instead of the Panchlaish police station, it will be Chandgaon police station, since the Halda river basin is not adjacent to Panchlaish.

3. On the 2nd page of the gazette, the term Panchlaish mentioned in J.L. plot number list (point number 6) needs to be replaced with Chandgaon.

4. Terms mentioned in point number 4 on the 2nd page of the gazette:

i. (B) and (D) can be merged to state 'Activities that are harmful and destructive to the habitat of fish and dolphins, as well as other aquatic animals and plants must be prohibited'.

ii. (E) maybe amended and written as '"Liquid and solid wastes generated from house-holds, industrial establishments, poultry farms and other establishments around Halda river and its tributaries cannot be discharged into the river."

iii. (F) can be amended to include 'Under no circumstances, the shape of river be changed by cutting its bend or it bank.'

iv. (G) Instead of 17 tributaries of the Halda river, it will be 24 tributaries, and it is requested to add the list of these 24 canals with the gazette. (List of canals in table 29).

v. (H) and (K) can be combined and written as 'New structures, such as sluice gate, rubber dam, concrete dam etc., that obstructs the normal flow of water in Halda River and canals connected to it, cannot be constructed. However, subject to the permission of the Heritage Committee, the existing sluice gates can be renovated in an environment and fish friendly.'

vi. (J) provides that research can be done on Halda River subject to the permission of the Bangabandhu Fisheries Heritage Supervision Committee. Such permission is unnecessary; rather, research should be encouraged. However, permission may be sought for research by a foreign company.

vii. Changing the term provided in (L) can be written as 'Engine driven heavy vessels (sand and cargo boats and dredgers, etc.) will not be allowed to operate from Karnafuli estuary of Halda River to Nazirhat throughout the year.'

5. Inclusion of the following conditions in the gazette is crucial -

(A) Lease of Balumahal of Halda River and its tributaries should be cancelled, and it should be prohibited to extract sand in a harmful manner with a dredger.

(B) There can be no tobacco cultivation in the river basin.

(C) Lethal pesticides cannot be used on agricultural lands in river basin areas.

(D) No brickfield may be set up in the area (at a defined distance) adjacent to the river bank.

It is requested to add the following list of 24 tributaries as the breeding ground for brood fish in Halda river (i,e, the canals where fish are caught) in the terms of 4 (G) of the gazette.

Table 29: List of canals to be added

Sl. No.	Name of canals	GPS Location	Upazila
1	Dhurong	22°40.37'N 91°46.28'E	Fatikchari
2	Mondakini	22°38.17'N 91°47.20'E	Fatikchari
3	Telparoi	22°32.59'N 91°50.41'E	Fatikchari/Raozan
4	Sorta	22°32.98'N 91°50.69'E	Raozan
5	Boalia	22°30.57'N 91°50.30'E	Hathazari
6	Chengkhali	22°30.11'N 91°51.07'E	Hathazari
7	Gocchhakhali	22°32.02'N 91°51.13'E	Hathazari
8	Shonair mukh	22°30.07'N 91°52.19'E	Raozan

Sl. No.	Name of canals	GPS Location	Upazila
9	Pataijjar tek (Old Halda)	22°29.46'N 91°52.25'E	Hathazari
10	Kagotia	22°29.38'N 91°52.40'E	Raozan
11	Porakopali	22°29.26'N 91°52.41'E	Hathazari
12	Domkhali	22°29.00'N 91°53.01'E	Raozan
13	Dulakhali	22°28.55'N 91°52.50'E	Hathazari
14	Mogdai	22°28.09'N 91°52.44'E	Raozan
15	Kumarkhali	22°28.03'N 91°51.23'E	Hathazari
16	Barighona (Old Halda)	22°27.49'N 91°51.23'E	Raozan/Hathazari
17	Khalifarghona (Old Halda)	22°27.36'N 91°51.31'E	Raozan/Hathazari
18	Madari	22°28.09'N 91°52.35'E	Hathazari
19	Boijja	22°26.25'N 91°52.08'E	Raozan
20	Katakhali	22°28.35'N 91°51.34'E	Hathazari
21	Khandakia	22°27.90'N 91°51.30'E	Hathazari
22	Krishnokhali	22°25.72'N 91°52.81'E	Hathazari
23	Sakorda	22°25.14'N 91°53.14'E	Raozan
24	Kachukhain	22°24.46'N 91°53.26'E	Raozan

4.8 Halda Management committees

A number of committees has been formed so far for management and conservation of Halda and its resources.

4.8.1 Committee formed in the Prime Minister's Office

A committee was constituted consisting of 19 (nineteen) members to maintain the genetic purity and preserve the natural breeding ground of carp fishes with distinct features under memorandum no. (33.00.0000.127.34.001.15.343) on 06-10-2015 under the leadership of the Chief Secretary in the Prime Minister's Office to coordinate the activities of various organizations related to Halda River.

The scope of work of the committee was as follows:

1. To increase the flow and speed of freshwater from the source of the Halda river till the junction of the Karnaphuli River without any hindrance;

2. To take necessary steps to increase the water holding capacity of the canals adjacent to the natural fish breeding ground of the carp fishes of Halda River;

3. To reduce the risk of salinity in the Halda River due to climate change. To ensure continuous discharge of water from Kaptai Hydroelectric Power Station to Karnaphuli River during the dry season so that sea salt water cannot enter Karnaphuli;

4. Arrangement of sluice gates at the entrance of 12 canals connected to the Halda river breeding ground as per the survey report by BFRI;

5. To make necessary arrangements for the restoration of the Garduara bend in Garduara of the Halda River and to keep the other bends unimpaired;

6. To find an alternative source of fresh water by Chattogram WASA without constructing any other structure for withdrawing water from the Halda River.

7. To ensure free and safe movement of brood fish in breeding grounds and simultaneously to increase the number of brood fish.

8. To prevent deforestation and to commence an afforestation program to avoid soil erosion in the hills and hilly lands at the source of the river;

9. To utilize the use of the river banks by planting sustainable indigenous trees enclosures and to ensure its proper maintenance;

10. To provide facilities for fish farming by digging up ponds in the bare lands on the banks of the river as an alternative source of income for the fishermen affected because of the declaration of the Halda River as a fish sanctuary and to provide incentives to improve the quality of their lives;

11. To take necessary measures to prevent the declining number of egg collectors;

12. To make arrangements for the construction of roads on both sides of the Halda river through LGED to stop navigation of engine-driven boats on the river;

13. To take necessary measures to prevent river pollution from protecting the biodiversity and fish habitat of the Halda river;

14. To stop the extraction of sand from the breeding ground of the Halda river;

15. To take measures to keep the migration route of brood fish in the Halda River uninterrupted during the breeding season;

16. Take steps to control the use of pesticides on agricultural land along the Halda Riverbank;

17. Other relevant issues.

The committee arranged two meetings. Chief Secretary, Md. Abul Kalam Azad chaired the first meeting, and the second meeting was chaired by Director General (Administration) Kabir Bin Anwar. Principal decisions taken in the discussion are mentioned below.

The meeting was held on 21.08.2014 at 11:00 am in the meeting room (second floor) of the Prime Minister's Office under the chairmanship of Director General (Administration) Kabir bin Anwar on various issues related to fish breeding in the Halda River. The following decision was taken after a detailed discussion in the meeting to overcome the human-made obstacles in the natural fish breeding ground of the Halda River (table 30 and table 31):

Table 30: Principal decisions taken in the discussion (meeting 1) by committee formed in Prime Minister's office

Serial no.	Decisions	Implementing Ministry/Department/Directorate/Organization
1.	The Department of Environment may be requested to take steps to declare the 83 km area of Halda River originating from Badnatali Hill of Ramgarh Upazila of Khagrachhari District and ending at Karnaphuli estuary as **Ecological Critical Area;**	The Department of Environment
2.	A team of local government, and the Ministry of Agriculture, Fisheries and Livestock, led by the Ministry of Environment and Forests, should be formed to study the environmental impact of the Sluice Gate and the rubber dam, especially on the disruption of the normal flow of the river;	Ministry of Environment and Forest, and related ministries
3.	LGED can arrange road construction on both banks of the Halda River;	Local Government Engineering Department
4.	The Water Development Board will have to take steps to re-excavate 18 canals connected to the Halda River;	Water Development Board
5.	To keep the required number of people to guard the river under the Department of Fisheries' proposed project and to involve the Ministry of Forests for afforestation at the source of the Halda River.	Ministry of Fisheries and Livestock
6.	Steps should be taken for afforestation at the source of Halda River to increase water flow:	Ministry of Environment and Forest, and Forest Department
7.	To take necessary action against illegal sand extractors by preparing a list of dredger owners;	Ministry of Fisheries and Livestock, and Ministry of Environment and Forest
8.	A list of industries located on the banks of the river should be prepared. Necessary steps have to be taken to	Department of Environment

Serial no.	Decisions	Implementing Ministry/Department/Directorate/Organization
	prevent these industries from polluting the river;	
9.	The area of khas land along the river should be determined and examined to see if it can be distributed among the fishing families;	Ministry of Fisheries and Livestock, and concerned Deputy Commissioner
10.	Reservoirs created as a result of loop cutting should be allocated to fishing families on a cooperative basis;	Ministry of Fisheries and Livestock
11.	Rehabilitate fishermen through aquaculture and cage culture by providing group loans;	Ministry of Fisheries and Livestock
12.	A list of brickfields should be made to take necessary measures to solve the environmental problems arising from such fields;	Ministry of Fisheries and Livestock, and Department of Environment
13.	By maintaining the time and rules, the rubber dams should be managed, so that river water flow and fish breeding are not disrupted, and whether the constructed rubber dams are required or not should be verified;	Ministry of Fisheries and Livestock, and Ministry of Water Resources
14.	In the present situation, it is necessary to take necessary action after studying the possible impact of the withdrawal of 90 million liters of water from Halda river by WASA;	Ministry of Fisheries and Livestock, Ministry of Water Resources, and WASA (Chattogram)
15.	The Kaptai Hydroelectric Dam Authority may be requested to check whether water can be discharged from the Kaptai Dam as per requirement during high tide to prevent salinity;	Power Division, BWDB, Power Development Board, and Ministry of Fisheries and Livestock
16.	If the Ministry of Fisheries and Livestock does not have the necessary funds to protect the Halda River, it can use the money from Bangladesh Climate Change	Ministry of Fisheries and Livestock, and Ministry of Environment and Forest

Serial no.	Decisions	Implementing Ministry/Department/Directorate/Organization
	Trust Fund if it is needed to take steps to protect the river;	
17.	PDB should be requested to take necessary actions to ensure that the wastes from the Hathazari power plant do not contaminate the river water;	Ministry of Fisheries and Livestock, and Department of Environment
18.	Initiatives should be taken to identify more natural fish breeding areas in the country using modern technology.	Ministry of Fisheries and Livestock

Table 31: Principal decisions taken in the discussion (meeting 2) by committee formed in Prime Minister's office

Serial No.	Subject	Decision	Implementing authority
1	Increasing the flow and speed of fresh water in Halda River:	1.1 In Bhujpur area of Fatikchhari Upazila, it is necessary to ensure that the maximum height of the rubber dam installed in the mainstream of the river is 2.50 meters to increase water flow in Halda River. 1.2 In addition, the Department of Agricultural Extension / Bangladesh Agriculture Development Corporation will look into the possibility of installing deep tube wells for irrigation as an alternative from November to May. 1.3 The Ministry of Agriculture	Ministry of Agriculture / Department of Agricultural Extension / Bangladesh Agriculture Development Corporation, Department of Fisheries, and Deputy Commissioner of Chattogram

Serial No.	Subject	Decision	Implementing authority
		will take the initiative to reduce the use of chemical fertilizers and pesticides in the land without disrupting agricultural production.	
2	Increasing water holding capacity in canals adjacent to Halda River:	2.1 The decision will be taken after the submission of the final report by a survey team comprising of water engineers, hydrologists, ecologists, agronomists, fisheries experts, irrigation experts, sociologists, and economists under the supervision of Prof. Dr. Ainun Nishat led by Dr. Umme Kulsum Novera (Lecturer of Department of Water Resources Strategy of BUET).	Ministry of Fisheries and Livestock
3	Reducing the risk of salinity in the Halda River:	3.1 At least 2 turbines of Kaptai Hydro Power Station should be kept running nonstop from November to May every year.	Power Division/ Bangladesh Power Development Board
4	Removal of unused sluice gates / making necessary repairs to make it fish friendly:	4.1 The decision will be taken after the survey team submits the final report under the supervision of Prof. Dr. Ainun Nishat.	Ministry of Fisheries and Livestock
5	Making necessary arrangements for the recovery of Garduara bend	5.1 Bangladesh Water Development Board will prepare a plan for rehabilitation of Garduara bend and submit it within the next 07 (seven) days. Deputy Commissioner of Chattogram will provide	Ministry of Water Resources / Bangladesh Water Development Board and Deputy Commissioner of Chattogram

Serial No.	Subject	Decision	Implementing authority
		necessary assistance in this regard.	
6	Avoiding any new construction by Chattogram WASA to extract water from the Halda River	6.1 Chattogram WASA will share the study report with the Department of Fisheries.	Local Government Department / WASA (Chattogram) and Department of Fisheries
7	Ensuring free and safe movement of brood fish in the breeding ground:	7.1 Roads will be constructed by LGED on both sides of the Halda river to facilitate public movement. 7.2 Deputy Commissioner, Chattogram will take necessary steps to stop Boat Race (Nouka Baich) on the Halda river.	Local Government Department / Local Government Engineering Department and Deputy Commissioner of Chattogram
8	Prevention of deforestation in the hills of Ramgarh and Manikchhari in Khagrachhari district, and initiating afforestation at the source of Halda River:	8.1 The Forest Department will take the initiative of afforestation at the source of Halda River in Ramgarh and Manikchhari hills in the Khagrachhari district. Moreover, the department will take necessary measures to prevent deforestation.	Ministry of Environment and Forests / Forest Department
9	Afforestation on both sides of Halda River:	9.1 After the construction of roads by LGED on both sides of Halda River, the Forest Department will commence with the afforestation.	Ministry of Environment and Forest / Forest Department
10	Increasing support for alternative income	10.1 The Department of Fisheries will commence the	Department of Fisheries

Serial No.	Subject	Decision	Implementing authority
	generation and digging ponds on khas lands along river banks:	project to increase the alternative income of the fishermen.	
11	Take necessary steps to prevent the declining number of egg collectors:	11.1 The Department of Fisheries will take necessary steps to motivate the new generation to procure fish eggs and hatchlings.	Department of Fisheries
12	Constructing roads on both sides of the Halda river by LGED:	12.1 The Department of Local Government Engineering will take necessary steps to construct roads on both sides of the Halda River to facilitate public movement.	Local Government Engineering Department
13	Taking measures to prevent river pollution:	13.1 Drainage of peaking power plant should be closed within 01 (one) month. 13.2 Necessary steps should be taken to keep the ETP of Asian Paper Mills running continuously. 13.3 Karnaphuli Paper Mills Limited will formulate a plan to set up ETP within the next 01 (one) month. 13.4 To make a list of all the mills located on both sides of the river, polluting the water from the junction of Halda and Karnaphuli River till the upstream as far as the tidal water enters and to take legal action	Power Division / Bangladesh Water Development Board, Ministry of Environment and Forest / Department of Environment, and Ministry of Industries / Karnaphuli Paper Mills Limited

Serial No.	Subject	Decision	Implementing authority
		against them.	
14	Stopping unplanned sand extraction from Halda River's fish breeding grounds:	14.1 Deputy Commissioner of Chattogram will take necessary steps to stop sand extraction.	Deputy Commissioner of Chattogram
15	Measures to keep the migration route of the brood fish in the Halda River uninterrupted:	15.1 The decision will be taken after submitting the final report by the survey team under the supervision of Prof. Dr. Ainun Nishat.	Ministry of Fisheries and Livestock
16	Controlling the use of pesticides on agricultural land along the Halda River:	16.1 The Department of Agricultural Extension will take necessary steps to control pesticide usage in the agricultural lands along the Halda river.	Ministry of Agriculture / Department of Agricultural Extension
17	Miscellaneous discussion:	17.1 Director General of Bangladesh Fisheries Research Institute, a representative from the Department of Zoology, Chittagong University, and Project Director of Impact Assessment of Upstream Water Withdrawal to Conserved Natural Breeding Habitat Major Carps in the River Halda Project, will be included in the committee. 17.2 Decision regarding the new installation of a rubber dam on the Halda River and disallowing cutting the loop will be taken after receiving the final report of the survey team formed under	Ministry of Fisheries and Livestock

Serial No.	Subject	Decision	Implementing authority
		the supervision of Prof. Dr. Ainun Nishat.	

4.8.2 Committee formed by the Ministry of Environment and Forest chaired by the Chittagong Divisional Commissioner

The Ministry of Environment and Forest has summoned the Divisional Commissioner of Chittagong Division on 17-09-2015 under the Memorandum No. 22.00.0000.073.13.005.2015 to form a committee to protect the unique features of the Halda River, to preserve the ecosystem of carp fish breeding grounds, and primarily to keep the water flow unaffected and to prevent river water pollution.

Following were the scope of work of the committee:

1. To make recommendations for the conservation of the environment of the Halda River and its surroundings, and to monitor the progress of their implementation;

2. In case the surroundings of the Halda River is damaged due to natural and environmental factors, the committee shall immediately inform the government on the matter and take necessary steps to resolve the arising problems and make recommendations to the government;

3. The committee will coordinate with all the initiatives taken by the concerned departments in conserving the environment and biodiversity of the Halda River;

4. The Committee may impose restrictions on the development projects or installation activities on the banks of the Halda River or may send recommendations to the Ministry of Environment and Forest if the implementation of development projects or establishment of industrial establishments by government/non-government organizations imposes a threat to Halda River or its surroundings;

5. If the Halda River is declared as Environmentally Critical Area (ECA) by the government, the committee will have the power to oversee the imposed restrictions;

6. The committee will hold meetings every three months. However, may call a meeting at any time in case of emergency;

7. The committee will be able to co-opt any appropriate person/institution if necessary. The following important decisions were taken in the exchange meeting on declaring Halda River as an Environmentally Critical Area (ECA), held on 29/06/2015 under the chairmanship of Md. Raisul Alam Mandal (Director General, Department of Environment).

Table 32: Meeting decisions from the committee formed by the Ministry of Environment and Forest

Serial no.	Recommended activities	Implementing Authority

Serial no.	Recommended activities	Implementing Authority
1	To declare Halda River as ECA, a proposal regarding the proper management has to be made following the Environmental Conservation Act, 1995 (amended in 2010) and Bangladesh Water Act 2013 and as per the recommendations of the meeting. The proposal then needs to be sent to the Ministry of Environment and Forest.	Department of Environment
2	Environmental considerations must be taken into account while constructing rubber dams, concrete dams, and Sluice gates that obstruct the flow of water in the Halda River. The sluice gates and rubber dams currently unused must be identified and opened or removed or made necessary repairs in case of emergency.	Bangladesh Water Development Board
3	In the case of water extraction from Halda, the project should be implemented after reviewing the total volume of water and the amount of water to be extracted.	WASA, Chattogram
4	Water should be retained during the monsoon season and used in a planned manner during the dry season.	Bangladesh Water Development Board
5	Water flow needs to be increased by removing those which obstruct the flow of water.	Bangladesh Water Development Board
6	An effective Sewage Treatment Plant (STP) needs to be set up to protect Halda from the liquid wastes discharged from Chittagong city.	WASA, Chattogram
7	Experts must do research on the fish breeding ground of Halda River.	Department of Fisheries, WASA (Chattogram), and Bangladesh Fisheries Research Institute
8	Research should be done to analyze the quality of water in Halda River, to know in what kind of water quality the fish lay eggs and to maintain such quality.	Department of Fisheries

Serial no.	Recommended activities	Implementing Authority
9	Afforestation work needs to be initiated along the 83 km long river bank of Halda, starting from the river source at Badnatali hill in Ramgarh Upazila of Khagrachhari district ending at the estuary of Karnaphuli river. Indigenous trees should be planted alongside the river, which will prevent soil erosion and provide food for the fish.	Forest Department
10	Care should be taken to prevent catching brood fish at the junction of all the rivers/tributaries connected with the Halda River.	Department of Fisheries, Police administration, and Local Upazila administration
11	The cutting of bend in the Halda River has to be stopped.	Bangladesh Water Development Board, Department of Fisheries, Police Administration, Local Upazila Administration
12	The use of prohibited current nets must be stopped.	Department of Fisheries and Police administration
13	Fishermen need to be provided with alternative employment.	Department of Fisheries
14	The navigability of Halda river should be maintained, and sand extraction should be stopped.	Bangladesh Inland Water Transport Authority (BIWTA), Bangladesh Water Development Board
15	The action plan needs to be adopted for the proper management of Halda River pollution.	District and Upazila administration
16	Impact Assessment on the kind of damage being done to Halda River's environment and its surrounding environment due to unplanned extraction of sand from Halda River must be made. If necessary, sand extraction should be stopped.	Department of Environment
17	Experts must be involved in the environmental protection activities of the Halda river.	Department of Environment

Serial no.	Recommended activities	Implementing Authority
18	To take action against those who are discharging liquid waste, in accordance with the Environmental Conservation Act, 1995 and the Environmental Conservation Rules, 1997.	Department of Environment
19	Take legal action to stop encroachment and dredging.	BIWTA, Bangladesh Water Development Board, Police administration, Concerned District administration, and Upazila Nirbahi Officer
20	To work with everyone to increase public awareness to prevent river pollution and the killing of brood fish.	Department of Environment, Halda River Rakkha Committee, and concerned District and Upazila administration
21	Committees should be formed at the district, Upazila, and union level to conserve the Halda river.	Department of Environment
22	A committee may be formed (as mentioned below) headed by the Divisional Commissioner to preserve Halda River's environment and biodiversity consisting of the representatives of the concerned departments, universities, journalists, and civil society.	Ministry of Environment and Forest, Forest Department

4.8.3 Committee formed to formulate an action plan for the protection of Halda

In the workshop on “Impact Assessment of Upstream Water Withdrawal to Conserve Natural Breeding Habitat of Major Carps in the River Halda Project” held at CIRDAP Auditorium on 03-12-2016, a committee was constituted under the chairmanship of Additional Secretary, Ministry of Fisheries and Livestock, to prepare an action plan and implement the recommendations adopted in the workshop. The scope of work of the committee was as follows-

a. Prepare an action plan according to the priority list by identifying short-term, medium-term, and long-term among the recommendations adopted in the workshop.

b. The committee was requested to prepare a report within the next 07 (seven) working days and submit it to the Ministry of Fisheries and Livestock.

4.8.4 Post-mortem committee to determine the cause of death of dolphins

A committee was formed under the leadership of Dr. Masud Hossain Khan, Chief Scientific Officer of Chandpur BFRI River Center, to unravel the cause of death of many dolphins in 2018 under memorandum no. 33.00.0000.003.07.53.

The scope of work of the committee was as follows-

a. Post-mortem of dolphins preserved in the Department of Zoology, University of Chittagong;

b. Determining the cause of death of dolphins and making recommendations;

c. The committee might co-opt any officer if necessary;

d. The committee sent a report to the Ministry of fisheries and livestock by 15-03-2018.

4.8.5 Ministry of Fisheries and Livestock, Taskforce

To coordinate the activities undertaken to protect the Halda River, a Task Force was constituted under Memorandum No. 33.00.0000.127.22.003.07-98 on 26 March 2018, chaired by the Secretary of Ministry of Fisheries and Livestock.

The scope of work of the committee was as follows:

a. Review and coordinate the progress of implementation of the action plan prepared on Halda River by the concerned department/agency;

b. Review of the activities and progress of the committee formed by the Prime Minister's Office led by the Divisional Commissioner of Chittagong to implement the field level activities;

c. Take necessary steps to protect the Halda River and solve the issues that have arisen and make recommendations to the government, if it deems necessary;

d. At least two meetings of the committee will be held yearly and

e. The committee members can co-opt other members if necessary.

The following decision was taken at a meeting of the Task Force held on 27/05/2018 under the chairmanship of the Secretary of the Ministry of Fisheries and Livestock Md. Raisul Alam Mandal.

At the end of the detailed discussion, the following decisions were taken:

1) To ensure regular activities of mobile courts and operations under the Fisheries Protection and Conservation Act, 1950;

2) The legal measures taken to control and ban of engine driven vessels, and termination of the lease of sand quarry in the Halda River should be maintained.

3) The Ministry of Fisheries and Livestock will take steps to issue rules and notifications so that the concerned departments/agencies, irrespective of government and the non-government organization works in coordination at the field level for the protection of the Halda river;

4) The Deputy Commissioner of Chittagong and Khagrachhari will take necessary measures to stop the construction of brickfields, prevent tobacco cultivation, and initiate tea plantation on both sides of the river banks;

5) Alternative livelihood arrangements should be made for the affected fishing community in the catchment area of the Halda River.

6) To protect the Halda River from pollution and preserve the natural breeding grounds, the Divisional Commissioner will take necessary steps in consultation with Chittagong City Corporation, Chittagong Development Authority and WASA. The Ministry of Fisheries and Livestock will assist in this regard.

4.8.6 Committee constituted by the Ministry of Fisheries and Livestock under the chairmanship of Chittagong Divisional Commissioner

A task force was constituted by the Ministry of Fisheries and Livestock under the leadership of the Chittagong Divisional Commissioner on 10-07-2018 under memorandum no. 33.02.0000.121.004.18.55 to coordinate the activities undertaken for the protection of the Halda River. The existing committee headed by the Divisional Commissioner will work in coordination with the newly formed committee. In addition -

a. Letters should be given to the concerned Ministries / Departments to take steps to prevent their subordinate bodies/institutions from polluting the river;

b. The concerned Ministry / Division will send a report to the Prime Minister's Office after conducting spot surveys of the effectiveness of all sluice gates and rubber dams;

c. Halda River and a specific area surrounding it must be declared as ECA at once;

d. The Halda River has to be declared as a unique river with a special distinctive feature. The Ministry of Environment and Forests will take steps in this regard;

e. The concerned Ministry will examine their involvement in the action plan and take action accordingly;

f. The next meeting will be held at the local level;

g. The locals and the media need to be involved.

4.8.7. Committee formed by Chittagong Development Authority

The Chairman and General Secretary of the Halda River Protection Committee issued a letter regarding changing the drainage system of Ananya residential area, installing STP, and re-excavating Bamanshahi canal to prevent pollution of Halda River. On receiving the letter, a committee of 8 members was constituted on 11/07/2018 based on memorandum no. 'PD / Halda / Letter / 69/10 /' by convening Mr. Jasim Uddin Shah, Board Member of CDA to give a full report. The committee thereafter inspected the area and provided a report.

4.8.8 Committee formed to determine the number of eggs and fish fries of Halda River

Given the memorandum No. 33.02.0000.121.18.004.18.55 of the Department of Fisheries for determining the number of fish eggs and fish fries in the Halda River, at the first meeting of the task force constituted by the Ministry of Fisheries and Livestock, some decisions were taken after reviewing the progress of implementation by the concerned ministries, departments and agencies as per the action plan prepared on Halda River.

As per the decision of the meeting, the Deputy Director, Divisional Fisheries Department, Chittagong Division, Comilla was convened on 10 September 2018 to determine the number of fish eggs and fish fries of Halda River; a committee was formed under the memorandum no. 33.00.0000.127.22.006.18.200. The scope of work of the committee was as follows-

a. To determine the number of fish eggs and fish fries in the Halda River and submit it to the Ministry of Fisheries and Livestock;

b. Publicity through various means after the approval of the Ministry;

c. Record the number of fish eggs and fish fries in the Halda River and take steps for long term preservation;

d. To provide advice in advance to public and private hatcheries on proper production and nursing of eggs and fish fries collected from Halda;

e. The committee will submit to the director of Department of Fisheries (Ramna, Dhaka).

f. The order is issued with the approval of the appropriate authorities.

Two committees were formed to supervise and implement decisions in Bangabandhu Fisheries Heritage.

4.8.9 Bangabandhu Fisheries Heritage Supervision Committee

On the celebration of the birth centenary of Father of the Nation Bangabandhu Sheikh Mujibur Rahman, the Bangladesh Fisheries Research Institute under the Ministry of Fisheries and Livestock has been tasked by the National Implementation Committee to declare the Halda River, a natural breeding ground for carp fish, a 'Bangabandhu Fisheries Heritage'. Accordingly,

the Bangabandhu Fisheries Heritage Supervision Committee was constituted under the chairmanship of the Chittagong Divisional Commissioner on 22-10-2020 with the approval of Memorandum No. 33.00.0000.127.23.001.20.289 in the Cabinet Division. The scope of work of the committee is as follows-

a. Coordination between the departments concerned with the conservation and protection of biodiversity of the Halda River.

b. Selecting a site for construction of an obelisk on the banks of the Halda River

c. Providing necessary instructions to the district committee from time to time.

d. The committee may co-opt one or more members as it deems necessary.

4.8.10 Bangabandhu Fisheries Heritage Implementation Committee

On the celebration of the birth centenary of Father of the Nation Bangabandhu Sheikh Mujibur Rahman, the Bangladesh Fisheries Research Institute under the Ministry of Fisheries and Livestock has been tasked by the National Implementation Committee to declare the Halda River, a natural breeding ground for carp fish, a 'Bangabandhu Fisheries Heritage.' Accordingly, Bangabandhu Fisheries Heritage Implementation Committee was formed under the chairmanship of Chittagong Deputy Commissioner on 03-11-2020 with the approval of Memorandum No. 33.00.0000.127.23.001.20.287 in the Cabinet Division. The scope of work of the committee is as follows-

a. Marking and demolishing the illegal establishments along the river.

b. Put an end to sand extraction.

c. Stopping the use of the engine-driven boat.

d. Prevention of all kinds of pollution, including industrial waste in the Halda River.

e. Conservation of fish eggs, fish fry, and prevention of illegal fishing of brood fish in Halda River.

f. Conservation of biodiversity of Halda River and its surrounding areas.

g. Assisting in the implementation of the Fisheries Conservation Act, 1950.

h. The committee may co-opt one or more members as it deems necessary.

4.8.11 Committee comprising of Chittagong Asian Paper Mills (Pvt.) Ltd. constituted by the Department of Environment

Department of Environment has shut down the Chittagong Asian Paper Mills (Pvt.) Ltd. in Hathazari of Chittagong, on 18/08/2019 for polluting Halda River. A committee was formed to investigate whether it will be appropriate for the Chittagong Asian Paper Mills (Pvt.) Ltd. to re-open, which was shut down due to river pollution, and whether the factory authorities have taken appropriate actions as to such re-opening (i.e., adequate and effective measures to control

pollution). The committee consists of 08 (eight) members chaired by Director (NRM), Department of Environment, Dhaka, constituted on 15-12-2020 based on memorandum No. 22.02.0000.056.04.124.14.281. The committee inspected the factory and provided a report.

But to the knowledge no integrated heritage committee has been suggested for sustenance of the Halda. The committee must be consisted of the representatives from Halda River bank people, local administrative bodies, researcher and academicians, media people, law enforcing agencies, representative from both government and non-government organizations already involved with Halda.

4.9 Halda River Research Laboratory (HRRL)

4.9.1 Establishment of Halda River Research Laboratory (HRRL)

Halda River Research Laboratory (HRRL) has been established in 20th August, 2017 under PKSF-IDF project where researchers work on the conservation of Halda issues.

4.9.2 The physical infrastructure of Halda research lab with project funding

The project has supported the establishment of HRRL by providing interior designing and construction with all furnishings, and lab Inauguration with a range of equipment including BOD incubator and analyzer, BOD nutrient buffer pillows, Digital reactor block, Single block, Programmable Spectrophotometer, COD vials - HIGH and LOW range, Ekman dredge, pH probe, precision (3-digit) balance, Underwater camera, Ethyl alcohol and specimen jar, Garmin map GPS, Digital echo sounder, Multi parameter portable water quality meters, Turbidity meter, Deep fridge, Air conditioner for the Lab, Glassware for the lab.

4.9.3 List of research conducted by HRRL

HRRL has been active in Halda related research projects since its inception with routine support from the project through IDF and other sources. The completed and ongoing research footprint of HRRL included:

- Whole-genome sequencing of Indian Major Carps from Halda river and their genome annotation to explore genetic variations
- Status and diversity of zooplankton in Halda during the breeding season (April to June)
- Abundance and biodiversity of benthos in the Halda river during the breeding season
- Assessment of water quality variations (pH, DO, salinity, BOD, COD, turbidity, conductivity and TDS) in Halda river in high tide and low tide during the breeding season (April to June)

- Investigation into non-carp organisms collected along with carps eggs from Halda
- Development of collection and counting methods of carps' eggs and fry from Halda
- Identification of breeding spots of Halda river
- Assessment of species diversity of *Trichodina ciliates* from freshwater fishes of Meghna river, Salimgonj, Nabinagar, Brahmanbaria
- Study on aquatic insects including hemimetabolous and holometabolous insects of Halda and its associated water bodies
- Diversity of arthropods and its ecological role on natural fish breeding ground Halda
- Water quality and benthos diversity of Krishnakali, Purakopali, Katakhali, Khondokia, Madari, Kagotia and Chandkhali canals of Halda
- Status of gigantic river dolphin in Halda river and their habitat identification by using an echo sounder
- Survey of kum (deeper areas of the river) of Halda river by using Echo-sounder
- Study on Embryotic larval and fry development of carps spawn from Halda river

4.9.4 Number of students at present working in HRRL

Currently**,** 2 PhD, 2 M.Phil., 18 MS and 12 undergraduate students are working on their projects at HRRL.

4.9.5 Programmes organized by HRRL

HRRL, besides the research projects, also undertook several programs with and without IDF support including

- Workshop on the determination of egg and fish fry of Halda river
- Online training on integrated river management
- Training on river conservation for sustainable life
- Webinar on inseparable water, wetlands, and life
- Awareness programs like documentary presentation, drawing and quiz competition
- Participating in 5th international water conference 2020
- Arrangement of awareness program at Madarsha Bohumukhi High School, Hathazari
- Seminar and reception program in the context of declaring Halda river as "Bongobondhu National Heritage"

- Online training program in collaboration with Malaysian World Academy of River and Environment
- Write about dolphin killing at virtual court at 2020
- Identification of quantity of eggs and fry by HRRL, Dept. of Fisheries, BFRI, IDF collaboratively
- Celebrating World Environment Day, 5th June 2020
- Virtual meeting about Dolphin killing
- Programs held on topic ' Effects of Covid 19 on river and riverside livelihood'
- Arranged webinar in collaboration with BAPA
- Virtual seminar on the 'Conservation of river and wetlands for healthy nature’
- Discussion meeting about overall conservation of Halda river
- Special webinar program on the celebration of 'World River Day'
- Meeting on the presentation of Environmental Impact Assessment (EIA) report of ' Water distribution from MWTP to Bongobondhu Sheikh Mujib Industrial City ' Project at DOE
- Joint exchange meeting with Wildlife Crime Control Unit for conservation of Dolphin of Halda river
- Participation in a live program arranged by America times in the context of conservation of Halda river
- Several exchange meetings at the riverside of Halda, Garduara
- Introductory and exchange meetings with volunteers about conservation of brood fish at IDF's office, Garduara
- Webinar on 'water extraction and its effects on Halda with collaboration with "pran-pokriti surokkha moncho'
- Educational initiatives program arranged with 'Chittagong University Journalist Association' collaboratively for recognition and conservation of Halda at the riverside of Halda, Garduara.
- Wide range of activities on reduction of tobacco cultivation

4.9.6 Future research plans to conserve Halda

HRRL's plan includes the continuation of similar research works about the conservation of Halda with plans to research other rivers of Chittagong for better conservation of nature and ecosystem.

4.9.7 Supports for future research works

HRRL envisaged the needs for logistic supports, instrumentation, manpower as lab attendant and field work level, scholarship for students, etc., as continued support from PKSF/IDF to grow into standalone research and knowledge extension facility for Halda.

4.9.8 Future challenges for HRRL

HRRL's challenges included rough handling of the instrument due to lack of technically sound lab assistant, risk of damage to the expensive instrument like pH meter, multi-parameter due to unskilled handling, shortage of space for expansion as needed, possibilities of damages to valuable samples and specimen due to the distance between Halda river and lab, risk of taking instruments to the riverside for experiment due to lack of proper transportation facility, less cooperation of local people in the context of the experiment. Support from projects like that of the project is critical to the existence and flourishing of this unique laboratory by assuring the presence of a technical person for proper handling of instruments, ensuring the safety of instruments and increasing logistic support, establishing riverine station of HRRL at the riverside, establishing lab-owned hatchery for better observation and experiments and ensuring other facilities for conducting better research and fruitful experiments.

4.9.9 Future potentialities of Halda research lab

HRRL's can play more crucial roles in saving rivers of Bangladesh for better overall ecological and environmental conservation by fostering future river experts for Bangladesh, take steps to provide diplomas on the conservation of Halda and other rivers, creating more conservation employment opportunities in the context of river conservation, augmenting livelihood of people living adjacent to Halda riverside, playing roles in phasing out hazardous practices following the successful example of HRRL at tobacco reduction at Manikchhari. However, HRRL will need a range of supports in implementing these activities which includes support in outsourcing of Halda related works, support for the continuation of all running programme and arranging funds.

5. Conclusion

Palli Karma-Sohayak Foundation (PKSF) has taken initiative to prepare a policy paper on environmental protection of Halda River by reviewing existing policies relating to Halda along with Halda river bank people's perception in conserving the ecosystem of the River. The aims are to identify major constraints in conserving the environment of the Halda River; to suggest integrated interventions along with responsible authorities and stakeholders and to develop

strategies for implementing policy interventions suggested by the paper which have been achieved through gathering qualitative and quantitative sources of data involving relevant stakeholders and analysis of the data for policy recommendations. The policy paper has suggested a number of recommendations based on the opinion, roles and responsibilities of different stakeholders (i.e. egg collectors; ex-tobacco farmers; rubber dam users; administrative bodies) in an integrated way to conserve the environment of the only natural fish spawning ground of Bangladesh. Among the stakeholders, the egg collectors have given emphasis on increasing monitoring of all the adjacent areas of Halda with stopping illegal brood fish catch with nets. Besides, most of the tobacco farmers have urged for training on cultivation method and techniques, requested for providing hybrid seeds, funding for cultivation market expansion, providing knowledge on technology, providing modern equipment, insurance on cultivation, loan facilities etc. Moreover, recommendations for management of drainage systems in irrigation areas through concrete drain or underground pipes, establishment of deep tube wells, arrangement of electric pump irrigation system by govt. forsaking the electricity bill etc. have been recommended by the rubber dam user. Besides, suggestions for proper surveillance surrounding the river, Halda, creating awareness, collective working effort, enforcement of law and rehabilitation of the fisherman, establishment of modern waste management system, building up individual authority for Halda River management, taking necessary steps for controlling pollution, conservation of the riverbank, tree plantation on riverside and focusing on Halda development projects have been come out from the administrative sides. On the other hand, research professionals' have given focuses on Sewerage Treatment Plant for waste management in Ananya residential area, fulfil the water demand of the industrial city located in the Mirsarai-Feni region from the nearest, simplest and economically viable source as a replacement of the Halda River, rehabilitation of 18 sluice gates and 19 branch canals, increasing navigability of Karnafuli River, more research on dolphin population, local community involvement in safeguarding process etc. All of these needs to be addressed in policy on priority basis for ensuring sustainability of Halda River. Based on the qualitative and quantitative information this policy paper have suggested an integrated management plan by mentioning the future activities, relevant stakeholders, probable barriers and possible solution for sustenance of the Halda.

6. Recommendations

Recommendations mentioned in the respondents sections have been enlisted below:

Egg collector

- ✔ To increase monitoring all the adjacent areas of Halda
- ✔ To stop illegal brood fish catch with net

Tobacco farmer

- ✔ Training on cultivation method and techniques
- ✔ Providing hybrid seeds

- ✔ Funding for cultivation
- ✔ Market expansion
- ✔ Knowledge on technology
- ✔ Providing modern equipment
- ✔ Insurance on cultivation
- ✔ Loan facilities

Rubber dam user

- ✔ Management of drainage system in irrigation areas through concrete drain or underground pipes
- ✔ Establishment of deep tube well
- ✔ Arrangement of electric pump irrigation by govt.
- ✔ Forsaking the electricity bill

Administrative bodies

- ✔ Proper surveillance surrounding the river, Halda
- ✔ Creating awareness
- ✔ Collective working effort
- ✔ Enforcement of law
- ✔ Rehabilitation of the fisherman
- ✔ Establishment of modern waste management system
- ✔ Building up individual authority for Halda River management
- ✔ Taking necessary steps for controlling pollution
- ✔ Conservation of the riverbank
- ✔ Tree plantation on riverside and
- ✔ Focusing on Halda development projects

Research perspective

- ✔ To establish Sewerage Treatment Plant for waste management in Ananya residential area
- ✔ To fulfil the water demand of the industrial city located in the Mirsarai-Feni region from the nearest, simplest and economically viable source as a replacement of the Halda River
- ✔ Rubber dam and concrete dams in the upstream region of Halda will have to be removed

- ✔ The 18 sluice gates of 19 branch canals need to be rehabilitated in an environmentally friendly manner to increase water flow in the upstream areas of the river
- ✔ The navigability of the Karnafuli River needs to be increased
- ✔ Further detailed studies are necessary to identify the limiting factors. dolphin
- ✔ To understand the growth, a more specific long term study is recommended
- ✔ Both the spawn of mud scoop and cemented hatchery is needed to rear in separate large pond after early fry stages
- ✔ Involvement of local community in the safeguarding of brood stock must be increased
- ✔ Strict enactment of law is key to protect the carp broodstock that is the main source of egg
- ✔ Reducing the illegal influence of local politician in the hatcheries
- ✔ Cutting of river bends must be banned which is largely liable for erosion and devastation of the breeding grounds
- ✔ Re-starting the Chittagong Asian Paper Mill's production process will not be an appropriate step considering the defective liquid waste treatment system of the factory, which is causing pollution of the Halda River

6.1 Integrated Halda River Management Plan

Table 33: Halda River Management Plan for future

Recommendation	Activities	Relevant Stakeholders	Barriers	Solution
1. Creating a single Halda Heritage Committee rather maintaining too many committees for Halda River management	• Protection of Halda River and its biotic and abiotic resources • Monitoring of industrial activities • Monitoring of illegal fish catch • Monitoring of dredging and lease of illegal Balumohal • Protection of Halda river bank • Monitoring of engine boat navigation • Plantation activities • Waste management	• Ministry of Fisheries and Livestock, • BWDB, • DoE, • BFD, • LGED, • Upazila administration • Upazila Fisheries Office, • River police • Non govt. organization (PKSF, IDF etc.) • Researcher, • Academicians, • Journalist, • Halda River bank people	• Lack of coordination and political good will	• Strict policy formation and enforcement of law • Top tire administrative practice • Accountability of each stakeholder to other before and after taking Halda River related decision
2. Training for egg collectors and fry	• Formation of egg collector and fry	• Upazila administration	• Lack of database	• Yearly database

Recommendation	Activities	Relevant Stakeholders	Barriers	Solution
producers ➢ Salinity problem solution ➢ Fixing up egg storage capacity	producer groups • Training on egg collection and fry production technique both in earthen well and hatchery • Ensuring fresh water supply for incubation of egg for which rain water harvesting can be a good option • Follow up training • Fixing 5 bucket of egg per well for egg incubation • Fixing up egg and fry price	• Upazila Fisheries Office • Non govt. organization (PKSF, IDF) • Local community • Researcher • Academician	• Repetition of training to same person	update • Monitoring
3. Training for ex-tobacco farmers	• Formation of ex-tobacco farmer group • Training on organic farming • Follow up training	• Upazila administration • Non govt. organization (PKSF, IDF)	• Lack of database • Repetition of training to same person	• Yearly database update • Monitoring

Recommendation	Activities	Relevant Stakeholders	Barriers	Solution
	• Funding for landless farmer • Proper storage capacity for fruits and vegetables • Campaign on environmental pollution, sustainable environmental management, adverse impact on health (like asthma, lung cancer, coughing, eye irritation, bronchitis etc.)	• Researcher • Academicians • Local elected persons and Religious persons like Imam, Purohit etc. in discussion meeting to encourage people		
4. Alternative Income Generation Activity (AIGA) during fish ban period	• Ensuring livestock based income generation • Training on tailoring, vegetable cultivation, livestock rearing etc. (importance to be given to women and unemployed young generation)	• Ministry of Fisheries and livestock • Other development organization like IFAD, • UNDP, • PKSF, • IDF, • BRAC,	• Lack of database • Identification of actual needy people • Lack of funding	• Yearly database update • Small scale loan • For monitoring local voluntary organization can be involved as a field worker. • To encourage local voluntary organization

Recommendation	Activities	Relevant Stakeholders	Barriers	Solution
	• Supply of necessary facilities, raw materials, sewing machine etc.	• Grameen Bank etc. • Ministry of Social Welfare		for engaging in this type of activities, certificate program like internship can be started under those organizations. • Especially women participation can be identified as more fruitful solution in this field • Enacting rules for ensuring the supply of handmade products to nearby shops, markets, industries with a remarkable percentage
5. Removal of rubber dam	• Renovation of all the existing sluice gates and concrete dam in environment and fish friendly way • Ensure natural water flow through the	• Ministry of Land, • Ministry of Water Resources, • Ministry of Fisheries, • BRRI, • LGED,	• Conflict between upstream and downstream community	• Involvement of local administration • Policy formation with proper implementation

Recommendation	Activities	Relevant Stakeholders	Barriers	Solution
	connecting canals • Direct financial help or other support to minimize the damage caused by rubber dam • Training on AIGA activities	• Ministry of Women and Children Affairs • NGOs such as IDF • PKSF • Local Administration • Upstream and Downstream community		
6. (a) Conduct proper Environmental Impact Assessment (EIA) before infrastructural development (Example- No EIA in rubber dam, concrete dam and embankment project of Water Development Board, False EIA in WASA water withdrawal project)	• Formation of EIA team with experts such as environmentalist, hydrologist, economist, political leaders, local people etc. • Consider all physical & biophysical aspects when conducting EIA • Cost-benefit analysis of that infrastructure • Identify needs and priorities	• DoE, • Ministry of Fisheries and Livestock, • MoA, • Ministry of law, Justice and Parliamentary Affairs • LGED • Upazila Administration • Halda River bank people • Environmentalist • LGED,	• Conflict between the upstream & downstream community • Political problem • Bureaucratic complexity • Conflict in understanding between different experts	• Strong initiatives should be taken by the govt. to create intersectoral collaboration, • Seminar, conference and meetings can create intersectoral linkage, • Incorporate environmentalists while doing EIA and feasibility studies

Recommendation	Activities	Relevant Stakeholders	Barriers	Solution
(b) Target towards the efficient design, operation & maintenance of infrastructure (Example- Sluice gate, Bridge, Culvert, Flood control embankment and blocks, Water withdrawal, rubber dam, etc.)	• Recruit efficient people when establishing such infrastructure • Establish larger sluice gates which can irrigate larger amount of agricultural land rather than establishing large number of smaller sluice gates. • Use environment friendly & local material, labour & equipment which reduce cost and pollution • Ensure active participation of local people both upstream& downstream • Surveying the local people & know their	• River Protection Commission, • Water Development Board, • Local administration, • Local people, • Local leader, • NGOs, • Research institutes, • Farmer	• Lack of intersectoral collaboration	• Strong initiatives should be taken by the govt. to create intersectoral collaboration, • Consultation with community people • Involve local people in decision making process • Inclusion of traditional knowledge • Periodically visiting, monitoring & evaluation of upstream & downstream condition • Identify the function off all members towards increasing the sustainability of these infrastructures

Recommendation	Activities	Relevant Stakeholders	Barriers	Solution
	views • Establishing infrastructures considering social welfare			
7. (a) Halda River zoning Very susceptible zone (Breeding ground)- No infrastructure is allowed **(b)** Moderately susceptible zone- Small infrastructure is allowed, ensure water flow **(c)** Less susceptible zone- Tobacco farming, ensure water source	• By different impact analysis it should be identified which area are more susceptible and which are less. • This zoning should be done by legal authority • Agricultural pollution control • Ensure water flow • Clear cut ban should be imposed on establishment of infrastructure in very susceptible zone	• Ministry of Land, • LGED, • Upazila Administration • Local Administration	• Lacking of intersectoral collaboration	• Strong initiative should be taken by govt. to create intersectoral collaboration • Seminar, conference and meetings can create intersectoral linkage
8. Improve the performance of agricultural production	• Sustainable agricultural policies • Scientific	• Halda River bank people • Upazila Agricultural	• Bureaucratic complexity • Conflict in	• Exchange of opinion through meeting, workshop, seminar

Recommendation	Activities	Relevant Stakeholders	Barriers	Solution
	management for irrigated agricultural production • Both the efficiency of inputs and outputs should be maintained in the agricultural system • Emphasizing organic farming • Promote vermicomposting, pheromone trap, organic fertilizer, discourage chemical fertilizer	Office • Local Administration • Non-government organization (PKSF, IDF etc.)	understanding between different experts	
9. Biodiversity conservation	• Plantation program • Branding of fry • Ex-situ conservation • Genomic analysis • Increasing Kalibaus • Dolphin conservation • Others biodiversity	• BFD, • Local Administration, • Academician, • Researcher, • River bank people • PKSF • IDF	• Plantation species selection • Political Barrier • Gene pole contamination • Unethical activities of local peoples	• Selection of native species • Expert consultation • Counselling

Recommendation	Activities	Relevant Stakeholders	Barriers	Solution
	conservation like prawn • Minimum water flow maintaining in the downstream	• IFAD • HRRL		
10. Supervision of fish catch and identification of the problems (Control of river bank erosion, waste management etc.) of the local people associated with Halda	• Regular monitoring of illegal fish catch area • Community consultation • CC camera installation • Drone Camera utilization • Waste management of Nazirhat municipality	• Local Administration, • River bank people • River police • Volunteer • BWDB • Non-govt. organization (PKSF, IDF)	• Lack of AIGA • Lack of incentive to the volunteer • Improper planning	• Creation of AIGA opportunities • Creation of monitoring team engaging the local people • Funding for volunteers
11. Banning of water withdrawal for Mirsarai economic zone	• Expert consultation • No water withdrawal • Reduce existing	• LGED, MoEF, MoFL • BWDB • WASA	• Lack of political good will	• Awareness creation through media people

Recommendation	Activities	Relevant Stakeholders	Barriers	Solution
	water withdrawal and find out alternative way	• Environmentalist • Mass media people, • Social media		
12. Research on Halda river status	• Watershed related research • Spawn related research • Writing popular articles to make research information available to masses • More intensive and collaborative high-quality research • Monitoring of river health/ Water level and rainfall data • Finding means to address salinity • Being vocal on the reduction of the use of agrochemicals • Promoting the idea of	• Academician • Researcher • Halda River bank people • Govt. and non govt. organization • Research organization • PKSF • IDF • HRRL	• Lack of funding • Recommendations from research outcome do not reach to the policy makers through proper channel	• Research for identifying the solutions of existing problems and make policy recommendations based on research outcome • Funding from govt. and non govt. organization • Inclusion of research outcome for policy making

Recommendation	Activities	Relevant Stakeholders	Barriers	Solution
	bring all project and all stakeholders under one roof and oppose additional water harvest from the river • Help project proponents in root cause analysis through systems thinking • Dialogue with all stakeholders • Community engagement • Public awareness creation			
13. Motivation and awareness building campaign	• Making video documentary, • Report writing • Social media	• Local Administration • School going kids • Mass media people • Academician • Volunteer • Local Imam, Purohit etc.	• Lack of funding • Lack of coordination • Lack of technical knowledge	• Monthly, bi monthly, half yearly and yearly campaign involving local community • Fund from govt., non govt. and social organization • Utilizing social and

Recommendation	Activities	Relevant Stakeholders	Barriers	Solution
		• IDF • PKSF		print media
14. Dolphin conservation	• Stop dredger and motor boat • Stop illegal net and gears to save dolphin • Monitoring by local community • Removal of rubber dam • Stop pollution and enforcement of strict law • Local awareness • Digital monitoring with CC Camera • Study of habitat and population, safe migration of Dolphin	• Local Administration • Department of Fisheries • IDF • PKSF • LGED • DoE • Local people • Local administration • HRRL	• Lack of coordination among local administration, Department of fisheries, DoE and LGED • Denial of sand quarrer, motor boat driver and illegal fish catcher	• Strict law enforcement, execution and monitoring engaging community people • Continuation of research on Dolphin status and inclusion of research outcome in policy formulation • Creation of alternative income generation options for sand quarrer, motor boat driver and illegal fish catcher
15. Kum conservation	• Stop utilization of cement blocks to protect river bank as it is disturbing the	• BWDB • Local administration • IDF	• Conflict with unscrupulous sand traders • Conflict with	• Strong and effective monitoring through local people and administration

Recommendation	Activities	Relevant Stakeholders	Barriers	Solution
	natural ecology of the river causing a decrease in Kum depth • Stop sand quarrying by a section of unscrupulous traders by using dredgers • Stop rubber dam utilization for irrigation purposes which cause the decline of the natural flow of the river • Create awareness through leaflet distribution, awareness campaign, video documentary demonstration	• PKSF • Local people • Media people	upperstream rubber dam beneficiaries	• Ensuring alternative inrrigation water ways instead of rubber dam utilization • Plant more trees to build a green riverbank area and for the protection of river bank
16. Pollution control and prevention	• Permanently stop the dumping of waste in the local Mara Chhara canal at Nandir Hat in Hathazari	• DoE • CDA • Local administration • Local people	• Lack of coordination	• Stirct law enforcement and monitoring • Effluent Treatment Plant (ETP) must be

Recommendation	Activities	Relevant Stakeholders	Barriers	Solution
	• Prevent the release of wastes from scattered illegal poultry farms. • Polluting industries need to be identified on an urgent basis • Disconnect the master drainage system of the Ananya residential area from the Bamanshahi canal and Kuwaish canal • To reform and excavate the Bamanshahi canal urgently to restore the navigability • The parts where the flow of water of the canal has changed, the obstacles that changed the course of the canal have to be removed • A dam needs to be constructed at the front	• Media people • HRRL • IDF • PKSF		built and used in factories located in Oxygen to Kulgaon area, including Hathazari peaking power plant • Oil-water separator's oil collection system and sludge preservation system of Hathazari Peaking Power Plant needs further improvement • Mass awareness through media coverage

Recommendation	Activities	Relevant Stakeholders	Barriers	Solution
	of the master drain of Ananya residential project, i.e. at the junction of Bamanshahi canal and drain. • Need STP (Sewerage Treatment Plant) for waste management of Ananya residential project • To clear water flow by digging small canals and streams in Shikarpur and Madarsha areas • Not to restart Asian Paper Mill until the ETP and other pollution control measures are correctly designed and implemented • Instructions may be given to re-locate the Chittagong Asian			

Recommendation	Activities	Relevant Stakeholders	Barriers	Solution
	Paper Mills (Pvt) Ltd. to an economic zone in Mirsharai located in Bangabandhu Sheikh Mujib Industrial City • Inspection of all the machinaries and ETP set up before restarting Hathazari Peaking Power Plant			

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8. References

Akhter, F. (2015). Change of Halda River flow due to different water control structures and its impact on Halda ecosystem. Masters of Science in water resource development. Institute of Water and Flood Management. Bangladesh University of Engineering and Technology.

Alam, M. S., Hossain, M. S., Monwar, M. M., & Enamul, M. (2013). Assessment of fish distribution and biodiversity status in Upper Halda River, Chittagong, Bangladesh. *International Journal*, *5*(6), 349–357.

Arshad-Ul-Alam, M. (2013). Fishing intensity of the Halda River, Chittagong, Bangladesh. *Int. J. Sci. Inn. Tech. Sec. A*, *2*(5), 10–16.

Arshad-Ul-Alam, M., & Azadi, M. A. (2015). Efficiency of fishing gears in the river Halda, Chittagong, Bangladesh. *Journal of Fisheries*, *3*(3), 275–284.

Asek, A. A. (2020). Study of embryonic, larval and fry development of carps spawn from Halda River and comparative growth rate and water quality analysis between traditional mud scoop and cemented hatchery methods. Halda River Research laboratory. Joint collaboration with the IDF and PKSF.

Azadi, M. A., & Alam, M. A. U. (2015). Ichthyofauna of the river Halda, Chittagong, Bangladesh. *Bangladesh Journal of Zoology*, *41*(2), 113–133.

Azadi, M. A., & Arshad-Ul-Alam, M. (2011). Diversity of Finfish and Shellfish of the river Halda with notes on their conservation. In *Proceedings of the International Conference on Biodiversity-Present State, Problems and Prospect of its Conservation* (pp. 91–101).

bdnews24.com. (2020). Halda jonno committee kore dilo high court (in Bengali). Retrieved on April 11, 2021. Available at: https://bangla.bdnews24.com/bangladesh/article1760472.bdnews

BWDB. (2021). Bangladesh Water Development Board. River bank protection work project to protect different areas from erosion on both banks of Halda River in Hathazir and Raozan upazilas of Chittagong District. Retrieved on April 11, 2021. Available at:

https://bwdb.gov.bd/en/ongoing-project#page-2

Dainik Purbakone. (2015)

DhakaTribune. (2020). Illegal sand extraction continues to harm Halda River ecology. Retrieved on April 09, 2021. Available at: https://www.dhakatribune.com/bangladesh/nation/2020/02/11/illegal-sand-extraction-continues-to-harm-halda-river-ecology

DhakaTribune. (2019). DoE shuts down state-run power plant for pulling the Halda River. Retrieved on April 10, 2021. Available at: https://www.dhakatribune.com/bangladesh/nation/2019/07/18/doe-shuts-down-state-run-power-plant-for-polluting-the-halda-river

DhakaTribune. (2019). No respite from mechanized boats plying Halda River. Retrieved on April 11, 2021. Available at: https://www.dhakatribune.com/bangladesh/nation/2019/05/22/no-respite-from-mechanized-boats-plying-halda-river

DhakaTribune. (2018). Illegal unit of Madina Tannery sealed off. Retrieved on April 10, 2021. Available at: https://www.dhakatribune.com/bangladesh/chittagong/2018/08/15/illegal-unit-of-madina-tannery-sealed-off

DhakaTribune. (2013). PM for protecting natural fish breeding grounds. Retrieved on April 10, 2021. Available at: https://www.dhakatribune.com/uncategorized/2013/07/03/pm-for-protecting-natural-fish-breeding-grounds

DoE. (2021). Department of Environment. Inspection report on Chittagong Asian paper Mills (Pvt.) and Hathazari Peaking Power Plant. Date of Inspection: 25 February, 2021.

Halda Gazette. (2007). Bangladesh Gazette. Ministry of Fisheries and Livestock.

Halda Gazette. (2010). Bangladesh Gazette. Ministry of Fisheries and Livestock.

Halda Gazette. (2020). Bangladesh Gazette. Ministry of Fisheries and Livestock.

HRRL, (2017-2020). Halda River Research Laboratory. List of dead Dolphin from Halda River.

HRRL, (2021a). Halda River Research Laboratory. Historical spawning data.

HRRL, (2021b). Halda River Research Laboratory. Status of water quality, precipitation, relative humidity and earth skin temperature.

Hossain, M. A. R. (2015). An overview of Fisheries sector of Bangladesh. *Research in Agriculture Livestock and Fisheries*, *1*(1), 109–126.

Islam, M. S., Akbar, A., Akhtar, A., Kibria, M. M., & Bhuyan, M. S. (2017). Water Quality Assessment Along With Pollution Sources of the Halda River. *Journal of the Asiatic Society of Bangladesh Science*, 61-70.

Kabir, M. H. (2011). Economic Valuation of Halda River. Institute of Forestry and Environmental Sciences, University of Chittagong, Chittagong.

Kabir, M. H., Kibria, M. M., Jashimuddin, M., & Hossain, M. M. (2013). Economic Valuation of Tangible Resources From Halda–The Carp Spawning Unique River Located at Southern Part of Bangladesh. *Int. J. Water Res*, *1*, 30–36.

Kabir, M. H., Kibria, M. M., Russel, I. A., & Hossain, M. M. (2014). Engineering activities and their mismanagement at Halda: a unique river for natural spawning of Major Indian carps. *International Journal of Surface and Groundwater Management*, *1*(1), 59–66.

Kabir, M. H., Kibria, M. M., & Hossain, M. M. (2015). Indirect and Non-use Values of Halda River-A Unique Natural Breeding Ground of Indian Carps in Bangladesh. *Journal of Environmental Science and Natural Resources*, *6*(2), 31–36.

Kabir Saim, M., Golam Must, M., Supratim S. B., Hossain, M. B., & Mofizur R. M. (2016). Marketing Channels of Indian Carp Fry Collected from Halda River and Livelihood of the Fry Traders. *Asian Journal of Agricultural Research*, *10*(1), 28–37. http://doi.org/10.3923/ajar.2016.28.37

Khan, M. M. H. (2019). Management plan for the Ganges river dolphin in Halda River of Bangladesh. Expanding the protected areas system to incorporate important aquatic ecosystems project. UNDP-BFD, 2018.

Kibria, M. M. (2015). Co-ordinator. Halda River Research Laboratory. University of Chittagong.

Kibria, 2017. Consultation report on Physico chemical parameters and plankton population of the Halda River under PACE project supported by PKSF.

Kibria, M. M. (2018a). Study report on "Field investigation report on the identification of sources of pollution disaster and massive death of fishes in Halda River". Joint collaboration with Halda River Research laboratory (HRRL) jointly with Department of Environment (DoE). June, 2, 2018.

Kibria, M. M. (2018b). Joint expert committee report on "Investigation and Post-mortem of death Gangetic river Dolphin *Platanista gangetica* in Halda River" as a member of joint expert committee formed by the Ministry of Fisheries and Livestock (MoFL) for the investigation the cause of unexpected massive death of dolphins in the Halda River on 23rd March 2018. Ministry of Fisheries and Livestock (MoFL) notice no. 33.00.0000.127.22.003.07-63 (7), date: 22/02/2018.

Kibria, M. M. (2020a). Co-ordinator. Halda River Research Laboratoy. University of Chittagong, Bangladesh.

Kibria, M. M. (2020b). Review and recommendations on the Environmental Feasibility Study Report prepared by Institute of water Modeling (IWM) for water supply from the Halda River ("Bangabandhu Fisheries Heritage") to the industrial city located in the Mirsarai-Feni region. 28 November, 2020.

Kibria, M. M. (2021a). Halda River (Bangabandhu Fisheries Heritage) Carp Fish Breeding in 2021 and relevant analysis. Halda River research laboratory (HRRL).

Kibria, M. M. (2021b). Co-ordinator. Halda River Research laboratory. University of Chittagong. Integrated initiatives to restore river ecosystem: Halda River (Bangabandhu Fisheries Heritage) is a successful example. Dainik Purbokone, June 05-06, 2021.

Kibria, M. M. (2021c). Co-ordinator. Halda River research laboratory (HRRL). University of Chittagong.

Kibria, M.M., Ali, M. & Farid, T.I. (2009). Halda Restoration Project: People's Expectations and Reality (in Bengali). Published by Chattagram Nagorik Uddogh, in association with Action Aid Bangladesh.

Kibria, M. M., Begum, M. A., Bhuyan, M. S. & Hossain, M. E. (2018). Livelihood status of egg collector and traditional knowledge of Carps Egg collection in the Halda River: A natural fish spawning heritage in Bangladesh. *SDRP Journal of Aquaculture, Fisheries & Fish Science*, 2(2).

Kibria, M. M., Shah, J. U., Khan, M. K. U., Khaled, S., Siddiqui, A. B., Alam, R., Anshari, M. A. I. & Das, R. (2020). Report of the committee formed by CDA on the pollution of Halda River. (Ref/serial no. PD/Halda/Chithipatra/69/308).

Saha, P., Oyshi, J. T., Haider, S. T. B., Nipa, S. N., & Khanum, R. (2019). Analysis on the changing trends of the channel pattern of Halda River and Public-Private Partnership (PPP) as a catalyst for the sustainable development. Proceedings on International Conference on Disaster Risk Management, Dhaka, Bangladesh, January 12-14.

Saimon, M. K., Mustafa, M. G., Sarker, B. S., Hossain, M. B., & Rahman, M. M. (2016). Marketing channels of Indian carp fry collected from Halda River and livelihood of the fry traders. *Asian J. Agric. Res*, *10*, 28-37.

Saleh, A. F. M., & Mondal, M. S. (2001). Performance evaluation of rubber dam projects of Bangladesh in irrigation development. *Irrigation and Drainage*, *50*(3), 237–248.

Siddique, M. A. M., Barua, P., & Ghani, M. H. (2012). Comparative study of physico-chemical properties of soil according to the age of aquaculture pond of Bangladesh. *Mesopot. J. Mar. Sci*, *27*(1), 29–38.

Sultana, M. N., Hossain, M. S., & Latifa, G. A. (2019). Water Quality Assessment of Balu River, Dhaka, Bangladesh. *Water Conservation & Management*, *3*(2), 08-10.

The Business Standard. (2021a). Halda losing fish species, spawning in crisis. Retrieved on: July 16, 2021. Avaiable at: https://www.tbsnews.net/bangladesh/environment/halda-losing-fish-species-spawning-crisis-274981

The Business Standard. (2021b). Halda's sorrow from climate change, human action. Retrieved on: July 16, 2021. Avaiable at: https://www.tbsnews.net/bangladesh/environment/haldas-sorrow-climate-change-human-action-274984

The Daily Star. (2020). Fresh threat haunts Halda. Retrieved on: April 08, 2021. Available at: https://www.thedailystar.net/frontpage/news/fresh-threat-haunts-halda-2006465

The Daily Star. (2020). Protection of river to save agricultural economy, life-livelihood and environment: Role of stae and citizens. Retrieved on: April 09, 2021. Available at: https://www.thedailystar.net/round-tables/news/protection-river-save-agricultural-economy-life-livelihood-and-environment-role-state-and-citizens-1982013

The Daily Star. (2019). Asian Paper Mill ordered to shut for pulling Halda. Retrieved on: April 09, 2021. Available at: https://www.thedailystar.net/environment/pollution/halda-river-pollution-asian-paper-mill-ordered-to-shut-down-1786846

The Daily Star. (2017). Halda losing fish species. Retrieved on: April 09, 2021. Available at:

https://www.thedailystar.net/frontpage/halda-losing-fish-species-1510732

The Daily Star. (2015)

The Daily Star. (2009). No policy guideline to rehabilitate fisherman. Retrieved on: April 13, 2021. Available at: https://www.thedailystar.net/news-detail-104766

The Financial Express. (2020). Govt. declares Halda Bangabandhu Fisheries Heritage. Retrieved on: April 13, 2021. Available at: https://today.thefinancialexpress.com.bd/last-page/govt-declares-halda-bangabandhu-fisheries-heritage-1608829591

The Independent. (2015).

Tilt, B., Braun, Y., & He, D. (2009). Social impacts of large dam projects: A comparison of international case studies and implications for best practice. *Journal of Environmental Management*, *90*, S249–S257. http://doi.org/10.1016/j.jenvman.2008.07.030

Tsai, C., Islam, M. N., Karim, R., & Rahman, K. S. (1981). Spawning of major carps in the lower Halda River, Bangladesh. *Estuaries*, *4*(2), 127–138.

Uddin, M. J., & Jeong, Y. K. (2021). Urban river pollution in Bangladesh during last 40 years: potential public health and ecological risk, present policy, and future prospects toward smart water management. *Heliyon*, *7*(2), e06107.

Zaman, F. (2014). RIVER HALDA AWAKENING: A RESEARCH TRAINING AND AWARENESS CENTRE. BRAC University. Available at: http://hdl.handle.net/10361/3605

Shaha, M. (2020). Identification of kum (deeper area of river) of Halda River by using echo-sounder. B.Sc. (Hons.) (Project paper). Department of Zoology. University of Chittagong, Bangladesh.

Nahian, (2020). Present status of Gangetic river dolphin (*Platanista gangetica*) and habitat identification from Halda River by using echo-sounder. B.Sc. (Hons.) (Project paper). Department of Zoology. University of Chittagong, Bangladesh.

ANNEX I

List of stakeholders

Upazila Office:

1. Mohammad Ruhul Amin, UNO, Hathazari
2. Zonayed Kabir Sohag, UNO, Raozan
3. Md. Saidul Arefin, UNO, Fatikchari

Fisheries Office:

1. Farhana Lavli, District Fisheries Officer
2. Pizush Provakor, Senior Sub-district Fisheries Officer
3. Mohammad Nazmul Huda, Senior Sub-district Fisheries Officer
4. Md. Mizanur Rahman, Sub-district Fisheries Officer

Integrated Development Foundation (IDF):

1. Muhammad Shah Alam, Deputy Co-ordinator, IDF, Chittagong

Department of Environment (DoE):

1. Mafidul Alam, Director, Department of Environment, Chittagong District
2. Mohammad Nurullah Nuri, Director, Department of Environment, Chittagong Metropolitan

Bangladesh Water Development Board (BWDB):

1. Md. Nurul Islam, Executive Engineer, Bangladesh Water Development Board
2. Tayan Kumar Tripura, Executive Engineer, Bangladesh Water Development Board

Forest Department (FD):

1. Abu Naser Mohammad Yeasin Newaj, Forest Department, Chittagong

River Police Station:

1. ABM Mizanur Rahman, Officer-in-Charge (OC), Sadarghat River Police Station, Chittagong

Politicians:

1. SM Rashedul Alam, Chairman, Hathazari Upazila Parishad
2. Alhaz Mohammad Ismail Hossain, Mayor, Fatikchari Pourosova
3. Moktar Begum Mukta, Mahila Vice Chairman, Hathazari Upazila Parishad

Chittagong Development Authority (CDA):

1. Rajib Das, Executive Engineer, CDA

Journalist:

1. Mohammad Ali
2. Chowdhury Farid

Resource Person:

1. Dr. Mosharraf Hossain, Professor, Institute of Forestry & Environmental Sciences, University of Chittagong
2. Md. Humayun Kabir, Associate Professor, Institute of Forestry & Environmental Sciences, University of Chittagong
3. Amina Begum, Assistant Professor, University of Chittagong
4. Tasnima Dilshad, Lecturer, Institute of Forestry & Environmental Sciences, University of Chittagong

ANNEX II

Semi structured questionnaires

হালদা নদীর সমস্যা, সমাধান ও সংরক্ষণের কৌশল নির্ধারণে ডিম সংগ্রহকারীদের জন্য প্রণীত প্রশ্নমালা

উত্তরদাতার নামঃ

বয়সঃ

ঠিকানাঃ

যোগাযোগের নম্বরঃ

(বি: দ্র: মুল্যায়ন: ১ এর মান সর্বোচ্চ এবং ক্রমান্বয়ে ৫ এর মান সর্ব নিম্ন)

১। ডিম সংগ্রহের সাথে কত বছর ধরে যুক্ত?

২। (ক) সবচেয়ে বেশি ডিম কত সালে পেয়েছিলেন?

(খ) কি পরিমাণ পেয়েছেন?

৩। এই/গত বছর (২০২০) কি পরিমাণ ডিম পেয়েছেন?

৪। (ক) ডিম থেকে কি পরিমাণ রেনু উৎপাদন করেছেন?

(খ) কত টাকা আয় করেছেন?

৫। বিগত ৫ বছরে ডিমের পরিমাণে পরিবর্তন হয়েছে বলে মনে করেন কি?

ক) কমেছে খ) বেড়েছে গ) অপরিবর্তিত ঘ) মন্তব্য নেই

৬। (i) কেন কমেছে বলে মনে করেন?

(ক) স্লুইস গেইট □ (খ) রাবার ড্যাম □ (গ) দূষণ □ (ঘ) তামাক চাষ □

(ঙ) মা মাছ নিধন □ (চ) বাঁক কাটা □ (ছ) বালু উত্তোলন □ (জ) ইঞ্জিন চালিত নৌকা □ (ঝ) কুম ভরাট হয়ে যাওয়া □ (ঞ) নদী ভরাট হয়ে যাওয়া □ (ট) পাহাড়ী ঢল না আসা □ (ঠ) কম বৃষ্ঠিপাত □ (ড) অন্যান্য □

(ii) কেন বেড়েছে বলে মনে করেন?

(ক) দূষণ রোধ □ (খ) তামাক চাষ বন্ধ □ (গ) মা মাছ নিধন রোধ □ (ঘ) বালু উত্তোলন বন্ধ □ (ঙ) ইঞ্জিন চালিত নৌকা বন্ধ □ (চ) কোভিড লকডাউন □ (ছ) অন্যান্য পদক্ষেপ □

৭। (ক) ডিম ফোটানোর কোন পদ্ধতিটি আপনি পছন্দ করেন? ক) মাটির কুয়া খ) সিমেন্টের কুয়া

(খ) কেন পছন্দ করেন?

৮। হালদাতে মা মাছের (রুই, কাতলা, মৃগেল ও কালিগনি) পরিমাণ কি বাড়ছে?

□ হাঁ □ না

(i) যদি বাড়ে- কোন কোন পদক্ষপের কারণে মা মাছ সমূহের পরিমাণ বাড়ছে বলে মনে করেন? (ক) পাহারার মাধ্যমে মা মাছ নিধন রোধ □ (খ) মাছের পোনার পুণ:মজুদ □

(গ) প্রশাসনিক মোবাইল কোর্ট □ (ঘ) দূষণ মুক্ত করা □ (ঙ) অন্যান্য

(ii) যদি কমে- কোন কোন কারণে মা মাছের পরিমাণ কমছে বলে মনে করেন?

(ক) মা মাছ নিধন □ (খ) শিল্প দূষণ □ (গ) নদী ভরাট □ (ঘ) লবন পানির প্রবেশ □

(ঙ) তামাক দূষণ □ (চ) পোলট্রি বর্জ্য □ (ছ) বালু উত্তোলন □ (জ) অন্যান্য □

৯। হালদাতে ডলফিনের পরিমাণ বাড়ছে নাকি কমছে?

ক) বাড়লে- কি কি কারণে ডলফিনের পরিমাণ বাড়ছে বলে মনে করেন?

খ) কমলে- কি কি কারণে ডলফিনের পরিমাণ কমছে বলে মনে করেন?

১০। হালদা নদীর মাছের প্রজননের পরিবেশের প্রধান বাধাগুলো কি কি?

(ক) স্লুইস গেইট □ (খ) রাবার ড্যাম □ (গ) দূষণ □ (ঘ) তামাক চাষ □ (ঙ) মা মাছ নিধন □ (চ) বাঁক কাটা □ (ছ) বালু উত্তোলন □ (জ) ইঞ্জিন চালিত নৌকা □ (ঝ) কুম ভরাট হয়ে যাওয়া □ (ঞ) নদী ভরাট হয়ে যাওয়া □ (ট) পাহাড়ী ঢল না আসা □ (ঠ) কম বৃষ্ঠিপাত □ (ড) অন্যান্য □

১১। মিরেশ্বরাই শিল্প নগরীর প্রয়োজনে হালদা থেকে পানি উত্তোলন করা হলে হালদার কি কোন ক্ষতি হবে? □ হাঁ □ না

১২। ক) যদি হাঁ হয়- কি ক্ষতি হবে?

১৩। খ) যদি না হয়- কেন ক্ষতি হবেনা বলে মনে করছেন?

১৪। হালদাতে কি কি ব্যবস্থা নিলে হালদার আরো উন্নতি হবে বলে মনে করেন?

ক)

খ)

গ)

ঘ)

ঙ)

চ)

ছ)

১৫। আপনি কি মনে করেন?

(ক) বঙ্গবন্ধু মৎস্য হেরিটেজ ঘোষণা ইতিবাচক / নেতিবাচক

(খ) নৌ পুলিশ কেন্দ্র ইতিবাচক / নেতিবাচক

(গ) প্রকল্প প্রনয়ণ ইতিবাচক / নেতিবাচক

(ঘ) সিসিটিভি ক্যামেরা স্থাপন ইতিবাচক / নেতিবাচক

(ঙ) পিকেএসএফ-আইডিএফের কার্যক্রম ইতিবাচক / নেতিবাচক

১৬। প্রশাসনিক কার্যক্রম জোরদার করেছে

উপজেলা প্রশাসন / মৎস্য বিভাগ / পরিবেশ অধিদপ্তর / পানি উন্নয়ন বোর্ড / অন্যান্য বিভাগ

হালদা নদীর সমস্যা, সমাধান ও সংরক্ষণের কৌশল নির্ধারণে তামাক চাষিদের জন্য প্রণীত প্রশ্নমালা

উত্তর দাতার নামঃ

ঠিকানাঃ

বয়সঃ

যোগাযোগের নম্বরঃ

১। তামাক চাষের সাথে কত বছর ধরে যুক্ত?

২। আপনার কি কোনো চাষযোগ্য জমি আছে?

ক) হ্যাঁ (নিজের/বর্গা) খ) না

৩। এই জমিতে কি কি চাষ করেন?

সাল	জমির পরিমাণ	ফসলের নাম	উৎপাদনের পরিমাণ (কেজি)	ফসলের একক মুল্য
২০২০				
(তামাক)				
(অন্যান্য)				
২০২১				
(তামাক)				
(অন্যান্য)				

৪। তামাক চাষের সুবিধা এবং অসুবিধা কি কি?

সুবিধা	অসুবিধা

৫। হালদা নদীর ওপর তামাক চাষের প্রভাব কি বলে মনে করেন?

ক) ইতিবাচক খ) নেতিবাচক গ) উভয়ই গ) প্রভাব নেই ঘ) মন্তব্য নেই

৫। ক) ইতিবাচক - কিভাবে?

৫। খ) নেতিবাচক - কিভাবে?

৬। তামাক চাষের ব্যাপারে আপনার মতামত কি?

ক) বন্ধ করা উচিৎ

খ) বন্ধ করা উচিৎ নয়

গ) তামাক চাষিদের বিকল্প জীবিকায়নের ব্যবস্থা করা উচিৎ

ঘ) মন্তব্য নেই

৭। তামাক চাষ বন্ধে কি ধরনের সহযোগীতা প্রয়োজন?

ক)

খ)

গ)

ঘ)

Questionnaire for Rubber dam user to assess the Rubber dam impact on Halda River

Respondent details

Name:

Age:

Village name:

Occupation:

Level of education:

Sex:

1. Do you know about the Rubber Dam?
   A) Well known B) Somewhat known c) Known d) Unknown
2. What is the main purpose of the rubber dam?.....
3. To what extent rubber dam is useful to the local communities?

A) Very useful B) Useful C) Not useful

4. Does Rubber dam have any negative impact?
   A) Yes B) No
5. If yes, what is the main negative impact of rubber dam on Haldariver?
6. What is the main cause of depletion of spawning on the Haldariver?
   A) Environmental Pollution B) Rubber dam C) Cutting of oxbow bends
7. Do you think rubber dam is the main reason
   A) Yes B) No
8. What is your suggestion about the Rubber dam? ……..
9. Why the river Halda important to you?

   A) Agriculture B) Fisheries C) Water source D) Recreation E) Sand extraction and F) Others
10. What could be the alternative to the rubber dam? (a) (b) (c) (d)

হালদা নদীর সমস্যা, সমাধান ও সংরক্ষণের কৌশল নির্ধারণে সংশ্লিষ্ট কর্তৃপক্ষের জন্য প্রণীত প্রশ্নমালা

উত্তরদাতার নামঃ .....

পদবিঃ ..... অফিসঃ .....

ঠিকানাঃ .....

মোবাইলঃ ..... ইমেইলঃ .....

১। হালদা নদীর পরিবেশ রক্ষায় আপনার কোনো দায়িত্ব আছে কি?

ক) হ্যাঁ খ) না

১। ক) যদি হ্যাঁ হয় তাহলে কি কি দায়িত্ব পালন করেন?

ক) ঙ)

খ) চ)

গ) ছ)

ঘ) জ)

২। হালদা নদীতে বর্তমানে বিদ্যমান কোনো সমস্যা আছে কি?

ক) হ্যাঁ খ) না

২। ক) যদি হ্যাঁ হয় সেগুলো কি কি?

ক)

খ)

গ)

ঘ)

ঙ)

চ)

ছ)

জ)

৩। বিদ্যমান সমস্যাসমূহ সমাধানে আপনার করণীয় কি?

ক)

খ)

গ)

ঘ)

ঙ)

চ)

ছ)

জ)

৪। সার্বিকভাবে হালদার সমস্যাসমূহ সমাধানে আর কি কি করা যেতে পারে?

ক)

খ)

গ)

ঘ)

ঙ)

চ)

ছ)

জ)

৫। হালদা নদীতে জলবায়ু পরিবর্তন জনিত কোন সমস্যা আছে কিনা?

ক) হ্যাঁ খ) না

৫। ক) যদি হ্যাঁ হয় সেগুলো কি কি?

ক)

খ)

গ)

ঘ)

৬। হালদাকে প্রকৃত অর্থে বঙ্গবন্ধু মৎস্য হেরিটেজ হিসেবে প্রতিষ্ঠিত করতে আপনার সুপারিশসমূহ উল্লেখ করুন।

ক)

খ)

গ)

ঘ)

Annex III

Some snapshots of activities

1. Some Photographs of Key Informant Interview (KII)

(a) KII with Mafidul Alam, Director, Department of Environment, Chittagong District.

(b) KII with Farhana Lovly, District Fisheries Officer, Chittagong.

(c) KII with Abu Naser Mohammad Yeasin Newaj, Forest Department, Chittagong.

(d) KII with Alhaz Mohammad Ismail Hossain, Mayor, Fatikchari Pourosova.

(e) KII with Rajib Das, Executive Engineer, Chittagong Development Authority (CDA)

(f) KII with Md. Nurul Islam and Tayan Kumar Tripura, Executive Engineer, Bangladesh Water Development Board

(g) KII with SM Rashedul Alam, Chairman, Hathazari Upazila Parishad.

(h) KII with Ruhul Amin, UNO, Hathazari Upazila, Chittagong.

(i) KII with Zonayed Kabir Sohag, UNO, Raozan Upozila, Chittagong..

(j) KII with Md. Saidul Arefin, UNO, Fatikchari Upazila, Chittagong.

(k) KII with Md. Mizanur Rahman, Upazila Fisheries Officer, Fatickchari Upazila.

(l) KII with Moktar Begum Mukta, Mahila Vice Chairman, Hathazari Upazila Parishad.

(m) FGD with egg collectors of Hatazari at Halda River, Chittagong.

(n) FGD with egg collectors of Raozan at Gorduara Noya hat, Hathazari, Chittagong.

(o) Interview with local egg collectors.

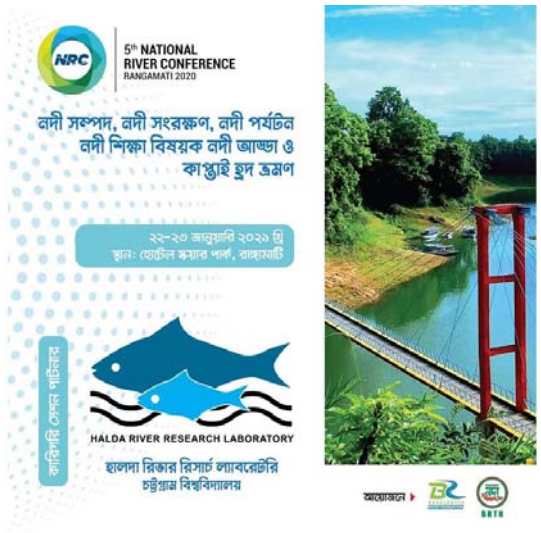
(p) Interview with local egg collectors.

(q) Interview with local egg collectors.

(r) Field training program on ‘Egg collection and fry production calculation methods’ with DoF officials and students of HRRL, CU at Halda River.

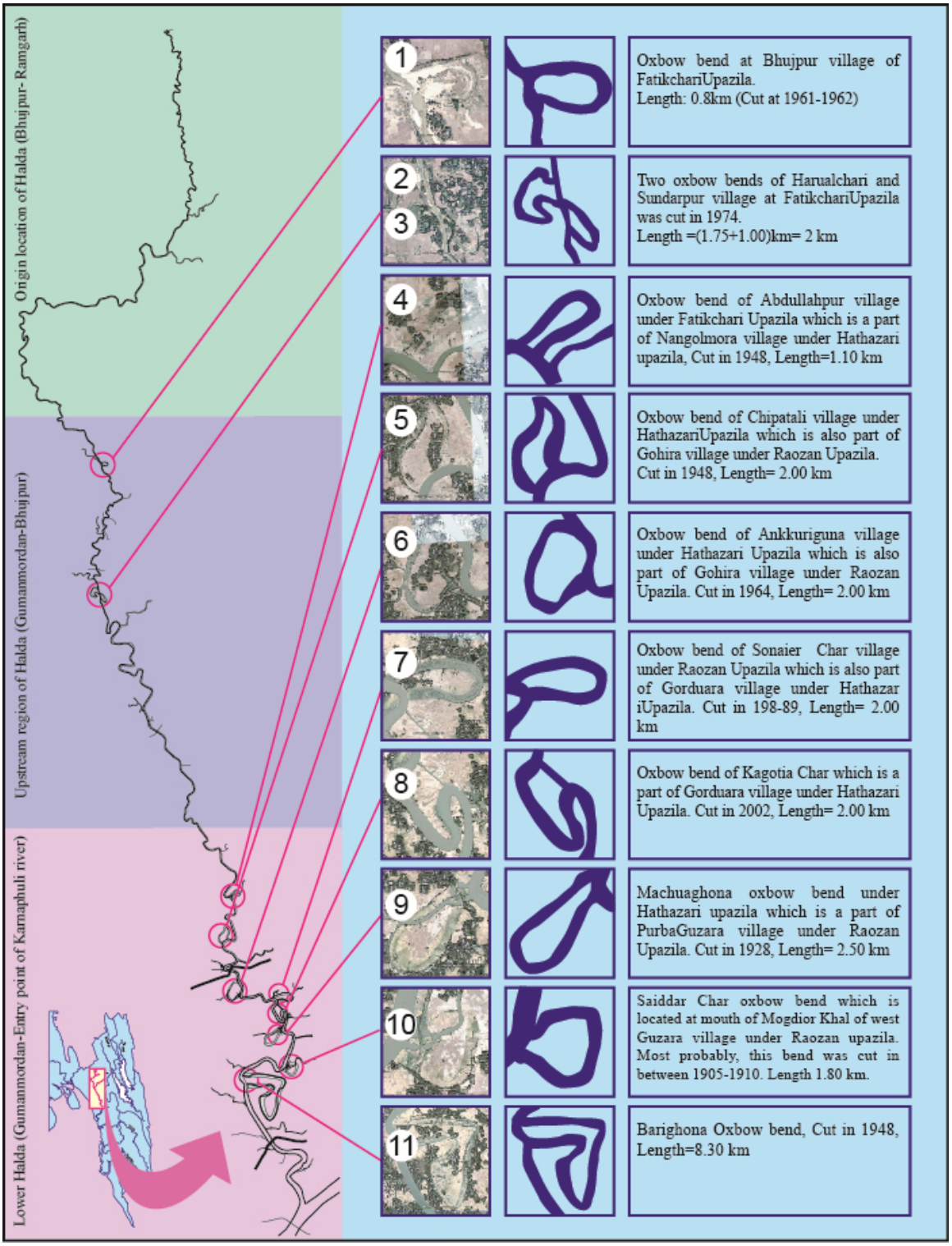
Annex IV

Some snapshots of Halda River Research Laboratory (HRRL)



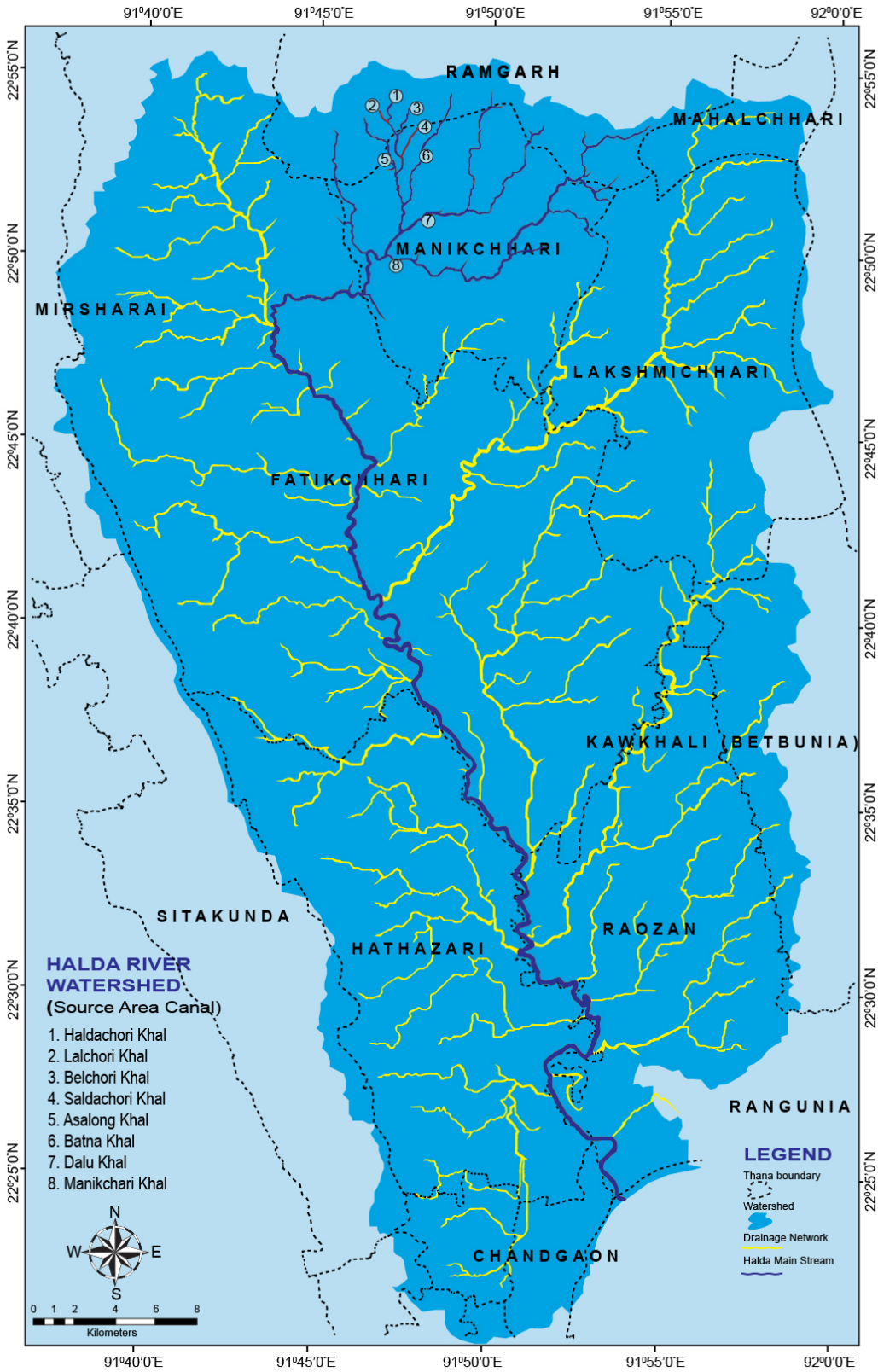
Annex V

Cutting of oxbow bends at the Halda river in the last 100 years



Annex VI

Map: Source of the Halda River and Watershed area.



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Halda River Research Laboratory