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Present Status of Wetland Biodiversity - A Study in Sujanagar Upazila, Pabna, Bangladesh

Md. Shafiqul-Islam[1]
Assistant Professor
Center for Sustainable Development, University of Liberal Arts, Dhaka, Bangladesh

Abstract: *This exploratory study was conducted over a period of three months; it was concentrated in three unions of Sujanagar Upazilla in Pabna district. The present state of wetland biodiversity is exacerbated due to a series of problems, including poverty, population growth, force from pressure groups and construction of flood-control embankment, through inappropriate regulations of water flow (sluicegate). Many species, including fish, plants and aquatic species, are shown to be threatened and endangered due to siltation of beel, changing physical nature of wetlands, indiscriminate uses of chemicals, construction of embankment and fishing of broods. Physical changes in watersheds and floodplains have drastically reduced the area and quality of wetlands. Flood-control embankments and water control structures have blocked fish migration routes. On the other hand, expanded irrigation ofcultivated areas and expanding areas of winter-rice cultivation have reduced the water available for aquatic life to survive in the six-month dry season. Losses of tree cover and poor cultivation practices in watersheds have caused high rates of siltation in rivers and loss of floodplain wetlands. The wetland environment unites the inhabitants into a society, which has a definite shape, culture and livelihood pattern. Over-exploitation of aquatic resources, destruction of habitats, unwise use of agrochemicals, land use conflict and conversion of land and construction of embankment and sluicegates are the major threats to wetland biodiversity. Many fishermen are losing their profession due to loss of wetland biodiversity (lack of fish). People's active participation can secure wetland restoration. Participatory wetland resource management or initiatives might save wetland biodiversity and aquatic resources.*

Key words*: Wetland biodiversity; threatened; endangered; climate change; impacts; restoration.*

I. Introduction

Bangladesh is lying between $20^0$34' and $26^0$38' N latitude and 88^0 51' and 92^0 41' E longitude. The country has a total area of 147 570 km^2 with a population of about 150 million. The land can be classified as 79 % flood plains, 12.6 % hilly areas and 8.3 % terrace soils. The catchment basin of the combined Ganges, Brahmaputra and Meghna rivers covers more than 1.5 million km^2. Bangladesh holds colossal wetland areas and, indeed, during the rainy season, about half of the country could be classified as wetland. It is estimated that about 50 % or more of the land surface of Bangladesh is wetland, consisting of about 700 rivers, creeks, streams and other water bodies known locally as haor, baor, beel and khal. About 6.7 percent of Bangladesh is always under water, 21 percent is deeply flooded (more that 90 cm) and 35 percent experiences shallow inundation (FAO, 1988). The average discharge of water in Bangladesh delta in the flood season is more than five million cusec. The wetlands in Bangladesh encompass a wide verity of dynamic ecosystems ranging from mangrove forest (about 577, 100 ha), natural lakes, man-made reservoir (Kaptai lake), freshwater marshes (about 400 haors), oxbow lakes (about 54488 ha, locally known as baors), freshwater depressions (about 1,000 beels), fish ponds and tanks (about 147, 000 ha), estuaries and seasonal inundated extensive floodplains (Akonda, 1989; cited in Akbar Ali Khan 1993 and DOF 1985).

Under the Ramsar international wetland conservation treaty, wetlands are defined as areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six metres. Wetland biodiversity is very rich in aquatic resources, including fish, plants and other aquatic animals. Several distinct vegetation zones that are found in the wetland zones are submerged, free floating, rooted floating and sedges and meadows zones.

The Asian Wetland Symposium of 1992 concluded that wetlands are being lost and degraded rapidly in Asia, as well as in other regions, and many people are paying the cost, some with increased cost of living, and some with their lives. In Bangladesh, Sujanagar Upazila of Pabna District is supporting a huge waterbody. This area is now a smouldering example, and known as a lost biodiversity unit, due to establishment of the Pabna Irrigation and Rural Development Project (PIRDP), and also establishment of the embankment of flood control by Bangladesh Water Development Board (BWDB). Flood-controlled dykes, sluice gates and pump houses have been established with a view to protect flood water, as well as supplying the river water into the cropping area in a controlled and systematic way. After the green revolution, farmers are still using chemical fertilisers,

pesticides, herbicides and other toxic substances to improve crop production to meet the growing needs. As a result, biodiversity in the study area has been misplaced and beneficial insects, birds and aquatic animals, useful for biodiversity conservation do not exist in that region. Fishermen groups are becoming more vulnerable by losing their profession and have been forced to change their profession. Conflict between fishermen, private leases and government over water access was common throughout the period and was the subject of a number of court cases (Pokrant et al. 1997). Every professional group from all sectors, except agricultural day labourers, have migrated to the other places or shifted their profession.

Wetlands are playing an enormous role in rural livelihoods and environment. Wetlands serve a wide range of functions, including ecosystem balance, flood control, water purification, protection from natural disasters, sources of livelihood, regular flow of water, and habitat for wildlife, fish, aquatic plants and animals. Paddy cultivation and lowland agriculture are the main rural livelihood options in the area at Sujanagar Upazila under Pabna District. The fisheries and other food and non-food resources are traditionally regarded common property in Bangladesh (Ahmed 1997). All of the aquatic resources in the common water bodies are common property regardless, so there is need of special care for its proper management. In the light of above circumstances, the aim of the study is to acquire knowledge of the present status of wetland biodiversity at Sujanagar Upazila, Pabna, Bangladesh. The associated objectives of the study are to: (i) determine the plant and fsih species in that area, (ii) explore the causes of the loss of wetland biodiversity, (iii) study perceptions of local people about the problems exists in the study area, and (iv) identify measures for the restoration of wetland biodiversity.

II. Materials and methods

Study areas

Sujanagar, Pabna is located at 23°55′00″N 89°26′00″E. It has 36136 households and total area 334.4 km². Only three unions from Sujanagra upazillas, Pabna were selected to conduct the study, based on the availability of waterbodies/wetlands. Three unions (Dulai, Ahammadpur and Raninagar) were randomly selected from the study area. The study areas were concentrated on 27 villages, of which 7 villages were in Dulai Union, 11 villages in Ahmmadpur Union and 9 villages in Raninagr Union.

Demography

As of the 1991 Bangladesh census, Sujanagar has a population of 214132. Males constitute are 51.86% of the population, and females 48.14%. Upazila's population over the age of eighteen is 102,202. Sujanagar has an average literacy rate of 26.7% (7+ years), and the national average of 32.4% literate. The total populations of the surveyed area were 71,438 people of whom 35,497 were females, 35,491 males, 16,228 children and 203 were disabled. According to family professions, 14,567 were farmers, 2,516 fishermen, 2,091 weavers (tanti), 1,124 tobacco labours, 876 businessmen, 233 teachers, 23 doctors, 578 van pullers, 1,333 services, 169 nochimon (korimon) drivers and 2,091 others. Average income per capita per diem was Taka 200.

Fishermen's livelihood

Fishermen's livelihood depends mainly on fishing activities including fishing, fish processing and fish marketing. For the preparation of fishing they need capital for purchasing fishing implements and maintenance of the existing ones. Eight units of fishermen groups are living in the vicinity of water bodies; 1) Dulai Natun para mathsayjibi shamity, 2) Char gobinda pur khara para matshyajibi shamity, 3) Char Dulai matshyajibi shamity, 4) Char Boalia matshyajibi shamity, 5) Syed pur matshyajibi shamity, 6) Rani nagar matshyajibi shamity, 7) Badai matshyajibi shamity and 8) Sharirvita matshyajibi shamity. The fishermen units each consist of about 30 members. Fishing was usually done once a day and preferably at night. Average duration of fishing was normally eight hours using local fishing implements. Fishing implements were country nets and other implements (dharma jal, jhaki jal, vashal jal, fansh jal, charo, and so forth). Due to lack of available fish, the yield was low (30 kg/??HA??/day) and the average fishing yield/day was 600 kg in the study area, which gives about 108,000 kg of fish a year when fishing every second day.

Capital

The main source of capital is a loan from Mahajon or an NGO's credit. In case of the Mahajoni loan, they have to repay with high interest and within a short time. But in case of an NGO loan, they can wait for some time before repaying. The maximum loan is normally not enough for them, though NGO charges lower interest than Mahajon.

Marketing opportunity

The fishermen groups in the study area are using local markets for fish marketing. Individual fishermen often sell their fish in the local bazaar or to the community in the villages.

Ownership of fishing implements

The fishermen rely heavily on local /indigenous fishing equipment, including several types of nets, traps and others. Most equipment belongs to them, made by threads, bamboo and other local resources**.**

Fishing practices

Fishermen in rural Bangladesh usually live in a community in the vicinity of water bodies. They cooperate closely among themselves in all sorts of social and livelihood activities. Most of the fishermen are primarily dependent on fishing. They use simple and traditional fishing equipment. For fishing in the inland waters the fishermen use non-motorised boats and traditional nets. The only touch of modern technology is the recent use of nylon nets. The practice of fishing may be an activity of an individual or a group of fishermen, but fishing equipment is normally owned by an individual and not by the group. The income from fishing is different, not only in accordance with the types of fishing practices, but also with the various seasons. The income level among the fishermen is differentially distributed. Thus, many fishermen have neither the possibility nor the capacity of improving their position.The life of fishermen in Bangladesh has changed gradually. Due to the decline of fishing grounds and fishery resources, members of the fishing communities have started to leave their traditional occupation in search of other jobs.

Sampling and data collection

A survey of the given areas was carried out over a period of three months from March to June 2010. A total of 70 semistructured and open structured questionnaires were administered randomly to adult males and females. The participants were selected randomly, and completion of questionnaires was facilitated through 'face-to-face' communication tools. The questionnaire included socio-demographic variables and a set of open-ended questions related to perceptions of respondents towards the loss of wetland biodiversity (Box 1).

Box 1. Questions presented to respondents to assess their perceptions of declining wetland biodiversity

1.	What are the resources (fish, animals, crops) available in your area and what is the present state of the wetlands?
2.	What are the common problems in your area, especially for wetland issues and livelihood issues?
3.	What are the major causes of wetland biodiversity loss in particular with fish resources and how will it improve?
4.	What can be done to involve women in wetland biodiversity conservation?
5.	Which type of assistance do you need for appropriate wetland biodiversity management?

Data analyses

Data were analysed using SPSS Version 16.0 (SPSS, Chicago, IL, USA). In this study, perceptions were related to level of occupation. The significance level was set at $p < 0.05$. Differences between perceptions were tested using Pearson's chi-square ($\chi 2$) test.

III. Results

Available wetland in the study areas

There about 33 water bodies in the study area (Table 1). These water bodies include rivers, canals, beels and burrowpits. The ownership of these water bodies/wetlands are of two types (khas and private). Lease systems prevail in the study area. Khas wetlands are managed by lease-delineating terms and conditions. Almost every water body has a connection point with others. All wetlands/ water bodies (including river, khal, beel and canal) are silted and lacking from storing of water during the dry season.

Present Status of Wetland Biodiversity

There are several species of fish, aquatic plants and crops were identified across the study areas (Table 2). Five types of rice, 11 of vegetables, 3 of pulse, 2 of oils and 2 of spices were recorded in the typical wetland and three types of cropping patterns (i.e., single cropping, double cropping and multiple cropping) were observed across the study areas. The farmers were normally growing monocrops followed by single-, and to some degree, double-cropping patterns. As a result, a vast area remains uncultivated during floods and, even in summer, due to flood and drought, respectively. Common fish species are found in local varieties of Kholisha, baila, kajuli (Jamuna ailia), Taki (spotted snakehead), tengra, boal (wallago), katol (catla), batashi (Indian potasi) mrigel, shing, gojar, ban, shol, tatkini, chingri, mola (mola carpet), chanda (toli shad), darika, kakila, koi (spiketail paradise-fish), punti (swamp barb), chela (silver razorbelly minnow) chang, veda, *Air*, *Gang Magur*, *Baim*, *Tara Baim*, *Gutum*, *Gulsha*, *Tengra*, *Titna*, *Garia*, *Beti*, *Kakila* etc. Common aquatic plants found in the wetland areas are: *Pistia stratiotes* (topapana), *Salvania natans*, *Potamogeton crispus* (keorali), *Aponogeton echinatus* (ghechu), *Nymphaea nouchali* (padma), *Trapa maximowiczii* (paniphal), *Phragmites kakra* (nal khagra), *Polygonumbarbatum* (bishkatali), *Barringtonia acutangula* (hijal), *Pongamia pinnata* (koroch), tetulpana, dhol kolmi, dall, bandhshola, motmoti, hijol, chul sheola, chechra grass, tuptupigrass, vadal grass,

Trapa natans, Vallisneria sp., *Potamogeton* sp., *Enhydra* sp., *Utricularia* sp. and *Nymphaea* spp. The terrestrial vegetation includes *Tamarix* sp., *Acacia nilotica, Bombax ceiba, Ficus* sp., *Dendrocalamus* sp., *Melia azadirachta, Calamus* sp., *Borassus flabellifer, Phoenix sylvestris, Musa* sp. and *Ipornoea* spp.

Problems perceived in the study area

Poverty, natural disasters, pollutions, lack of water and fish are the common features in the study area. All the respondents recognised that poverty is the top priority problem, followed by lack of fish, siltation of beels, chemical pollutions, lack of water, siltation of beel and natural disasters (drought, flood and cyclone) are the major problems (Table 3).

Loss of wetland biodiversity

Wetland biodiversity loss is occurring due to a number of factors, and no one is predominant. Threats to biodiversity are numerous and human activities are responsible for most of them. Over-population growth creates crucial threats to biodiversity by over-harvesting, clearing forests, interrupting natural processes and converting of land for industrial uses. Everyone agreed that population growth is the main reason for wetland biodiversity loss (Table 4)

Conversion of land affects biodiversity for agricultural production, residential and commercial uses; 82.8 % respondents identified that conversion of land for agriculture also leads to wetland biodiversity loss. On the other hand, hunting is another reason of wetland biodiversity loss. Pressure groups have also played a role in accelerating the process of wetland biodiversity loss. Indiscriminate uses of chemicals were responsible for the issue. Construction (embankment) works created obstacles to enter web-tide water during moonson, which leads to negative impacts on fisheries, aquatic resources and agrobiodiversity. Climate change is also responsible for wetland biodiversity loss (Table 4).

The number of fish species and volume of fish both are diminishing due to many factors, including lack of water, use of chemicals, fishing broods, use of current jal, lack of awareness, weak enforcement of fishing ACT and construction of dam/embankment. All respondents mentioned that lack of water around the year is a core cause in diminishing local fish (Table 5). Many factors are diminishing local fish as compared to the past, including indiscriminate use of chemicals, fishing broods, catching of pregnant mother fish, lack of awareness, use of current jal and creation of obstacles in the mouth of water bodies.

Measures for wetland biodiversity restoration

Biological diversity is essential for the survival and balancing of nature and humanity. It provides the basis for improvements of domesticated species maintains functions of ecosystem stores and cycles nutrients essentials for life. Now it is time to think about wetland biodiversity; and to take measures for wetland biodiversity restoration. Many people think differently. In the study 87.1 % of respondents agreed for re-excavation or digging of beels, canals and other water bodies (Table 6). Other measures, including planting of local varieties, conserving aquatic resources and declaration of fish sanctuary, were also mentioned by the respondents.

Role of women in wetland biodiversity restoration

It is now widespread known that women are the backbone of agricultural workforce (NRCWA 2004). Women's work is both wide ranging and multi-faceted throughout the year, and they perform multiple tasks in the sphere of agriculture. Women's indigenous knowledge and skills are vitally necessary for wetland biodiversity conservation and restoration; 95.7 % of respondents mentioned that women can play great roles in producing and preserving local seeds for wetland biodiversity conservation (Table 7). On the other hand, they can also play a vital role in creating family awareness, planting trees and child education on wetland biodiversity.

Support need

It is not an individual work. Greater awareness is crucial for the event. Everyone should have to play a role in conserving wetland biodiversity. Both coping with adaptation and improvement measures are required for wetland biodiversity conservation; 70 % of respondents mentioned that they need training in seed production and preservation, followed by cultivation, nursery, small trade and training in modern technology including information systems (Table 8).

IV. Discussion

Wetlands provide habitats for a variety of resident and migratory birds, and a large number of commercially important birds. Wetlands are the most fertile and productive ecosystems and important breeding grounds for birds and growing areas for fisheries. Millions of people depend on the wetland resources for their livelihoods, but, paradoxically, wetlands have been labelled as wastelands associated with disease, difficulty and danger. Wetlands have therefore been ignored for ages. Numerous development interventions like constructing

embankments, dams, hydraulic structures, roads, and so forth, have been going on since the 1960s for the country's economic development, particularly for increased agriculture production and improved road communication.The unplanned development interventions, as mentioned above, have led to a wide range of damage and extinction of the wetland ecology and resources causing significant negative impacts on the livelihoods. Bangladesh has traditionally been rich in fish stocks. The inland fisheries system is estimated to contribute almost 73 % of the total production and supplies 80 % of the country's animal protein requirements (Khan et al. 2009). According to Wood (1994), the experience with group access to water bodies has revealed the presence of other vested interest. Similar findings were found in the study area, many people have created fictitious groups in order to gain access to fishing rights.

Ahmed et al. (2008) reported that fisheries and agriculture are the two major livelihoods for local people living in and around wetlands, while other livelihood supports are provided by cattle grazing. Despite all these support to human livelihoods, many parts of the world have experienced loss or degradation of wetlands on a massive scale, because of agricultural use, urbanisation, excessive exploitation by local population (Karim 1993)**.** In Bangladesh, where inland water bodies constitute nearly 50 % of total land area (Khan et al. 1994), wetlands are critical to economic development and environmental improvement. The major role of wetlands are nutrient retention/removal, support for food chains, fisheries production, habitat for wildlife, recreation, natural heritage values, biomass production, water transport, biodiversity preservation and micro-climate stabilisation (Dugan 1990). The wetland environment unites the inhabitants into a society, which has a definite shape, culture and livelihood pattern. Over-exploitation of aquatic resources, destruction of habitats, unwise use of agrochemicals, land use conflict and conversion of land, construction of embankment and sluicegates are the major threats to wetland biodiversity. Recently, capture fish production has declined to about 50 %, with a negative trend of 1.24 %/year (Ahmed 1995). The popular and abundant local fish species have declined drastically due to the negative impact of wetland biodiversity loss.

V. Conclusion and Recommendations

Wetland biodiversity provides food, shelter, habitats and services to a greater extent and it is crucial for the survival and balance of nature and human welfare. Wetland resources and diversity form the basis of Bangladesh economy. The country's fisheries and agriculture, along with a number of aquatic resources, are supporting community livelihoods. Wetlands can play vital role by providing support for floating agriculture during flood season. People's active participation can secure wetland restoration. Nishat, A. 1993 pointed out that the degradation of wetlands in Bangladesh were mainly due to: increase of population and expansion of human habitats; expansion of agriculture and subsequent conversion of wetlands through drainage into rice fields; flood control and irrigation project for enhancement of agricultural productivity. In my study similar observation was found. Participatory wetland resource management or initiatives might save wetland biodiversity and aquatic resources. It is the critical time for wetland conservation and we need to undertake appropriate steps for its better management.

The pollution problems frequently initiate from 'abuse, misuse or cocktail' use of pesticides, and overdose and untimely application of fertilizers and from domestic wastes. All the rivers flowing through Bangladesh originate outside the country and these carry heavy loads of silt, sediments and other debris, including domestic, agrochemical and industrial wastes, from far-away places.

The following recommendations may consider for next steps planning:

Policy-level recommendations

- Public-private partnership co-management may restore wetland biodiversity and can reduce further degradation of wetland biodiversity.
- The critical wetland zones need to be declared as fish sanctuaries.
- Enforcment of fishing ACT.
- Need advocacy programme for wetland biodiversity restoration at national level.
- Need to ensure community participation in wetlands management.

Research level recommendation

The following study will help in the potential field of wetland biodiversity:

- Study of breeding status of endangered and threatened local fish species.
- Study of natural food availability for local fish species.
- Study of impacts of agro-chemicals on aquatic resources.

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Table 1 Available wetlands

	Name	Area (ha)	Legal	Own	Lease Period	Lease	Union	Type	Connectivity
01.	Atrai	20.28	Khas	G	N/A	N/A	Dulai, Ahmedpur, Rani Nagar	River	Isamoty River
02.	Atrai Borpit	8.11	K	G	N/A	N/A	Dulai, Ahammadpur,	Borpit	No Connectivity
03.	Jiel Gari	-	Private	P	N/A	N/A	Ahammadpur	Beel	Badai River
04.	Boro Beel	-	K	L	36 months	Bodya, Subhas, Mazid	Rainagar,Hatkhali,Ahmmadpur	Beel	Badai River
05.	Bara Sher Jola	1.29	P	P	N/A	N/A	Dulai	Segment of a beel	Badai River
06.	Kajir Khapa	-	P	P	N/A	N/A	Ahmmadpur	beel	
07.	Birahim Pur Baor	-	P	P	N/A	N/A	Ahammadpur	Baor	No Connectivity
08.	Chalkpatta (putigara)	84	P	P	N/A	N/A	Dulai	Beel	Badai River
09.	Kata Jola	1.35	P	P	N/A	N/A	Dulai	Segment of a beel	Badai River
10.	Gorar beel	128.3	K	L	36 months	Mr. Nawab Ali	Dulai	Beel	Badai River
11.	Kana Pukur	-	K	NL	N/A	N/A	Ahmmadpur	Pond	No connectivity
12.	Kolmi gara	-	P	P	N/A	N/A	Ahammadpur	Beel	Badai River
13.	Mati Kata	7.08	K	L	36 mon	Mr. Nawab Ali	Dulai	Beel	Badai River
14.	Loher Thali	7.35	K	L	36 months	Mr. Nawab Ali	Dulai	Beel	Badai River
15.	Kui bila	2.18	K	L	36 months	odya, Subhas, Mazid	Raninagr	Beel	Badai River
16.	Bokchor	-	K	L	36 months	odya, Subhas, Mazid	Raninagar	Beel	Badai River
17.	Boksher Jola	2.47	K	L	36 months	Bodya, Subhas, Mazid	Dulai	Segment of a beel	Badai River
18.	Jiai Nodi	-	K	L	36 months	Bodya, Subhas, Mazid	Raninagr	Segment of a beel	Badai River
19.	Jomer Thali	4.47	K	L	36 months	Bodya, Subhas, Mazid	Dulai	Beel	Badai River
20.	Laxman Thakurer par	-	K	L	36 months	Bodya, Subhas, Mazid	Raninagr	Beel	Badai River

21.	Bostaler Jola	-	K	L	36 months	Bodya,Sub has, Mazid	Raninagar	Segment of a beel	Badai River
22.	Sona patila	7.07	K	L	36 months	Bodya,Sub has, Mazid	Raningar	Beel	Badai River
23.	Lochu Mollar Jola	-	K	NL	N/A	N/A	Raninagar	Segment of a beel	Badai River
24.	Shuber Beel	-	K	NL	N/A	N/A	Raningar	Beel	Badai River
25.	Dighir Beel	-	K	NL	N/A	N/A	Ahmmadpur, Raninagar	Beel	Badai River
26.	Hiron Nodi	-	K	NL	N/A	N/A	Raninagar	Segment of a beel	Badai River
27.	Are Pother Jola	-	K	NL	N/A	N/A	Raninagar	Segment of a beel	Badai river
28.	Tepar Beel	-	P	P	N/A	N/A	Raninagar	Beel	Badai River
29	Icha Khalir Beel	-	P	P	N/A	N/A	Raninagar	Beel	Badai River
30.	Shohi baj	3.08	K	L	36 mon	Md. Nawab Ali	Dulai	Beel	Badai River
31.	Shanhai	-	P	NL	N/A	N/A	Ahmmadpur	Beel	Badai River
32.	Nangla khali	9.17	K	NL	N/A	N/A	Ahammadpur	Beel	Boalia canal
33.	Boalia Canal	-	K	NL	N/A	N/A	Ahammadpur	Canal	Dighir Beel

Table 2 *Cropping patterns in the wetland*

Description	
Crop season	3 seasons (Rabi, Kharif-1 and Kharif -2)
Major crops	Rice, vegetables, oil seeds, pulses, spices, wheat and sugarcane.
Vegetables	ladies finger (okra), cucumber, ridged gourd, bitter gourd, snake gourd, amaranth, brinjal, pumpkin, Indian spinach, taro, wax gourd, spinach, bottle gourd, yard-long bean, bean, tomato, potato, cauliflower, cabbage, kohlrabi, turnip, radish and carrot.
Spices	Ginger, onion, turmeric and chili.
Field crops	Rice, wheat, mustard, potato, sugarcane.
Vegetation and aquatic plants	kolmilata, water lily, lotus, shewla, dhol kolmi, dol, kuttar jihba, bhatshola, motmoti, hijol, chul shewla, chechre, bhadale, tupri, bil kahe, panifal, hizol tree, koros tree, rakhal sitka
Fish	sheat, climbing, fry, walking, magur, eel, cat, tatkini, mola, chanda, darika, kakila, mrigal, kholisha.
Commercial species	Crub, tortoise, kasim, frog, chip
Endangered/ threatened fish species	snail, jheenuk, lily, snake, crubs, frog, tepa fish, sharputi, meni, pabda, rani putul, magur, gojar, aeer, chapila, raik, mola, bash pata, batashi, boro ban, kali baush, chitol, foli, rita.

Table 3 *Problems in the study area*

Problem	**Fishermen N (%)**	**Farmers N (%)**	**Women N (%)**	**Elite N (%)**	**All N (%)**
Lack of fish	20 (100)	18 (90)	20 (100)	8 (80)	66 (94.3)
Siltation of the beel	18 (90)	20 (100)	16 (80)	7 (70)	61 (87.1)
Lack of water round the year	17 (85)	16 (80)	19 (95)	10 (100)	62 (88.6)
Pollution by using chemicals	20 (100)	17 (85)	18 (90)	10 (100)	65 (92.9)
Disaster (Drought, flood, cyclone)	20 (100)	15 (75)	10 (50)	5 (50)	50 (71.4)
Poverty	20 (100)	20 (100)	20 (100)	10 (100)	70 (100)

Table 4 *Causes of wetland biodiversity loss*

Causes	**Fishermen N (%)**	**Farmers N (%)**	**Women N (%)**	**Elite N (%)**	**All N (%)**
Population growth	20 (100)	20 (100)	20 (100)	10 (100)	70 (100)
Climate change	19 (95)	17 (85)	11 (55)	7 (70)	54 (77.1)
Conversion of land for agriculture	20 (100)	10 (50)	18 (90)	10 (100)	58 (82.9)
Hunting of birds	15 (75)	11 (55)	10 (50)	8 (80)	44 (62.9)
Encroachment by pressure group	20 (100)	14 (70)	-	5 (50)	39 (55.7)
Indiscriminate uses of chemicals	20 (100)	12 (60)	17 (85)	10 (100)	59 (84.3)
Desertification	14 (70)	18 (90)	11 (55)	8 (80)	51 (72.9)
Embankment	20 (100)	10 (50)	9 (45)	7 (70)	46 (65.7)

Table 5 *Major causes for diminishing local fishes*

Causes	**Fishermen N (%)**	**Farmers N (%)**	**Women N (%)**	**Elite N (%)**	**All N (%)**
Lack of water around the year	20 (100)	20 (100)	20 (100)	10 (100)	70 (100)
Fishing through drying of beel	19 (95)	15 (75)	16 (80)	6 (60)	56 (80)
Chemicals use in fishing	18 (90)	16 (80)	19 (95)	7 (70)	60 (85.7)
Fishing broods	20 (100)	20 (100)	19 (95)	8 (80)	67 (95.7)
Lack of awareness	15 (75)	15 (75)	11 (55)	7 (70)	48 (68.6)
Use of current jal	18 (90)	14 (70)	14 (70)	8 (80)	54 (77.1)
Fishing of mother fishes	20 (100)	18 (90)	17 (85)	9 (90)	64 (91.4)
Obstacle in entering water	19 (95)	14 (70)	10 (50)	6 (60)	49 (70)
Disobey the fishing ACT	14 (70)	10 (50)	-	7 (70)	31 (44.3)

Table 6 *Measures for wetland biodiversity restoration*

Measures	**Fishermen N (%)**	**Farmers N (%)**	**Women N (%)**	**Elite N (%)**	**All N (%)**
Re-excavation of beel/water bodies	20 (100)	16 (80)	15 (75)	10 (100)	61 (87.1)
Planting of local variety	19 (95)	20 (100)	10 (50)	9 (90)	58 (82.9)
Conserving aquatic resources	20 (100)	20 (100)	10 (50)	10 (100)	60 (85.7)
Declaration fish sancuary	15 (75)	15 (75)	-	5 (50)	35 (50)

Table 7 *Role of woment in wetland biodiversity restoration*

Activity	**Fishermen N (%)**	**Farmers N (%)**	**Women N (%)**	**Elite N (%)**	**All N (%)**
Raising family awareness	20 (100)	10 (50)	15 (75)	8 (80)	53 (75.7)
Planting trees	15 (75)	20 (100)	10 (50)	7 (70)	52 (74.3)
Child education on biodiversity	10 (50)	11 (55)	5 (25)	9 (90)	35 (50)
Producing & preserving local seeds	20 (100)	19 (95)	18 (90)	10 (100)	67 (95.7)

Table *8 Training required*

Training	**Fisherme n N (%)**	**Farmers N (%)**	**Women N (%)**	**Elite N (%)**	**All N (%)**
Training in cultivation	10 (50)	20 (100)	11 (55)	7 (70)	48 (68.6)
Training in nursery	8 (40)	15 (75)	16 (80)	8 (80)	47 (67.1)
Training in seed preservation	11 (55)	11 (55)	18 (90)	9 (90)	49 (70)
Training in modern technology	11 (55)	5 (25)	3 (15)	5 (50)	24 (34.3)
Training in small trade	10 (50)	9 (45)	5 (25)	6 (60)	30 (42.9)