

Community Based Assessment of the Changes of Provisioning Ecosystem Services of Aral Haor of Sylhet District



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ABSTRACT: Haor is a well-known wetland feature in Bangladesh because of its dynamic ecosystem which is changeable with the seasonal variation. The majority people of the community are critically dependent on the haor. This paper attempts to analyse the provisioning ecosystem services of Aral Haor of Sylhet District, their changes and why the changes occurred during the last 30 years since 1990 to 2020 through community assessment. The papers argues that the community based approach integrates the local people to reveal the actual scenario of the livelihood dependency on the provision ecosystem services as they are the main user of the provisioning services. Thus the primary data were collected through observation, FGD, Community Mapping and interview with experts. The study found that community the service providing area of the Aral haor have not been changed in mentionable level over the 30 years, however the shape of the haor have been changed slightly due to high sedimentation. Along with rice cultivation during dry season, natural irrigation, fishing and bird nesting were most important to provisoing services to the community which have been changes due to both natural and anthropogenic activities. The study concludes that even having importance of the Aral hoar, not any measurer has been taken by local authority to conserve the Aral hoar ecosystem services those are very vital for the livelihood of the thousands of community people living nearby.

KEYWORDS: Haor, Ecosystem services, community based assessment, haor fish, and migratory birds.

I. INTRODUCTION

Bangladesh is called a land of water, lies in the largest delta (the Bengal Basin) in the world [1]. It is estimated that the total area of wetlands in Bangladesh are of 7-8 million hectares which is about 50% of its entire land surface [2]. These wetlands include rivers and streams, freshwater lakes and marshes, haors, baors, beels, water storage reservoirs, fish ponds, flooded cultivated fields and estuarine systems with extensive mangrove swamps. Among different wetlands in the country, the haors, baors, jheels and beels are known as freshwater wetlands because of their fluvial origin [3]. Haors are large bowl shaped floodplain depressions having some unique hydro-ecological characteristics located mostly in the north-eastern region of Bangladesh covering about 1.99 million ha (19,998 sq km) of area and accommodating about 19.37 million people [4]. There are 373 haors located in the districts of Sunamganj, Sylhet, Habiganj, Maulvibazar, Netrakona, Kishoreganj and Brahmanbaria, covering an area of about 859,000 ha which constituted around 43% of the total area of the Haor districts.

Haor is a mosaic of wetland habitats including rivers, streams, canals, large areas of seasonally flooded cultivated plains and beels. The physical setting and hydrology of the haor region have created innumerable opportunities as well as constraints for the inhabitants of the haor. Haor wetland include some of the world's most productive ecosystems and provide ecosystem services leading to countless benefits [5][6] and keeping ecological balance of ecosystems [7][8]. The local community in the north-eastern region of Bangladesh are mostly depended on the provisioning ecosystem services (PES) for their daily livelihood and wellbeing [9][5]. The haors play unique roles in the landscape by providing unique habitat for a wide variety of flora and fauna and by regulating water resources for utilization of indigenous community [10].

This paper attempts to assess the livelihood dependency on the provisioning ecosystem services of Aral Haor of Sylhet District and what the changes occurred during the last 30 years. Based on community assessment at first, this paper identified the provisioning services of Aral haor those are related with the community wellbeing. Secondly, the changes of the provisioning service providing area from 1990 to 2020 were mapped using community perception along with an assessment of the changes of the provisioning services over the last thirty years. Finally, the paper examines the cause and effect of the changes of the major provisioning services of the Aral haor within the studied period.

II. SITE DESCRIPTION

The Aral haor (locally known as Arali beel) lies roughly between 24° 51'11.24"N - 24° 52'19.15"N and 92° 02'47.25"E - 92° 03'45.05"E and is situated about 20 km east of Sylhet district in Bangladesh (Figure 1). The haor is bounded by Surma River on

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the north, Amura union on the south, Alinagar union on the east, Golapganj Upazilla on the west. It is a very small haor having an area of only 442 ha [4]. Administratively the haor is located in Glopaganj union within five mouzas; Chandanbagh, Fazilpur, Ghogarkul, Goyashpur and Manjurabad. According to the census 2011, Golapganj Union has a population of 19,785 where 50.94% of the population are males and 49.06% females. Average Household size 6.23 person and population density is 1136 person per km². Golapganj union has an average literacy rate of 57.27%. The region enjoys rainfall almost every day. The average annual rainfall is about 3,768 mm/y. The driest month is December when average 7 mm rainfall occurs. In June, about 752 mm average rainfall occurs. The haor water start to increase from the first week of April and remain stable from the middle of May till September. The haor receives water by Surma River. The recession of haor water starts from the first week of October and ends in the middle of November.

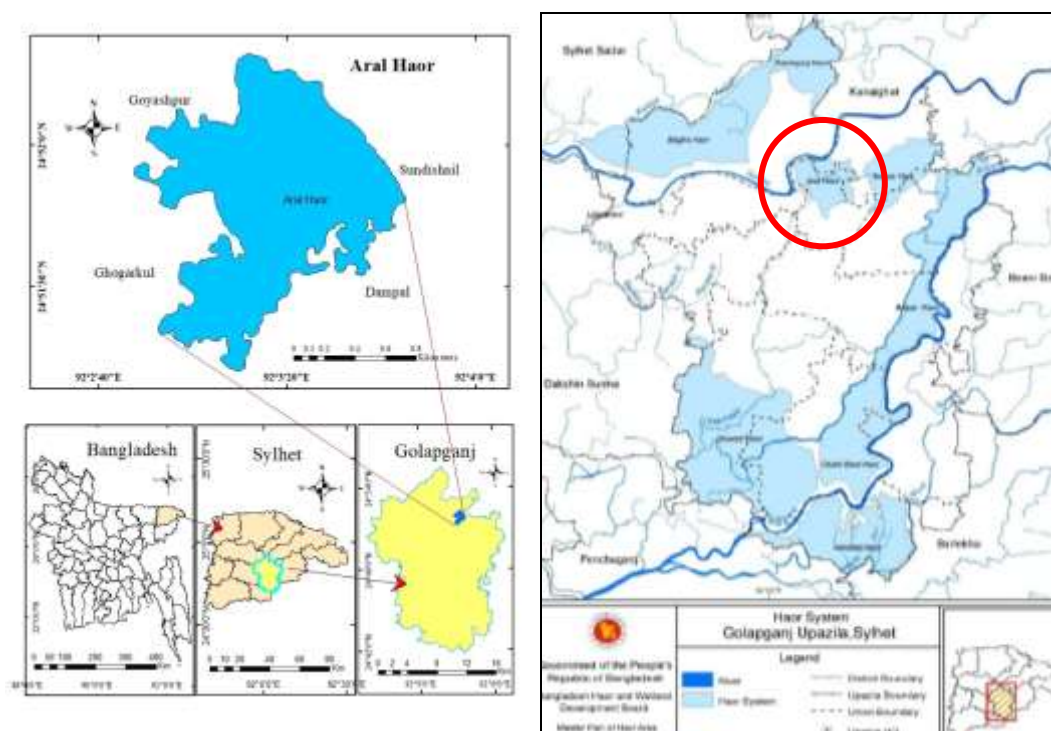


Figure 1: Map of Aral Haor, Sylhet.

III. METHODOLOGY

This research adopted participatory methods for primary data collection. Primary data were collected through observation, FGD, Community Mapping and interview with experts. Secondary data from different authentic sources was used substantially. An intensive field work was carried out in 2020. A based of Aral haor was prepared from topo map on 1:16 scale before going to the field work.

During field survey, an intensive observation was done at first in order to make a preliminary inventory of the provisioning services of Aral haor with the help of group of community peoples living nearby villages and who are directly related to haor resources for their daily livelihood. During observation, informal discussions were done with the community people. In second stage, a community mapping was performed to map the ecosystem service providing area of 1990 and 2020 to visualize the changes over time. A total of 20 community people disaggregated to sex and age were participated in community mapping exercise and expressed their knowledge, experience during mapping of provisioning service zones. The research argues that as the study area Aral haor, in its areal extent, is not big wetland, the community people were aware of the different ecosystem services, the changes of areal extent of service provisioning areas including the activities occurring in the haor. Finally, four FGDs were done with four district groups like male group, women groups, adolescent mixed group and older people (more than 50 years) group. In each group 6 to 8 participants were attended and participants were selected snowball sampling methods with the basis of the occupation, experience and sphere of knowledge related to the haor. The available key ecosystem services, how the neighbourhood community depends on those services, what changes have occurred in the key ecosystem services including the major biodiversity changes during last two decades and what are the causes of these changes were mainly explored through FGDs.

For data analysis, maps produced by the community were finalized by proper scale in ArcGIS 10.6 version and then descriptive statistics was generated for the changes of the Aral haor's areal extent of provisioning area. Qualitative data was analyzed

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through standard qualitative data analysis tool by content, narrative, discourse analysis and phenomenology having a grounded theory approach. Perceptual tables were also generated on present status of the major flora and fauna of the Aral haor.

IV. RESULT AND DISCUSSION

A. Provisioning ecosystem services of Aral Haor related with community wellbeing

The Aral haor provides much diversified provisioning services as the haor functions both land and wetland ecosystem. The haor functions as a land ecosystem during the dry season from November to March and as wetland ecosystem it gives the services from first week of April till September each year. The haor receives water by *Surma* River during this wet season, and the recession of haor water starts from the first week of October and ends in the middle of November. The provisioning services related to community wellbeing have enlisted (table 1) along with their seasonal availability. The community living nearby the the Aral haor have identified four key provisioning ecosystem services such as agriculture, natural vegetation, water supply and bird nesting. According to the table 1, community people agreed with the highly importance of rice cultivation in the haor. Along with the rice cultivation, natural irrigation, fishing and bird nesting were most important to them. During the middle of November when the water recession starts, farmers built land dividers to store water for irrigation into the rice fields. Haor also being used as a grazing land for domestic animals like cow, buffalo, goats, etc. which common scenario of haor region. Rearing these animals in the haor grazing land was moderately important provisioning service to the community. When the haor filled up with water, fish became highly available. The haor also provide habitat to both local and migratory birds.

Table 1: Provisioning ES Related to Community Wellbeing

Provisioning Services	Availability		Relative importance for community
	Dry Season	Wet Season	
Rice cultivation	High	Not available	Highly
Vegetable cultivation	Moderate	Not available	Moderately
Reared Animals	Moderate	Low	Moderately
Fish Farming	Low	High	Highly
Plants and algae from in situ aquaculture	low	High	Moderately
Birds Nesting	Moderate	High	Highly
Water for domestic use	Low	Moderate	Less
Water for irrigation	Moderate	Not	Highly

Source: field survey, 2020

Vegetation cultivation and the plants and algae from in situ aquaculture were found moderately important. Local people generally cultivate vegetables in the front yard or back yard of their houses. During dry season very few vegetables for example pumpkin, gourd, bean; chili and spinaches are cultivated on the edge of the haor boundary. In wet season, some aquaculture species such as *kalmi*, *helencha* and water lily become available. Moreover, duckweed and water hyacinth are used as food to the domestic animals. People rarely use haor water for domestic purpose like bathing or washing belongings and became less important to community.

B. Changes of Service providing area (SPA) from 1990

The service providing area of the Aral haor, have not been changed too much over the 30 years, however the shape of the haor slightly have been changed (see Figure 2a and 2b). The community reveals that sedimentation was the primary underlying reason of the changes of the shape of the haor. In context of the total area, the haor area was decreased by only 2 hectare whereas the beel area was decreased by 11 hectare from 1990, now a days is being used as as cropland (Table 2).

Table 2: Changes of Service Providing Area (SPA) in Aral haor.

Service Providing Area (SPA)	At 1990 (hectare)	At present (hectare)
Haor	161	159
Beel	67	56
Crop land	85	94
Grazing land	6	6
Islands	3	3

Source: Field survey, 2020

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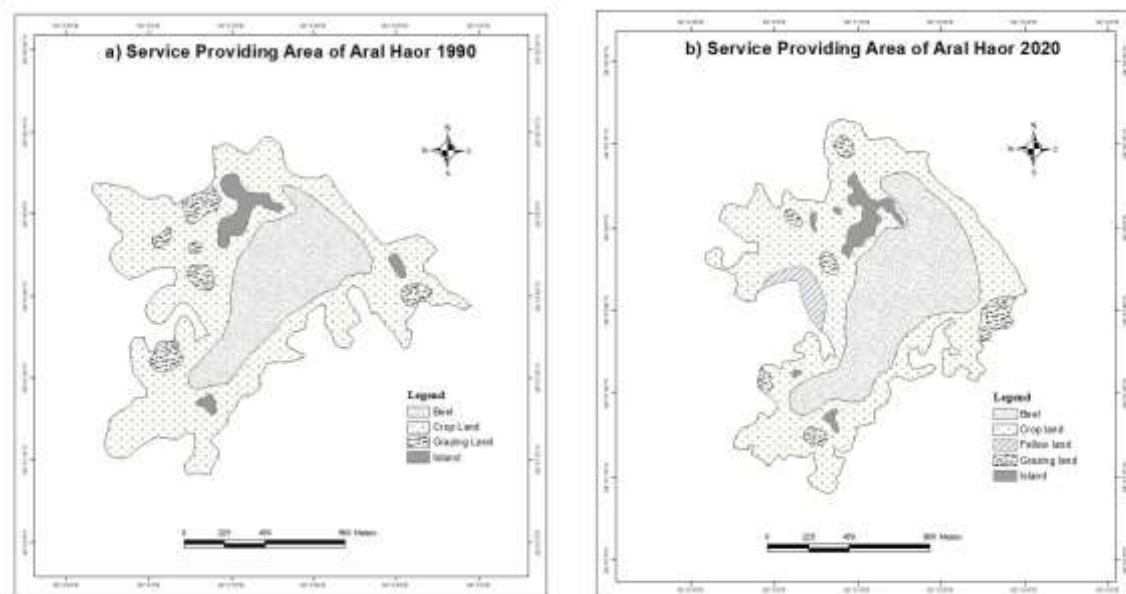


Figure 2: Service providing area of Aral haor in a) 1990 and b) 2020.

Source: Author, 2020

C. Changes of provisioning services

Though the providing area of the Aral haor have not been changed in mentionable account, the provisioning services have changed over the years which either positively or negatively impacted the livelihood of the community. The major changes that were found among the different provisioning services of the haor during the last 30 years were identified through the community people assessment is given in Table 3.

Table 3: Changes of Provisioning Services in Aral Haor.

Provisioning services	At 1990	At present (2019)	Remarks
Rice cultivation	Medium	High	Increased
Vegetable cultivation	Low	Low	No change
Reared animals	Medium	High	Increased
Fish cultivation	High	Medium	Decreased
plants from in situ aquaculture	Medium	Medium	No change
Water for domestic use	High	Low	Decreased
Water for irrigation	High	High	No change
Birds nesting	High	Medium	Decreased

Source: Field survey, 2020

Rice cultivation was medium in the decades of 90's which eventually increased by 2020, followed by the reared animals. ON the other hand, the vegetable cultivation was low in 1990's and remained same at present. Fish, a major provisioning services was provided by any haor was also found a great importance to the community. About 30 years ago, the provision of fish in the Aral haor was very high. But gradually, the provision of fish in the haor became decreased. Besides, many local variety of fishes that were abundant in the past are now rarely found in the haor (see Table 4).

Table 4: Changes of fish varieties in Aral haor.

SI	Local	English name	Scientific name	Remarks
1.	Rui	Indian major carp	Labeo rohita	Rare
2.	Catla	Indian major carp	Jubilant catla	Common
3.	Kali baush	Black rohu	Labeo calbasu	Abundant

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4.	Mrigal	Indian major carp	Cirrhinus cirrhosus	Rare
5.	Gonia	Kuria labio	Labeo gonius	Abundant
6.	Silver carp	Silver carp	Hypophthalmichthys molitrix	Common
7.	Grass carp	Grass carp	Ctenopharyngodon idella	Common
8.	Carpio	Common carp	Cyprinus carpio	Abundant
9.	Shol	Snakehead murrel	Channa striatus	Abundant
10.	Taki	Spotted snakehead	Channa punctatus	Abundant
11.	Chang	Asiatic snakehead	Channa orientalis	Rare
12.	Gajar	Giant snakehead	Channa marulius	Rare
13.	Khalisha	Striped gourami	Colisa fasciatus	Rare
14.	Chuna khalisha	Honey gourami	Colisa chuna	Rare
15.	Lal khalisha	Red gourami	Colisa lalia	Rare
16.	Koi	Climbing perch	Anabus testudineus	Common
17.	Kata chanda	Round glass perchlet	Chanda baculis	Abundant
18.	Lal chanda	Indian glass perch	Chanda ranga	Rare
19.	Nama chanda	Elongated glass perchlet	Chanda nama	Abundant
20.	Meni	Mud Perch	Nandus nandus	Abundant
21.	Guchi baim	Striped spiny eel	Mastacembelus pancalus	Abundant
22.	Tara baim	One striped spiny eel	Macrognathus aculeatus	Abundant
23.	Lal baim	Tire-track spiny eel	Mastacembelus armatus	Abundant
24.	Gulsha	Long whiskered catfish	Mystus gulio	Common
25.	Bujuri	Long bled catfish	Mystus tengra	Abundant
26.	Tengra	Striped dwarf catfish	Mystus vittatus	Abundant
27.	Air	Long whiskered catfish	Sperata aor	Rare
28.	Magur	Walking catfish	Clarius batrachus	Abundant
29.	Shing	Stinging catfish	Heteropneustes fossilis	Abundant
30.	Batashi	River catfish	Pseudeutropius atherinoides	Common
31.	Bashpata	Gangetic ailia	Ailia coila	Common
32.	Bacha	River catfish	Eutropiichthys vacha	Rare
33.	Modhu pabda	Butter catfish	Ompok pabda	Common
34.	Boal	Freshwater shark	Wallago attu	Abundant
35.	Phul chela	Barb	Chela phulo	Rare
36.	Lamba chela	Barb	Chela bacaila	Rare
37.	Mola	Barb	Amblypharyngodon mola	Common
38.	Dhela	Barb	Rohtee cotio	Rare
39.	Jatpunti	Spot fin swamp barb	Puntius sophore	Abundant
40.	Tit punti	Fire fin barb	Puntius ticto	Abundant
41.	Darkina	Top minnow	Esomus dandricus	Rare
42.	Chapila	Indian river shad	Gudusia chapra	Abundant
43.	Kakila	Freshwater gar fish	Xenentodon cancila	Abundant
44.	Gutum	Guntea loach	Lepidocephalus guntea	Rare
45.	Baila/bele	Bar-eyed goby	Glossogobius giuris	Common
46.	Chitol	Humped feather back	Notopterus chitala	Rare
47.	Golda	River prawn	Macrobrachium	Rare
48.	Gura chingri	Monsoon river	Macrobrachium	Abundant
49.	Choto tepa	Oscillated puffer fish	Tetraodon cutcutia	Abundant
50.	Telapia	Telapia	Oreochromis	Common

Source: Field survey, 2020

Migratory birds from different parts of the world come to Bangladesh, especially to wetlands known as "haor" and "beel". During winter, the wetlands in higher altitudes dry up, and local birds from the hills fly down to flat wetlands, bottom hillocks and open fields. Some of these migratory birds also came to the Aral haor. A variety of migratory birds used to come to the haor. But

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in recent times the diversity of migratory birds have decreased in the haor. Table 5 shows the condition of the migratory birds in this area. The birds visited the haor more frequently classified as common whereas the birds which rarely have seen in the haor were classified as rare. The birds that can be seen regularly were classified as abundant. Abdul Karim Kim, general secretary of Bangladesh Paribesh Andolon's (Bapa) Sylhet chapter, said to the Daily Star correspondents, "Poachers are mainly hunting different kinds of local and migratory birds like wild ducks, Indian Pond Heron (kani bok), eastern great egret (dhobol bok), Asian openbill stork (shamuk khol) etc. They are also particularly hunting down doves, common myna (shalik), bronze-winged jacana (jolphipi) and many other varieties" [11].

Table 5: Changes of bird's species in Aral haor.

SI	Birds name (English)	Scientific name	Remarks
1.	Indian pond heron	<i>Ardeola grayii</i>	Abundant
2.	Green sandpiper	<i>Tringa ochropus</i>	Abundant
3.	Gadwall	<i>Mareca strepera</i>	Abundant
4.	Intermediate egret	<i>Ardea intermedia</i>	Common
5.	Eurasian wigeon	<i>Mareca penelope</i>	Abundant
6.	Common kingfisher	<i>Alcedo atthis</i>	Abundant
7.	Cotton pygmy-goose	<i>Nettapus coromandelianus</i>	Rare
8.	Brown-headed gull	<i>Chroicocephalus brunnicephalus</i>	Rare
9.	Garganey	<i>Spatula querquedula</i>	Common
10.	Black drongo	<i>Dicrurus macrocercus</i>	Abundant
11.	Little cormorant	<i>Microcarbo niger</i>	Common
12.	Common moorhen	<i>Gallinula chloropus</i>	Rare
13.	Eurasian coot	<i>Fulica atra</i>	Rare
14.	Grey heron	<i>Ardea cinerea</i>	Abundant
15.	Little grebe	<i>Tachybaptus ruficollis</i>	Common
16.	Striated grassbird	<i>Megalurus palustris</i>	Abundant
17.	Spotted redshank	<i>Tringa erythropus</i>	Common
18.	Little egret	<i>Egretta garzetta</i>	Abundant
19.	Tufted duck	<i>Aythya fuligula</i>	Abundant
20.	Great crested grebe	<i>Podiceps cristatus</i>	Rare
21.	Red crested pochard	<i>Netta rufina</i>	Common
22.	Common sandpiper	<i>Actitis hypoleucos</i>	Common
23.	Great cormorant	<i>Phalacrocorax carbo</i>	Rare
24.	Grey headed lapwing	<i>Vanellus cinereus</i>	Rare
25.	Pied kingfisher	<i>Ceryle rudis</i>	Rare

Source: Field survey, 2020

The use of water for the domestic purpose became decreased whereas for irrigation remained same. The provision of aquatic vegetation of Aral haor haven't changed too much. At present days, people prefer roads instead of waterway for transportation.

D. Causes of the changes in provisioning services

The paper also identified the causes of the changes of the provisioning services of the Aral hoar through community assessment, given in Table 6. The community people were reported both various natural and anthropogenic causes responsible for the changes. As the major changes have occurred regarding rice provision, fish provision and birds nesting that's why the causes of the changes in those provisioning services have presented in this paper.

Table 6: Major causes of the changes in provisioning services in Aral Haor.

Changed provisioning services	Causes of changes	Impacts of changes
Rice cultivation	GM crops The introduction of GM (Genetically Modified) crops have increased the yield of rice production. Now a days highly cultivated rice varieties were BR28, BR29 and Ranjit as the production rate was very high. As	Increased rice production
		Local rice variety decreased

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	a result the local rice varieties have decreased.	
	<p>Sedimentation in Haor During monsoon, the upstream water used to bring sediments with it. These sediments settled down into the haor. Due to the sedimentation, the beel zone of the haor have decreased. On the contrary, the rice field have increased which results in higher rice production in the haor.</p>	Increased rice cultivation Beel area decreased
	<p>Change of season In recent years, the arrival of the monsoon season have changed. The monsoon period became shorter than before. As a result, farmers got much time for rice harvesting. Few years ago, the rice field of the haor remained inundated till mid-October. But at present days, the inundation level became decreasing from mid-September.</p>	Extended dry season results in higher crop production
Fish cultivation	<p>Lease system The wetland (Jolmohol) of the Aral haor were part of the lease system. The lease system was a major problem not only to the fisherman's of the haor but also for the fish diversity of the haor. Noted economist Prof Abul Barkat presented a survey result titled, "Haor Ruling System of Bangladesh and the Rights of Haor People" in which he said, "Although poor fishermen have ethical and legal rights on haor, rich and influential lessees continue to occupy those. The fishermen cannot even participate in the leasing process. As a result, they have no other option but to sell license of their associations to influential people, who subsequently lease the waterbodies" [12].</p>	Fish varieties decreased
	<p>Over exploitation The leaseholders cultivated fish in the haor. Instead of natural food, they feed the fish readymade foods. Readymade foods helps to grow fish faster than the natural foods. As soon as the fish have grown, the leaseholder catches them and sell them to the market. This process have been going on from a long period of time. Thus the over exploitation of the fish of the haor exert pressure on the ecosystem. The natural ecosystem for fish have been destroying gradually.</p>	Fish becomes threatened
Birds' nesting	<p>Birds poaching Indiscriminate hunting, trapping and selling of local and migratory birds at different upazilas in Sylhet was posing a serious threat to nature and biodiversity. Rampant poaching by professional and amateur hunters became quite unruly during winter, starting from mid-October to mid-March, all over the division. Buying and selling of birds became rampant on Dhaka-Sylhet highway [13]. Bird hunter Mirazul islam, 28, a resident of Golapganj upazila, said he earns a livelihood for his four-member family by selling the birds. In order to hunt birds from haor areas, and trees, he use electrical nets to trap the birds.</p>	Birds becomes threatened
	<p>Habitat destruction The activity of the local community such as cutting down the branches of trees, bushes, bamboo trees have destroyed the habitat of the birds. The destruction of the natural habitat of the birds forced them to migrate.</p>	Birds migration

Source: Field survey, 2020.

V. CONCLUSION

This research concludes that the livelihood of the community people mostly depends on the provisioning ecosystem services of haor. With the change of seasons, the functionality of haor ecosystem changed, thus the habitats, landscape elements as well as the

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land use pattern are also changed. The intensity of the service provision of rice and fish have increased throughout the last thirty years but the diversity have decreased due to mostly the anthropogenic causes. In order to restore the biodiversity the Government, NGO's and the local community should work altogether. Certainly, many plans and actions might have taken by Governmental as well as Non- Governmental Organizations and some are now ongoing. So far as we see that, all the wetland restoring and conservation projects in the county mainly focused on the large haors like Tanguar or Hakaluki Haor, small isolated haor like Aral haor are mostly neglected by the authority. And most of the cases, implementation of the top-down plans may go in vein without the involvement of the local community. But the community based approach integrates the local people to reveal the actual scenario of the livelihood dependency on the provision ecosystem services as they are the main user of the provisioning services. Thus this papers recommended that government should take proper planning and actions to conserve the small and local level haors and other wetlands in the country to make them sustainable in one hand, and on the hand to make alive for the community who are solely depended on the wetland resources.

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