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Landscape Change Of Wetland And Its Impact On Surrounding Environment: A Case Study Of 46 No. Morakolong Beel Of Morigaon District, Assam

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Abstract
Wetlands have been identified as one of the most important natural resources, which are associated with the distribution of human settlements. According to U.S definition (1956) the term 'wetlands' refers to lowlands covered with shallow and sometimes temporary or intermittent waters. They are referred to as marshes, swamps, bogs, wet, meadows, potholes and river over flow lands etc. Wetlands are important features in the landscape that provide numerous beneficial services for people, wildlife, fish and other aquatic life. Some of these services or functions include protecting and improving water quality, providing fish and wildlife habitats, storing flood waters maintaining surface water flow during dry periods and opportunities for recreation and aesthetic appreciation. Morigaon district with 183 wetlands (with unit area of over 2.5 hectares, (ARSAC), is ranked highest among all districts of Assam in context to area under wetlands. 46 No. Morakolong Beel is located in the southern parts of Morigaon district at latitude 26 ^{0}13`50`` N to 26 $^0$14`47``N and longitude 92 ^{0}18`27`` E to 92 $^0$19`52`` E. The increasing population growth as well as the developmental activities have led to loss of biodiversity, change in landscape and decreased the natural balance of wetland environment. Hence the present paper is an attempt to identify the changes has been taking place under the influence of several developmental activities and to suggest conservation plans for sustainable development. The changes have been identified based on the comparison of topographical map, satellite imageries, remote sensing data, Google earth image and field data.
Keywords: *46 No. Morakolong Beel, Biodiversity, wetland, landscape, Sustainable development.*

INTRODUCTION

The wetlands have been identified as one of the most important natural resources, which are associated with the distribution of human settlements. The Ramsar Convention (1971) defines the wetlands as, "areas of marsh, fen, peat land or water bodies whether natural or artificial, permanent or temporary with water that is static or flowing, fresh or brackish or salt including areas of marine water, the depth of which at low tide, does not exceed 6 metres (20 ft)." In Assam lake like natural water bodies are locally known as 'beel' while marshes and swamps are generally known as 'Jalah', 'doloni', 'pitoni','doba', or 'hola' (Sharma, 1993).

Morigaon district with 183 wetlands (ARSAC) is ranked highest among all districts of Assam in context to area under wetlands. It is also ranked highest amongst all districts of the state in the context of the percentage of population (11%) being dependent on the wetlands for their livelihood. Therefore, the present study entitled, "Landscape change of wetland and its impact on surrounding environment: A case study of 46 No. Morakolong Beel of Morigaon District, Assam", will be significant towards assessing the ecological and economic importance of the wetlands for the dependent communities of the district and finding out effective solutions to prevent the wetlands from degradation and loss.

The 46 No Morakolong beel located in the southern parts of Morigaon district. It extends between 92°18`28``E-92°19`52``E longitude and 26°13`49``N- 26°14`46``N latitude. The beel was created by Kolong River, which is one, the largest rivers flowing through this sub-zone. The total area of the beel is 78 ha. This is registered beel under the administrative control of the Assam Fisheries Development Corporation (AFDC), Guwahati and is leased to local fishers` cooperative society time to time.

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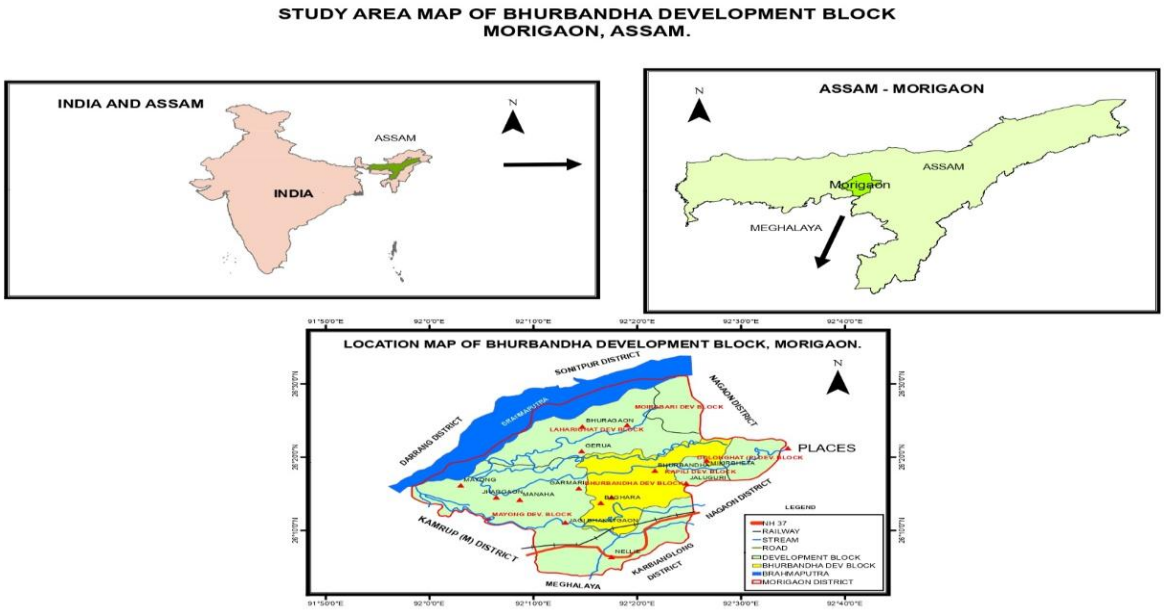

Figure 1: Location of the study area
Source: GIS based study

MATERIAL AND METHODS

The present study is based on data from both primary and secondary sources as an integrated approach of using Remote Sensing (RS) and Geographical Information System (GIS) techniques and field based data collection and analysis i.e., socio-economic data, physical characteristics data etc. Secondary data has been collected from the Census of India (2011), Statistical Handbook of Assam (2001,2011,2021), Statistical Handbook of Morigaon district(2001,2011,2021), Economic Survey of Assam (2001-2021), Assam Fishery Development Corporation Office, Assam Remote Sensing Application Centre (ARSAC), Guwahati, Village Panchayat Offices of Bhurbandha Development Block, Morigaon District Fishery Office, Meteorological Research Centre, Guwahati etc. A Superimposed Map has been generated by combining multiple layers in Arc GIS 10.8 environment. This aims at visualizing how the boundaries have changed geographically. LULC maps have been prepared for the year 2001, 2011 and 2021 depicting the decadal change in wetland morphology along with its 2 kms buffer areas. These maps are crucial for assessing the factors affecting LULC change in the wetland and for informing sustainable practices. Normalized Difference Vegetation Index (NDVI) has been calculated in Arc GIS 10.8 environment of 46 No. Morakolong Beel for the year 2021. This map highlights the density and health of vegetation within 2 kms buffer areas. Primary data has been collected through a household survey with the help of a well-designed schedule cum questionnaire and discussion with local people related to the beel especially the leaseholders of the beel.

Dataset used:

- The base map of the study area is carried out from the SOI topographical sheets with number of 83B/6, 83B/7, 83B/8 and 83B/9 at 1: 50,000 scale.
- Wetland identified from SOI Toposheet of 1970 and verified with the help of GPS tools.
- Landsat -8 satellite imagery is used for Normalized Differential Vegetation Index (NDVI) analysis, which allows generating vegetation map of the study area in Morigaon district.
- Registration of topographical sheet using UTM/WGS84 Projection System.
- Subset operation of satellite imageries of 2001, 2011 and 2021 have performed by ERDAS imagines 9.2 software and Arc GIS 10.8.

RESULTS AND DISCUSSION

Morphological Characteristics:

Wetland morphology refers to the shape, size, depth, inundation pattern, the hydrological system of the wetlands. These characteristics are influenced by the location, slope, hydrology, geology, etc. of the wetlands.

Depth:

Depth is one of the very important factors of wetland health. When the depth is more of a particular wetland the beel ecology becomes stronger because these beels have more water-retaining capacity. The beel of the study area are found to be shallow. On rainy days the beel are filled with water and the depth increases but in the dry season, the beel become completely dry and become grazing land. According to the Central Inland Fishery Research Institute (Barrackpore, 2000), the depth of the beels is categorized into three types i.e. shallow beels, medium depth beels, and deep beel. Shallow beels are beels which have a depth from 0 to 3 meter. Beels which having maximum water in the range of 3 to 10 meter are considered as medium depth beel and the beel having a depth over 10 meters can be considered as deep beel. 46 No Morakolong beel comes under medium depth beel categories.

Inlet – outlet connection:

Inlet – outlet channels are an important part of the health of floodplain wetland. These are called feeder channels also. The ecology of a floodplain wetland highly depends upon the inlet-outlet connection. The feeder channel which connects the beel with the river can be considered as the lifeline of the wetland. Pokoriya River originates from the Kolong River is the feeder river for 46 No Morakolong Beel.

Fish can enter into the beel through the feeder channel which ultimately breeds in the beels. The productivity of fish and the growth of macrophytes are largely dependent upon the feeder channels. Blockage of feeder channels due to constructional activities and settlement hampers the aquatic ecosystem.

Table 1: Morphological characteristics of 46 No. Morakolong Beel

46 No. Morakolong Beel		
Area (in Ha)	78.00	
Location	92°18`28``E Longitude to 92°19`52``E Longitude and 26°13`49``N Latitude to 26°14`46``N Latitude	
Shape of the wetland	Oxbow	
Perennial/Sessional	Perennial	
Feeder Channel	Pokoriya River	
Depth	Depth in Summer (in meter)	Depth in Winter (in meter)
	5-6	2-3

Source: Field based study

Wetland boundary change of the beels in space and time:

The beel area has been a gradually decreasing over time. The areal change from 2001 to 2021 is highest (Table 2). So far as the areal extension of 46 No Morakolong Beel is noticed that from 2001-2021 the beel area has decreased from 1.98 sq km to 0.83 sq km. It is important to note that within the last 20 years 46 No. Morakolong Beel has lost 1.15 sq km. of its area due to several man-made factors. The agricultural practices in the fringe areas of the beel become the main factor for wetland degradation. Due to the rapid population growth in the fringe villages, tremendous pressure is exerted and the land use is also unplanned moreover there is an expansion of agricultural activities. The impact of agriculture directly falls upon the hydrology and morphology of wetlands as well as on the biodiversity of the wetlands. Due to the unscientific use of fertilizers, pesticides, and insecticides the water has excessive growth of weed especially water hyacinth.

Table 2: Changes in boundary of 46 No. Morakolong Beel from 2001-2021

46 No. Morakolong Beel	
Area in 2001 (sq km)	1.98
Area in 2011 (sq km)	1.53
Area in 2021 (sq km)	0.83
Rate of change in the wetland (in %)	
2001 to 2010	-29.41
2011 to 2021	-84.33
2001 to 2021	-138.55

Source: GIS based study

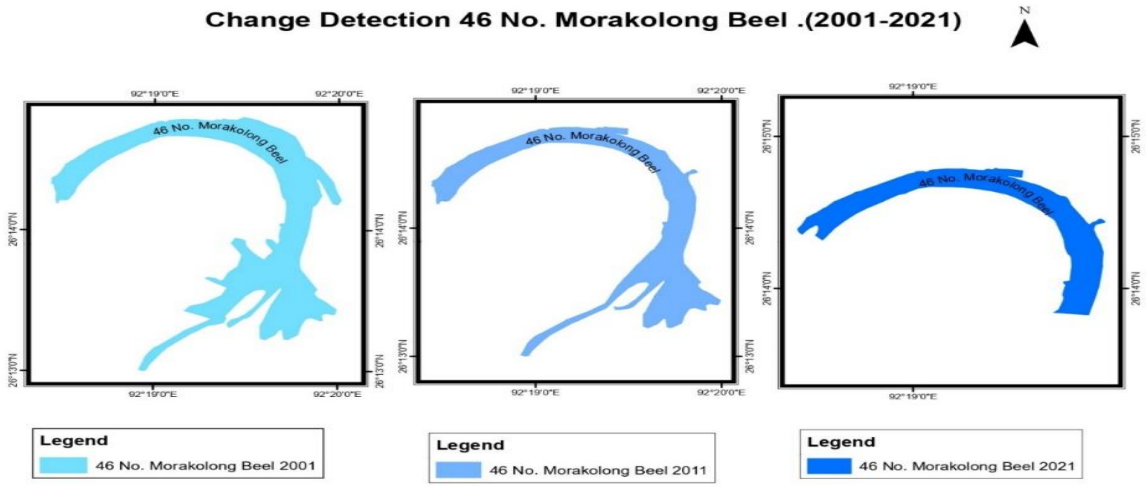

Figure 2: Change Detection of 46 No. Morakolong Beel from 2001-2021

Source: GIS based Study

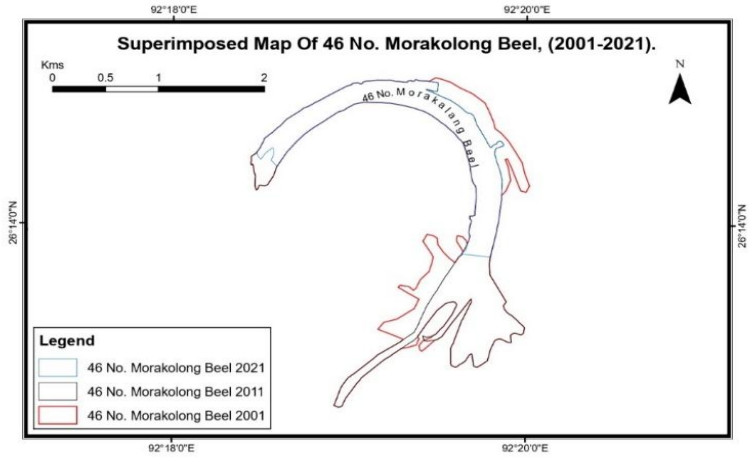

Figure 3: Superimposed Map of 46 No. Morakolong Beel (2001-2021)
Source: GIS based study

Table 3: Dataset used for the study

Data Types	Path/Row
Landsat TM	136/42
IRS 1D LISS III	111/53
IRS P6 LISS III	111/53
Survey of India Toposheet at 1:50,000 scale	83B/6, 83B/7,83B/8, 83B/9

Source: GIS based study

Land use land covers the change in the wetlands buffer:

The terms land use and landcover are both interrelated as changes in the land use cause change to the landcover (Saikia and Sharma. 2019). Landuse patterns of any area directly affect the subsistence of a particular region because changes in land use can cause a switch of livelihood practices i.e. primary production to secondary production.

It has been observed that in the year 2001, the area occupied by agricultural land was highest, i. e 12.05 sq. km and followed by Settlement (5.78 sq km), Fallow land (4.58), Water body (4.07) and Vegetation (1.44). In the year 2011, agricultural land is the dominant land use (13.47 sq. km.), Settlement (7.44 sq. km.), water body (4.03 sq. km.), Fallow land (2.45 sq. km.) and Vegetation (0.51). In the year 2021, the land use /land cover has changed in this area. The area occupied by agricultural land was highest, i.e. (15.32 sq. km); followed by Settlement (10.23 sq. km), water body (1.81 sq. km) and Vegetation (0.33 sq. km). Due to the tremendous increase in settlement through homesteads, the marshy areas and scrubland have decreased at the cost of homesteads.

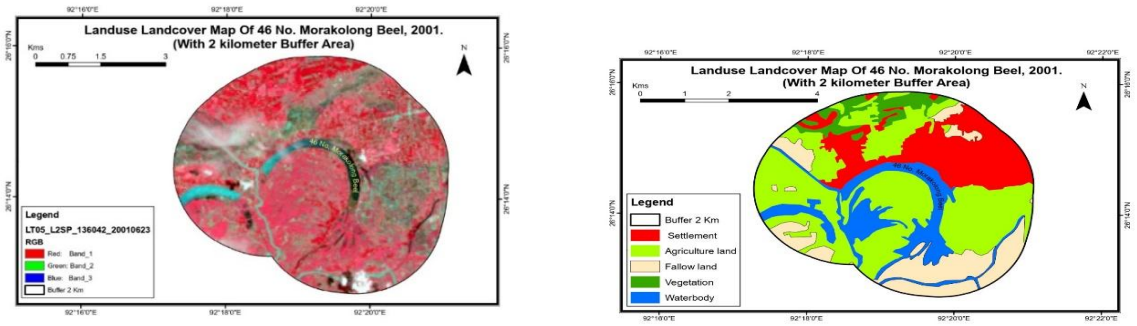

Fig 4: Landuse Landcover Map of 46 No. Morakolong Beel, 2001
Source: GIS based Study

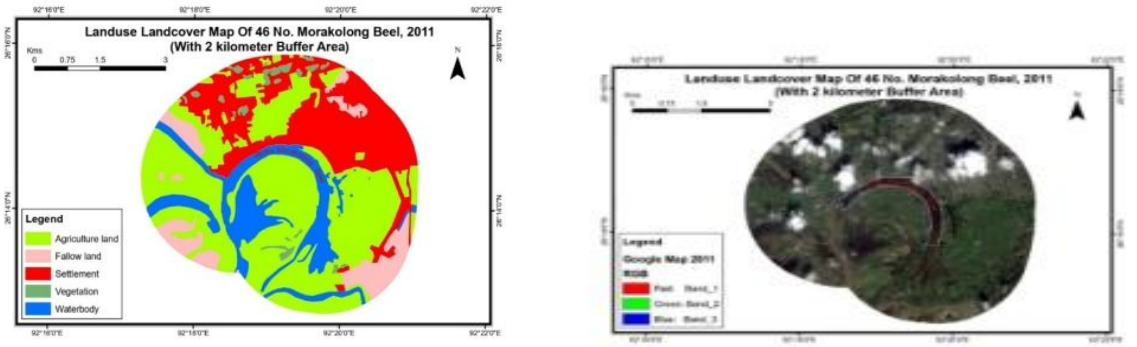

Figure 5: Landuse Landcover Map of 46 No. Morakolong Beel, 2011
Source: GIS based study

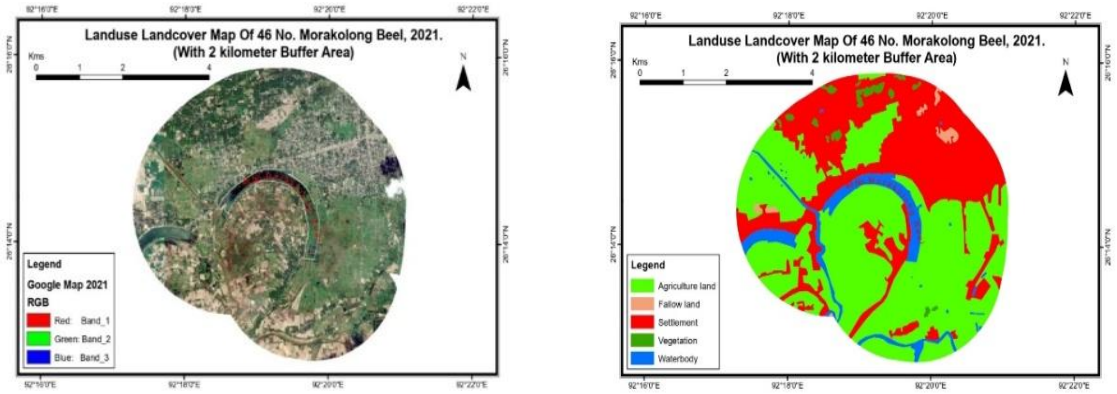

Figure 6: Landuse Landcover Map of 46 No. Morakolong Beel, 2021
Source: GIS based study

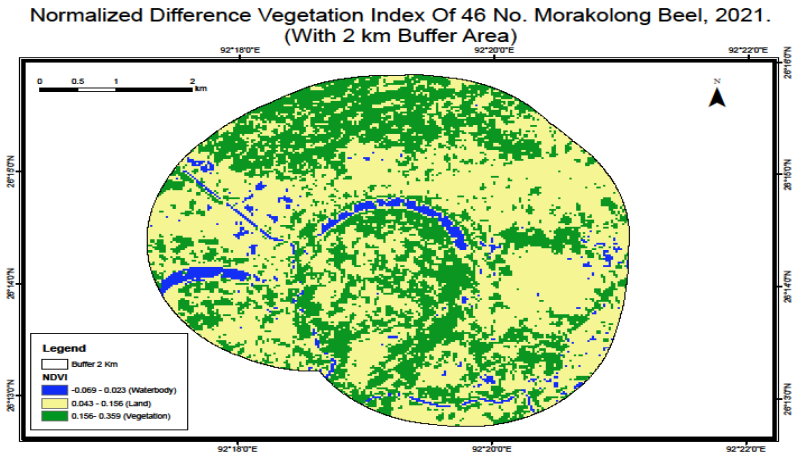

Figure 7: NDVI of 46 No. Morakolong Beel, 2021
Source: GIS based study

Table 4: Decadal change in area of 46 No. Morakolong Beel, 2001-2021

Land use/ land cover class	2001	2011	2021	Decadal change in area 2001-2011	Decadal change in area 2011-2021	Net change in area 2001-2021
	Area in sq.km	Area in sq.km	Area in sq.km	Area in sq.km	Area in sq.km	Area in sq.km
Agricultural Land	12.05	13.47	15.32	+1.42	+1.85	+3.27
Fallow land	4.58	2.45	0.22	-2.13	-2.23	-4.36
Vegetation	1.44	0.51	0.33	-0.93	-0.18	-1.11
Water body	4.07	4.03	1.81	-0.04	-2.22	-2.26
Settlement	5.78	7.44	10.23	+1.66	+2.79	+4.45
Total	27.9	27.9	27.9			

Source: GIS based study

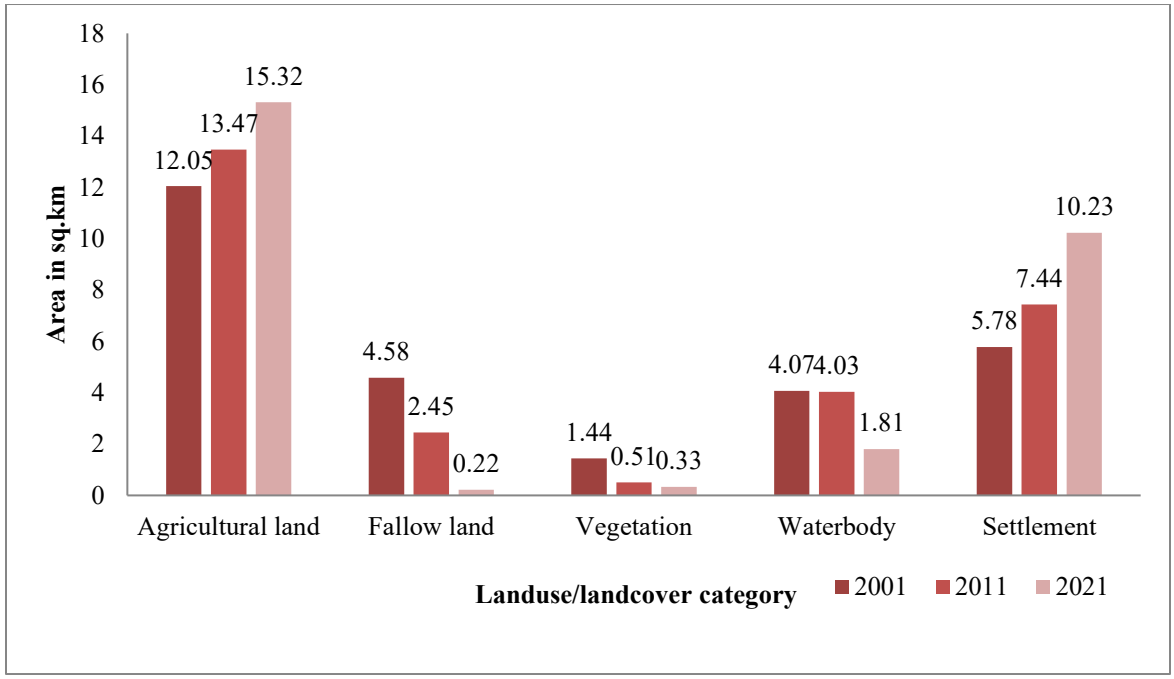

Figure 8: Landuse Landcover category of 46 No. Morakolong Beel, 2001-2021
Source: GIS based study

MAJOR FINDINGS:

1. 46 No. Morakolong beel is of fluvial origin. The shape of the beel is oxbow shaped. The area of the beel is 78ha.
2. The rain and connecting rivers mainly control the hydrological characteristics of the wetland. The water level seasonally changes and monsoon rain is the main governing factor of the water level of the beel. The depth has found 5-6 meter in summer and it decreased up-to less than 2-3 meter in the winter season.
3. Feeder channel of the beels are becoming shallow day by day due to the siltation of agricultural activities and the debris from the town.
4. From the analysis, it has been observed that the beel has drastically changed in the time of 2001-2021. It has lost 1.15sq km of area since last 20 years.

5. The beel is very rich in fish species. Different large and small fish have been identified in the beel. Both cultural and ornamental fish are available in the beel of the district. Cultural fish has high market value than ornamental fishes.
6. From the field survey various bird species has been identified in the beel.
7. Construction of roads and bridges in the surrounding areas of beel has prevented the free flow of water to and from the beel and thereby auto stocking of fish and other aquatic resources have hampered.
8. The analysis of land use land cover changes in the 2 kms buffer of beel has shown major changes in the wetland environment. The agriculture land has increased in the beel area at a very high speed where vegetation and water spread area of the beel has been decreasing. The encroachment has been identified in the beel periphery.
9. The beel have given in lease to a certain period. The lessee tries to maximize their income swipe out all the fishes.
10.Agricultural activities in the fringe areas of the beel are also an important cause of degradation of beel ecology. The pesticides and insecticides that are extensively used in the agricultural fields drain into the beel in the rainy season, which is the result of various diseases of fish.

SUGGESTION AND RECOMMENDATION

1. Human encroachment of the beel is the main problem of beel. The revenue department of the government should do the demarcation of the boundary so people should not settle in the beel area.
2. Overgrowth of water hyacinth in the beels is becoming a major problem of beel ecology. Necessary steps should be taken by the respective authority to overcome this problem.
3. The feeder channel should be clear so the water can freely flow to the beels.
4. Most of the villagers do not know about the ecological value of the wetlands. Some awareness program is necessary among the villages for the knowledge of beel ecology and its importance.
5. There should be some strict government rules and regulations regarding fishing activities, fishing gears used in the beel, resource exploration, disposing of garbage/waste, and encroachment in the peripheral areas of the wetlands.
6. It has been observed that insecticides and pesticides are commonly used in the agricultural field of the surrounding areas of the beel that is very harmful to the aquatic flora and fauna. The agricultural systems around the wetlands should therefore be practiced fully in an organic way.
7. The construction of roads, bridges, and the setting up of industry should be strictly prohibited in the periphery of the beels.
8. Eco-tourism should be developed in the beel. Some entertainment like boating, fishing, etc. should be practiced for the tourist. Lodging and fooding should be arranged for the night stay of the tourist. Local people can show their ethnic diversity and food culture to the tourist.
9. In designing and implementing the plans and policies for the conservation and sustainable use of the wetlands local people, the government should involve NGO s and other related institutions.

CONCLUSION:

Wetland or Beel are highly productive and biologically diverse systems that enhance water quality, control erosion, maintain stream flows, sequester carbon, and provide a home to at least one third of the all threatened and endangered species. In the not too distant past, wetlands were regarded as wastelands. Most of the people felt that they were places to be avoided, and it was common practice to drain them, fill them or treat them as dumping grounds.

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