

Population Growth, Changing Landuse Pattern and Their Impact on Wetland Ecology: A Case Study of Samaguri Wetland of Nagaon District, Assam

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Abstract: Nagaon district which is located in the middle part of Assam is endowed with rich wetland resources and within Assam highest numbers of wetlands are found in this district. Most of the wetlands of this district are located in agricultural environment. These wetlands have been considered as most productive area for food and fodder production. Samaguri beel which is an oxbow shaped wetland located in agricultural environment 20 kms away from Nagaon town in the eastward side. Due to ever increasing population growth of the surrounding villages of the wetland area have created tremendous pressure on wetland environment. The alarming human dependency upon wetlands and several developmental activities lead to landuse change on the surrounding wetland environment and have created threat to geo-ecological characteristic of the beels and in this way the natural ecosystems have lost much of their original character, leading to reduce biodiversity and reduce performance and productivity. Hence, the present paper is an attempt to identify what changes have been took place under the influence of developmental activity within wetland environment and to suggest conservative plan. The changes have been identified based on the comparison of topographical map, different period of remote sensing data, google earth image and field data collected from Samaguri beel.

Key words: Areal change, landuse change, management plan, population growth, wetland ecology

I. Introduction

Wetlands are considered as one of the important resource. Wetlands provides habitat for aquatic plants and animals, it provides services to human being. Wetlands are considered as one of the most biologically productive ecosystem as they are rich in species diversity, they perform various functions to support the livelihood through crop production and direct resource extraction. Wetlands considered as important ecological site by performing lots of functions which mentioned as flood control, sediment trapping, pollution trapping, toxic removal, water storage, flow regulation, biological productivity, provides habitat for species etc.

“Wetlands are considered as the areas of marsh, fen, peatland or water, whether it is either permanent or temporary, natural or artificial, static or flowing” (Ramsar Information Bureau 1998). “Wetlands are land area which is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface or land is covered by shallow water” (Cowardin et al 1979). Wetlands are “areas of seasonably, intermittently or permanently waterlogged soils or inundated lands whether it is natural or artificial, fresh or saline (Wetland Advisory Committee 1977).

Landuse change is a major driver behind the loss of wetland and associated ecosystems. In the study region several developmental activities are the main driving forces behind the wetland loss and biodiversity loss. Human interference has been increasing upon environment to fulfill endless need of human being. As a result unprecedented landuse land cover changes have been took place which impact upon ecosystem and environmental processes at local, regional and global level. The alarming human dependency upon wetlands and several developmental activities have been took place in wetland environment which created threat to geo-ecological characteristic of the beel.

II. Study Area

Samaguri beel lies towards the north eastern side of the Nagaon District. The Samaguri beel is located between 26° 25' N latitude and 92° 51' E longitude. Samaguri beel one of the ox-bow lake shaped wetland of Nagaon district. This wetland is formed due to the shifting of meandering courses of river Kolong. It is situated about 20 kms away from Nagaon town. The area covered by the beel is 43.65 hectares in 2015 according to Google earth image. It is surrounded by Sonaibali and NH 37 in the north, Gatanga in the east, Samaguri Grant and Auniati satra in the south and Baziagaon in the west direction. Still Samaguri beel is connected with a small stream which is locally known as ‘Ghatir Ghulung’.

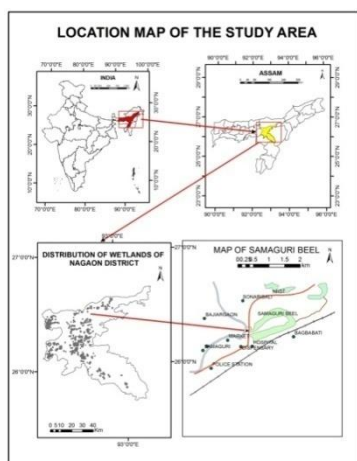


Fig1: Location Map

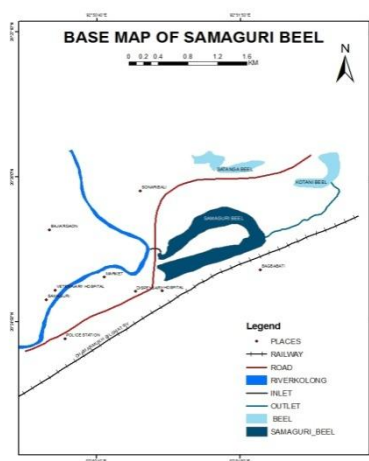


Fig 2: Base Map of the study area

III. Objectives

The main objectives of the study are :

- To know the geo-ecological set up of the wetland environment
- To identify the map extent of the area of Samaguri beel corresponding to the year 1991, 2006, and 2015
- To identify what type of landuse changes have been took place in and around wetland environment.

IV. Methodology

The base map of wetland has been prepared from survey of India Toposheet No. 83B/15. Arc GIS 9.3 and Erdas Imagine 9.1 has been used for derivation of required results. Google Earth and ETM+ imagery has also been used to detect changing status. The following imageries are used: LANDSAT ETM+ Imagery of the year 1991, LANDSAT ETM+ Imagery of the year 2006, Google Earth Imagery of 2015, dated 4th September.

To analyze the water quality of the wetland several physical and chemical parameters have been tested in State Public Health Laboratory, Bamunimaidam, Assam. To detect landuse changes in wetland environment create 1 km buffer and after that subset the images and to perform supervised classification.

To delineate the water boundary MNDWI has performed. For calculating MNDWI in ETM+ images band 2 (G) and band 5(MIR) has been used.

$$\text{MNDWI} = \frac{\text{Green- MIR}}{\text{Green+ MIR}}$$

V. Physical Background Of Study Area

The areas of Samaguri beel characterized by hot-wet summer and cool-dry winter. The temperature of these area drops to minimum of 8⁰c and raises up to maximum of 34.3⁰ C. The average annual rainfall is about 1514.44 mm. June, July, August and September are the hottest months. On the other hand December and January record the minimum rainfall.

VI. Biodiversity Of Samaguri Beel

Samaguri beel one of the important wetland of Nagaon district which is mainly fall in Samaguri region. Samaguri beel is rich in aquatic resources which help in maintaining the biodiversity of the beel. The wetland is rich in flora and fauna. The fauna resources include both aquatic birds and fishes. Both aquatic and terrestrial floras are spotted there.

FLORA

Water hyacinth is common free floating plant in the beel. Pista, Azolla, Lemna, Wolffia are other free floating plant species found in the beel. Lotus and water lilies etc. are rooted floating plants habited in the beel. The submerged plants found in the beel include Hydrilla, Vallisneria, Aponogeton, Colocasia, Saggittoria, karks, Ludwigia puruviflora etc. Besides these some other terrestrial vegetation are also found in wetland areas which are shown in following table.

TABLE 1: Floral Diversity

Local Name	English name	Scientific Name
Aam	Mango Tree	Mangifera Indica
Kalgas	Banana Tree	Musa Balbisiana
Kathal	Jackfruit Tree	Artocarpus heterophyusus
Bagari	Jujube Tree	Ziziphus mauritiana
Tamul gas	Betelnut plant	Areca cathecu
Bahgas	Bamboo Tree	Babusa balcooa
Simalu gas	Silk cotton Tree	Bombax ceiba

Source : Field Survey

Fauna

Samaguri beel rich in faunal diversity include various types of aquatic birds and fishes. But due to several anthropogenic activities create threat to reduce these diversities. Few name of the fishes are given below in the following table.

TABLE 2 : List of fish species

Local Name	English Name	Scientific Name
Puthi	Minnows	Punitus stetrarupagus
Dorikona	Flying Barb	Esomus danricus
Khalihona	Spotted Snakehead	Channa punctatus
Karati	Indian River shed	Gudusia chara
Kandhuli	Asian Knifefish	Notopterus notopterus
Cheniputhi	Olive Barb	Puntius Sarana
Bordoiya	Indian Potasi fish	Pseudeutropius atherinoides
Bata	Bata	Labeo bata
Bhangun	Bata Labeo	Labeo bata
Magur	Walking catfish	Clarias batrachus
Mirika	Mrigalcarp	Cirrhinus mringala
Moa	Mola Carplet	Amblypharyngodon mola
Sol	Striped snakehead	Channa stratus
Rou	Rohu	Lebeo rahita

Source : Field Survey

Birds

Various types of aquatic birds are found in Samaguri beel which include Sarali hah (whistling duck), Dolghora (Gray headed lapwing), Panikauri (Phalacrocoran niger), Samuk bhanga (Asian Openbill), Masruka (Kingfisher) etc.

VII. Ecological Setup Of Samaguri Beel

To know about ecological condition of wetland it is necessary to assess the water quality of wetlands. Several physico- chemical parameters have to taste for this purpose which include- Physical parameters include Turbidity, pH, colour, odour and Chemical Parameters include Total Solids (TS), Total Dissolved Solids (TDS), Total Suspended Solids (TSS), Total Hardness, Nitrates, Phosphates, Sulphates, Chlorides, Dissolved Oxygen (D.O), Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD).

VIII. Physical Parameters

Colour of the water of Samaguri beel found in Colourless and odour are agreeable. Turbidity: Turbidity is responsible for scattering and absorption of light by water. Turbidity leads to decrease of photosynthesis activity and depletion of oxygen content Standard limit of turbidity in water for living fish condition is 25(NTU). Turbidity value are found in 60 NTU.

pH: pH is a measure of the hydrogen ion concentration of the water as ranked on a scale of 1.0 to 14.0.It expresses the acidity or alkinity of water. The largest varieties of aquatic animals prefer a pH range of 6.5 - 8.0. pH outside of this range reduces the diversity in the stream because it stresses the physiological systems of most organisms and can reduce reproduction. According to the World Health Organization (WHO) the desirable drinking water standard of pH ranges from 7.0-8.5 and the maximum permissible limit is 6.5 – 9.2.In the surveyed beel pH values found in desirable limit which is 6.8.

IX. Chemical Parameters

Dissolved oxygen (DO): Dissolution of inorganic substances in water dissolved oxygen is needed. Living organisms need oxygen to maintain their metabolic processes. It is an essential requirement of aquatic life. DO is 4.5.

COD: The COD determines the oxygen required for chemical oxidation of organic matter with the help of strong chemical oxidant. The COD of Smaguri beel is 14.85 mg/l.

BOD: BOD refers to the oxygen in water consumed by micro organisms feeding on organic pollutants. It also indicates the intensity of biodegradable matters present in water. The BOD of unpolluted waters is less than 1.00 mg/l; moderately polluted (BOD 2.0– 9.0mg/l) while heavily polluted waters have BOD more than 10.0 mg/l (Adakole, 2000). BOD value found in Samaguri beel 5.5 which indicates moderately polluted.

Chloride : Small amount of Chloride invariably present in all natural water and its content goes up appreciably with increasing salinity. The Chloride content in waste water is higher than in raw water. Desirable limit of Chloride concentration in drinking water is 250mg/l (according to WHO).

Sulphate : According to WHO the standard limits of sulphate in water not more than exceed in 250mg/l. Sulphate values found in Samaguri beel is under desirable limit.

Total solids : Total solids are dissolved solids plus suspended and settleable solids in water. Elevated levels of total solids however, can lead to eutrophication or increased turbidity.

Total Hardness : Hardness indicates the water quality mainly in terms of calcium and magnesium ions. When water consumes large quantity of soap than hardness is objectionable. The standard limit of TH in water is 150 mg/l. TH value is 36 mg/l.

Calcium : Calcium is one of the principle alkine earth metal cations which impart hardness to water. The presents of moderate amount of calcium is desirable in beel water because it is observed that its presence neutralizes the toxicity of various substances like lead, cadmium, mercury etc. The standard limit of calcium value in fresh water is 0 to 100 mg/l but higher level of these range do not cause health effect.

Total Suspended Solids: Total suspended solids are a total quantity measurement of solid material per volume of water. TSS are found above 100mg/l.

Magnesium: Magnesium is another alkine earth metal cations which impart hardness to water. Magnesium: It is essential for the survival of aquatic plants, chlorophyll bearing bacteria and algae. Mg value is 4.9.

Total Dissolve solids: Total dissolve solids are the total amount of minerals, salts and metals dissolve in given volume of water. TDS levels in lakes and streams are typically found in the range of 50 to 250mg/L.

The following table shows the physical and chemical properties of the wetland :

TABLE 3 : Water sample analysis

Parameters	Samaguri Beel
Turbidity(N.T.U)	60.0
Ph	6.8
D.O	4.5
COD(Mg/L)	14.85
BOD(Mg/L)	5.5
Chloride(Mg/L)	4.0
Sulphate(Mg/L)	3.0
Total Hardness(Mg/L)	36.0
Calcium(Mg/L)	6.4
Magnesium(Mg/L)	4.9
TDS(Mg/L)	74.0
TSS(Mg/L)	104.0
Total Alkinity(Mg/L)	36
Phosphate(Mg/L)	0.02
Nitrate(Mg/L)	0.0
Sulphate(Mg/L)	3.0

Source : Laboratory analysis

X. Soil Analysis

To analysis the soil quality of agricultural field several parameters has been tasted which are as follows : i) pH: pH value of a soil indicates the activity of H⁺ ion of the soil water system. pH value indicates whether soil is acidic, neutral or alkaline. Crops are vulnerable to soil reaction in both acidic and alkaline range. pH value of Samaguri beel is slightly acidic which is 5.36.

ii) Organic Carbon : Organic carbon refers to carbon present in organic matter. Organic carbon presents in Samaguri beel is 2.28 which indicates very high.

iii) Phosphorous : In Samaguri beel phosphorous content is very low. 3.21kg/Acre presents in this wetland.

iv) Potassium :Potassium content in Samaguri beel is low which is 89.34kg/.

v) Texture: Soil texture of Samaguri beel found is sandy clay soil.

TABLE 4: Soil Sample analysis

Parameters	Presence in Samaguri beel
pH	5.36
Organic Carbon(%)	2.28
Phosphorous(kg/Acre)	3.21
Potassium(kg/Acre)	89.3

Source: Laboratory analysis

XI. Surrounding Villages And Its Population Structure Of Samaguri Beel

Morikolong beel surrounded by several villages Viz., Bazia Gaon, Sonaibali, Auniati Satra, Samaguri Grant and Gatanga. This beel located easternmost part of the Nagaon town. The increasing trend of population growth of the surrounding villages create tremendous pressure on this beel. Due to the beautiful location of the beel several resort, parks have been constructed within the wetland area and some parts of the beel converted to settlement.

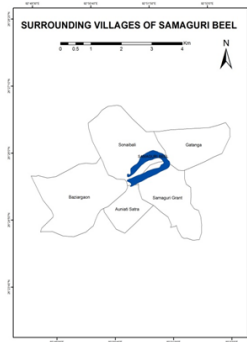


TABLE 5: Population structure of the surrounding villages of Samaguri beel

Village Name	Total Population 2001	Total Population 2011
Samaguri Grant	932	1146
Auniati Satra	1216	1456
Baziar Gaon	5817	6681
Sonaibali	5346	7050
Gatanga	1178	1182

Fig 3: Surrounding villages of Samaguri beel

TABLE 5: Population structure of the surrounding

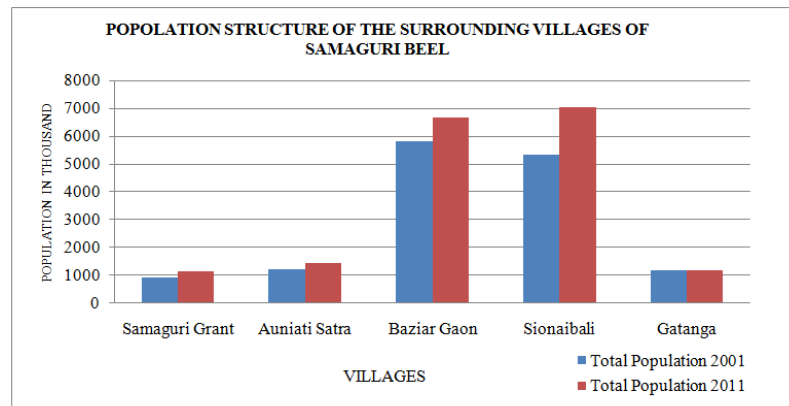


Fig 4: Population structure of surrounding villages

XII. AREAL CHANGES OF SAMAGURI BEEL FROM 1991- 2015

To delineate the wetland boundary MNDWI technique has been used to detect the areal change. Remote sensing imagery has long been used in water resource assessment. This application has involved the delineation of open water using thematic information extraction techniques. Various methods have been used to extract the water bodies viz. NDWI, MNDWI etc. MNDWI will produce more accurate extraction of open water as built up area, vegetation and soil have notably suppressed. 1991 ETM+, 2006 ETM+, and 2015 Google earth imagery has been used to delineate the wetland boundary. In the present study it is found that the area of the Samaguri beel in 1991 was 57.50 hac which is decrease to 43.65 hac in 2015.

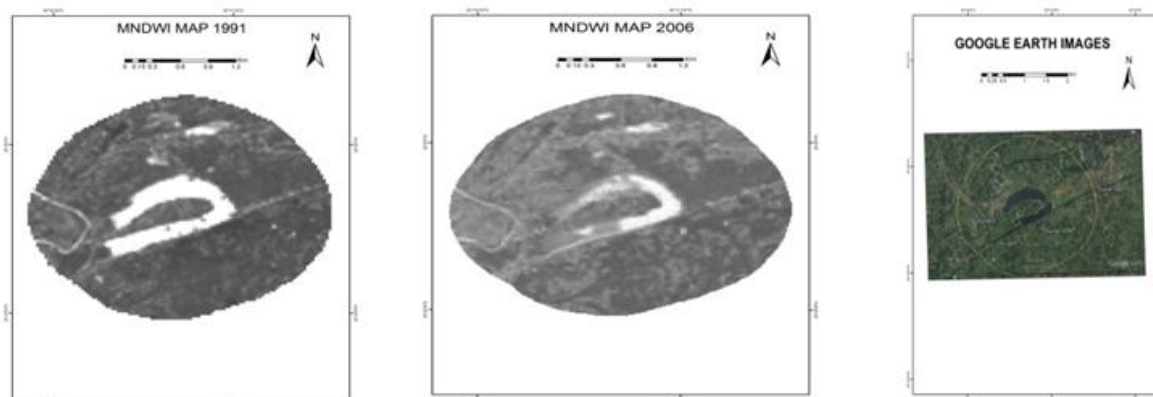


Fig 5: MNDWI and Google earth image of Samaguri beel

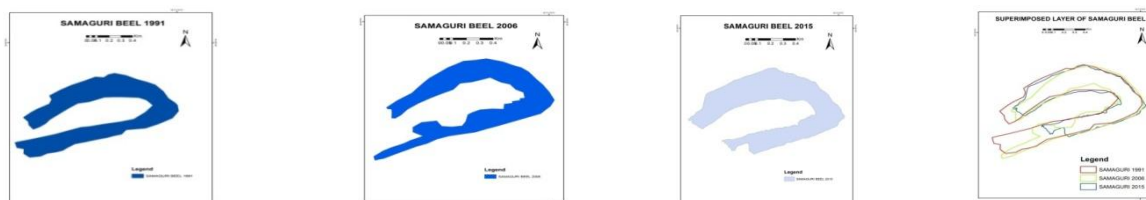


Fig 6: Extension of Samaguri beel in the respective year 1991, 2006, 2015 and their superimposed layer

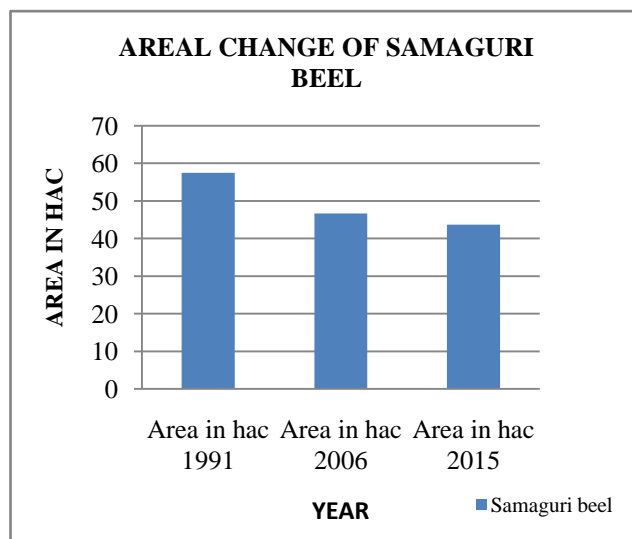


Fig 7: Areal change of Samaguri beel

TABLE 6 : Areal change of Samaguri beel

Name	Area in hac 1991	Area in hac 2006	Area in hac 2015
Samaguri beel	57.50	46.67	43.65

XIII. LANDUSE CHANGE IN AND AROUND SAMAGURI BEEL

The growing population of the surrounding villages have ensured fragmentation of landholding structure and cropping pattern. The expansion of non agricultural function with the growth of population and economic development cause considerable increase in the built up area which affect the landuse pattern within the wetland environment. The pattern of landuse changes bring considerable change to the present status of the wetland condition of the study region. In the study region commercial purpose is the main driver behind the wetland loss and its biodiversity loss. The diverse pattern in landuse of Samaguri beel is the result of manifold uses of its land for different purpose. The wetland area mainly falls within residential, commercial and

agricultural environment. Due to commercial purpose several development have been constructed within wetland area which leads to tremendous landuse change to in and around wetland environment.

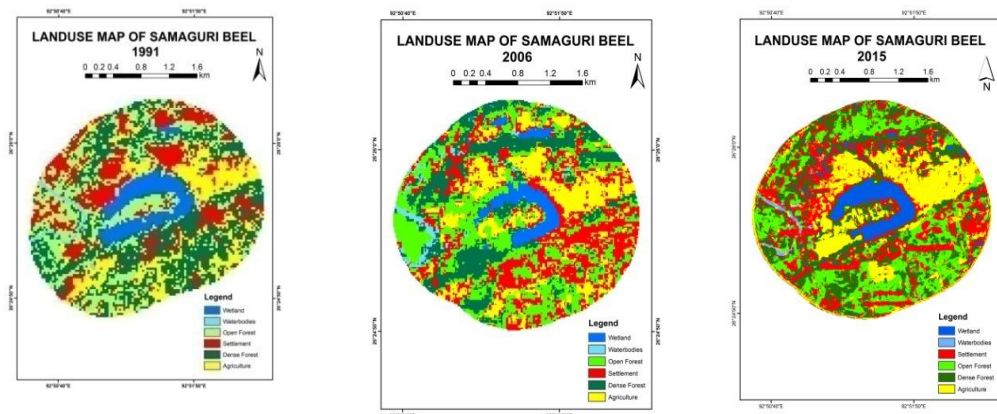


Fig 8: Landuse map of Samaguri beel in the year 1991, 2006 and 2015

TABLE 7: Landuse structure of in and around Samaguri beel

Landuse class	Area in hac 1991	Area in hac 2006	Area in hac 2015
Waterbodies	14.13	15.75	20.47
Dense Forest	241.56	121.5	153.83
Wetland	58.05	32.91	52.31
Agriculture	133.65	113.06	137.95
Settlement	151.47	161.93	165.85
Open Forest	166.95	182.79	243.64

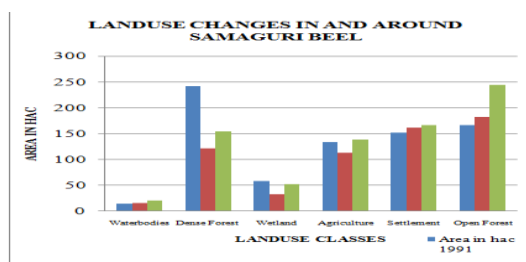


Fig 9: Changing landuse pattern in and around Samaguri beel

XIV. Need of Conservation for Wetland Ecology

Wetland conservation mainly aimed at protecting and preserving those areas where water exist at or near the earth surface. Wetland provides food and services to human being. They perform lots of functions which are beneficial to human being and entire natural environment. Therefore such useful resource is need to be conserved and people should use wetland wisely. But due to several anthropogenic pressures this wetland lost much of their original character. Therefore from economic importance to aesthetic value, the need of conservation of wetland has become one of the important step for human being towards the conservation of the environment.

XV. Findings

- i) Several developmental activities have been setup within wetland environment. Resort and park have been constructed within wetland area which may cause reverse affect to wetland environment.
- ii) Local people involves indiscriminate fishing, hunting, trapping and killing of aquatic birds in the wetlands which leads to reduce biodiversity.
- iii) From 1991-2015 the area of the Samaguri beel has decreased 57.50 hac to 43.65 hac.
- iv) From 1991- 2015 settlement has increased 14.38 hac and agricultural land increased 4.3 hac within 1 km buffer.
- v) The beel is facing tremendous problem of aquatic weeds. Due to abundant growth of aquatic weed sunlight can not penetrate thus productivity of planktons becomes low and it decreases the fish productivity.

XVI. Conclusion

Samaguri beel of Nagaon District plays important role in socio-economic condition of the study area. This wetland enhance the aesthetic beauty of the entire region and facilitated the local people in different ways. The pattern of landuse constitute a important role in maintain the wetland. From the above study it reveals that due to increasing population growth may create several developmental activities within wetland environment which leads to threat to wetland ecology.

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