Journal of Data Acquisition and Processing
ISSN: 1004-9037
https://sjcjycl.cn/
DOI: 10.5281/zenodo.7778240

AGRICULTURAL PRACTICES AND ITS IMPACT ON WETLAND ECOLOGY: A CASE STUDY OF SAMAGURI *BEEL* OF NAGAON DISTRICT, ASSAM

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Abstract: *Nagaon district is located in the middle part of Assam which is endowed with highest number of wetland resources within Assam among all other districts of the state. 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*.

Keyword *: Agriculture landuse pattern, landuse change, , population growth, wetland ecology, management plan*

Introduction

The riverine wetlands have considered as most valuable land area for food and fodder product from the early development of agricultural activities (Verhoeven *et al*, 2010). It is however, in the track of history found that most of the world's wetlands have reclaimed for agricultural purpose with more effective facilities of drainage and land fertility. Ever increasing population and higher food grain requirement have created tremendous pressure on available agricultural land, the wetlands have been reclaimed for agriculture and in this way the natural ecosystems have lost much of their original character, leading to reduce biodiversity and reduce performance and productivity (Hassan *et al*. 2005). More than 50% of floodplain wetlands have been lost mostly through converse to intense agricultural use in North America, Europe and Australia (Millenium Ecosystem Assessment, 2005). Since the development of human civilization wetlands and agriculture are closely linked together (Gopal 2000). The conversion of wetland into agricultural activities has caused premature degeneration of wetland resources (Olhan *et al.* 2010). Wetlands are considered as the most productive ecosystems in the world which provide resources and different kind of services to human society (Khan*, et al*, 2009, Millennium Ecosystem, 2005). Like any other natural entities wetlands have also been

confronting growing pressure and threat from a variety of natural and man-made factors. During the recent period man-made factors have proved to be highly invasive and destructive towards the loss of wetland biodiversity (Walker, *et al*.1987). It is noteworthy that the conversion of wetlands for agricultural purpose is considered as the principal cause of wetland degradation (Dahl, 2000). Since 20^{th} century half of the worlds wetlands have been disappearing (Barbier, 1994) out of which 87 percent have been lost due to agricultural development, 8 percent by urban development and 5 percent for other conversions (Frayer, *et al*. 1983, Maltby, 1991). The irrational land use patterns have caused degradation of wetlands at an alarming rate. This has great impact upon its bio-physical productivity. Therefore, there is a great need to make the concerned people aware towards the conservation and management of wetland resources.

The Samaguri *beel* of Nagaon district in Assam is one of the prominent ox-bow shape wetlands of the district faced big challenges in recent time which have emerged as a result of irrational developmental activities like construction of roads, railways, extension of settlement and also from farming practiced in marginal wetland areas. This paper is an attempt to study the present agricultural landuse pattern in marginal wetland areas and the changing landuse pattern and its impact on wetland ecosystem so as to formulate conservative plan and management strategies to restore the wetland ecosystem.

Study Area

The Samaguri *beel,* a perennial wetland is located towards the north eastern side of the Nagaon district. The Samaguri *beel* lies between $26^0\ 25^/$ N latitude and $92^0\ 51^/$ E longitude. Samaguri *beel* is one of the ox-bow lake shaped wetlands of Nagaon district which is formed due to intense meandering course of river Kolong. It is situated about 20 kms away from Nagaon town. The *beel* area spreads over 63.51 hectares along with unique biodiversity. It is surrounded by Sonaibali and NH37 in the north, Gatanga in the east, Samaguri Grant and Auniati satra in the south and Baziagaon in the west direction. The management system of Samaguri *beel* is registered under Fishery Department of Assam and the *beel* is governed by lessee (leaseholder) for a period of five to seven years.

The hydrological condition of Samaguri *beel* is maintained by receiving water from Kolong and Nonoi river. Guniya jan connected the *beel* with river Nonoi and through a narrow channel(*Ghatir Ghulung)* the *beel* also connected with Kolong river which flows in the northern direction (Saikia and Dutta, 2006).

The enormous splendour of Samaguri *beel* give rises to set up as a one of the important tourist destination in Nagaon district which popularly known as ‘bird pilgrimage’ by arrival of variety of migratory birds during winter season from all over the world. It is noteworthy that to enhance the tourist destination floating restaurant and cottages and bird watching tower to enjoy birds frolicking has been set up within *beel* environment. Due to these developmental activities the *beel* areas has been encroached and create threats to the existence of wetland ecology.

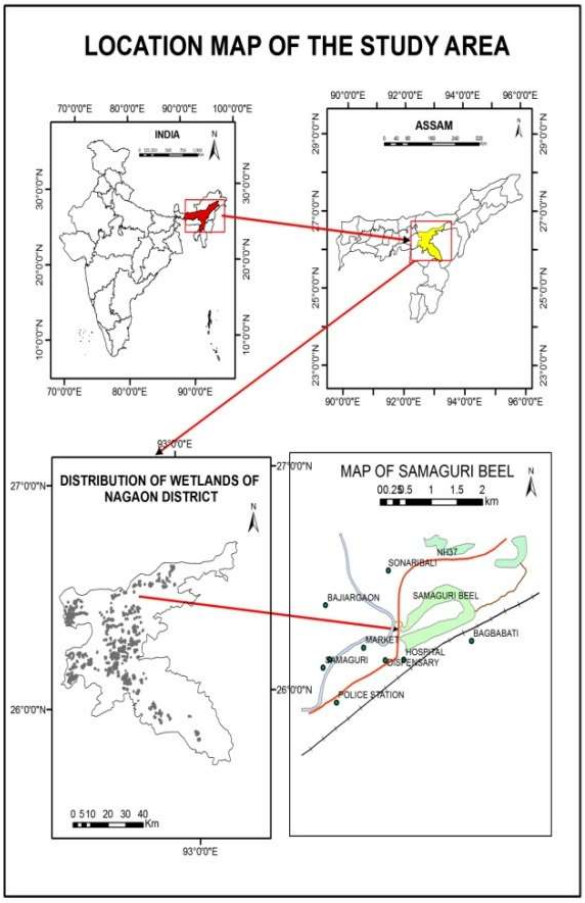


Fig. 1: Location of the Study Area

Objectives

The main objectives of the study are

1. to assess the present landuse landcover change in the study area
2. to assess the present agricultural landuse pattern in and around the Samaguri *beel*
3. to examine the factors responsible for degradation of wetland ecology and formulate conservative plan to manage the wetland ecosystem.

Database and Methodology

The base map of wetland has been prepared from survey of India Topo sheet No 83B/15. Arc GIS 9.3 has been used for derivation of required results. Landsat ETM+ 2006 and Landsat OLI 2015 has been used to assess the changing landuse pattern in marginal wetland areas. These imageries has been collected from United States Geological Survey (USGS) website. Cadastral map or Dag map of the surrounding villages collected from the Revenue Circle Office, Nagaon, Assam has been used to prepare the surrounding agricultural land use pattern of the *beel*. Regarding information of each dag number the cadastral map was collected from the *Mandals* (land surveyor of the village), *Gaonburhas* (village head) and also through the field visits of the area.

The primary information regarding availability of floral and faunal species, domestic and migratory birds, hydrological characteristics and their changing status, causes of wetland

degradation, agricultural practices in and around wetland and their impact on wetland ecology were investigated from the field observation through well structured questionnaire.

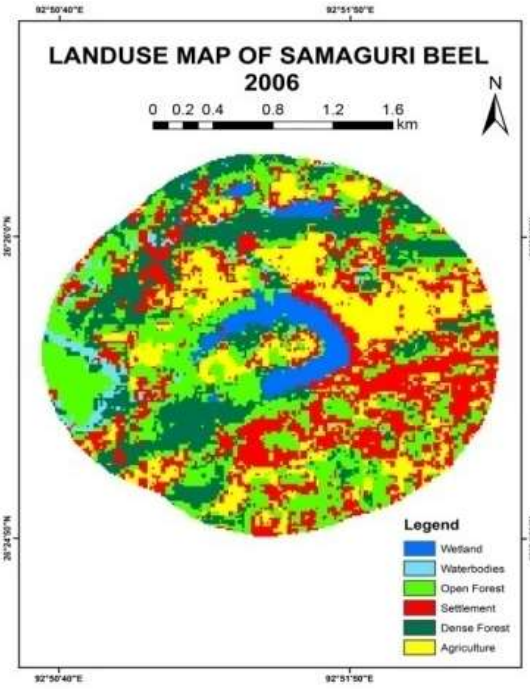
To know the ecological conditions of the *beels*, water and soil samples were collected from the wetland during pre-monsoon and post-monsoon seasons and they were tested in laboratory considering different parameters. Water parameters include Turbidity, conductivity, pH, Dissolved Oxygen (D.O), Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Total Solids (TS), Total Dissolved Solids (TDS), Total Suspended Solids (TSS), Total Hardness, Nitrates, Phosphates, sulphates, Chlorides etc are considered. Soil samples were also collected to test some parameters like pH, Org C, P2O5, K2O and soil texture.

Landuse Landcover Pattern

In order to assess and analysed the spatio temporal change in landuse landcover (LULC) pattern, the marginal area of Samaguri *beel* is divided into six distinct classes viz. Wetland, waterbody, agriculture, settlement, open forest and dense forest. During the study period, the marginal area of Samaguri *beel* has been seen that agriculture and settlement landuse classes were increased and dense forest and open forest began to decrease. From the classification it has been noticed that agriculture is the most dominating factor towards the degradation of wetland. Besides agriculture, the developmental activities which has been took place near the *beel* areas create tremendous threat to the ecology of the wetland.

Table 1: Area of different LULC classes of study area

Landuse class	Area in hac (2006)	Area in hac (2015)	Change in %
Waterbodies	15.75	15.15	-3.80
Dense Forest	121.5	103.83	-14.54
Wetland	65.91	63.51	-3.64
Agriculture	113.06	137.95	22.01
Settlement	161.93	166.45	2.79
Open Forest	182.79	173.64	-5.00



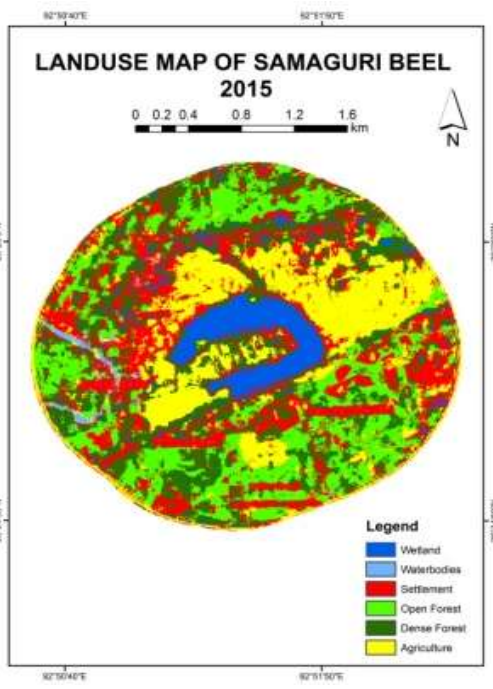


Fig. 2 : LULC Map of Samaguri *Beel*, 2006 **Fig. 3 : LULC Map of Samaguri *Beel*, 2015**

Samaguri *beel* and its surrounding

It is found that there are 5 numbers of adjacent villages around Samaguri *beel* which is inhabited by 7695 people in 1971 and it increased as 19369 persons in 2011 at a changing rate of 152% during 1971-2011.The name adjacent villages of Samaguri *beel* are Sonaibali, Gatanga, Samaguri Grant, Auniati Satra and Baziagaon respectively.

As wetlands have been provided the source of income from the period of human civilization, since then the rural communities intrinsically related to wetland services and this way they are responsible for altered the ecosystem in a great extent. It is noteworthy that the wetland communities of the selected wetlands of Nagaon district are basically involved to utilize the wetland resources for the purpose of agriculture and fishing and majority of the farmers of the villages are occupied the wetland areas for agricultural practiced. Besides, increasing trend of population growth of the adjacent villages create tremendous pressure on wetland ecosystem and emerged as one of the important cause to changing land use pattern around the wetland environment.

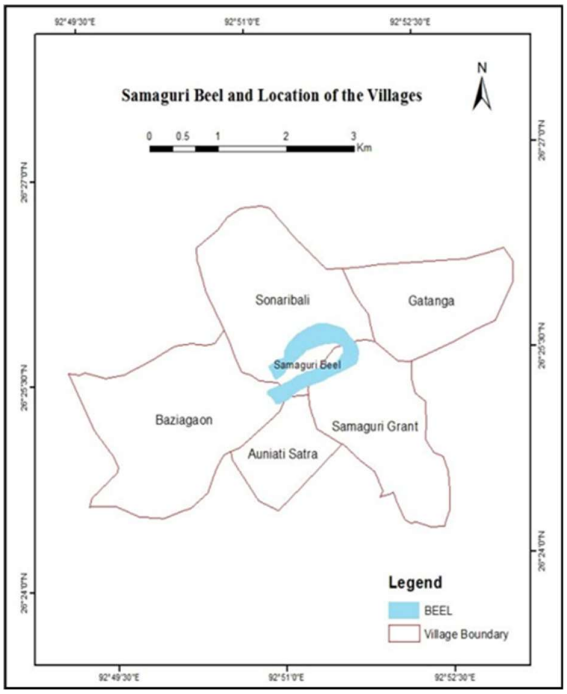


Fig. 4: Adjacent villages of Samaguri *Beel*

Agricultural Landuse Pattern in and Around Samaguri *beel*

It has been noticed that the agricultural land of the surrounding villages of Samaguri *beel* may be categorized into four main classes, viz. foringtoli (highland), *baotoli* (*bao* rice field), *salitoli* (winter transplanted paddy of *sali* rice), lahitoli (winter transplanted paddy of *lahi* rice). The agricultural land use category is influencing by the factor of saturation of water level in crop field and it also determines to cultivate the different type and pattern of agricultural crops in the field in different seasons as different crops are needed different level of water for their sufficient growth. Therefore, the farmers of the villages try to cultivate different crops at different crop fields on the basis of their traditional knowledge.

Besides these agricultural land use categories of marginal wetland areas of villages, the other part is also covered by different land use pattern like grazing land, residential land (bastimati), water bodies, road and govt. land. The residential land is used for habitation purpose for human settlement and is also covered with the type of trees like betel nut, coconut, banana, neem, mango, jackfruit, citrus plant, and bamboo. The grazing land is characterized by slightly elevated land covered with different types of grasses and trees and is used shelter for cattle, buffalo etc during day time.

The adjacent villages of Samaguri *beel* viz. Samaguri grant, Gotanga and Sonaibali which together having an area of 1014.34 ha of which agricultural land(*boatoli, faringtoli, lahitoli, salitoli*) covers by 630.01 ha account for as 62.11% of total land area of the villages. Besides, the grazing land covers by 2.25%, residential land 13.24%, water bodies 14.20% and road and govt. land includes 8.19% of total area of the villages.

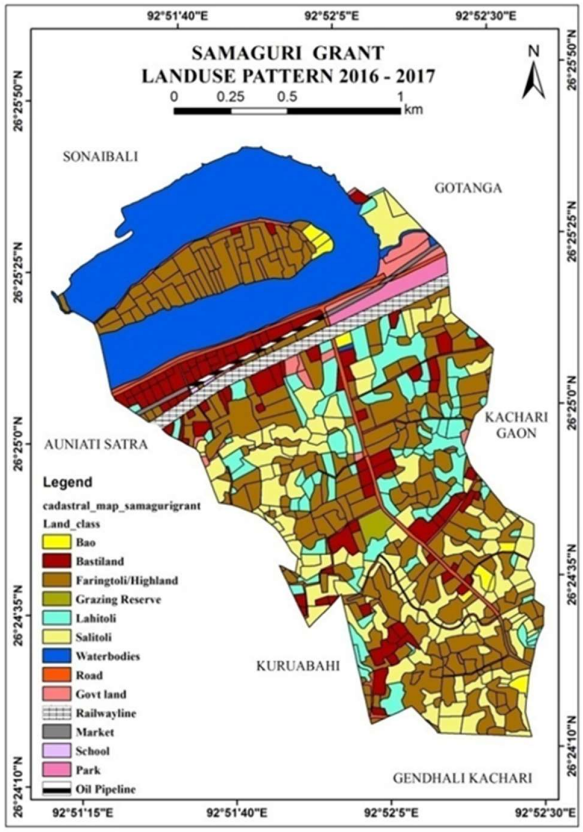


Fig. 5 : LULC map of Samaguri Grant Village

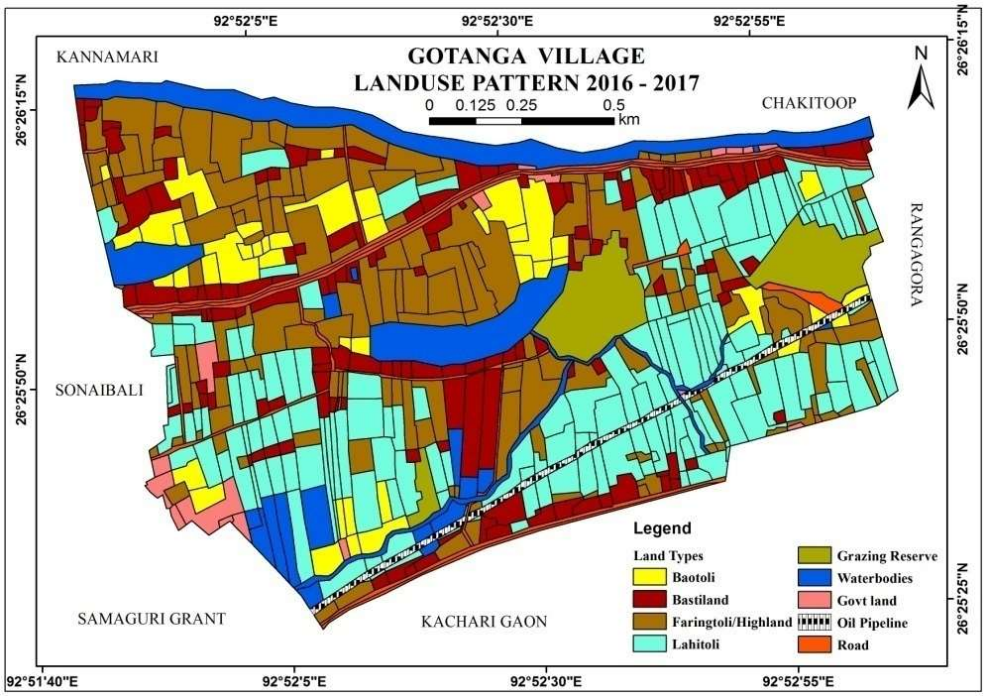


Fig. 6: LULC map of Gatanga Village

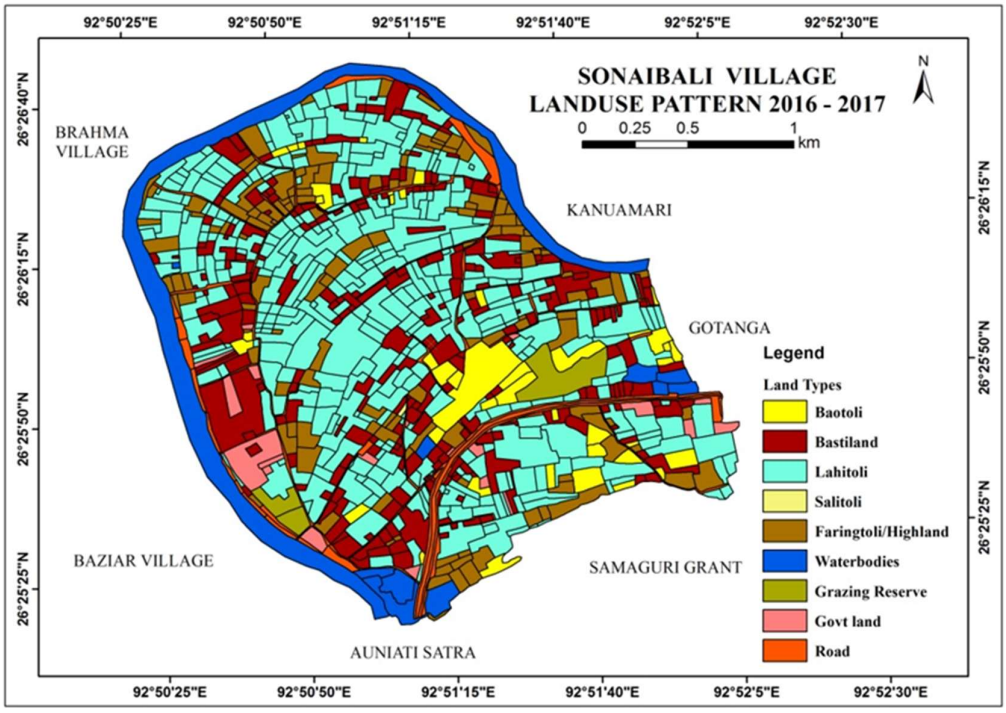


Fig. 7 : LULC map of Sonaibali Village

Table 2 : Land use pattern of adjacent villages of selected wetlands, Nagaon district

Name of wetland	Adjacent villages	Areas (ha) in different Land use categories									
		Baotoli/Bao rice field	Faringtoli/ Highland	Lahitoli/winter rice field of lali rice	Salitoli/winter rice field of Sali rice	Grazingland	Bastiland/ Residential land	Waterbodies	Road	Govt. land	Total
Samaguri	Samaguri Grant	3.27	102.23	30.87	53.66	1.62	26.45	67.67	20.52	10.81	317.1
	Gatanga	17.72	60.31	65.47	-	12.09	27.05	26.95	10.06	6.72	226.37
	Saonaibali	26.2	55.64	214.51	0.13	9.16	80.76	49.41	24.24	10.82	470.87
	Total	**47.19**	**218.18**	**310.85**	**53.79**	**22.87**	**134.26**	**144.03**	**54.82**	**28.35**	**1014.34**

Impact of agricultural practices on wetland Ecology

The rapid population growth of the adjacent villages exerted pressure to expansion of agricultural development and developed unplanned land use pattern in the marginal areas of the wetland which cause the degradation of wetland ecology(Bhagabati, 2007, Bassi *et al*,

2014). The unscientific use of fertilizers, pesticides and insecticides in marginal agricultural land are the main cause of the water pollution of wetland area and also cause of decrease of fish resources. As most of the people of adjacent villages involved in agricultural activity and involved deep irrigation from wetland, therefore expansion of agricultural activity in and around the wetland areas leads some problem like depletion of water level, shrinkage of wetland size due to conversion of wetland area into agricultural land, increase the pollutant load in water by the excessive use of agricultural input like fertilizer, pesticides and insecticides or by animal faeces due to use as grazing land which resulting the weed infestation in *beel* area.

The use of fertilizer, different form of pesticides and insecticide are considered as an important part of present agricultural system to enhance the crop productivity by mitigates the needs of growing population. But, excessive rely on chemical fertilizers often has an adverse effect on wetland ecology. The closeness of the wetland to the vicinity of the agricultural cropland permit to agricultural fertilizers enters into wetland areas which cause threat for wetland resources. However, the farmers preferred to use fertilizers like urea, potas and DAP for enhance the crop productivity. These fertilizers has been used different purposes like urea is used to promote rapid growth of the plant, DAP has been used to stimulate blooming and formation of seed and Potas is used to increase the quality of grain and seed and also increases the resistance of crop to drought and disease. It is however the excessive use of these fertilizers in agricultural operation create detrimental situation for wetland health(Bhagabati and Dutta, 2001). It has been noticed that the amount of fertilizers applied in the adjoining farmland of wetland environment is higher than the recommended amount of fertilizers. It is obvious that it greatly impact on soil and water quality of wetland resources and creates threat for wetland biodiversity.

Table 3 : Fertilizer consumption status in adjacent areas of wetland

Fringe areas of wetland	Fertilizer consumption status of different crops (kg/bigha)			Recommended amount of fertilizers(kg/bigha)
	Winter rice	Summer rice	Jute	
Samaguri	Urea 25 kg, potas 9 kg,DAP 10 KG	Urea 35 kg, potas 10kg,DAP 20KG	Urea 20 kg ,Potas 7 kg, DAP 10kG	**Winter rice** r: Urea 18kg, potas 5 kg,DAP 9 kg, **Summer rice**: Urea 18,Potas 5 , DAP 6, **Jute**: Urea 12, Potas 4kg, DAP 7. (Provided by Department of Agriculture, Assam)

Source: Field survey, 2014-2018

The impacts of agricultural practices on wetlands' ecological conditions are assessed mainly by their pressures on biodiversity status and aquatic ecosystems. The agricultural factors like encroachment of *beel* area due to conversion of agricultural land, excessive use of

fertilizers, pesticides and insecticides, over grazing, irrigation from wetlands are considered for the degradation of soil and water quality of wetlands which lead to drastic change in reduction of biodiversity status by decreasing species richness or by extinction of several species. The *beel* is rich in its exotic floral and faunal species. The prominent migratory bird species including *anas quarquedula* (garganey), *anas platyrhynchos* (mallard), *anas clypeata* (northern shoveler), *anas acuta* (pin-tail duck),*dendrocygna bicolor* (large whistling duck) have been seen during winter which coming from different parts mainly Siberia, central Asia and Russia. Generally the Samaguri *beel*s of perennial wetlands are rich in various types of fishes *like Lerbeo rahita, Catla catla, Wallagoattu, Cirrhinus mrigala, Rebio calbasu, Aorichthys aor, Notopterus chitala, C.marulius* etc. The floral species of wetland resources consist of different kind of vegetables, medicinal plants, grasses, submerged, rooted floating and free floating aquatic plants.

However, the Simson's diversity intex has been used to showing the present biodiversity status of the *beel* based on availability of floral and faunal species. The index value is ranges from 0 to1. The value which close to 1 represent the high diversity and the value close to 0 reflect the low diversity status. It is seen that in Samaguri *beel* the biodiversity index represent as 0.65 which considered as moderately rich biodiversity index.It has been noticed that several bird and fish species are gradually decreasing their trend. The fishes like *singi, magur, sol, sal, kawai, puthi, muwa, misamas, kandhuli, kusia, borali, sitol, ari, tura, kokiladora* etc. are getting endangered in nature. The decreasing nature of fishes have an great impact towards the birds species Therefore, there have been seen in gradual decrease of bird species also which feed on fishes like cattle egret, openbill stork , paddy bird, little cormorant white breasted waterhen, kingfisher, crane etc.

Conclusion

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. The agricultural pattern of marginal wetland area is not only responsible for the creating imbalanced in aquatic ecosystem but also cause to rapid degradation of biodiversity status of wetland ecosystem. It is therefore, degrading biodiversity status of wetland have reduces the ecological services of wetland which have great impact on the life and livelihood of wetland depending communities as well.

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