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A Study of Land Use / Land Cover Changes in Three Blocks of Darrang District, Assam Using Geoinformatics

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Abstract - The study is an attempt to analyse the changes in the land use / land cover pattern in three administrative blocks of Darrang district, Assam over a period of time (2003 to 2015) using the techniques of geospatial technology. Digital satellite imageries of IRS LISS III and high resolution Google earth images were used to demarcate the land use / land cover classes of the year 2003 and 2015. The study area is classified into six land use / land cover categories viz. Settlement (villages), Agricultural land, Forest, wetland, water body and river.

Geographic Information System (GIS) was used to integrate the layers of land use / land cover classes of different time to quantify the changes. In addition to the study of overall changes in the land use / land cover over a period of time, category wise changes were also quantified and mapped. For each land use / land cover category the area unchanged, area extended and area reduced over a period of time were quantified and depicted in the respective maps. The land use / land cover category wise study provides the nature of change in each category over time. The overall land use / land cover changes were shown in the form of land use loss and gain map. The nature of changes of the land use pattern was also compared across the blocks.

The study area falls under the three administrative blocks under Darrang district, Assam. The blocks include Sipajhar, Pub Mangaldai and Pachim Mangaldai; situated in the north bank of the river Brahmaputra. The total area of the three administrative blocks is 900 sq.km (approx.).Topographically, the study area is flat in nature which is situated in the alluvial plain of the Brahmaputra River, with some hillocks seen as inselberg.

Keywords – Land use, Land cover, Remote Sensing, GIS, Darrang

I. INTRODUCTION

Land use is the human function of a given area while land cover is the physical surface of the land [3]. The land use / land cover pattern of a region is an outcome of natural and socio– economic factors and their utilization by human in time and space [4]. Land cover and land use change are increasingly recognised as major factors of global environmental change and important for sustainable management of natural resources [1]. Land is one of the important resources which plays dominant role in determining human, economic, social and cultural progress. The proper utilization of the land is the economic backbone of a region. Land use is a primary indicator of the extent and degree to which man has modified the land resources [2].

Land use pattern of an area is determined by the physical set up and growing inhabitants as well as the dynamic human decisions. The land use pattern of land varies from one region to another more importantly as a result of variations in the adaptability of human beings under the inter functions of nature and human, rather than the diversity in the endowments alone. Land use can be considered an interface between natural conditions and anthropogenic influences. The growth of population and industries has been changing the land use pattern and land cover scenario of a particular locality.

II. STUDY AREA

The study area includes three administrative blocks viz Sipajhar, Pub Mangaldai and Pachim Mangaldai under Darrang district, Assam which is located in the north bank of the river Brahmaputra (Fig. 1). The area extends from 91°11′ to 91°45′ longitude and from 26°12′ to 26° 32′ latitude. Each block covers an area of 365, 197 and 334 sq.km respectively. Topographically the area is a flat plain sloping towards south and drained by southerly flowing rivers (like Barnodi,Nonoi, and Saktola) ultimately meeting the river the Brahmaputra in the south.The average elevation of the area is 54 m above MSL.

Volume 4 Issue VI, June 2016
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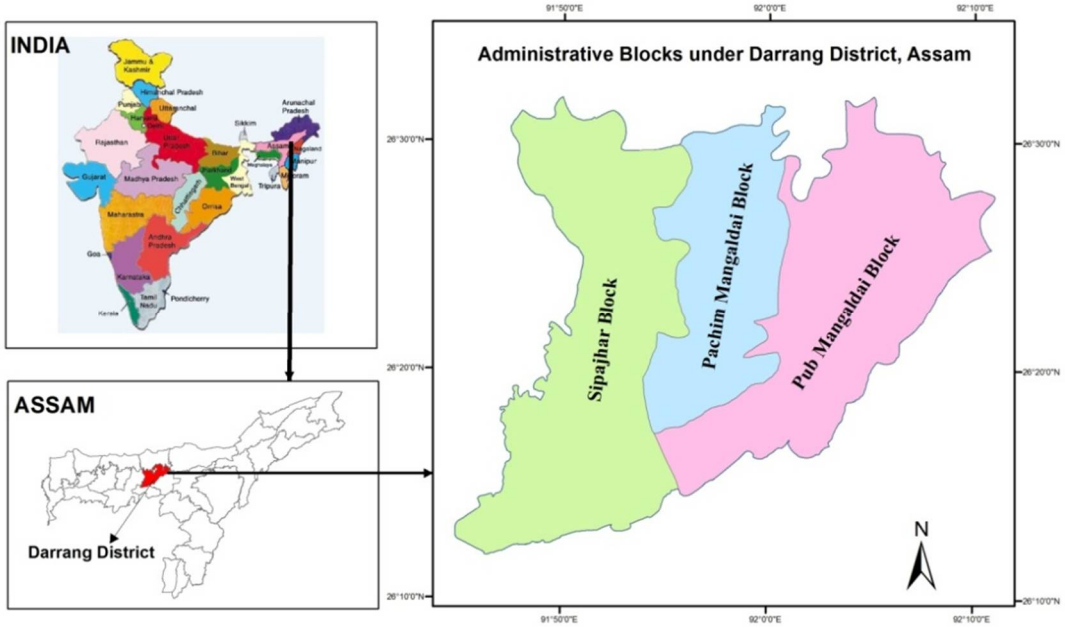

Fig. 1 Location map of the study area

III. OBJECTIVE OF THE STUDY

The objective of the study is to map and quantify the land use / land cover changes in the three administrative blocks in the year 2015 with respect to the year 2003. A comparative evaluation of the changing pattern in three blocks to be made for each land use classes

IV. DATABASE AND METHODOLOGY

IRS-P6 LISS-III satellite imagery of 2003 and high resolution Google earth imagery of 2015 were used for land use / land cover mapping by standard visual image interpretation techniques. The land use / land cover classes of the year 2003 within the study area were manually digitized from the LISS-III imageries in Arc GIS and of the year 2015 were digitized from the Google earth imageries in QGIS. The GIS database was prepared in WGS_1984_UTM_Zone_46N coordinate system. Raster overlay analysis in GIS was performed between land use layers to detect the change in land use / land use between 2003 and 2015.

V. RESULTS AND DISCUSSION

The area under study is classified into six land use / land cover categories – settlement (villages), agricultural land, forest, wetland, water body and river. The area under each land use categories are changed over the years because of the increasing anthropogenic intervention arising from the population pressure in the district. The land use / land cover map generated for the year 2003 and 2015 reflect this fact. The trend of changing pattern in each land use category is shown in the map and also quantified. The spatial distribution of the land use classes for the year 2003 and 2015 are shown in the Fig. 2 and 3 respectively.

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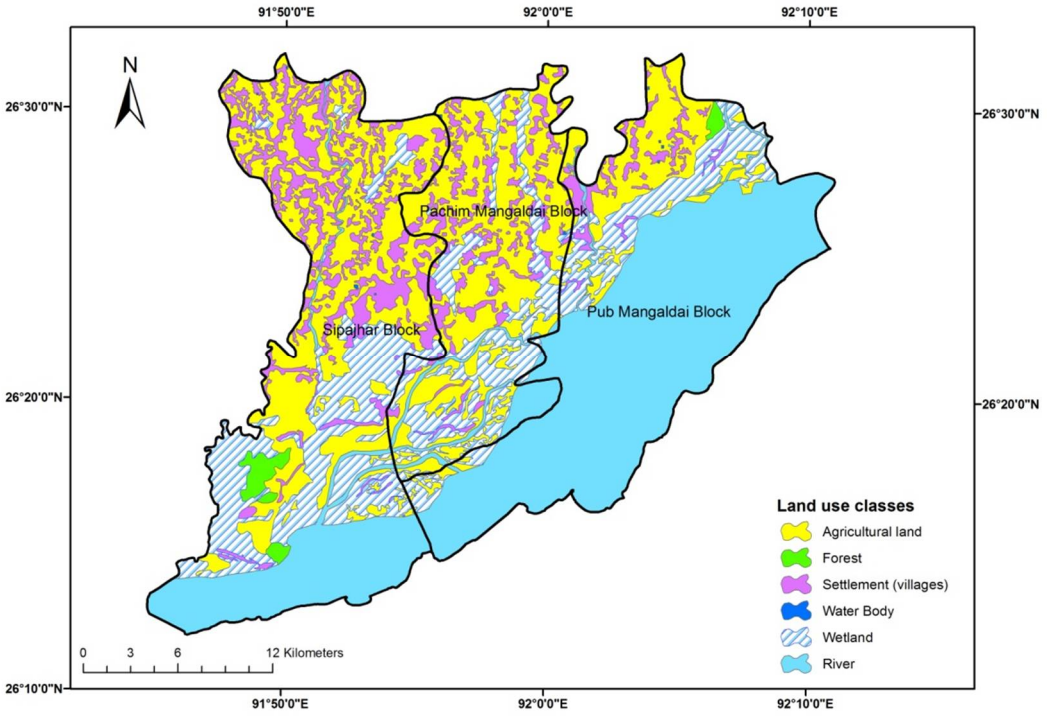

Fig. 2 Land Use / Land cover map of 2003

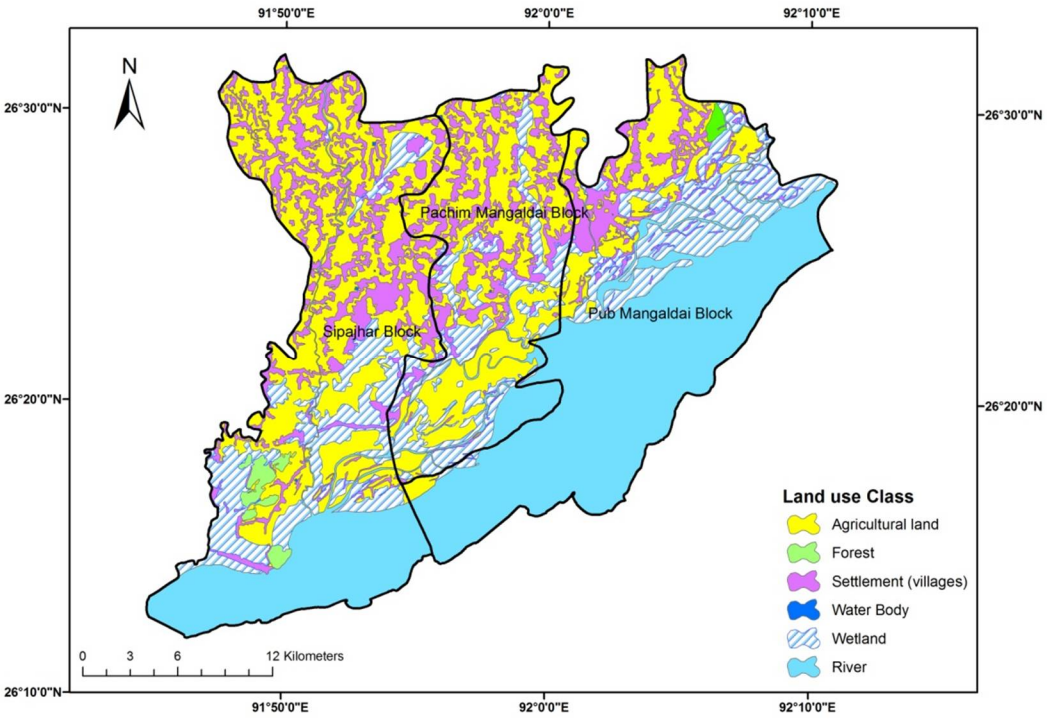

Fig. 3 Land use / Land cover map of 2015

The composite picture of gain, loss and unchanged area of all the land use categories in 2015 with respect to 2003 are shown in the Fig. 4 to Fig. 6. These maps show the areas where a land cover has been extended (gain) or removed (lose); or maintain their

Volume 4 Issue VI, June 2016
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original position over the years.

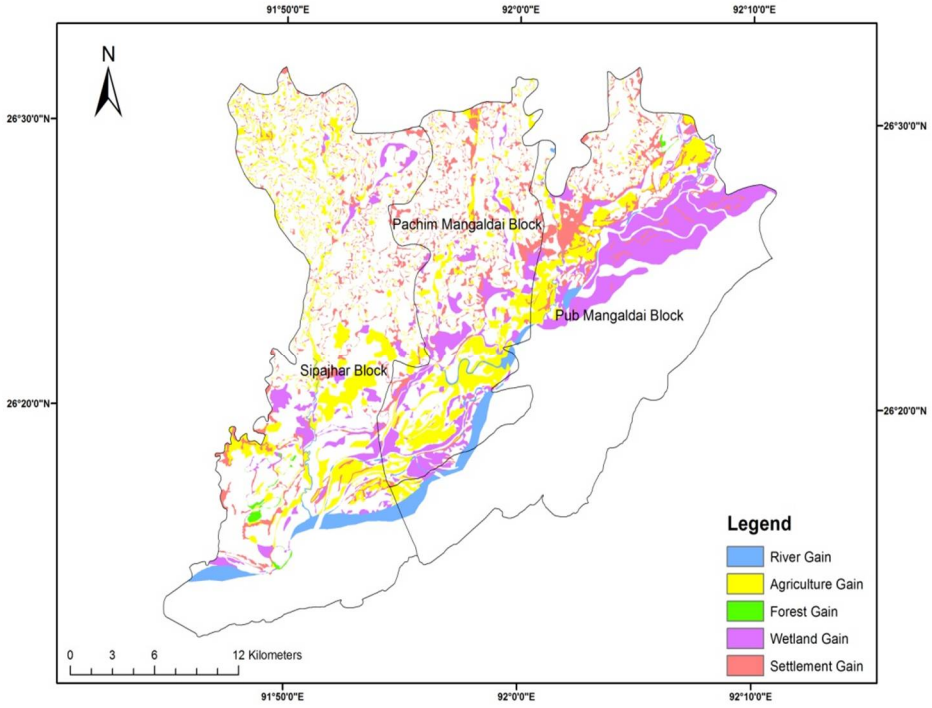

Fig. 4 Land use gain map in the year 2015 w.r.t. 2003

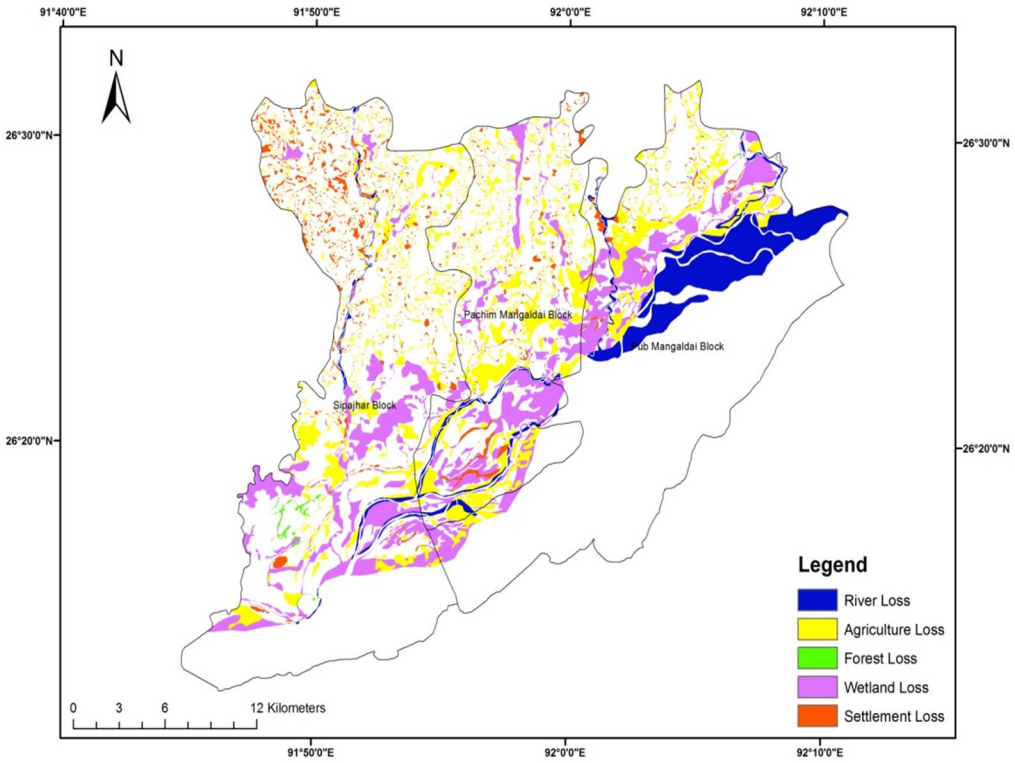

Fig. 5 Land use loss map in the year 2015 w.r.t. 2003

Volume 4 Issue VI, June 2016
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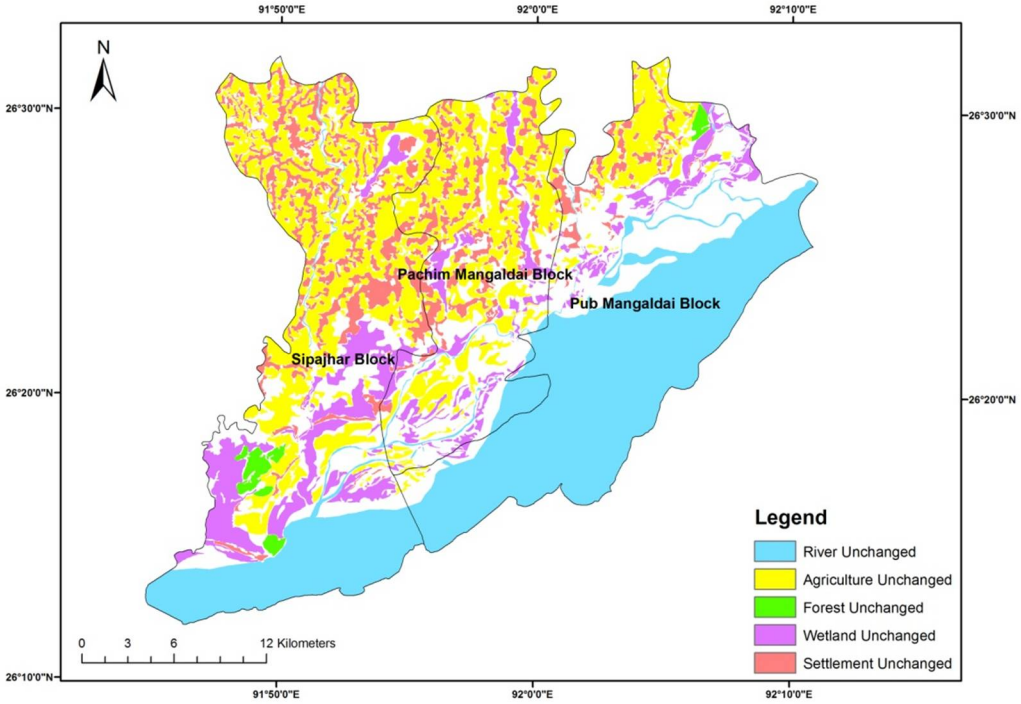

Fig. 6 Land use remains unchanged in the year 2015 w.r.t. 2003

Administrative block wise distribution of land use and their changes in 2015 with respect to 2003 is quantified. TABLE 1, 2 and 3 gives the area of each land use categories under the three administrative blocks along with the percentage of area covered by each of them in the year 2003 and 2015. The proportion of area covered by each land use / land cover categories differs in three blocks under consideration.

TABLE I
SIPAJHAR BLOCK (Total area under Sipajhar block is 365.23 sq.km)

Sl No	Land use Category	Area in Sq Km		Percentage (%)	
		2003	2015	2003	2015
1	Water Body	0.14	0.26	0.04	0.07
2	Settlement (villages)	68.34	75.41	18.71	20.65
3	Agricultural Land	134.53	142.4	36.84	38.99
4	Forest	7.16	7.35	1.96	2.01
5	Wetland	82.42	60.47	22.57	16.56
6	River	72.63	79.3	19.89	21.71

Volume 4 Issue VI, June 2016
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TABLE 2
PACHIMMANGALDAI BLOCK (Total area under PachimMangaldai block is 196.88 sq. km)

Sl No	Land use Category	Area in Sq Km		Percentage (%)	
		2003	2015	2003	2015
1	Water Body	0.09	0.06	0.05	0.03
2	Settlement (villages)	31.8	44.04	16.15	22.37
3	Agricultural Land	102.79	96.22	52.21	48.88
4	Forest	-	-	-	-
5	Wetland	48.12	41.19	24.44	20.92
6	River	14.09	15.35	7.16	7.80

TABLE 3
PUB MANGALDAI BLOCK (Total area under Pub Mangaldai block is 333.89 sq. km)

Sl No	Land use Category	Area in Sq Km		Percentage (%)	
		2003	2015	2003	2015
1	Water Body	0.1	0.14	0.03	0.04
2	Settlement (villages)	13.3	28.97	3.98	8.68
3	Agricultural Land	45.17	43.2	13.53	12.94
4	Forest	1.68	1.82	0.50	0.55
5	Wetland	39.54	57.56	11.84	17.24
6	River	234.08	202.17	70.11	60.56

The TABLE 4, 5 and 6 gives the area which is extended, diminished and not changed in each land use class under the three administrative blocks in the year 2015 with reference to the year 2003. Percentage of net change is also calculated with reference to the total area of each block.

TABLE 4
Changing pattern of land use in Sipajhar Block

Land use Category	No Change (in Sq. km)	Extended (Gain) (Sq. km)	Diminished (Loss) (Sq. km)	Net Change (Gain-Loss)	% of Net Change
Settlement (villages)	54.28	21.13	14.06	7.07	1.94
Agricultural Land	104.43	37.98	30.1	7.88	2.16
Forest	6.12	1.23	1.04	0.19	0.05
Wetland	45.43	15.03	36.99	-21.96	-6.01
River	69.48	9.84	3.15	6.69	1.83

Volume 4 Issue VI, June 2016
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TABLE 5
Changing pattern of land use in PachimMangaldai Block

Land use Category	No Change (in Sq. km)	Extended (Gain) (Sq. km)	Diminished (Loss) (Sq. km)	Net Change (Gain-Loss)	% of Net Change
Settlement (villages)	26.13	17.92	5.66	12.26	6.23
Agricultural Land	69.54	26.68	33.26	-6.58	-3.34
Forest	-	-	-	-	-
Wetland	19.99	21.21	28.12	-6.91	-3.51
River	10.01	5.35	4.08	1.27	0.65

TABLE 6
Changing pattern of land use in Pub Mangaldai Block

Land use Category	No Change (in Sq. km)	Extended (Gain) (Sq. km)	Diminished (Loss) (Sq. km)	Net Change (Gain-Loss)	% of Net Change
Settlement (villages)	10.87	18.09	2.43	15.66	4.69
Agricultural Land	26.17	17.03	19.01	-1.98	-0.59
Forest	1.58	0.24	0.09	0.15	0.04
Wetland	14.15	43.39	25.38	18.01	5.39
River	196.02	6.18	38.07	-31.89	-9.55

Fig. 7 to Fig. 11 gives the land use category wise spatial distribution of their changing pattern (extended, diminished and no change) in 2015 with respect to 2003.

Volume 4 Issue VI, June 2016
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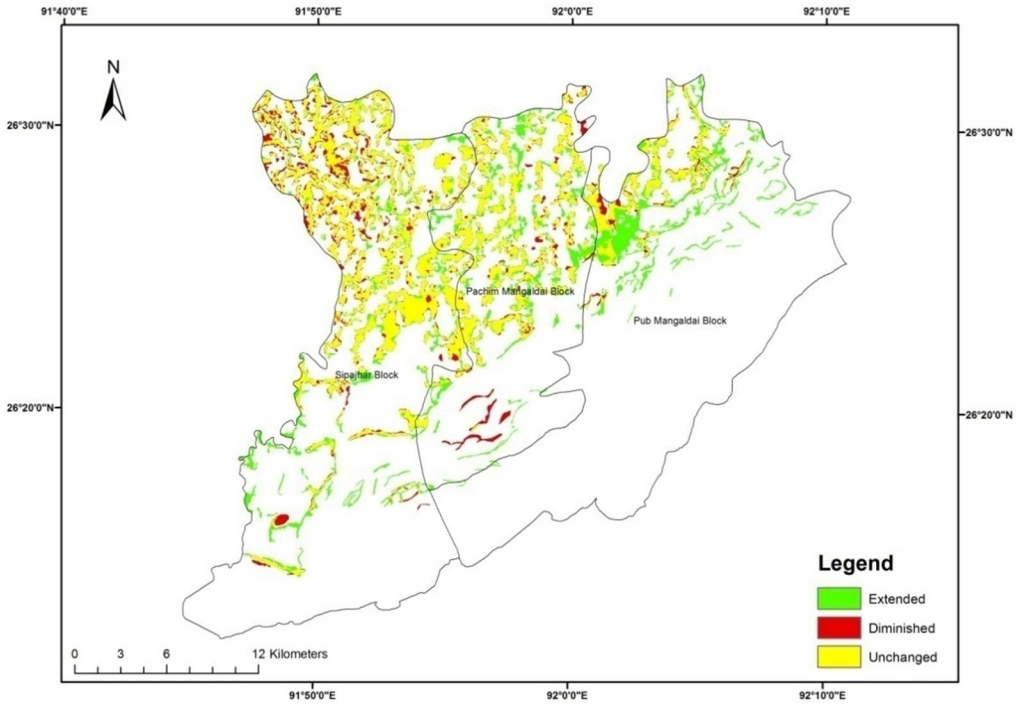

Fig. 7 Changes in the Settlement area in 2015 with reference to 2003

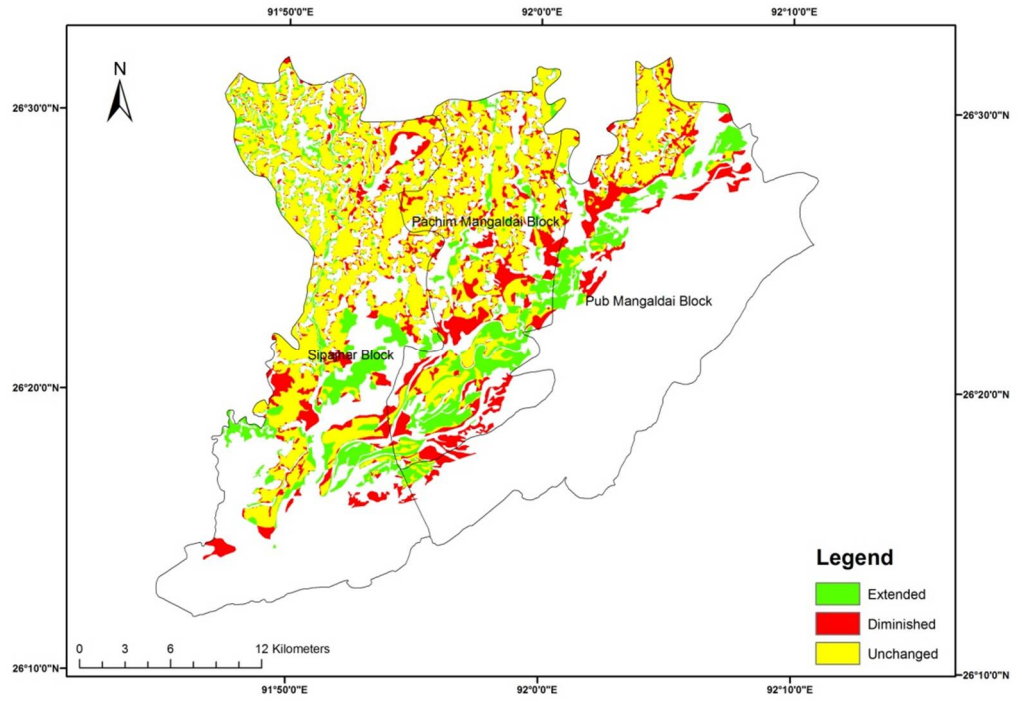

Fig. 8 Changes in the Agricultural Land in 2015 with reference to 2003

Volume 4 Issue VI, June 2016
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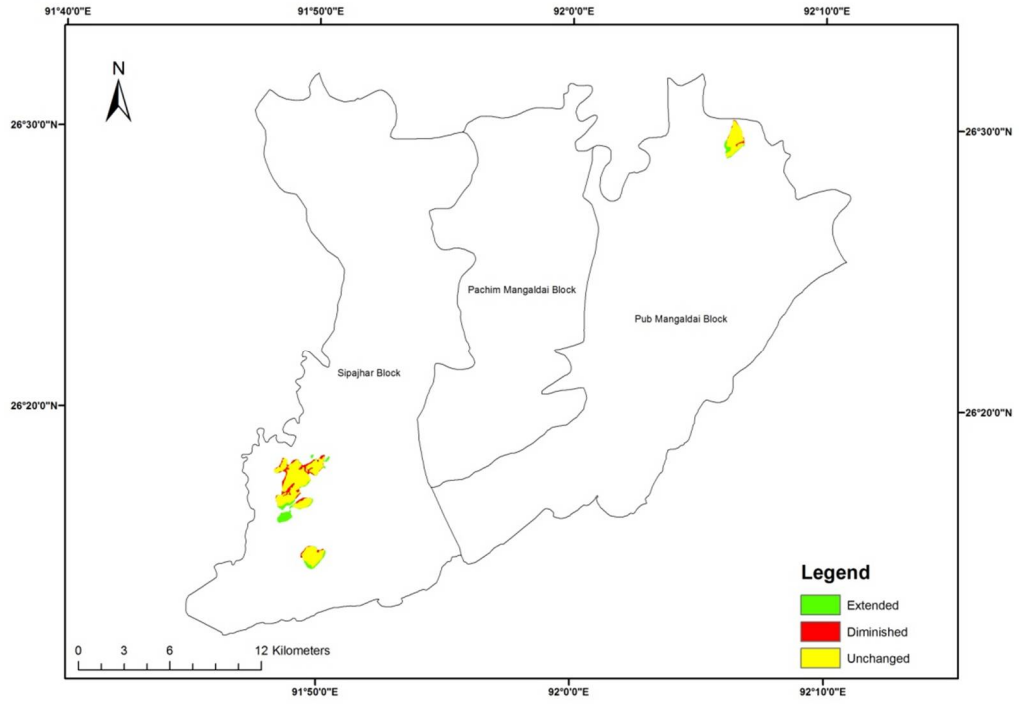

Fig. 9 Changes in the Forest Land in 2015 with reference to 2003

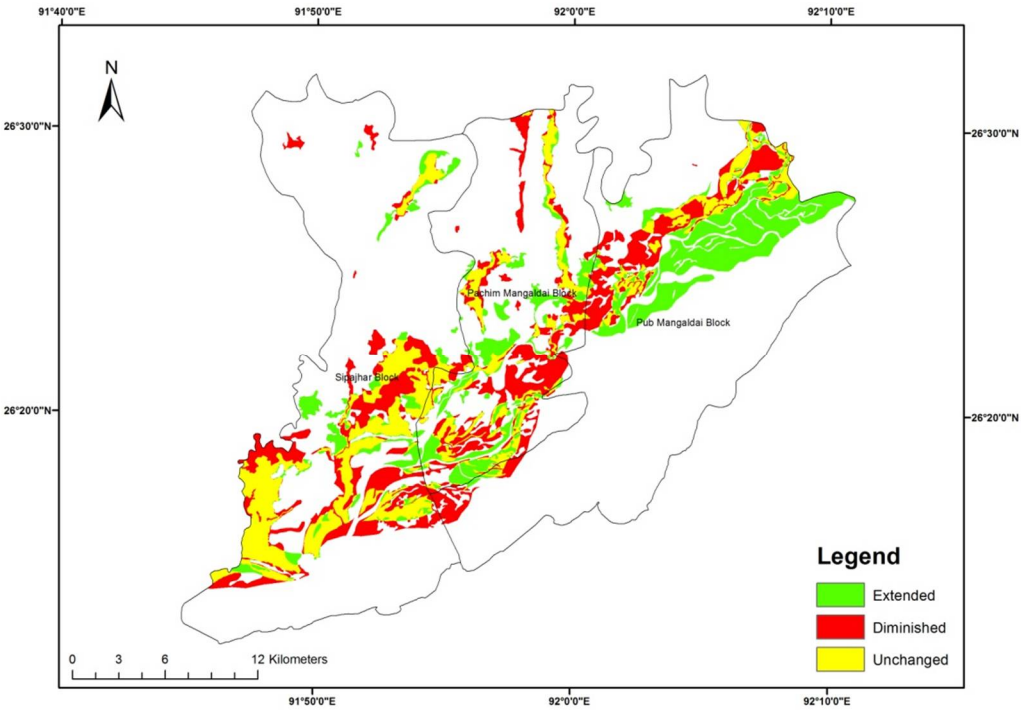

Fig. 10 Changes in the wetlands in 2015 with reference to 2003

Volume 4 Issue VI, June 2016
ISSN: 2321-9653
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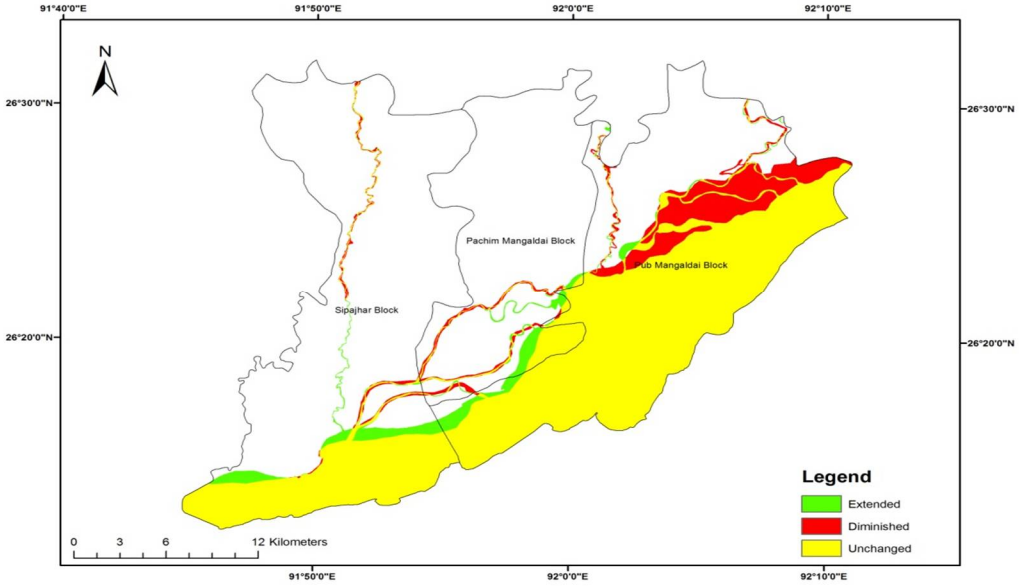

Fig. 11 Changes in the River channels in 2015 with reference to 2003

There is a 6.01% decrease in the wetland area within the Sipajhar Block in 2015 with respect to 2003. This wet land area is altered to either Agricultural land (2.16% increase) or settlement (1.94% increase). Part of the wet land is being affected by river erosion also. No change in the forest cover has been recorded within this block.

It has been observed that there is a 6.25% increase of settlement area in the Pachim Mangaldai block in 2015 with respect to 2003. This block records the maximum increase in the settlement area out the three blocks under study. This increase is observed to be mainly in expense of the agricultural land (3.34% decrease) and wet lands (3.51% decrease) present in the block in 2003. There is no natural forest cover in the block.

In Pub Mangaldai block, the River Brahmaputra covers about 60% of its total area. In this block river bank line receding is very prominent with about 9.5% decrease in the river bed. Mostly this area is occupied by newly formed wet lands and settlement. There is a marginal decrease and increase in the area of agricultural land and forest respectively.

VI. CONCLUSION

The changing pattern of land use in each administrative block is quite different. In Sipajhar administrative block the marginal increase in Settlement, agricultural land and river erosion has cost the wet land area of the block. In PachimMangaldai block the 6.23% increase in the settlement, which is highest among the studied blocks, is in expense of the agricultural land and wet land. Whereas in Pub Mangaldai Block the settlement and wet land area increase is linked with the new land emerged from the Brahmaputra bank line recession in its north bank. (TABLE 7)

TABLE 7
Summary of the changing pattern of land use in three administrative blocks

Land use Category	Sipajhar Block	Pachim Mangaldai Block	Pub Mangaldai Block
	% of Net Change		
Settlement (villages)	1.94	6.23	4.69
Agricultural Land	2.16	-3.34	-0.59
Forest	0.05	-	0.04
Wetland	-6.01	-3.51	5.39
River	1.83	0.65	-9.55

Volume 4 Issue VI, June 2016
ISSN: 2321-9653

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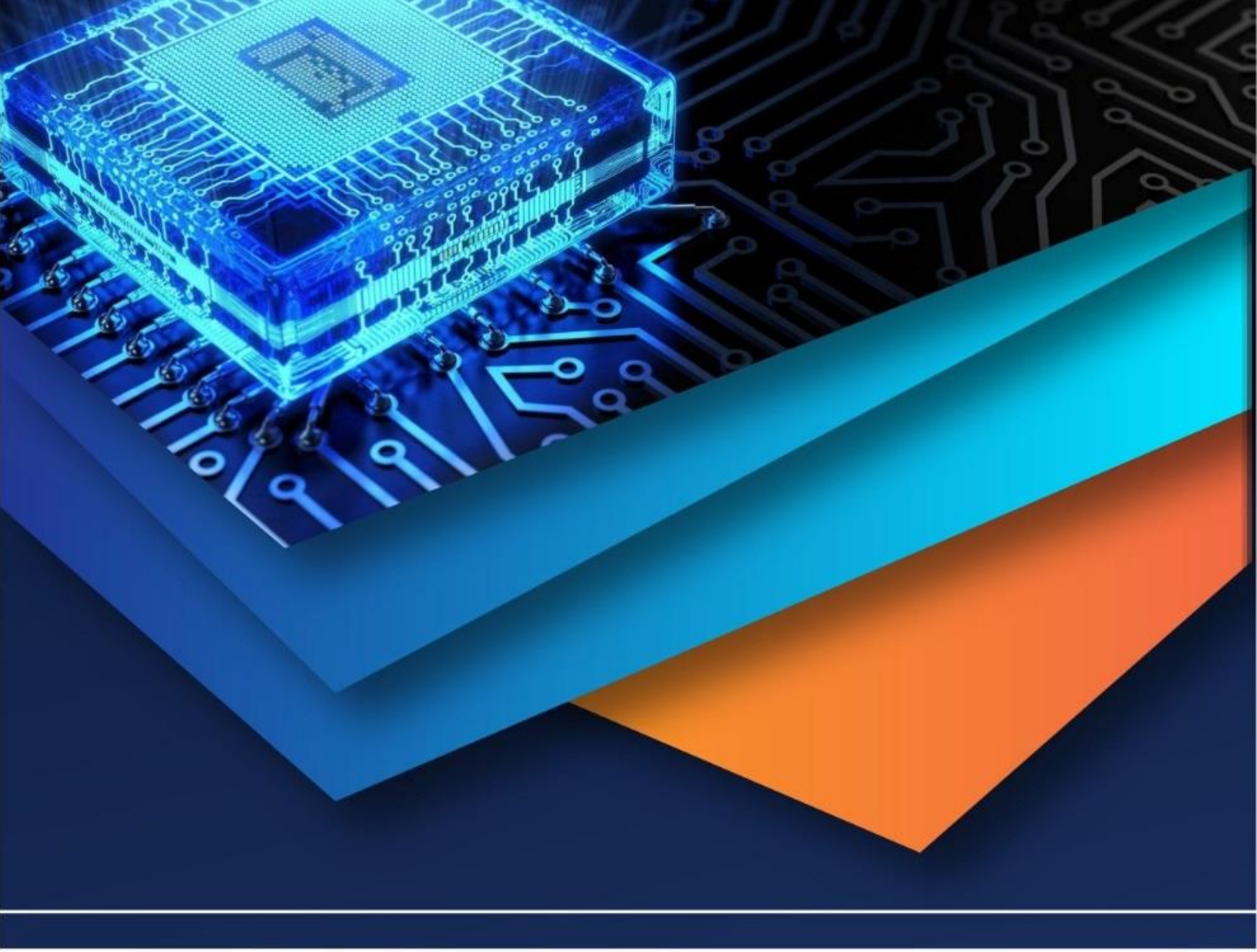

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