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Changing Land Use / Land Cover Analysis in Contai (Kanthi) Coastal Belt, West Bengal and Odisha

Swapan Kumar Tala

M. A., M. Phil., UGC NET

Abstract: ***Land is the basic resource for human life on which many of other human activities are based.Land use and land cover change is always caused by multiple interacting factors. The mix of driving forces of land use/land cover change varies in time and space and according to specific physical and human environment conditions. The rapid increasing population and socio-economic needs crate pressure on land use/land cover, and this pressure results in unplanned and uncontrolled growth. Land use/land cover changes are usually caused by growth of rural and urban land uses, mismanagement of agriculture, forest and water bodies, which lead to several environmental problems. Present study is an attempt to explore the salient features of spatio-temporal changes in the complex land use system of Contai coastal belt from a geographical perspective. The study is based mainly of secondary sources. General land use characteristics of the area for two different periods, namely 2000 and 2015 are taken into consideration for present study. Water body, vegetation and fallow land area have been decreased due to population growth, expansion of agricultural field, increasing of settlement area etc.***

Keywords: Land, Land use, Land cover, Land use and land cover change, Degradation

1. Introduction

Land is a product of nature and a three dimensional dynamic body. Man is a product of earth's surface. As man cannot be a living being without soul, similarly civilization cannot evolve without land. It is the container of the earth on which human civilization has developed and sustained. Since, the dawn of civilization, humans have altered the surface of earth while acquiring valuable resources such as food, fiber and shelter. These alterations of the landscape and their consequences have been noted for a long time. Greek philosophers like Aristotle and Plato, Roman emperors such as Hadrian had reported about the deterioration of natural vegetation and erosion of fertile land (Goldewijk & Ramankutty, 2004). However, records on analysis of changes in land use areavailable only from the beginning of the 18th century. Von Thunen (1826) for the first time studied the spatial layout of various crops and other land uses of his estate and developed a more general model or theory of how rural land uses should be arranged around a market town (Briassoulis, 2000). Malthus (1798) who first articulated that "land is a finite resource with limited carrying capacity to support the high growth rates of the human population" (Brandão *et al*., 2010).Rapid and extensive modifications of land use /land cover due to accelerated human activities have been a major cause of global environmental change in the past three centuries, although evidence for land covers alteration dates back many million years (Vitousek et al., 1997). Land use and land cover change has important environmental consequences through theirimpacts on soil and water, biodiversity, microclimate, reduced CO2absorption and hence contribute to watershed degradation (Lambin *et al*., 2001). According to S. Samanta and S. K. Paul (2016), shallow water, salt marsh, cultivated land, dry sand area were decreases while settlement area increased rapidly during 1973–2002. Coastal flood play the dominant role to change the land use pattern and agricultural practices (Purkait et. al., 2017).Remote sensing and Geographical Information System technologies are being applied to carry out change detection studies for land use/ land cover analysis especially in coastal regions where there are other constraints besides accessibility.

2. Objectives

The present study has been carried out to identify the existing land use and land cover analysis of Contai coastal belt. The detailed work has been carried out with the following objectives:

1) To observe the existing land use/ land cover analysis in our study area.
2) To workout the factors responsible for land use/land cover change.

3. Study Area

Contai coastal belt is located in West Bengal and Odisha. Its large portion is located in Purba Medinipur District, West Bengal and rest portion is located in Balasore District, Odisha. The northern limit of the coastal tract is demarcated by Orissa coast canal and Hijili tidal canal and southern limit of the coastal tract is Bay of Bengal (A. Paul, 2002). It extends from the mouth of Rasalpurriver to mouth of Subarnarekha river. Total length of Contai (Kanthi) coastal belt is about 45 Km. Contai coastal belt is divided into six different sectors according to breaking point by rivers or tidal inlets. These are as follows: Junput coastal sector, Soula coastal sector, Mandermoni coastal sector, Sankarpur coastal sector, Digha coastal sector and Talsari coastal sector.

Contai coastal belt is covered in Topo-Sheet map no. 73 O/6, 73 O/10, 73 O/13 and 73 O/14 of Survey of India (SOI). Latitudinal extension for the study area is 21º47′ 20.93″ N to 21º 34′ 00.67″ N and longitudinal extension 87º 53′ 29.16″ E to 87º 24′ 23.74″ E.

Location Map of the Study Area

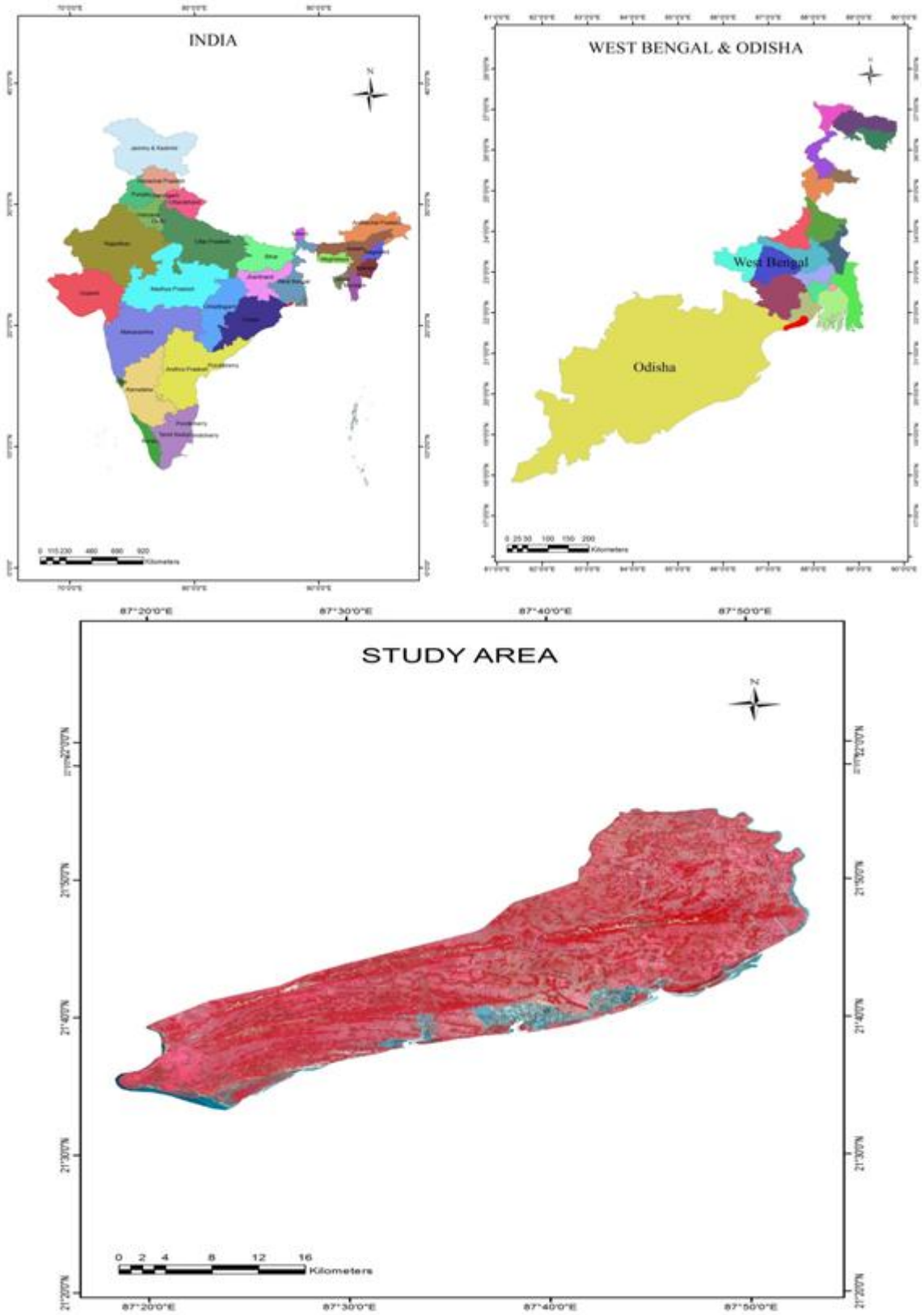

Figure 1: Location map of study area

4. Data base and Methodology

Intensive visits to the study area, extensive literature survey and experimental documentary analysis are three key measures to prepare for conducting this study.

The study area was delineated from the Survey of India (SOI) Topo-sheet No. 73 O/6, 73 O/10, 73 O/13 and 73 O/14 of 1979 (1978-1979) on 1:50,000 scale. Band wise Landsat-ETM 2000 and 2015 satellite images (Spatial resolution all

images are 30m) were downloaded from the website **www.landcover.org**. Then, layer Stack, image pre-processing, image sub-setting, supervised image classification etc. are done through Arc-GIS software. These two images were compared to work out the change detection. The generated land use / land cover maps of the two different time periods were validated after ground truthing.

5. Data analysis

Land Use/Land Cover Analysis-2000: The analysis of the land use/ land cover of the study area for the year 2000 and 2015 were done in order to detect the changes that had taken place in different categories. The classification of land use/land cover 2000 consists of five classes which were derived from Landsat ETM satellite image. Each of the land use/land cover classes identified and their extents are provided in the table 1 and depicted in the map (fig.2).Table 1 and fig 3 reveals that in the year 2000, total area under water bodies' category was 65.75 Sq. km about 6.94% of the total area of the study area. The vegetation covered an area of about 375.98 Sq. km that accounted a percentage of 39.69 of the total study area. The total area under Settlement category was 88.91 Sq. km which constitutes about 9.39%. Fallow land account for 46.93 Sq. km accounted for a percentage of 4.95 of the total area. The agricultural area covered an area of 369.73 Sq. km and constitutes a percentage of about 39.03. Vegetation area is maximum (39.69%) and fallow land category is minimum (4.95%) in our study area in 2000. Total study area is 947.30 sq. km.

Table 1: Land use/land cover of the study area (2000)

Land use/land cover	Area(Sq. km)	Area (%)
Water bodies	65.75	6.94
Vegetation	375.98	39.69
Settlement	88.91	9.39
Fallow Land	46.93	4.95
Agricultural Field	369.73	39.03
Total	947.30	100.00

Source: Landsat-ETM (2000)

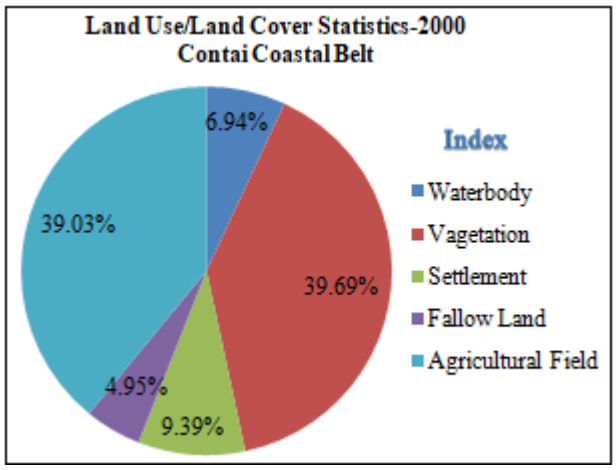

Figure 2: Land use and land cover-2000
Source: Landsat-ETM (2000)

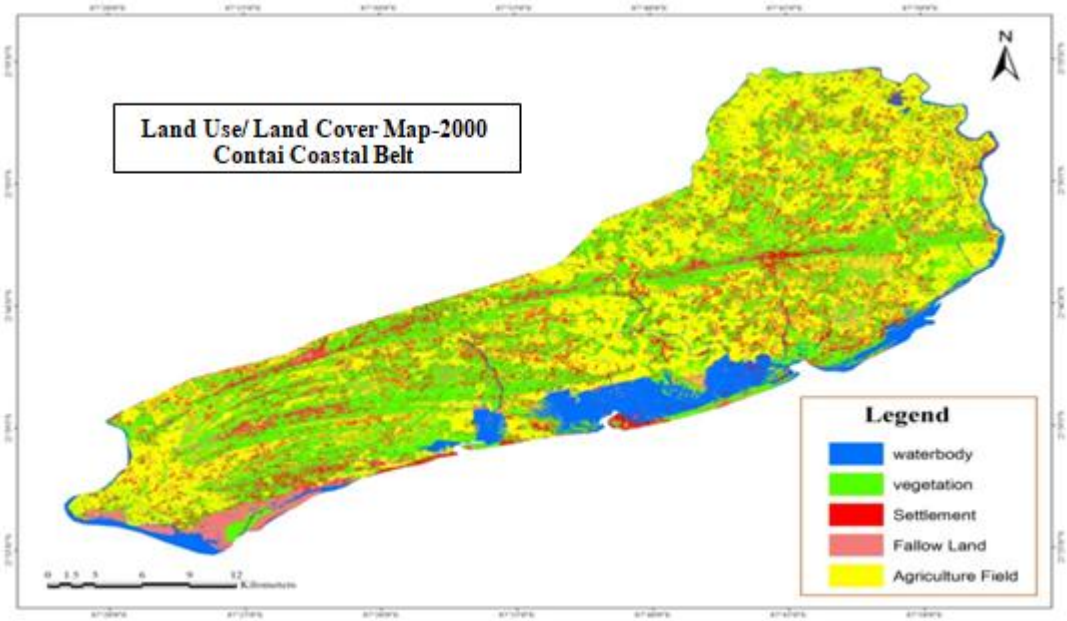

Figure 3: Land use and land cover map-2000
Source: Landsat-ETM (2000)

Table 2: Land use/land cover of the study area (2015)

Land use/land cover	Area (Sq. km)	Percent (%)
Water bodies	45.74	4.83
Vegetation	365.33	38.57
Settlement	100.04	10.56
Fallow Land	46.26	4.88
Agricultural Field	389.82	41.16
Total	947.19	100.00

Source: Landsat-ETM (2015)

Land Use/ Land Cover-2015:
Land use/Land cover status of year 2015 reveals that there has been discernible change in some of the categories. The table 2 and fig. 5 shows that so far as water bodies is concerned it recorded total area of 45.74 sq. km accounts

4.83% percent, which means a decrease in area under this land use. The Vegetation area showed decrease trend and covered an area of 365.33 sq. km, accounted a percentage of 38.57 of the total land area. The settlement covered an area of 100.04 sq. km constituted a percentage of 10.56 of the total land area. The fallow land accounted 46.26 sq. km i.e. about 4.88% of the total geographical area of our study area. Agricultural field constituted an area of about 389.82sq. Km accounts for 41.16 percent.

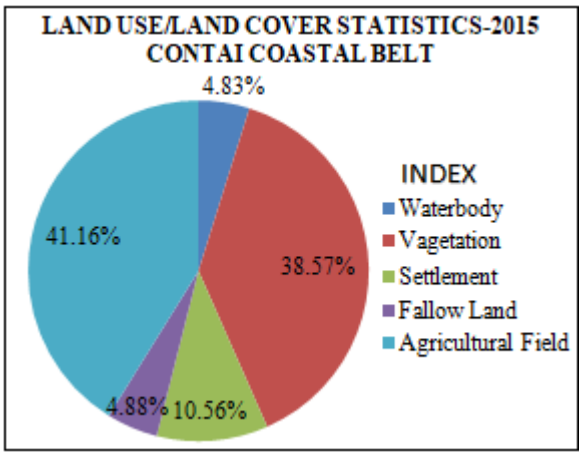

Figure 4: Pie-graph of land use and land cover-2000
Source: Landsat-ETM (2015)

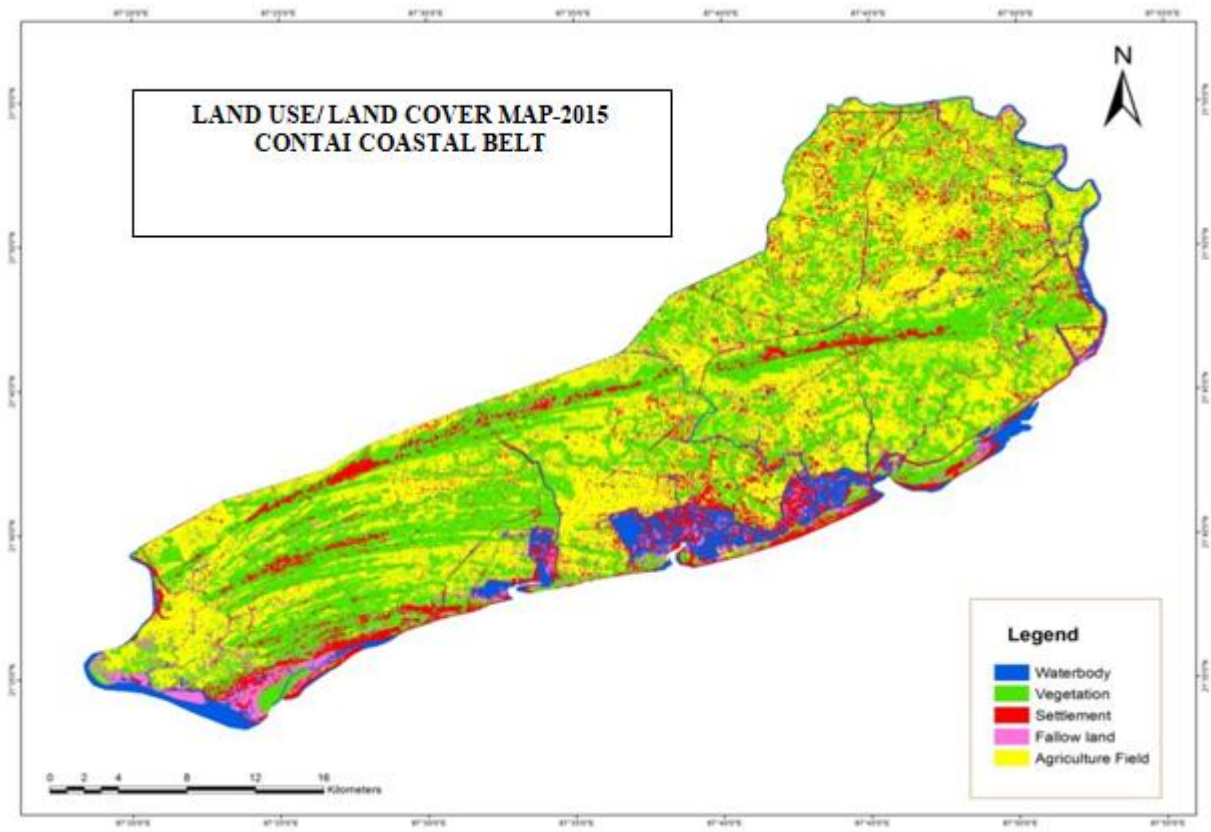

Figure 5: Land use and land cover map-2015
Source: Landsat-ETM (2015)

Change Detection Analysis of Land Use/Land Cover (2000-2015)

The change detection analysis was performed in order to analyze the change in land use/ land cover that has occurred from 2000 to 2015. Table 3 reveals that there has been discernible change in land use / land cover of the study area during the years 2000 to 2015.The land under water bodies has shown a remarkable change as it has decreased from 65.75 sq. km in 2000 to 45.74 sq. km in 2015, a decrease of 20.01sq. km depicting a negative growth rate of 2.11 percent and an average annual negative growth of 0.14 percent. In 2000 an area of vegetation cover was 375.98 sq. km and whereas in 2015 the area under this category was 365.33 sq. km. showing a decrease of about 10.65 sq. km. This category shows decline of 1.12 percent and an annual growth of 0.07 percent. The settlement area in the year 2000 was 88.91 sq. km and in 2015 it was 100.04 sq. km accounting an increase of 11.13 sq. km. The increase in this category was 1.18 percent and an annual average growth was 0.08 percent. The total area under fallow land category was 46.93 sq. km. in 2000 whereas in 2015 it was 46.26 sq. km., registering a decline of 8.64 percent and an average annual negative growth of 0.07 percent. The land under agriculture has remarkable increased. It was 369.73 sq. km. in 2000 on the other hand in 2015 it was 389.82 sq. km. depicting an increase of about 20.09 sq. km. During the period of 2000 to 2015-this category showed a growth of 2.13 percent and an average annual growth of 0.14 percent.

Table 3: Change in land use/cover from 2000 to 2015

Land Use/Land Cover -2000			Land Use/Land Cover -2015			Growth in sq. km		Growth in percentage	
Land use/ land cover	Area (Sq. km)	Area (%)	Land use/ land cover	Area (Sq. km)	Area (%)	Growth in sq. km	Annually growth in sq.km	Growth (%)	Annually Growth (%)
Water body	65.75	6.94	Water body	45.74	4.83	-20.01	-1.33	-2.11	-0.14
Vegetation	375.98	39.69	Vegetation	365.33	38.57	-10.65	-0.71	-1.12	-0.07
Settlement	88.91	9.39	Settlement	100.04	10.56	11.13	0.74	1.18	0.08
Fallow Land	46.93	4.95	Fallow Land	46.26	4.88	-0.67	-0.04	-0.07	Trace
Agricultural Field	369.73	39.03	Agricultural Field	389.82	41.16	20.09	1.34	2.13	0.14
Total	947.30	100.00	Total	947.19	100.00	-0.11	-0.01		

Source: Landsat-ETM (2000 & 2015).

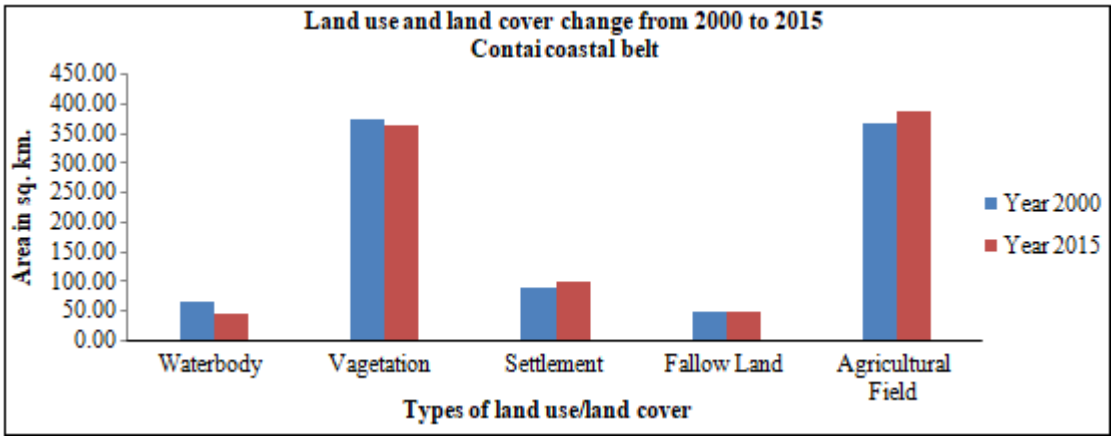

Figure 6: Land use and land cover change (2000-2015)
Source: Landsat-ETM (2000 & 2015)

During the field work, it was observed that most of the land has been shifted to agricultural field and settlement. The most important reason for this is that the return from agriculture and settlement sector has been quite attractive and the farmers are fast transferring their water bodies and fallow land to settlements and agricultural field. It was found that the vegetation has also decrease subsequently.

6. Conclusion

The current study aims to observe land use/land cover change that occurred in Contai coastal belt from 2000 to 2015 using remote sensing and GIS. The study of land use and land cover classification establish the fact that the accurate land use data can be obtained from the satellite imagery more resourcefully and precisely than traditional methods. By using image processing techniques, the different land use classes are analyzed and mapped easily. The land use category compares with 2000 and 2015; it shows that there is expansion in agricultural field and settlement area. This occurs, I think, mainly due to growth of population. Water body, vegetation and fallow land area have been decreased due to population growth, expansion of agricultural field, increasing of settlement area etc. The land use and land cover changes are important elements of the larger problem of global and regional environmental changes. Land use and land cover data is essential for planners, decision makers and those concerned with land resource management. Change detection techniques with temporal remote sensing data provide complete information to detect and assess land use dynamics.

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Author Profile

Swapan Kumar Tala received his B.A. Hons. Degree on Geography in 2004 from Bajkul Milani Mahavidyalaya (Vidyasagarsagar University), M.A. on Geography and Environment Management in 2006 from Vidyasagar University and completed M. phil. degree on Geography in 2017 from Fakir Mohan University. He commenced his professional carrier from 2006 to 2010 as a Part-time with contractual lecturer of Geography in Pravat Kumar College, Contai, PurbaMedinipur (Vidyasagar University). He is now working as a Counselor of Geography (NetajiSubhas Open University, Pravat Kumar College Study Centre, Contai, PurbaMedinipur).