

CHANGE DETECTION OF LAND USE AND LAND COVER FOR SUSTAINABLE DEVELOPMENT: A CASE STUDY OF SANKA RIVER BASIN, INDIA

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Abstract: *Land use and Land cover form an integral part of all change detection caused due to the interactions of the human activities with the environment. As such, we need suitable process to explain the changes in the land use patterns and the resulting land cover and also to forecast them. The Sanka River is flowing from north-east to south-west covering the states of West Bengal and Jharkhand. The Sanka River has been originated in the area of Matha Protected Forest, where Gorgaburu range (677 m) is located. After entering in the Jharkhand state Sanka River flowing towards south and after that towards east and finally meets with Subarnarekha River at Dhatkidiah region where Chandil dam is located. In this paper an attempt is made to study the changes in land use and land cover in Sanka River basin about 40 years period (1982-2012). The study has been done through remote sensing and GIS using SOI map (1982) to digitize the Sanka River and delineate the basin area, and RESOURCESAT-1 (LISS- III) image of October 2012. The land use land cover classification was performed based on the SOI topographical sheets and Satellite imageries. Image processing software like Erdas Imagine 14.0 and GIS software like Mapinfo 10.5 is used to prepare the thematic maps. Ground truth observations were also performed to check the accuracy of the classification. The present study has brought to light that forest area that engaged about 30 per cent of the basin area in 1982 has decreased largely about 21 percent in 2012. Scrubs, Agricultural land, Barren Land, Settlement, Water Bodies area also have experienced change. Sanka River basin needs a proper land cover management and land use planning for a sustainable development.*

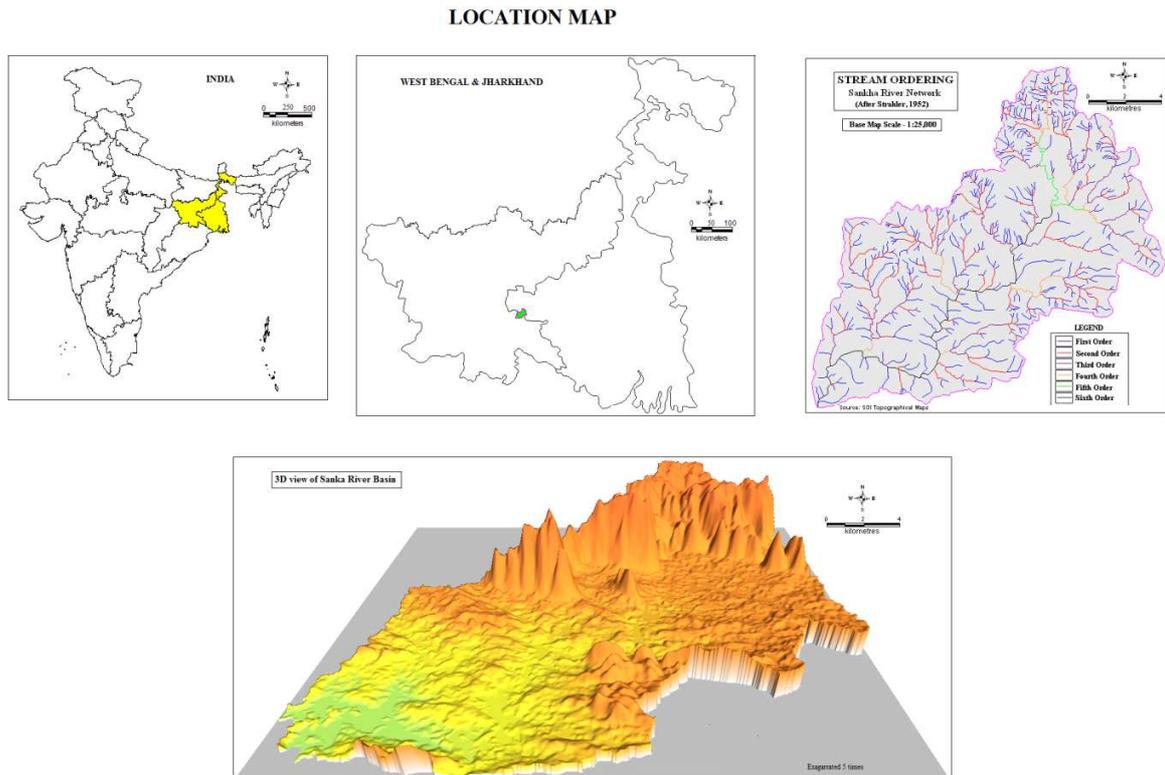
Key words: Land use, Land cover, Change Detection, Sustainable Development.

Introduction

Human needs food, clothing, shelter and energy which are fulfilled by the land. Land is considered as a resource base rather than a resource itself (Mather, 1986). Land use and land cover characterized by bio- physical and economic attributes of the earth's surface. Land use refers to man's economic activities on land. Land cover, on the other hand, describes the vegetation and artificial construction covering the land surface (Burgess and Pirman. 1977). It "Describes the physical state of the land surface: as in cropland, mountains or forest" (Meyer and turner, 2002). Human always tries to bring changes in the character of the land to the beneficial of them. The term land use describes series of operations on land, carried out by humans, to obtain products and/or benefits through land resources (Lillesand et al. 2008). Both terms are different from each other. Land use refers to how land is used by humans while land cover refers to the vegetation, structures or other features that cover the land area (CARA, 2006). The investigation of the changes on the surface of the earth, both terms are jointly used, because human beings affect land use as well as land cover. Land use and land cover (LULC) change is the change in the terrestrial earth's face. Human beings are the most active agents who change the makeup of the land more than any other agent. Originally the nature is dominating factor for land use and land cover change. But now, human beings are

chief to nature and modifying the earth which is very difficult to carry under its original purpose. Century's old forests are now being cleared and that region is being brought under agriculture, industries and settlement for large cities. The land resources are being degraded at a shocking rate in an unplanned manner. In digital image classification, an analyst evaluates several characteristics such as tone, texture, pattern, size, shape and association and his own knowledge about the land use and land cover distribution in order to categorize the components of the image (Kumaravel. et al. 2012).

Figure 1. Location Map



Study Area

The geographical location of this basin (Fig.01) is confined within the latitudes of $23^{\circ}01' \square 52' \square N$ and $23^{\circ} 11' \square 36' \square N$ and longitudes of $86^{\circ}01' \square 22' \square E$ and $86^{\circ}12' \square 42' \square E$. The Sanka River flows from north-east to south-west direction across the western margin of West Bengal and parts of Jharkhand. The Sanka River originates from the *Matha* Protected Forest, where *Gorgaburu* peak (677 m) is located. The Sanka River started flowing from the south of *Edelbera* and *Puniyashasan* villages of Purulia district and flows southward through a rugged terrain receiving many tributaries on both the banks. As a result, the river is also often prone to flash floods accentuated by swift runoff from tributary channels and quick discharge accumulations in the downstream segments. After entering Jharkhand the River flows further south and again towards east. Finally it meets with the Subarnarekha River at Dhatkidiah where the Chandil Dam is located. The Sanka River in Jharkhand meets with Subarnarekha River at $23^{\circ} 01' \square 22' \square N$ latitude and $86^{\circ} 01' \square 22' \square E$ longitudes. The upper reaches of the basin is located in West Bengal and lower reach of the basin is located in Jharkhand. To be identical it is to be stated that the River is a tributary of Subarnarekha River.

Objectives

The main objective of this paper is to classify and analyse the nature and extent land use and land cover changes in Sanka River basin in the past 30 years and to identify the main reasons behind the changes.

MATERIALS AND METHODS

Data products

The Survey of India (SOI) Toposheet map Nos. 73I/4/NW, 73I/4/NE, 73I/4/SE, and 73I/4/SW at scale 1:25,000 of 1983 and Resourcesat-1 (February, 2012) LISS III path 106 row 045-C. The geocoded digital data was downloaded from Bhuvan to ERDAS system as an image format.

Methods

Digitization of SOI topographical sheets under GIS environment using MapInfo 10.5 software was done. For data processing visual image interpretation and digital image interpretation techniques are used. Signatures are identified from satellite imageries. Erdas Imagine 14.0 and MapInfo 10.5 software were used for data processing. Supervised classification was done for image. Classifications of land use and land cover are created in both time periods. The changes in area under each category, analyzing, mapping etc. all work is done with the help of GIS software. The land use and land cover are classified on basis of the scheme of classification of National Remote Sensing Center (NRSC) in seven classes which are mentioned below:

1. Forest Area
2. Scrubs
3. Agricultural land
4. Barren Land
5. Built-up Area
6. Water Bodies

Result and Discussion

Land cover mapping serves as a basic inventory of land resources for all levels of government, environmental agencies and private industry throughout area (Vijith and Satheesh 2007). The findings after applying the classification techniques on SOI maps and satellite image changes in land use and land cover are found. The findings of the present of present investigation in table 1. Changes are identified in every land use and land cover class. Due to human pressure and anthropogenic causes day by day forest area are converting in scrub area, agricultural land settlement area. According to SOI map of the year 1982 forest covered almost 31 per cent of the study area (Table1). This has decreased to about 21 per cent in 2012, February RESOURCESAT-1 (LISS- III) Imageries. It is worth observing that in the 30 years almost 30 per cent (Fig – 2, 3 & Table1) of the forest lands have got transformed to Scrubs area and Built-up area. Because of human population forest area got converted to scrub, Settlement and Road. Majority of forest area is mainly under protected forest for this reason forest area basically converted to scrub land.

Table 1 Area and Changes in Land Use and Land Cover in Sanka River Basin, 1982 & 2012

#	LULC	1982		February, 2012		Changes (1982-2012)	
		Area in Sq k.m.	Area in Percentage (%)	Area in Sq k.m.	Area in Percentage (%)	Area in Sq k.m.	Percentage (%)
1	Forest Area	58.25	30.49	41.79	21.88	16.46	- 8.61
2	Scrubs	0.01	0.01	16.46	8.62	16.45	8.62
3	Agricultural Land	113.78	59.56	104.93	54.92	8.85	- 4.64
4	Barren Land	12.61	6.60	12.61	6.60	No change	No change
5	Built-up Area	4.99	2.62	7.21	3.78	2.22	1.16
6	Water Bodies	1.38	0.72	8.02	4.20	6.64	3.48
	Total	191.02	100	191.02	100		

Source: Computed by author

Figure 2. Land use and land cover of 1982

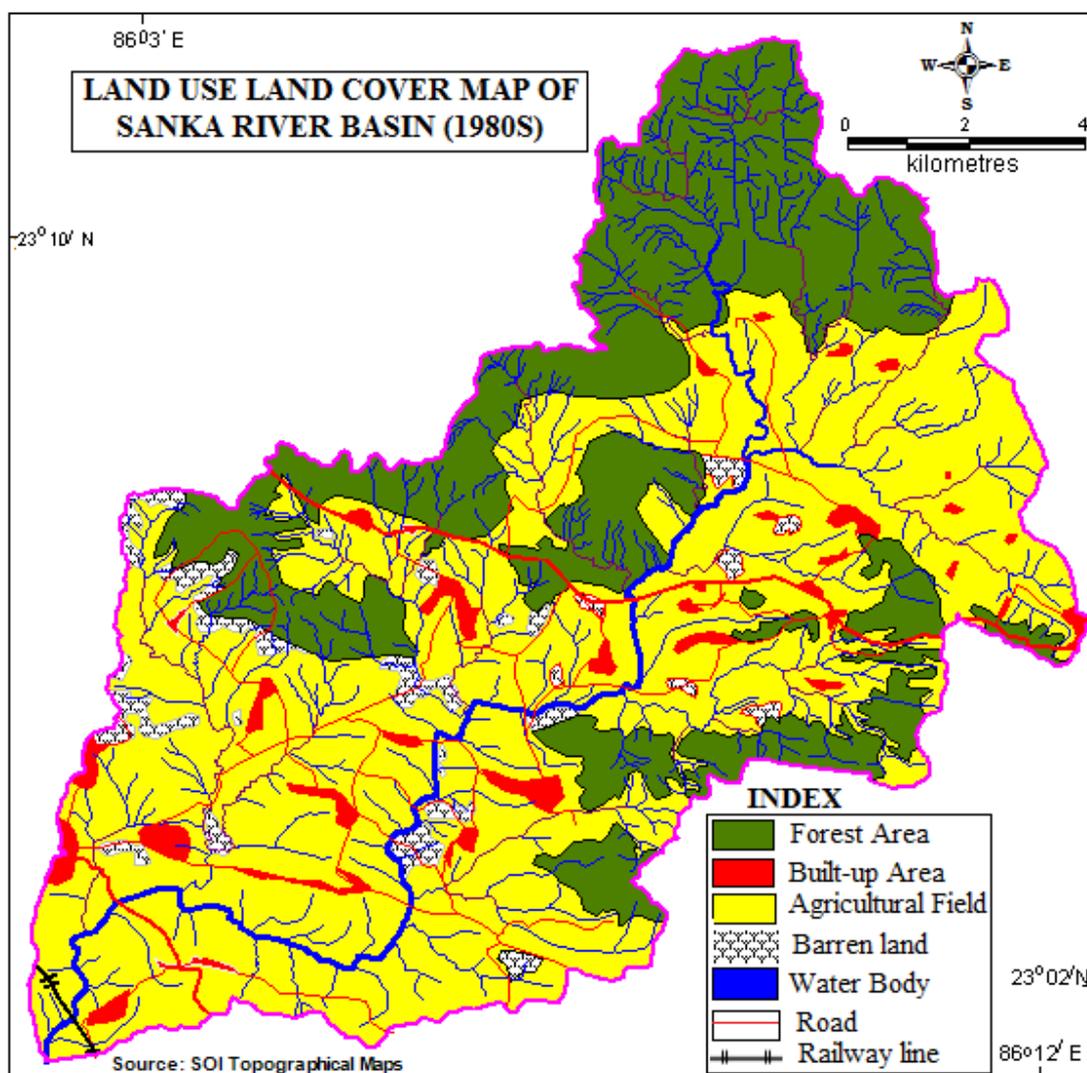
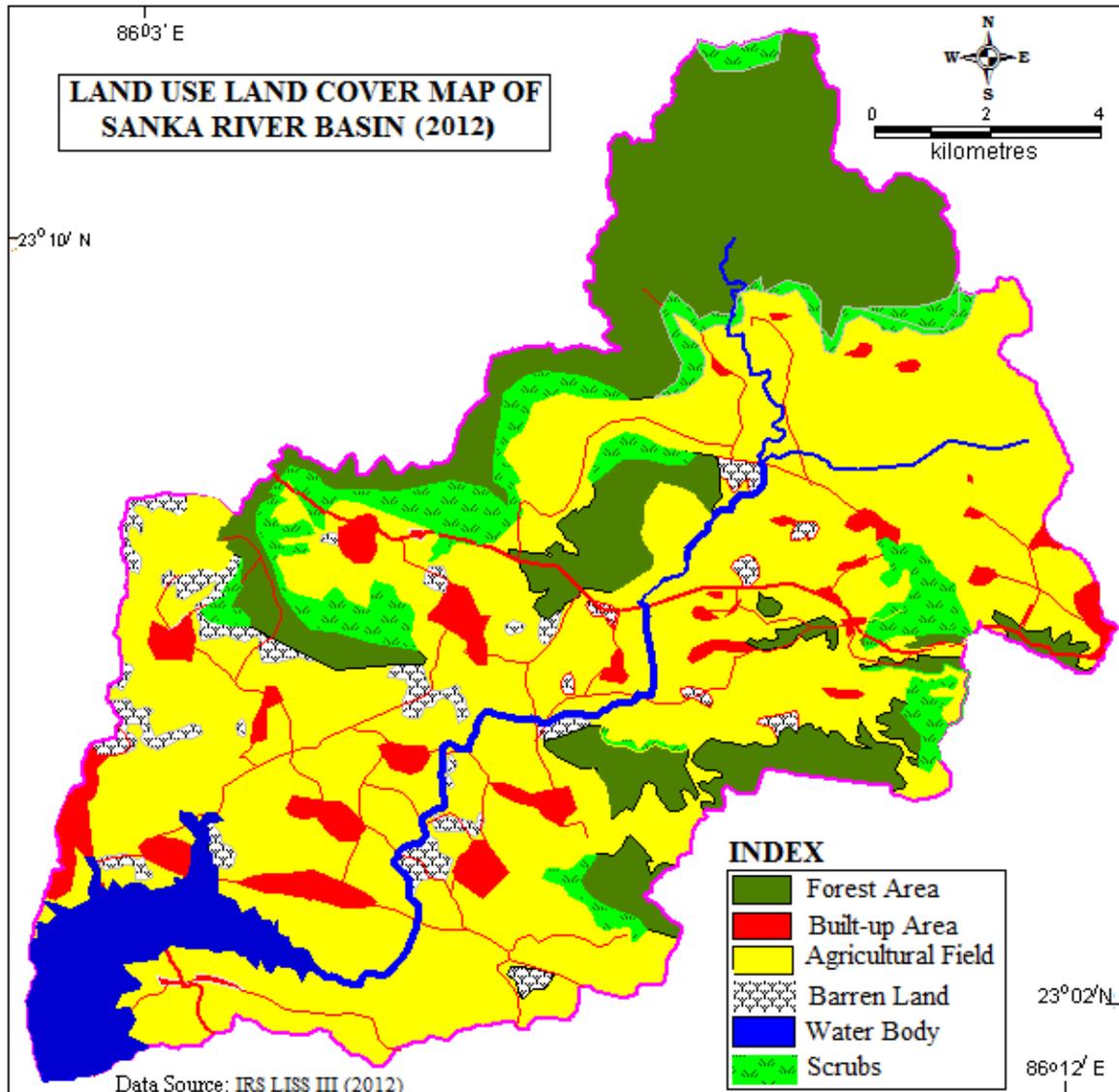


Figure 3. Land use and land cover of 2012



Forest is an area with the notified boundary bearing an association predominantly of trees and other vegetation types capable of producing timber and other forest produce. It is described as a dense thicker or woody vegetation or forest cover occurring in north eastern part of the basin and some patches are also distributed in whole basin area. It includes different species of trees. Forests covered in the study area are 58.25 km² in 1982 and due to human action many forest area converted in scrub, built-up area and agricultural land, covering 41.79 sq. km. in 2012. Agriculture land occupies sizeable area. It is defined as the land primarily used for farming and for production of food, fiber, and other horticulture crops. It includes land under crops (irrigated and unirrigated), fallow, etc. Crop land has occupied in the study area of 113.78 km² in the study period in 1982 and it has decreased only to 104.93 km² in 2012. Huge area of agricultural land converted to reservoir for construction of Chandil Dam at the confluence of river and increase of built-up area for construction of hotels and settlement. It is described as agricultural land which is taken up for

cultivation but it is temporarily allowed to rest un-cropped for one or more seasons, but not less than one due to unavailability of water. Main crop of this area is rice. Barren land basically denotes the area of bare rock surface, outcrops etc. The barren land has occupied in the study area of 12.61 km² in the study period in 1982 and it has also remained same in 2012. Built-up area basically denotes settlement, village, and road and communication system. It is defined as an area of human habitation developed due to non-agricultural use and that which has a cover of buildings, transport, communication utilities in association with water, vegetation and vacant lands. Moreover they are sparsely present in the entire study area. The built-up-land occupies in the study area is 4.99 km² in the year of 1982 and increased to 7.21 km² in the year of 2012. Water Bodies included ponds, reservoirs, rivers and streams. Water bodies covered only 1.38 km² of the study area land in 1982 and increased to 8.02 km² in 2012. This fluctuation due to the construction of Chandil Dam at the confluence and conservation of water created huge reservoir.

Conclusion

Ajodhya Hill is a famous hill station in Purulia district as well as in West Bengal for tourism and trekking purposes is one of the major sources of income through tourism. As a result construction of road and increase of built-up area increased. The land under forest cover has experienced a declining trend in the past thirty years. Here forest land converted to Scrubs, areas Built-up and agricultural land due to this changes we loss our natural ecosystem and biodiversity also. The local people of that area cut the trees for their own needs and huge area of *Matha* Protected forest converted in scrubs land. Empirical observation also shows afforestation is taken by Forest department in recent times. Sprawl of settlement area is also identified many areas among which due to the presence of nodal point at *Balarampur* village at north eastern part of basin and *Baghmundi* block in north western part of basin. Apart from the conversion of little forest area into agricultural land there display decreasing trend in agricultural land because huge area of basin converted into reservoir for chandil dam and people have less importance for agriculture due to scarcity and unavailability of water. The increase in the area under built up lands and scrubs may lead to a lot of environmental and ecological problems. Change detection of land use land cover pattern of the area would be of immense help in formulation of policies and programmes required for sustainable development.

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