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Morphometric And Landuse And Landcover Change Analysis Of Lokjuriya River Basin, Jharkhand, India Using Remote Sensing And Gis Technique

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Abstract: *TheStudy discusses the morphometric characteristics of Lokjuriya River basin and also the changing pattern of Landuse and Land cover. Rapid lanuse and land cover change has taken place in the Chotanagpurregion in the last decade due to growth of population and agriculture development. The prime objective of the study to revel the morphometric condition and also investee the land use land cover change from 1989 to 2014.In this paper Land use changes dynamics were investigated by the combined use of Remote sensing, GIS and also field survey. The result indicates that there has been a notable and uneven urban growth in the Lower part and tremendous loss in dense forest in the upper and middle part in the River basin. The study demonstrates that the integration of satellite remote sensing and GIS is an effective approach for analyzing the morphometric pattern and land use change.*

Key Words: *Land Use change, GIS, Singhbhum Shear Zone (SSZ).*

I. Introduction

Scientifically study of available natural resources is very much necessary for progress and sustainable development for local area people mainly who are living in a tribal region. Water, vegetation etc. , which are precious natural resources, vital for sustaining all life on the earth is becoming scarce due to various reasons including reduction in infiltration rates, runoff, uneconomical use, overexploitation of surface water and vegetation as a result Land use change and degradation of land cover(Santosh et al,2012).

Satellite remote sensing , in conjunction with Geographic Information System(GIS), has been widely applied and been recognized as a powerful and effective tool in detecting land use and land cover change (Qihao Wen ,2001;Janicki et al., 2002; Hazr et al.,2012; Arunachalam et al., 2011;Sanyal et al,,2014;etc.).Satellite remote sening provides cost effective multi-spectral and multi-temporal data and them into information valuable for understanding and monitoring land development patterns and process and for building land use and land cover data sets (Qihao weng,2001).

Morphometric study of a river basin is very much significant for understanding the characteristics of the river and also for the land use pattern. A number of morphometric study has been carried out in different watershed in India as well as worldwide (Chaudhury et al.,1998; Singh et al., 2003;Biswas et al., 2014 studies morphometric characteristics of this Garanala basin and its terrain evaluation. Sanyal et al.,2014; conduvted study on remote sensing and GIS application for monitoring and management of Konar watershed of Damodor River basin. Mukhopdhayay et al. 1996 empathies on different parameter like geology, climate, geomorphology and also formation of the entire Subarnarekha Basin.

The measurement of morphological and Land use characteristics by conventional method is laborious abut also using the latest technology like Remote sensing and GIS, the morphometric analysis and LULC change measurement is better archive. Morphometric parameter like relative relief, stream order with soil and Land use also play very important role in generating sustainable development planning. Now a day interaction of Remote sensing and GIS is helpful in planning and management of land and water resources for adoption of location specific technologies.

II. Characteristics of the studies basin

The Lokjuriya River basin is a tributary of Subarnarekha River in its middle course. The study area lying between latitudinal extension is form 22 34’12’’ N to 22 40’18’’ N and longitudinal extension from 86 29’ 4’’E to 86 31’ 6’’E. The selected study area is situated in East Singhbhum district of Jharkhand, India. The basin is very much significant by its geological characteristics, because the Lokjuriya river basin is situated in SinghbhumShear Zone (SSZ), a place of paleotectonism between Chhotanagpur plate and Singhbhum Micro plate. The Singhbhum Shear Zone (SSZ) is a unique fault line zone which leads to deposition of several radioactive mineraldepositions like Uranium, Iron, Copper, Manganese etc. The study area is characterized by

present of oceanic ophiolites that have been trusted into the edge of continental plates, which is evidenced by the presence of Dalma Hills which is actually formed by mafic lava of oceanic origin. Thepast underseavolcanoes are exposed out by erosion agents and present day they stand as small residual hill with flat top, the Fuldungri hill is a great example of such kind of erosional hill.

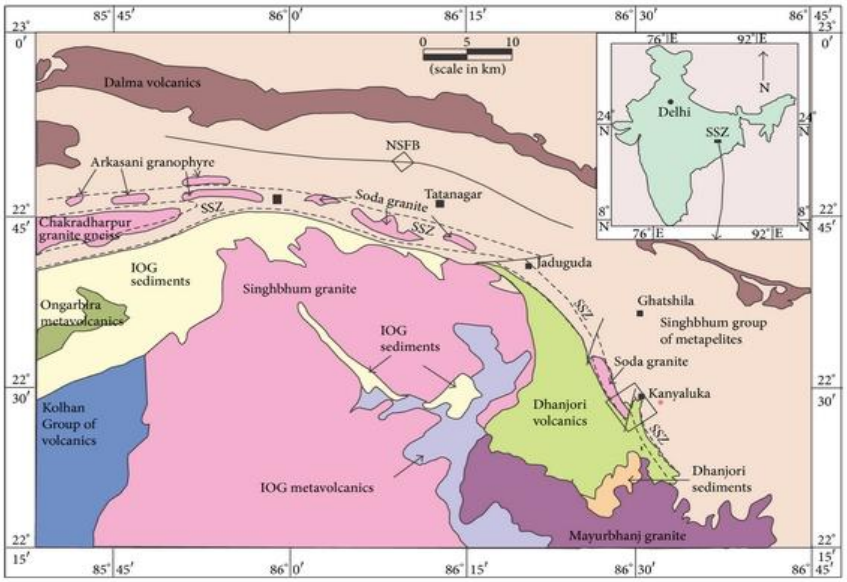

Figure No-1. Geological map showing the distribution of stratigraphic units in a part of eastern India . After Dunn and Dey and Saha.(SSZ=Singhbhum Shear Zone, NSFB= North Singhbhum Fold Belt, IOG= Iron Ore Group).

The study area is characterized by Monsoonal climate, but according to Koppen's climatic classification it falls under the semi-arid climate. In order to pursue the present day Geomorphological studies of the Lokjuriya river basin, it is necessary to identify the evaluation of the area under different climatic region. Climate plays a very important role in sculpting the landform through time. The change of climate condition from Arid to Humid. The existing residual hills found at different parts of this region(ex- Phuldungri Hill) and some tree like Cactus, which are found near Rajbarighat are proved this type of climatic change.

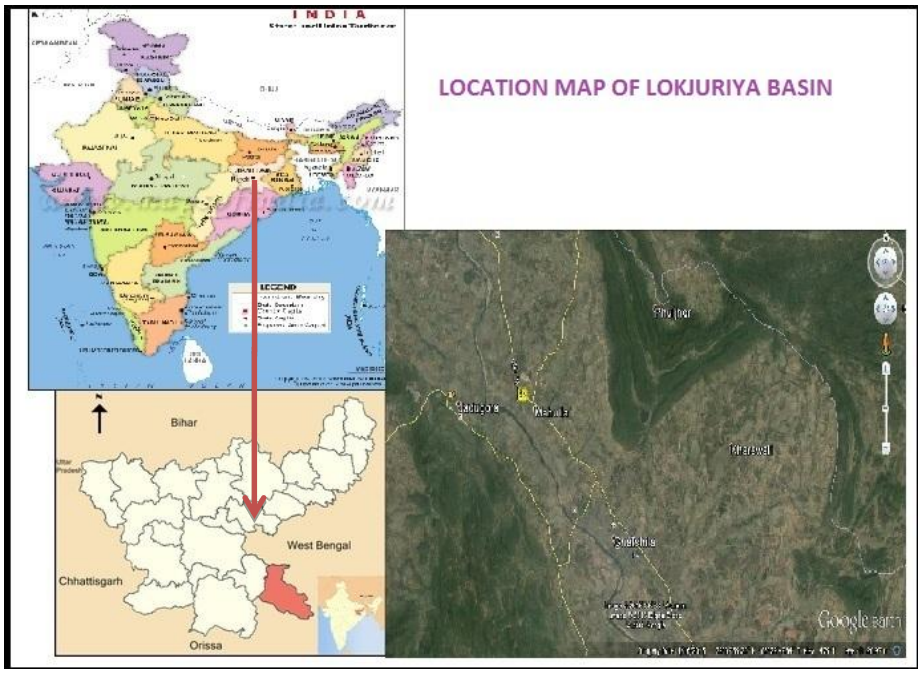

Figure No-2. Location Map of LOKJURIYA BASIN.

III. Objective of the study

The main objective of the study are- to correlate different aspects of hydro-geomorphologic study and study the changing pattern of Land use and Land cover Using the Modern Techniques.

IV. Metirials and Methods

The geomorphic map and landuse and land cover map has been generated by considering different thematic layers. These maps were prepared using remote sensing data, topographical maps, rainfall data, SRTMdem data. The different data sets were analyzed for information generation likes morphometric features, landuse land cover etc. The SRTM Dem was analyzed for the generation of slope map, Drainage map etc by using TNT map software. Table1 and Table 2 listed below shows the details of various data sets used.

Table 1: Lists of Satellite maps used for analysis.

Satellites	Sensors	Month/ Year	Ground Resolution
Landsat-7	TM	March,2014	30 m for bands 1,2,3,4,5and7 120m for band 6 resampled to 30 meters.
IRS-P	LISS-3	March, 1990	5.8m for Bands 1,2,3.
Digital Elevation Map (DEM	Surface Radar Terrain Mapper (SRTM)	Aprile,2014	90m

Table 2: Lists of maps used for the analysis.

Data Type	Details	Data Source
Topographical Map	1:50000	Survey of India
Geological Map		Geological Survey of India and other source.
Rainfall Map, Block Wise	1:450000	Jharkhand govt

The methodology mainly relies on analysis of the image and field visit. I t involved such way like- Field data collection, preparation of base map for study area and interpretation of the result and finally the validation of the results generated. The following technique has been applied to remote sensing images using ERDAS Imagine 9.2 software and TNT Atlas 2013 software.

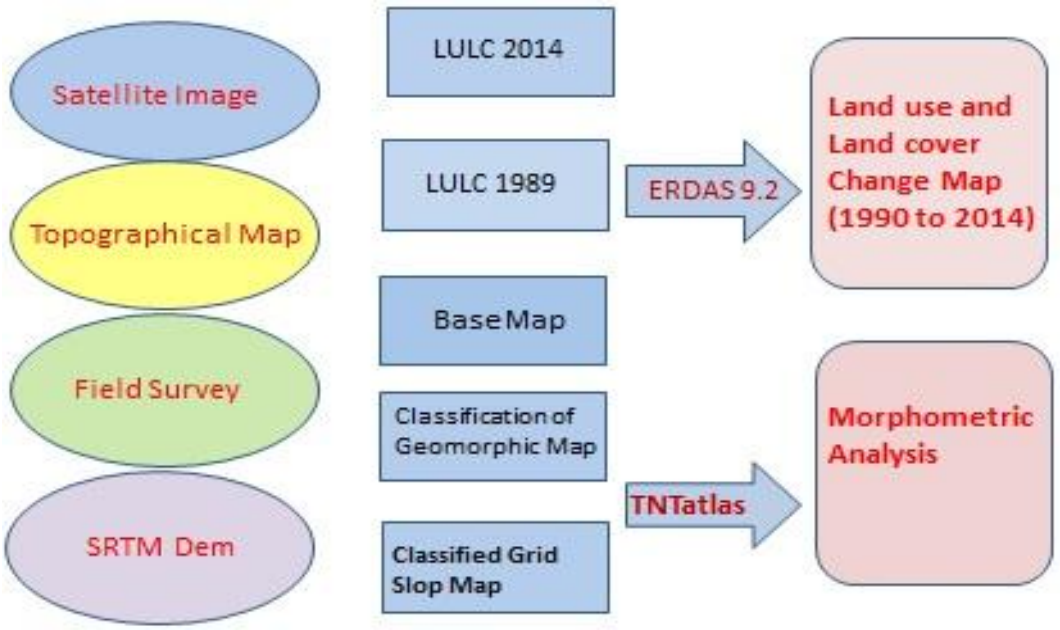

Figure 3:The detail flow chart of methodology adopted for morphometric analysis.

V. Morphometric Analysis

Morphometric methods are defined as the numeric systemization of landform elements measured from the topographical maps provides the real basis of quantitative geomorphology. To analysis the drainage and its different aspects, along with its impact on topography, the method of morphometric analysis has been preferred based on SRTM DEM with the use of TNT Atlas2013 software.

Relief Aspect: The study area has significant relief feature. In basin relief aspects, the parameters were evaluated are given below.

Relief ratio (Rh)

The relief ratio (R**h**) was estimated as the ratio between the relief and the distance over which relief measured (Schumn, 1956). It is an indicator of erosion process operating on the slopes of the basin. It measures the overall steepness of the watershed and can be related to its hydrologic characteristics.

Relative relief (Rp)

Therelative relief is the ratio of basin relief (H) to the length of the perimeter (P). It is an indicator of general steepness of the basin from summit to mouth.

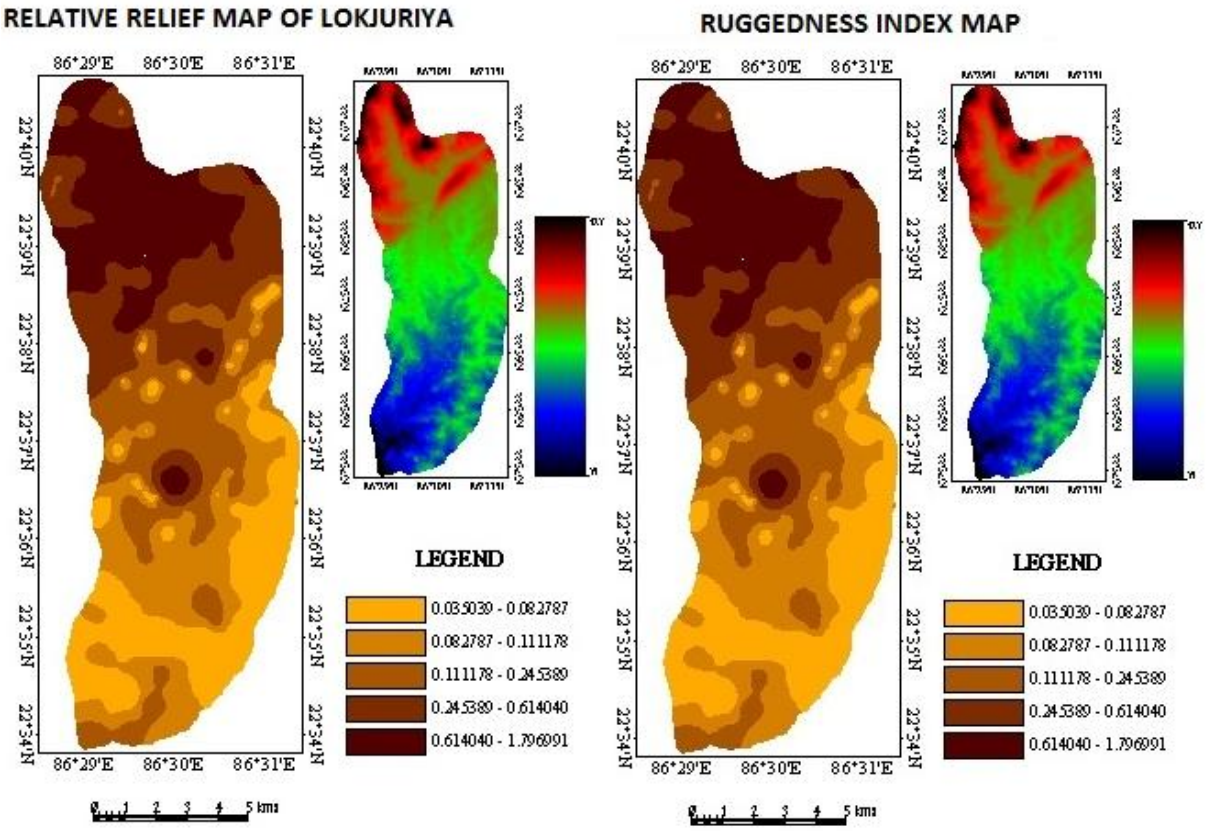

Figure no-4, Relative Relief and Ruggedness Index Map.

The topographic ruggnessindex(TRI):

TRI is a measurement developed by Riley et al., 1999; to express the amount of elevation difference between adjacent cells of a digital eleveation grid. A Ruggedness index map has been prepared on the basis of SRTM dem. High Ruggedness is on the northern part of the river basin because of the presence of Dalma Hill where in the middle and lower part of the river has low index.

Bifurcation Ratio (Rb):

The Rbwas computed using Horton‟s law of stream numbers (Horton, 1945) which was stated as, “The number of stream segments of each order form an inverse geometric sequence with order number”.

Rb= Nu/ Nu+1

Here, Nu= number of segments of order „u", and
Nu+1=number of segments of higher order „u+1".

In general, the value of Rbnormally varies in between 1 to 5 and tend to be more forelongated basins and it is a useful index for hydrograph shape forwatersheds similar in other respect. High value of Rbmight be expected in region of steeplydipping rock strata. An elongated basin is likely to have high Rb, whereas a circular basin islikely to have low R.

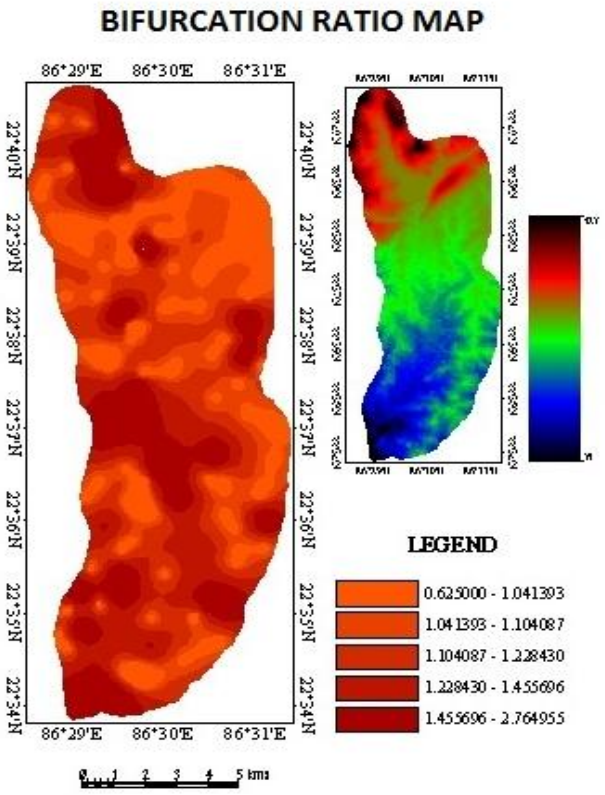

Figure no-5. Bifurcation Ratio Map

Areal Aspects:

Drainage density (D):

It was estimated as the ratio of total length of channels of all orders in the basin to the drainage area of the basin. Drainage density is defined as a ratio of length of all streams to the total area of the basin(Horton,1932). High drainage density value indicates the region having impermeable subsurface or mountainous relief. The areas having higher value of density are from the northern or middle part of the basin. The areas where we observed the lowest values drainage density are from the lower course of the basin, and near the confluence of the river Drainage Density is minimum.

Stream Frequency(Fs): The total number of stream of all orders per unit is known as stream frequency(Horton,1932). It is a good indicator of understanding drainage pattern. Drainage density and Stream frequency map has been prepared on the basis of SRTM dem of the study area(Figure no-6).

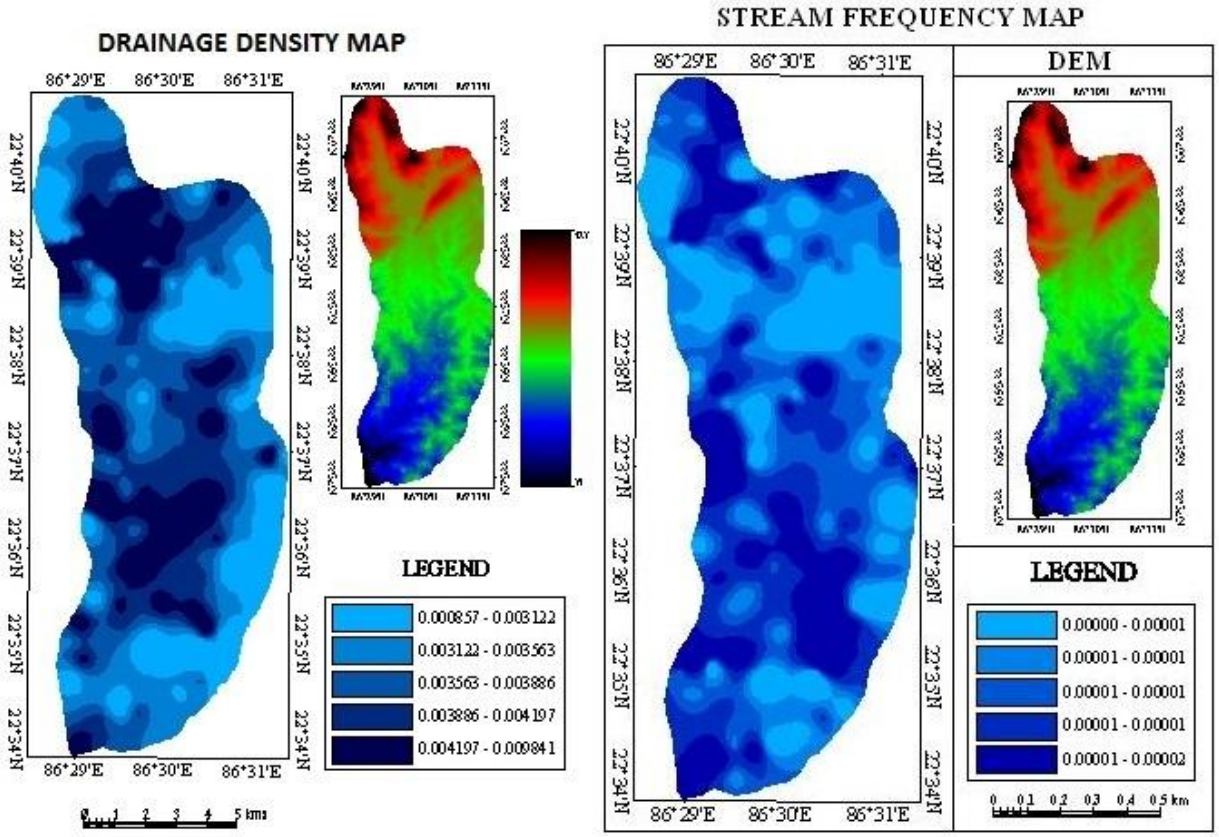

Figure No-6. Drainage density and Stream frequency Map.

VI. Changing Patern Of Landuse (1990 To 2014)

Supervised classification using ERDAS 9.2 was carried out for Landsat-TM image of 2014 and IRS LISS-III image of 1990. The layer assigned with name ' Land use and Land cover'. The available LULC include seven different categories namely-Lateritic Exposure, Open Forest, Dense Forest, Settlement, Bare Land, Water and Agricultural Land. The land cover classes report feature on the land surface while Land use represents the actives within which the land cover is being used. This is the classification scheme of selecting the representative areas with the help of the spectral characteristic of the feature in the image.

Table-3 Landuse and Landcover classification.

Land use/ Land cover	Description
Open forest	Sparsely vegetation, near rural area and agricultural area
Settlement	Urban Land, rural residential land and other built up area
Water body	Lake, River, Pond
Agricultural land	Paddy land mainly, different vegetable land
Dense Forest	Forest area
Bare Land	Current fallow, permanent fallow
Laterite exposure	Open laterite area, residual hill etc.

Land use and Land cover map ,1990:

LULC map has been prepared from the IRS LISS-3 image with the help of ERDAS Imagine 9.2 software. Analysis of land cover/use has been shown in this map(fig-7). This area was characterized by dispersed settlement which was only 3% of the total area. The tribal population like Santhal and Munda usually resides in the forests. The percentage of agricultural land was 11%.

Landuse And Land Cover Map Of Lokjuriya Basin, 1990

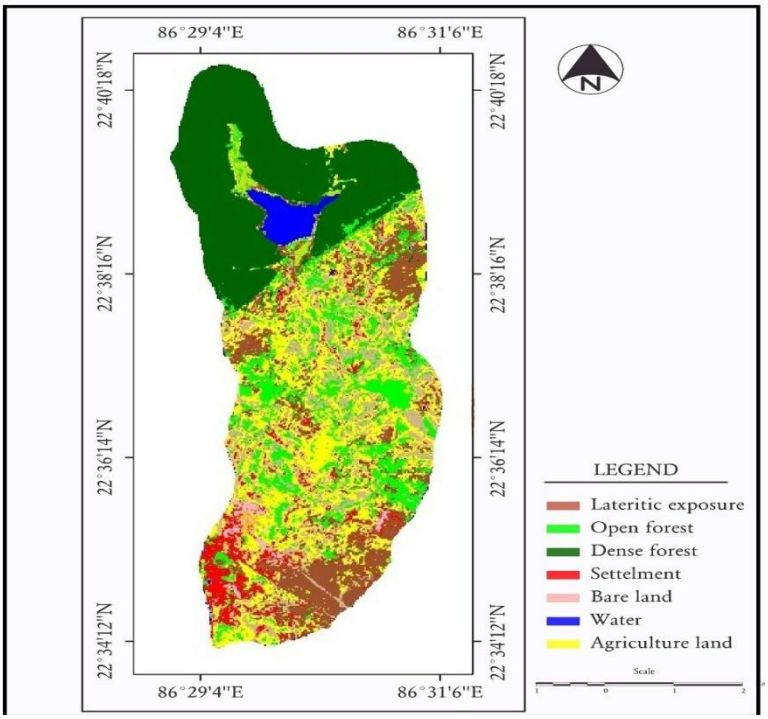

Figure No-7. Land use and Land cover map of 1990.

Land use and Land cover classification, 2014:

This Land use and Land cover map has been drawn from LANDSAT-TM image with the help of ERDAS Imagine 9.2 software. Here a magnificent change has been notified in Land use pattern.

The half of the total area is covered by Dense forest and Agricultural land with 26% and 23%respectively followed by bare land with 15% and open forest holds 9%. It is due to Increase of population, agricultural development and deforestation. The main source of water and the other water bodies holding 5% of the total area and its confluence is near Rajbari where it meets with the river Subarnarekha.

Landuse And Landcover Map Of Lokjuriya Basin,2014

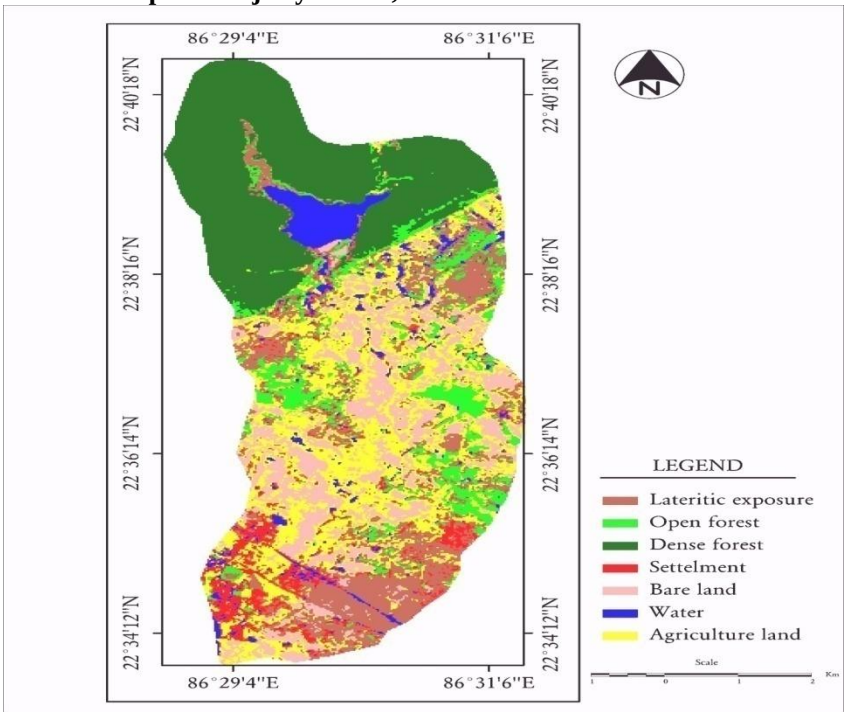

Figure No-8: LULC Map of 2014.

VII. Result

Changing pattern of landuse from 1990 to 2014:

The study between natural and human environment has been a major concern in the fields of Geography. The cultural characteristics and landuse system of a place are highly influenced by physiography of that very place. All the hydrological factors and the terrain elevation zones are densely populated. In this particular study it has notified that the natural environment is least modified by human activities, since the physical environment is extremely rugged and unfavorable for development or modification. In the middle parts, the people of the small settlements are mostly running their lives by first order economic activities that are agricultural, gathering of fuel-wood and mainly economy is subsistence economy.

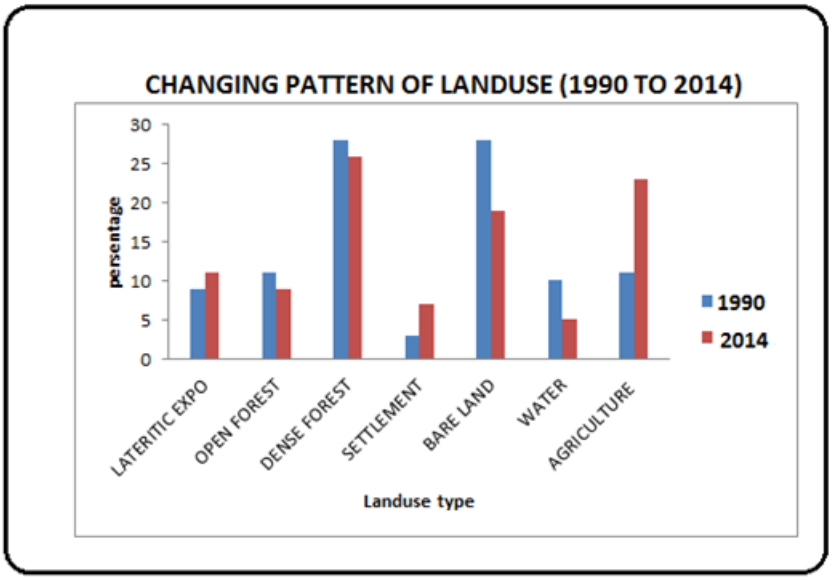

Figure No-9 Changing pattern of Landuse and Landcover from 1990 to 2014.

Analysis of landuse andLandcover changes between 1990 and 2014 in Lokjuria basin has shown there have been significant changes. There have been increases in Lateritic exposure. The settlement has increased from 3% to 7% firstly because there has been an adequate supply of water from Burudih Lake, moreover as the land for agriculture has been widened there is a need for increased supply of working force, for cultivating the land, increasing crop yield by growing crops to meet the demand. Thus the settlement has grown. The agricultural land has increased from 11% to 23%.

However, there has been a decrease in open forest from 11% to 9%. Forest decline is the result of actions by different agents. For agricultural development they convert forest land to agricultural land. Agents include the shifting cultivation of the tribal. Thus dense forests have decreased from 28% to 26%. Also there has been more fragmentation of the natural forests.

VIII. Conclusion

The present field study brought forward some interesting hydrological and land use characteristics of that particular area. The geomorphological and hydrological settings are in dynamic condition. Being situated in a rugged terrain region and being subjected to upliftment and erosion several times, the rejuvenation and formation of terraces occurred in this area. Being relatively flatter surface, most of the settlements and agricultural fields occur mostly occur in this region. The confluence of the river Lokjuriya is situated in low elevated flat land. So, the density of settlement is maximum in this region. The local geomorphology and has a great effect on the Local Landuse and Land cover changing pattern.

The present study shows that satellite remote sensing based morphometric and landuse mapping is very much effective for study of a dissected hilly River basin. The study has been conducted with the high resolution satellite data and SRTM dem, shows minor changes in the land use pattern for periods from 1990 to 2014. There is an increase in the settlement and agriculture. The major change of landuse pattern is noted along the central part of the study area where altitude is medium and water connectivity has increased. Hence, water supply and scientifically utilization of forest is some essential tool for future planning and management of tribal region ofchotanagpur.

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