Development of Satellite Data for Infrastructure Updation and Land Use/Land Cover Mapping - A Case Study from Kashipur & Chhatna Block, Bankura & Purulia District, West Bengal

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Abstract

Rapid population development and anthropogenic behavior on earth is implementation the usual surroundings extremely. Therefore, an attempt has been made in this paper; a case study has been full up for Kashipur and Chhatna block of Bankura District of West Bengal. This is to appreciate changes in Land use/Land cover and infrastructure improvement predominantly in simple and group of people expansion area. For this purpose the infrastructure, Land use/Land cover, drainage, slope, aspect and contour maps have been prepared using SRTM DEM data of the study area. Besides this an attempt has been made to prepare LU/LC maps from multispectral remote sensing digital data sets of IRS-1C LISS-III & IRS-P6 LISS-IV, applying DIP techniques and Alarm masking technique for MAXLIK & MINPAR supervised classification as well as to organize Infrastructure map applying to raster based vector classification and spatial data extraction method. NDVI method was used for the classification of water and forest classes. It is established that the Infrastructure output map and Land use/Land cover output maps can be used for systematic urban development of the study area.

Keywords: Alarm Masking; LU/LC Classification; Arc GIS; ERDAS, MS Office

I. INTRODUCTION

Land is one of the most significant natural resources and hence all developmental behavior are based on it. Landuse refers to the category of employment to which man has used the ground for his every day actions like socio economic movement, urban and agricultural activity and this evaluation of land with deference to a variety of natural characteristics (Aggarwal, 2003). But the Landcover refers to the type of land which is sheltered by the material substance at the surface of the earth. Landcover includes grass, asphalt, trees, forest, built up area, bare ground, water, Lake Etc. Landuse/Landcover and infrastructure are necessary for planners, decision makers and those concerned with land resource management also this valuable information is very much helpful for monitoring and sustainable management of the urban environment (Jensen, J.R, 1999). Rapid population growth and anthropogenic activities have significant impact on our ecosystems and its present conditions. Perfect and modernized in sequence on the position and trends of ecosystem is necessary to expand strategy for sustainable progress and to get better the occupation. The capacity to check land-cover/land-use & communications is extremely attractive by local community and by guidelines pronouncement makers. With augmented ease of use and superior excellence of multi-spatial remote sensing data as well as ground particulars and new diagnostic techniques, it is now probable to observe changes in Landuse/Landcover and infrastructural developmental data(Kumar,2010).

II. STUDY AREA

Kashipur is a community development block is in Rghunathpur subdivision of Purulia district and Chhatna is community development block is in Bankura Sadar subdivision of Bankura district in the state of West Bengal. Kashipur is bounded by Raghunathpur I and Santuri CD Blocks on the north, Chhatna CD Block, in Bankura district, on the east, Hura CD Block on the south and a part of the west, and Para CD Block on the west and Chhatna is bounded by Saltora and Gangajalghati CD Blocks on the north, Bankura II and Bankura I CD Blocks on the east, Indpur CD Block on the south and Kashipur and Hura CD Blocks, in Purulia district, on the west. The kashipur block consists of 1 panchayat samity, 13 gram panchayats, 137 gram sansads (village councils), 211 mouzas, 98 inhabited villages and 3 census towns. The Chhatna block consists 1 panchayat samity, 13 gram panchayats, 147 gram sansads (village councils), 288 mouzas, 277 inhabited villages and 1 census town. Chhatna police station serves this block. Headquarters of this CD Block is at Chhatna. Kashipur CD Block has an area of 451.31 km^2 and Chhatna CD Block has an area of 447.47 km^2. Location Map of study area is presented in Fig 1.

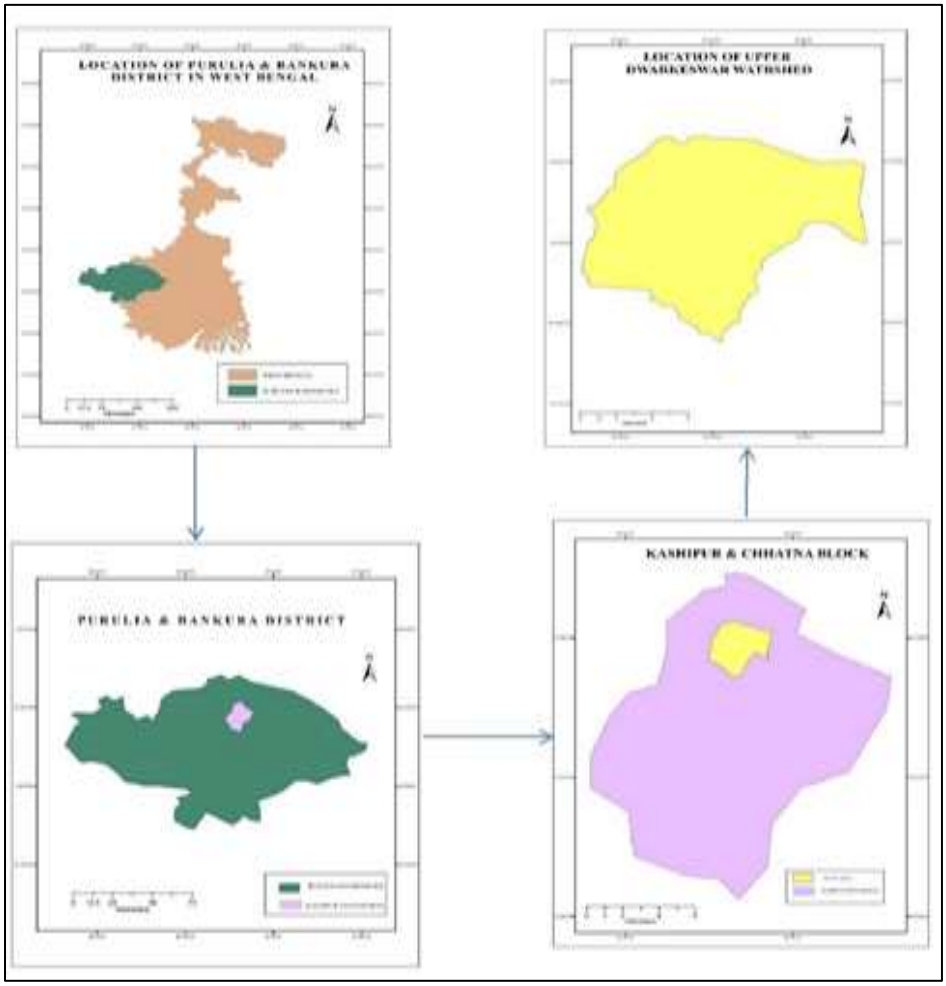

Fig. 1: Location Map of the Study Area

A. Geographic Location

This area is bounded by latitudes $23^0$15´00´´N to $23^0$30'00" N and from longitudes $86^0$30'09"E to $86^0$45'19"E, Midnapore, Bankura and Burdwan districts of West Bengal and Dhanbad, Bokaro, Hazaribagh, Ranchi, West Singbhum, East Singbhum district of Jharkhand State bound this district. It is covered in the survey of india Toposheet numbers 73 I/11 on 1:50,000 scale.

B. Demography

As per the 2011 Census of India Kashipur CD Block had a total population of 200,083, of which 174,325 were rural and 25,758 were urban. There were 101,801 (51%) males and 98,282 (49%) females. Population below 6 years was 23,737. Scheduled Castes numbered 57,015 (28.50%) and Scheduled Tribes numbered 49,537 (24.76%). Kashipur block had a total population of 186,980, out of which 95,259 were males and 91,721 were females. Kashipur block registered a population growth of 11.75 per cent during the 1991-2001 decade. Decadal growth for Purulia district was 13.96 per cent. Decadal growth in West Bengal was 17.84 per cent. As per the 2011 Census of India Chhatna CD Block had a total population of 195,038, of which 189,712 were rural and 5,326 were urban. There were 99,523 (51%) males and 95,515 (49%) females. Population below 6 years was 24,229. Scheduled Castes numbered 58,493 (29.99%) and Scheduled Tribes numbered 39,975 (20.50%).Chhatna community development bloc had a total population of 169,141 of which 85,562 were males and 83,579 were females. Decadal growth for the period 1991-2001 was 8.32% for Chatna, against 13.79% in Bankura district. Decadal growth in West Bengal was 17.84%.

C. Climatic Condition

The climate of Dwarkeswar Basin in Purulia district is classified as humid continental, warm summer type and is characterised by high evaporation and low precipitation. (USDA 1986).

D. Temperature

The climate is extreme with maximum temperature up to 60^0C and minimum temperature down to 42^0C. The annual rainfall of the study area varies between 1055 mm and 1070.3 mm. The relative humidity in the month of April is 61 (2008) and in the month of

September is 99 (2008). The maximum altitude is 435 mt., demarcated in the middle part and the minimum elevation is about 67 mt., observed in the south eastern part of the watershed.

E. Rainfall

The maximum amount of rainfall received during the monsoon season from June to September about 80.73%. But uneven, scanty and erratic rainfall results agricultural drought in the kharif season. The ten years rainfall data of the study area has been averaged to reach at monthly rainfall.

F. Communication

1) Railways:
This study area population density is 3262128.5 sq.km. The area is served by three Rail connections provided by the South Eastern Railways. One line runs from Jharkhand state in the South through the district upto Asansol passing through Adra division. Another line runs between Bankura and Dhanbad also via the Adra Division. The third one connects Jhalda to Chas in Jharkhand. Major cities and towns like Ranchi, Tatanagar, Patna, Howrah, Dhanbad, Asansol, Bhubaneswar, Delhi, Mumbai, and Chennai etc. are now connected with Purulia by direct mail/express trains (Andreassian,2004).

2) Road:
The road transport is adequate in terms of bus availability of bus and flow of goods carraige. NH 32 connects this district with Jamshedpur, Bokaro, Chas and Dhanbad. National Highway 60A connects Purulia with State Highway 9 at Bankura and subsequently to NH2 at Durgapur. State Highway 5 also plays important role in district's transport network as it connects the towns like Raghunathpur, Adra, Santaldih and Neturia to NH2 also plays important role in district's transport network. Purulia has also excellent road connectivity with Raniganj-Asansol industrial belt. (Hjelmfelt et al., 2001).

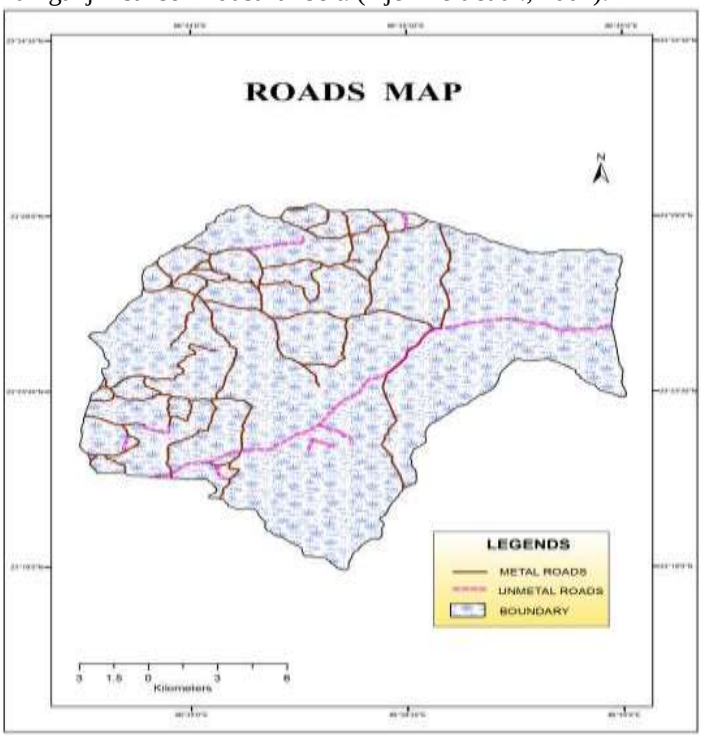

Fig. 2: Road Map of the Study Area

G. Administrative Divisions

The total geographical area of the district is 6259 sq. kms. Out of which the Urban and Rural areas are 79.37 sq. kms (1.27%) (Municipalities & Non-Municipalities) and 6179.63 sq. kms (98.73 %) respectively. The district headquarter is situated at Purulia town having three administrative sub-divisions viz. Sadar East, Sadar West and Raghunathpur. There are 21 Police Stations, 20 Community Development Blocks, 3 Municipalities (Purulia, Raghunathpur, Jhalda), 8 non-municipal towns, 170 Gram Panchayats, 2683 mouzas (2468 inhabited villages) and 1911 Gram Sansads (Census of India, 2011).

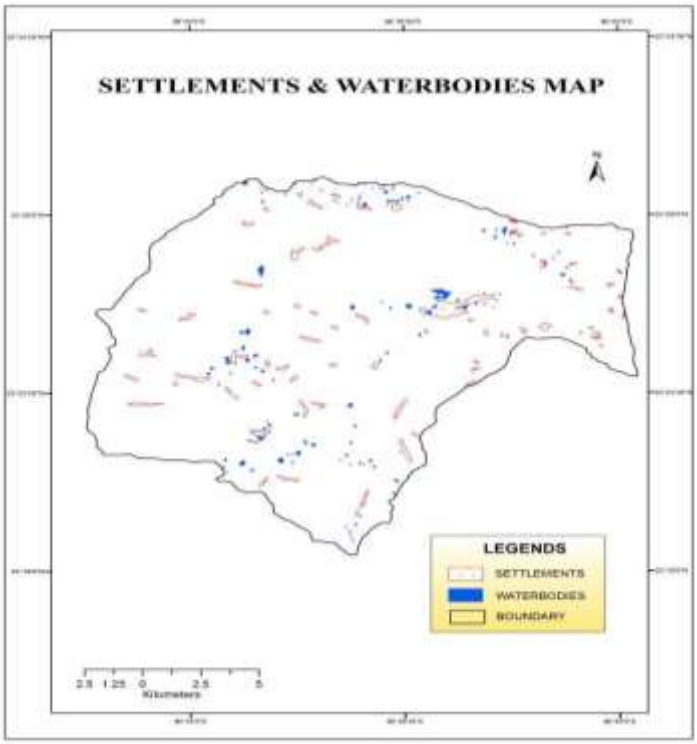

Fig. 3: Settlements & Water bodies Map of the Study Area

III. METHODOLOGY

Remote Sensing and GIS tools have been used for the processing of digital images and preparing of thematic maps. GIS was used as added tool for preparation of many vector layers. Using all thematic maps and GIS information. IRS LISS-IV Data geometrically corrected with reference to already geo-corrected IRS LISS-III Data keeping RMS Error within the range of sub-pixel and output image was resample using nearest neighborhood resampling method (Congalton, K., and Green, A., 1999). The Polyconic projection was used with Everest coordinate system. An AOI (Area of interest) layer of the study area was prepared and applied to IRS LISS-IV data for extraction of the study area. Few enhancement techniques were applied to visually enhance the quality of the image. It was found that linear enhancement algorithms were best suited to identify various features of the study area as well as tonal boundaries of look-alike features. The methodology can be divided into two parts one is rasterization and other one is vectorization. The vectorization process created vector coverages like; administrative boundaries (i.e. block and village boundaries), drainage layers, infrastructure layer (i.e. metal & un-metal roads, water bodies, settlement, canal, sluice, river) and also forest boundaries etc. The rasterization involves creation of sub-setting of image, mosaicking, image enhancement, NDVI techniques, image classification, recoding and reclassification etc., (Lillesand, 2001). The calculation parameters were derived from the generated raster and vector layers. For infrastructure layer extraction purpose proper enhancement techniques were applied to enhance the details of drainage with shuffling of different band combination like 4, 1, 2 and 2, 1, 3 and 4, 1, 4. This improves visualization of drainage. LISS–IV data was classified using supervised classification techniques with maximum likelihood algorithm for the preparation of land use/ land cover map. The classification of the imageries was performed by using supervised classification. In this particular type of classification signature extraction are first, based solely on the DN information in the data, and are then matched by the analyst to overall image using Alarm masking technique. Supervised classifiers is utilize training sets basis for classification. Rather it involve algorithms called Maximum likelihood or Minimum Parallelepiped algorithms, that examine the known pixels in an image and aggregate them into a related classes based on the user selection in the image values (Kumar, P., 2010). Thus supervised classification, it starts with a pre-determined set of classes, and it is done completely with human intervention. The entire methodology which has been adopted in this study is explained in the flow chart (Figure 2). Source data details are presented in table (Table 1). The study area is covered by 73I/11 Survey of India Toposheets on 1:50,000 scales and IRS LISS III & IV satellite imagery with 23.5 and 5 meter resolutions.

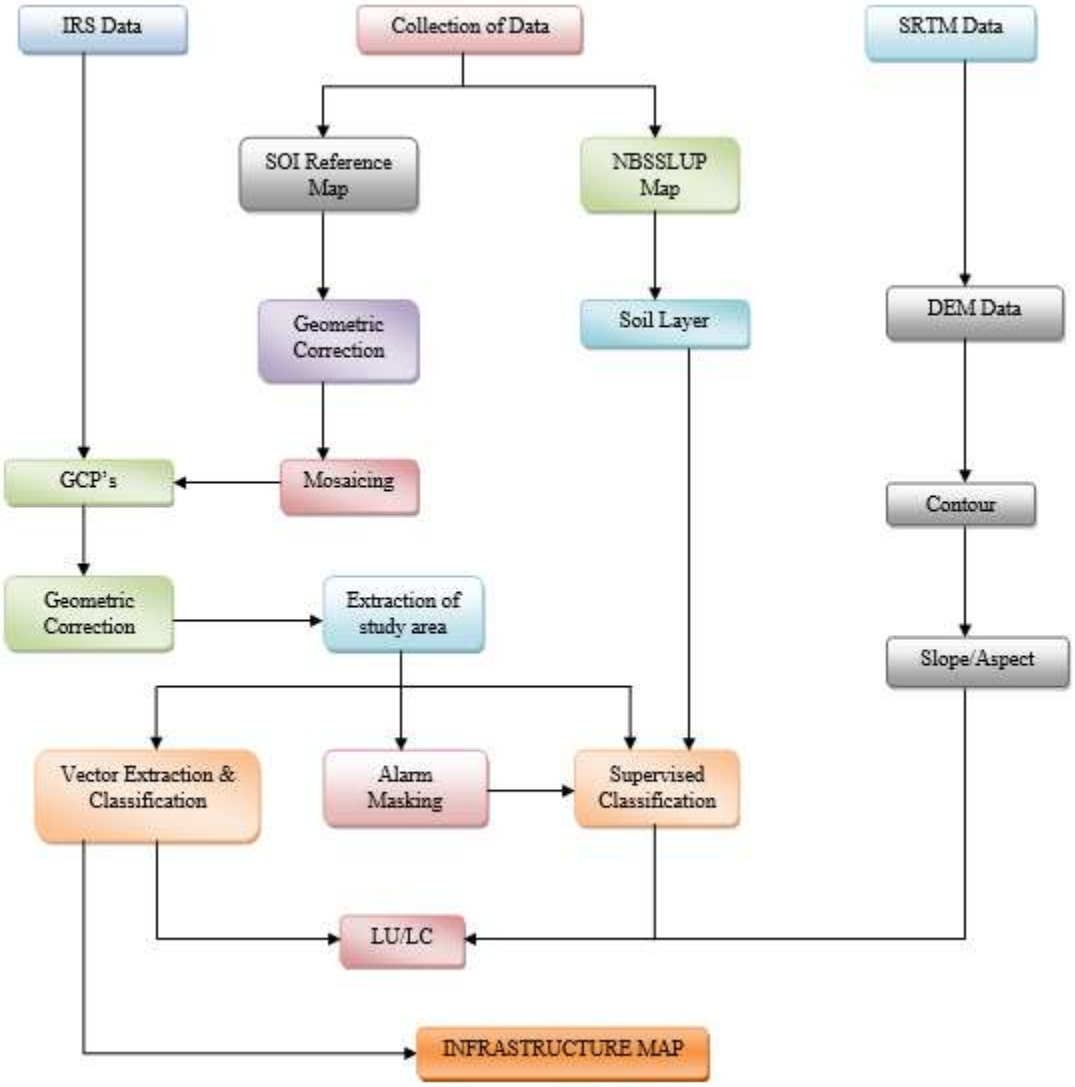

Fig. 4: Methodology of the Study

Table – 1

Sources of SOI, Satellite Data, DEM Data, Soil Map

Type of Data	*Details of Data*	*Source of Data*
SOI Reference Map	*73 I/11 (Scale 1: 50,000)*	*SOI,*
Thematic maps: Soil Map	*(Scale 1: 5,00,000)*	*NBSS&LUP*
DEM Data	*90 mtr Resolution*	*SRTM Website*
Remote Sensing Digital Data IRS-1C-LISS-III & IRS-P6-RESOURCESAT-LISS-IV	*December - 2012*	*Bhuvan Website & NRSC*

IV. Results, Discussion and Conclusion

A NDVI (Normalized Difference Vegetation Index) index was performed to derive the class in the forest area and water-bodies. As all the LISS–IV scenes were acquired in the different time interval hence, each was separately used for NDVI and then desired classes were sliced while clubbing other classes. Final NDVI map was overlaid on the classified image to represent the classes which were not considered during the supervised classification. A supervised classification technique was adopted with maximum likelihood algorithm. Due care was taken in generating the signature sets for the desired classes and where validated with the error of omission and error of commission. Wherever, overlapping of signatures was found, new sets of signatures were generated to improve the classification of LISS-IV image. Basic visual and digital interpretation parameters were followed like; tone, texture, shape, size, pattern, location and association for the recognition of objects and their tonal boundaries. Further refinement was carried out in the classified image with filtering and recoding of few classes. The final classified output image was assigned 7 classes (Table 2). Validation was performed with respect to SOI reference maps and other collateral data. Overall good accuracy of 90- 95% was achieved (Figure 5). Also using resource satellite data, we have extracted the infrastructure layer like i.e., metal &

un-metal roads, water bodies, settlement, canal, river etc., and these all layer overlaid into the village boundary map and generated infrastructure layer (Figure 6). The current Land use and land cover data and infrastructure data can be used by State government and local agencies for effective water-resources inventory, flood control, water-supply planning, and waste-water treatment and irrigation planning and other agricultural activities.

Table – 2
Land Use- Land Cover Classification Scheme

Code	*LU/LC Categories*
1	*Waterbody*
2	*Stony Waste*
3	*Settlement*
4	*Open Scrub*
5	*Open Forest*
6	*Dense Forest*
7	*Agriculture*

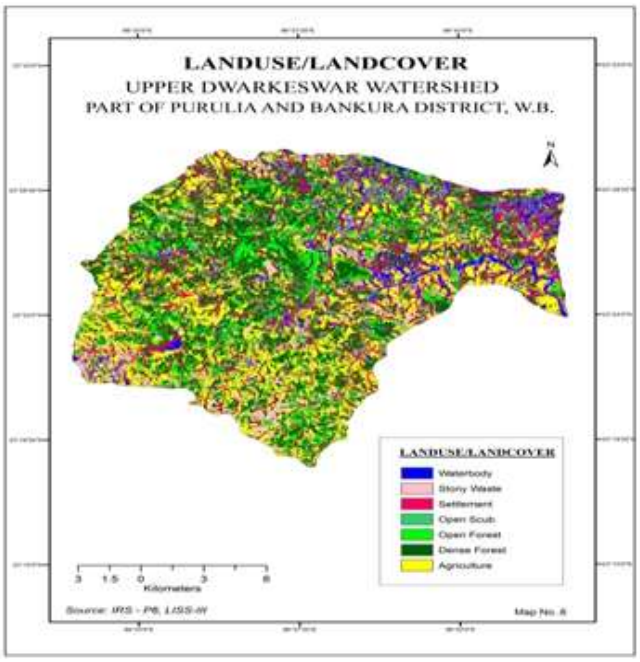

Fig. 5: Land use/Land cover map of the study area

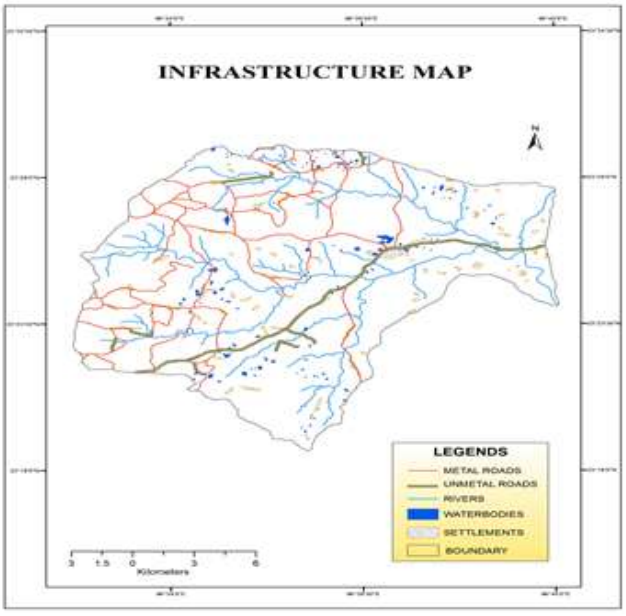

Fig. 6: Infrastructure Map of the study area

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