CREATION OF REMOTESENSING AND GIS BASED PHYSICAL CHARACTERISTICS INFORMATION SYSTEM FOR SURFACE WATER MANAGEMENT : A MODEL STUDY

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Abstract
The demand for water is increasing day by day due to increasing population , rapid urbanization, industrial growth and agricultural utilization. The levels of Water Resources is decreasing over years due to all the above activities and decreasing of annual rainfall year by year due to climatic changes and increasing runoff due to urbanization and deforestation. Hence, it is necessary to increase water Resources and maintain the quality of water along the riverbeds due to urbanization the changes of physical characteristics is impacting the water Resources to meet for future demands. Keeping this in view, we have done a model study for along the musi riverbed. The Study area is situated at Hyderabad district and very less part coming into the Nalgonda district of Andhra Pradesh between The part of Survey of India toposheet 56 K/11 and is situated between $78^{0}30^{1}$ and $78^{0}45^{1}$ East longitudes and $17^{0}20^{1}$ and $17^{0}25^{1}$North latitudes The present study was carried out to delineate physical characteristics study along the musi riverbed using IRS-ID PAN and LISS-III geocoded data on 1:50000scale.The information on Basemap,Drainagemap,Watershedmap,Slopemap,Landuse/Landcovermap,structures map and were generated. Geographical Information System was used to prepare database on the above layers, analysis of relationship and integrated the above data to study the physical characteristics along the musi riverbed. The result in the form of integrated maps could be properly analyzed using the advantage of technology like GIS as the methodology, which includes analysis of many resources and their interpretation. River beds study and to prepare any action plans along the river beds is useful for to meet future demand.

Key Words: physical characteristics, Water Resources, Remote sensing and GIS

1. Introduction
Water is a marvelous substance flowing, swirling, seeping, constantly moving from sea to land and back again to sea. Water is a key resource in all economic activities ranging from agriculture to industry. Only a tiny fraction of the planet's abundant water is available to us as fresh water. About 97% is found in the oceans and is too salty for drinking, irrigation, or industry. The remaining 3% is fresh water. About 2.997% of it is locked up in ice caps or glaciers or is buried so deep that it costs too much to extract. Only about 0.0035 of Earth's total volume of water is easily available to us as soil moisture, exploitable ground water, water vapor, and lakes and streams.In India, average annual rainfall is of 1170mm. Out of total rainfall in an area of 3290 lakh hectares, a rainfall of 4000 billion cubic meters annually occurs. Out of the total, 41% is lost-evaporation, 40% is lost-run off, 10% is retained-soil moisture, 9% seeps in for recharging ground water. Of the 40% stream flow water, 8% is used for irrigation, 2% for domestic use, 4% for industry, 12% for electric generation.Our of total available water resource 1869 bcm, the usable, water resources are only 1122 bcm, which consists surface water 690bcm, ground water 432 bcm, which the present per capita available water resources is 1122cm and by 2050 it is likely to reduce to 748 cm. When the countries per capita water availability is less than 1700 cm it is considered as water stress country.water is an important resource and a major source of drinking water for the world's population. Groundwater is also an abundant resource and accounts more than 90% of the global fresh water resources, excluding water glacial ice. Groundwater is the source of about 90% country's drinking water. In rural areas, almost all of the water supply comes from groundwater and more than one-third of our 100 largest cities depend on it for at least part of their supply. Historically, groundwater has been considered to be safe to drink.With ever increasing pressure of human population, there is severe stress on water resources. The water resources are not uniformly distributed throughout the world and are particularly scarce in arid regions. However, water is becoming contaminated with industrial effluents discharged on land and septic systems, as well as illegal and uncontrolled hazardous waste sites. Once contaminated, water is difficult, if not impossible, to restore. In present days, usage of surface and groundwater is increasing due to rapid urbanization, industrial growth and agricultural utilizations. Consequently, rapid depletion of surface and ground water is taking place. The conventional methods like geological and geophysical studies are generally used to locate bore well points. Compare

to the conventional methods Remote Sensing is the advanced technology, because of its wide coverage and repetitively, to proper management of surface water resources.

2. Description Of Study Area

The study area covered in part of Survey of India toposheet 56 K/11 comprises part of Hyderabad and Nalgonda districts of A.P, India and is situated between $78^0$30' and $78^0$45' East longitudes and $17^0$20' and $17^0$25' North latitudes. The study area map is shown in Fig 1.The study area is situated in the Krishna basin and the river Musi, which is a tributary of river Krishna, is passing through the city of Hyderabad, and bifurcates the city into Northern and Southern Hyderabad. The soils are mainly brownish sandy and Ready loamy. Rocks like dolomite and quartz basalt associated with granites yield in general brownish sandy soil and where the dolomite is predominant, the soil changes to black cotton one.

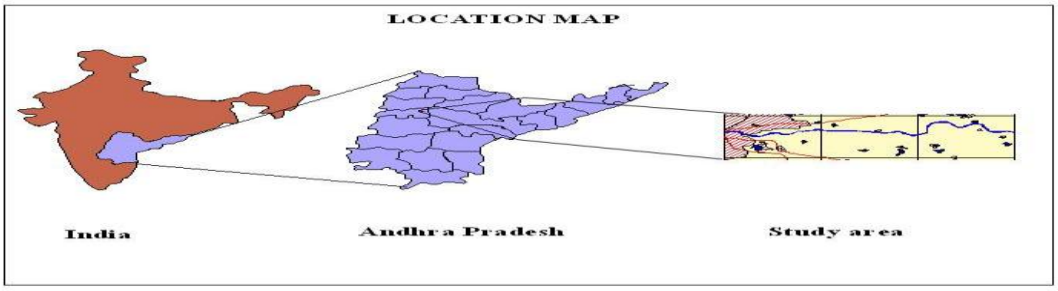

Fig 1. The study area map

3. Study Objectives

1. Preparation of thematic maps like Basemap, Drainagemap, watershed map, Slope map, Structural map, using survey of toposheets and satellite imagery.

2. Study of physical characteristics along Musi riverbed.

4. Methodology

4.1 Data Collection

Different data products required for the study include SOI toposheets bearing the number 56k/11 on 1:50,000 scale, data of using IRS-ID PAN and LISS-III geocoded satellite imagery obtained from National Remote Sensing Agency (NRSA) and collateral data collected from related Government organizations and demographic data

4.2 Reference Maps

The Spatial data used consist of Reference data consisting of maps prepared by Different Govt. Organization which are the key source for the Reference. The Reference data or Maps used in this study and the Source are specified in

MAP NAME	SOURCE ORGANISATION
Topo Map	SOI
Satellite Data	NRSA
Geology/ Lithology Map	GSI
Soil Map	AGRICULTURE
Hydro Geology Map	CGWB/SGWB
Taluk & Mandal Map	CSO

Table 1.Data sources of Reference Maps

4.3 Satellite Data Processing

The second generation operational Indian Remote Sensing IRS-ID were launched in the year 1998 by the indigenously developed Polar Satellite Launch Vehicle (PSLV) from Sriharikota, India. This satellite is placed in a near circular, sun-synchronous, near polar orbit with nominal inclination of 98°. 53′ at a mean attitude of 780 Km. There are three sensors, namely 1) Panchromatic Camera (PAN) 2) Linear Imaging and Self Scanning Sensor (LISS III) 3) Wide Field Sensor (WiFS) (Anji Reddy, 2001).

In this study, the remote sensing data in the digital mode is used and is obtained by LISS III and PAN of IRS ID(Fig:4)fore, it is more appropriate to give the sensor characteristics of LISS III and PAN . LISS Ill sensor operates in four spectral bands, there are separate optics and detector arrays for each band. Map of 1:50,000 scales obtained from SOI covering the entire study area is used to extract the Ground Control Points (GCPs) and to demarcate the

boundary of study area. This information is then used for image registration of LISS III and PAN digitally using EASI/PACE software.

4.4 Hardcopy Generation

The step-by-step procedure for preparing the Hardcopy

- Delineation of the study area from the area from toposheet obtained from SOI
- Conversion of raster data to vector format
- Creation of the baseline data by digitizing the map and a digital database is prepared using AutoCAD software
- Preparation of the baseline digital map (hard copy)Preparation of thematic maps by visual interpretation
- Preparation of thematic map from SOI toposheet, and thematic maps like Landuse/Land cover ,slope ,drainage, watershed, structural maps prepared on the visual interpretation of satellite image in conjunction with the existingmaps/literature.
- Scanning and digitizing all these maps and creation of digital Databases
- Field visits for checking the interpretation collecting the additional information.
- Incorporation of field observations in the thematic maps.
- Preparation of Action plan for physical characteristics by combining the thematic map information.
- Incorporation of corrections/modifications based on the collateral data
- Final output generation using GIS software.

5. Results And Discussion

5.1 Base Map

A topographic map is a representation of the shape, size, position and relation of the physical features of an area. The base map is prepared using SOI toposheet on 1:50,000 scale and updated with the help of satellite imagery. It consists of various features like the road network, settlements, water bodies Musi River, canals, The South central railway line passes through the study area and vegetation etc. delineated from the toposheet. The map thus drawn is scanned and digitized to get a digital output. The information content of this map is used as a baseline data to finalize the physical features of other thematic maps. Since the topo sheets are very old all the features like roads, railways, settlements etc are updated with the help of rectified and scaled satellite imageries of the area. The major settlements in the present study area are etc

5.2 Transport map

In the study area all the settlements are connected either by Metalled road or Un-Metalled road. Railway network

(south central railway) passes through the study area.

5.3 Drainage Map

The drainage map (Fig.7)prepared from the toposheet forms the base map for the preparation of thematic maps related to surface and groundwater. All the streams, Musi river, tributaries and small stream channels shown on the toposheet are extracted to prepare the drainage map. The study area is a first , second, third,forth order streams and Musi River are present. The present study area dendrite drainage patron are present. The flowing of water is tamed through construction of number of tanks and channels.

5.4 Watershed Map

The watershed map is prepared in accordance with the National Watershed Atlas, 1990. India is divided into 6 regions out of which the present study area comes under Region-4 i.e. the river flowing into Bay of Bengal. The total area occupied by this region is 1130.48 lakh hectares and is sub-divided into 8 basins. Hyderabad area falls under basin-D i.e. the Krishna basin which has a total area of 272.03 lakh hectares. The Krishna basin includes 8 catchments, 41 sub-catchments and 271 watersheds. The present study area is located in catchment–1 in the lowermost part of the basin below the Nagarjunasagar dam. The total area of this catchment is 3,837 hectares and is further divided into A, B, C, D and E sub-catchments. The sub-catchment-E i.e. Musi sub-catchment of 1134 hectares consists of the present study area and occupies the parts of 4D1E5 and 4D1E6 watersheds.

5.5 Structural map

The attitude and relative positions of the rock masses of a area; the sum total of structural features resulting from such processes as faulting, folding, and igneous intrusion. Structural-geological studies commence by deciphering planar discontinuities in the rocks, with a view to understanding their characteristics, discomposition and spatial relations.

Structural features are… Bedding, Folds, Faults,Lineaments,Strike,Dip, Neovolcanic rift zones Intrusives.Structural features found in the study area are lineaments.the term lineament to define a significant line of landscape which reveals the hidden architecture of rock basement. the usage of this term and defined lineament essentially in a geomorphological sense as a mappable simple or composite linear feature of a surface whose parts are aligned in a rectilinear or slightly curvilinear relationship and which differs distinctly form the pattern of the adjacent features and presumably reflects a sub-surface phenomenon. Lineaments may be associated with springs or they may promote movement of groundwater to shallow depth. Among lineaments inferred and conformed lineaments are identified in the study area.

5.6 Slope map

Survey of India Toposheet maps on 1:50,000 scale are used for deriving the information. Contour lines on topographic maps are useful for preparation of slope map. Closed space contours on the map reflect steepness when compared to widely spaced contours. The different classes of slopes have been categorized as per the guidelines suggested by All India Soil and Land Use Survey (ALS & LUS). Slope categories are indicated in Table 1.The density of contours on 1:50,000 scale Survey of India toposheets with 20m contour interval have been used for preparing the slope map (Fig:6).

Sl. No and Category	Slope %	Contour Spacing
1. Nearly level	0-1	More than 4cm
2. Very gently sloping	1-3	1.33 – 4cm
3. Gently sloping	3-5	0.8-1.33cm
4. Moderately sloping	5-10	0.4-0.8cm
5. Strongly sloping	10-15	0.26-0.4cm
6. Moderately steep to steep sloping	15-30	0.11-0.26cm
7. Very steep sloping	>35	0.11cm and less

Table 2 : Slope categories (Source: IMSD, NRSA 1995)

Slope classes 1, 2, 3, 4 and 6 are observed in the study area. The distance between the successive contours is wide and only a few contours developed in most part of the total study area (69%) indicating its near level nature, whereas the distance between the successive contours is little wide in about 20% indicating very gently sloping and the distance between the successive contours is short in about 4% and 5% indicating gently sloping and moderately sloping respectively. Numerous contours are present in very few parts of the total study area (2%) indicating moderately steep sloping nature.

5.7 Land Use/Land Cover

The LU/LC map (Fig.5)of the study area is prepared from satellite imagery using visual interpretation technique. This technique consists of a set of image elements, which help in the recognition or interpretation of various land use /land cover features systematically on the enhanced satellite imagery during the classification of features (Lillesand and Kiefer 1994). The land use/ Land cover classification system used in this study is the system, which is pioneered by United States Geological Survey (USGS) and is modified by National Remote Sensing Agency (NRSA) according to Indian conditions. A preliminary image classification key is prepared for the fused pictorial data and is used during interpretation process. The base map is overlaid on the satellite imagery. Then the features of LU/LC classes are extracted and transferred from the satellite pictorial data. The doubtful areas (due to similar spectral response and spectral signature) identified during the preliminary image classification are listed out before ground verification. The doubtful areas are physically verified by field observation, based on which, corrections and modifications of misclassified land use/land cover details are carried out for preparation of final maps so as to extract the entropy or information content in accordance with the above thematic maps. Present land use/land cover map showing the spatial distribution of various categories and their areal extent is vital for the present study. The spatial distributions of various land uses are interpreted based on fused data of IRS-1D, PAN and IRS-ID, LISS III data. The different land use land cover classes existing in the area over space and time are briefly discussed here in their dimension. The land use/land cover categories such has River with water(1%), Dry river(0.05%), Tank with water(1%), Dry tank(2%), River island(2%), Military/Defence areas(2%), Major industries(3%), Single crop(17%), Double crop(15%), Fallow lands(0.05%), Plantation(0.2%), Scrub forest(5%), Barren sheet area(2%), Land with scrub(30%), Land without scrub(4%), Mining/Industrial wastes(0.006%), Mining areas(0.06%), Village(5%), Other settlements(12%), Others

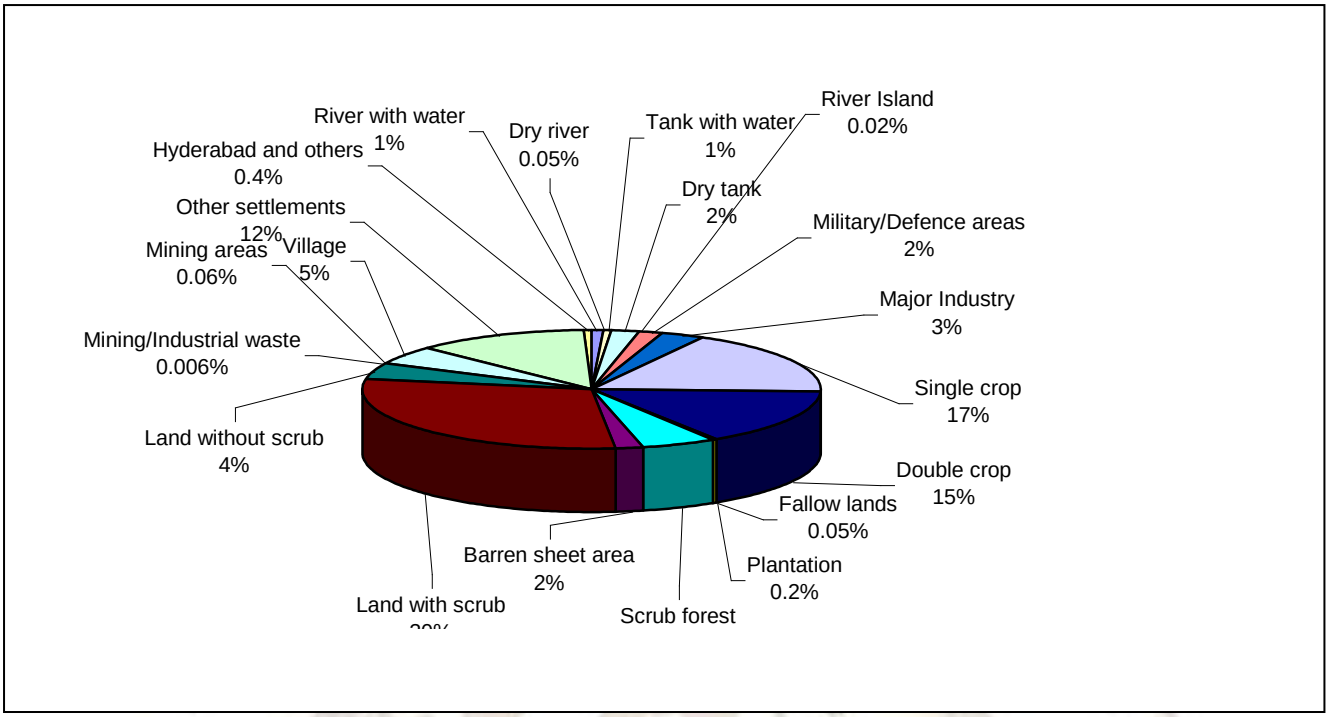

Fig.2: Pie Chart showing percentage distribution of Land use/ Land cover in the study area

Lu/lc	**Area (Sq.kms)**
River with water	5.14
Dry river	0.41
Tank with water	3.91
Dry tank	15.59
River island	0.15
Military/Defence areas	11.63
Major industries	22.28
Single crop	127.91
Double crop	112.62
Fallow lands	0.37
Plantation	1.48
Scrub forest	38.91
Barren sheet area	14.78
Land with scrub	216.91
Land without scrub	31.26
Mining/Industrial wastes	0.04
Mining areas	0.47
Village	35.86
Other settlements	91.07
Others	3.59

Table 3: Landuse Landcover classification of Study area.

6. CONCLUSION AND RECOMMENDATION

By studying the existing scenario of study area through the spatial analysis of agriculture activities, socio-economic and their impacts on the land and water Resources using Remote Sensing and GIS tools, following conclusion s are drawn.

1. Through the analysis of physical characteristics attribute data,gives the information of affected by erosion. In future this may lead to consequential problems to the Musi River. This could be best controlled by construction of gully control bunds and extensive reforestation / a forestation or through agricultural soil conservation and management practices.

2. As irrigation water requirement varies with different crops, cropping pattern in the study area is to be changed for optimum utilization of this resource. Crops like pulses, vegetables should be cultivated, which may result lower requirement of water, fertilizer and also pesticide load.

3. The three key activities that are essential for the management of Resources.Irrigation management,Catchment management,Drainage basin monitoring and managementTo address these three activities planners need physical characteristic information on comprehensive lines. Hence, the present work, concentrated on the development of physical characteristics for study area**.**

4. This model study helps to get the digital data of the total study area Physical characteristics information, according to their importance. If we analyze any resources we can get the total detailed information. We can get the information of the each Physical characteristic , and to plan to meat future demands. We can obtain the full details of the River current status as it is this type of study to Support the take the decision for micro level for proper management of Rivers. This study is very useful for government officials can easily get the data and to take decisions to manage the any disaster and surface water resources management.

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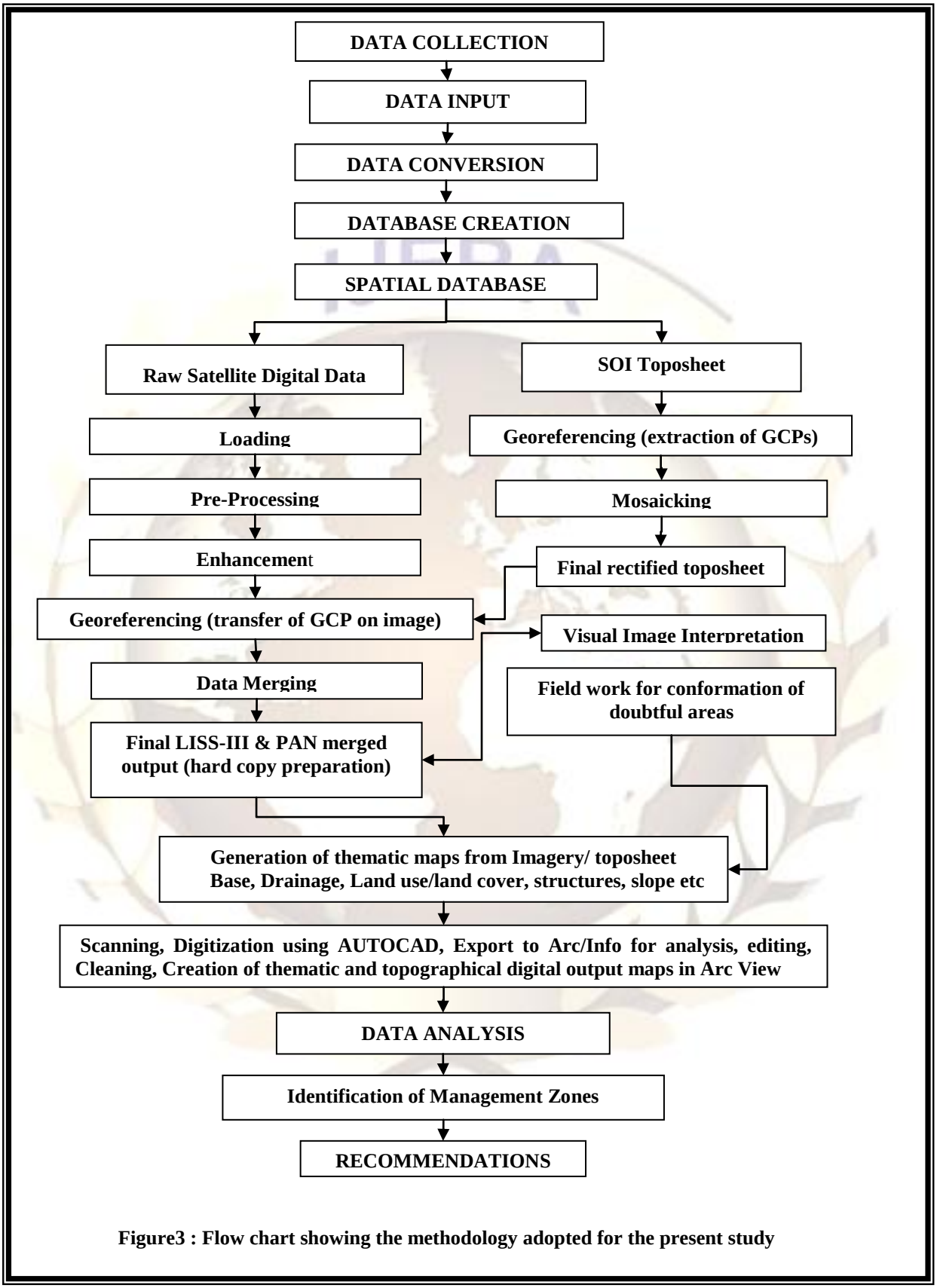

Figure3 : Flow chart showing the methodology adopted for the present study

Figure4:Satellite Image of study

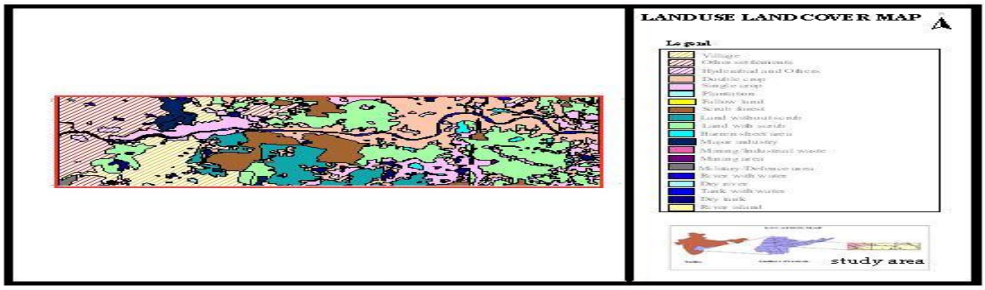

Figure5: and use/Land cover of study

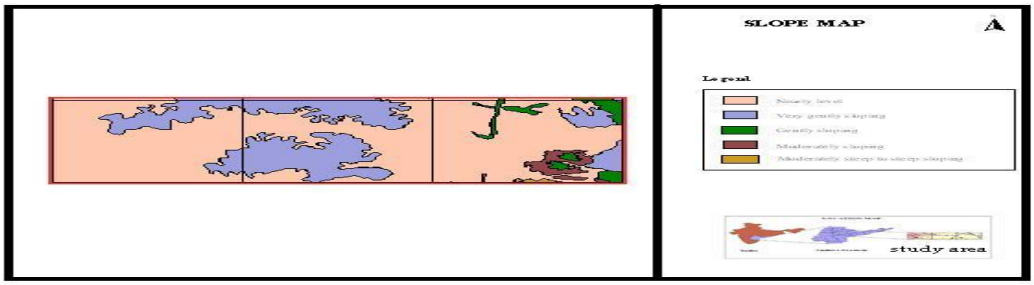

Figure 6: Slope map of study area

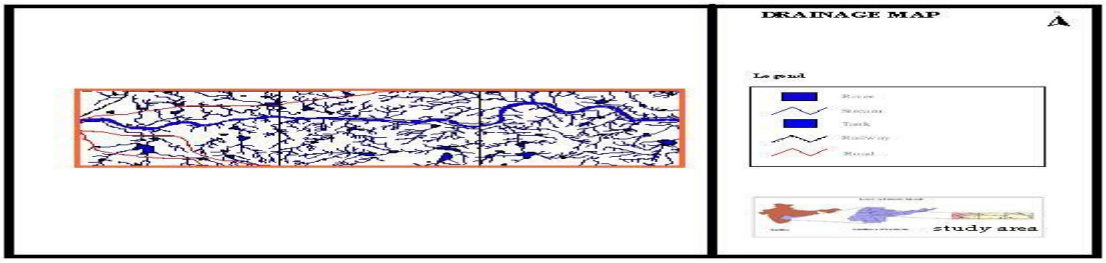

Figure 7:Drainage map of study area