V. Mallikarjuna et. al. / International Journal of Engineering Research and Applications (IJERA) ISSN: 2248-9622 www.ijera.com
Vol. 2, Issue 6, November- December 2012, pp.746-752

RS & GIS Based Assessment of Land Use/ Land Cover Characteristics for Krishna Delta, Andhra Pradesh

V. Mallikarjuna[1], K.R.K. Prasad[2], P. Udaya Bhaskar[3], M. Sailakshmi[4]

[1]Associate Professor, Department of Civil Engineering, V.R. Siddhartha Engineering College, Vijayawada – 520 007, Krishna District, Andhra Pradesh, India,

[2]Professor & Dean, K.L. University, Vaddeswaram-522 502, Guntur District, Andhra Pradesh, India.

[3]Principal, Jawaharlal Nehru Technological University College of Engineering, Vizianagaram-535 002, Vizianagaram District, Andhra Pradesh, India.

[4]Post-Graduate Student, Department of Civil Engineering, V.R. Siddhartha Engineering College, Vijayawada – 520 007, Krishna District, Andhra Pradesh, India.

ABSTRACT:

Watershed management is a comprehensive term, means the rational utilization of land and water resources for optimal production with minimum hazard to natural resources. The economical development in a country like India is pivoted around the agricultural productivity, which in turn depends much on effective implementation of watershed management programmes.

Watershed studies require real time data of several characteristics of the catchment. The space based satellite Remote Sensing due to its synoptic, repetitive and multi-spectral coverage will facilitate techniques of mapping, analysis, drawing inferences and management of natural resources information on vegetation, land use/ land cover, geology, hydro-geomorphology and soils, which are prerequisite in any developmental planning.

In the present investigation, an attempt has been made to develop a GIS based Watershed Model for the assessment of spatial distribution of runoff for the Krishna Delta in Andhra Pradesh, India. The GIS layers namely, contours, Digital Elevation Model (DEM) were prepared including watershed boundary. The Digital Elevation Model (DEM) of the study area was generated in ArcGIS using Contours and Stream layers. Subsequently land use/ land cover map was prepared using unsupervised classification for the study area.

Keywords: DEM, Digitization, GIS, Land use/ Land cover, Remote Sensing, Unsupervised classification, Watershed.

1. INTRODUCTION:

Remote Sensing with its advantages of spatial, spectral and temporal availability of data covering large and inaccessible areas with in short time has become a very handy tool in assessing, monitoring and conserving land use/ land cover classification around the world. The GIS and Remote Sensing technology have opened new paths in water resources studies.

The scarcity of information at required scales and the lack of standardization of historical maps produce several problems in the use of past sources of information. The GIS and Remote Sensing techniques together have been considered as an efficient tool, which provides quick and useful baseline information on the parameters like geology, geomorphology, land use/ land cover etc.,

Land use/ land cover maps developed for a particular watershed are very useful in estimating the surface characteristics and the various uses that are being carried out over that area, with a particular reference to water resources management. Land use/ land cover data are needed in the analysis of environmental processes and problems that must be understood, if living conditions and standards are to be improved or maintained at current levels.

The Krishna Delta lies between longitude 80^0 10'E & 81^0 20' E and latitude 15^0 42' N & 16^0 40' N. The objective of the present study is to delineate the study area, to prepare the contour map, to develop Digital Elevation Model (DEM) followed by land use/ land cover map using ArcGIS & ERDAS software with the help of SOI Toposheets and Indian Remote Sensing Satellite Image.

2. STUDY AREA:

The areas in Krishna Delta include the south-eastern parts of the Krishna-Godavari alluvial basin complex along the east coast of India. It is bounded by longitude 80^0 10'E & 81^0 20' E and latitude 15^0 42' N & 16^0 40' N, constituting major portions of two districts namely Krishna and Guntur in Andhra Pradesh (Refer Fig. No. 1).

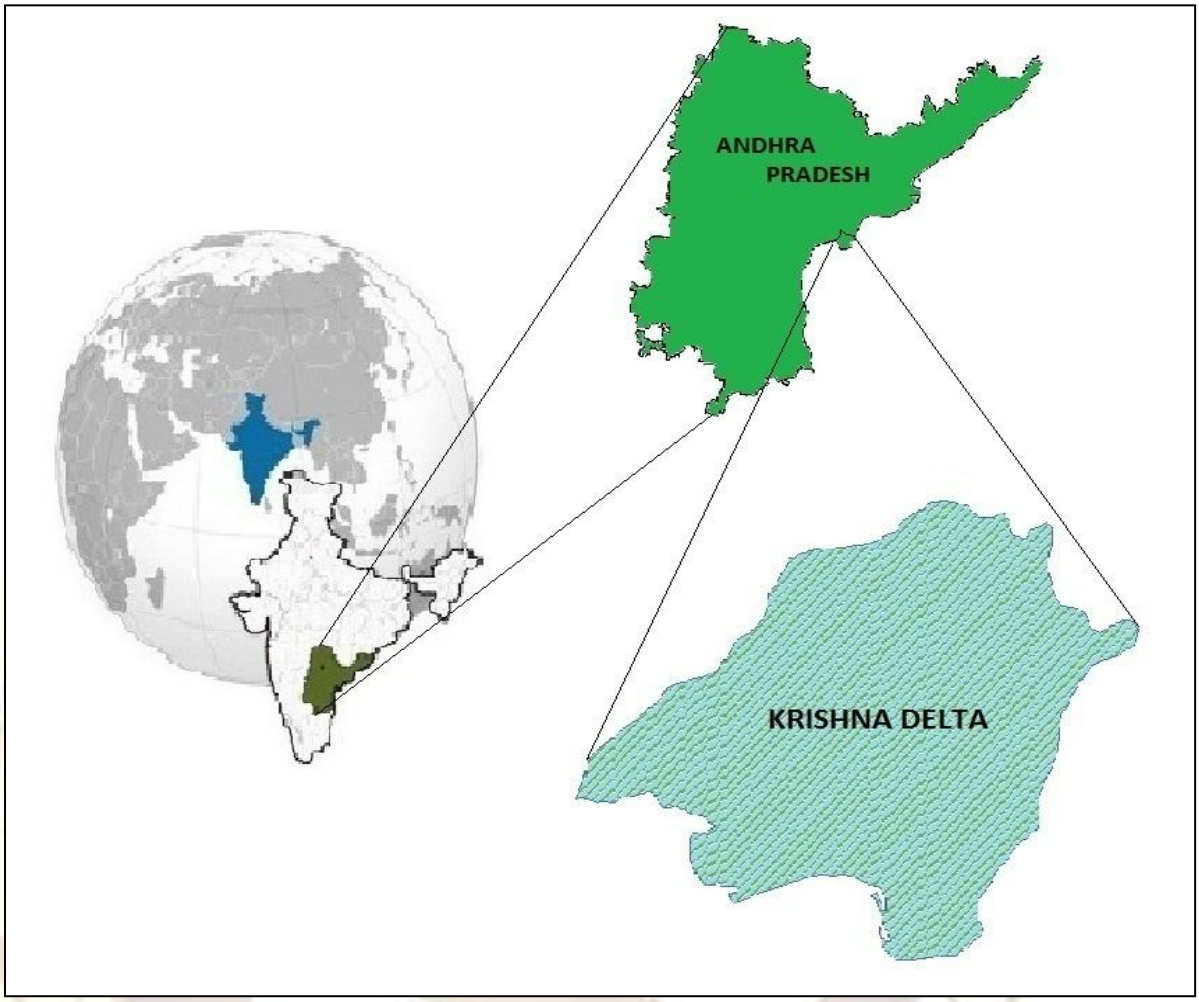


Fig. 1 Location Map of the Study Area

2.1 CHARACTERISTICS OF THE STUDY AREA:

Area: Krishna Delta comprises an area of about 6931 Sq.Km., with a perimeter of about 430 Km. (Refer Table No. 1). The Delta has about 120 Km. coast along Bay of Bengal.

Geology: The delta is a gently rolling low lying plain with a maximum altitude of 16 m above the MSL near Vijayawada and minimum of 3.50 m above the MSL at Machilipatnam. The general slope of the terrain is towards south and south-east. Most of the delta region is overlain by the river alluvium (clay, sand & gravel) and beach alluvium (sand).

Soils: The soils of Krishna Delta are very deep and dark brown to grayish brown in colour. The soils are very high in clay content, which ranges between 50 and 75 percent. Soils differ in their infiltration capacity in different parts of the delta depending upon the kind of soil.

Agriculture: Main Occupation of the people is Agriculture, which is dependent on the vagaries of monsoon.

Climate: The delta region is influenced by tropical semi-arid type climate. The mean annual temperature is about 29^0 C. The delta receives rainfall mainly from south-west monsoon (June-September) and from North-East monsoon (October-December). The mean annual precipitation is about 800 – 1000 mm.

Streams: The watershed has a well-defined stream network draining the precipitation into River Krishna.

Table No. 1 ATTRIBUTES OF BOUNDARY_PROJECT:

FID	SHAPE	Id	AREA (Sq.Km.)	PERIMETER (Km.)
0	Polygon	0	6931.3901	430.10599

3. DATA USED:

* SOI Toposheets pertaining to the area on 1:50,000 scale.
* IRS – P6 – LISS – III image of 30th December, 2010.
* Watershed Atlas of India (Plate – 2 & Plate – 4) on 1:1,000,000 scale.
* Soil maps of Krishna & Guntur Districts on 1:50,000 scale

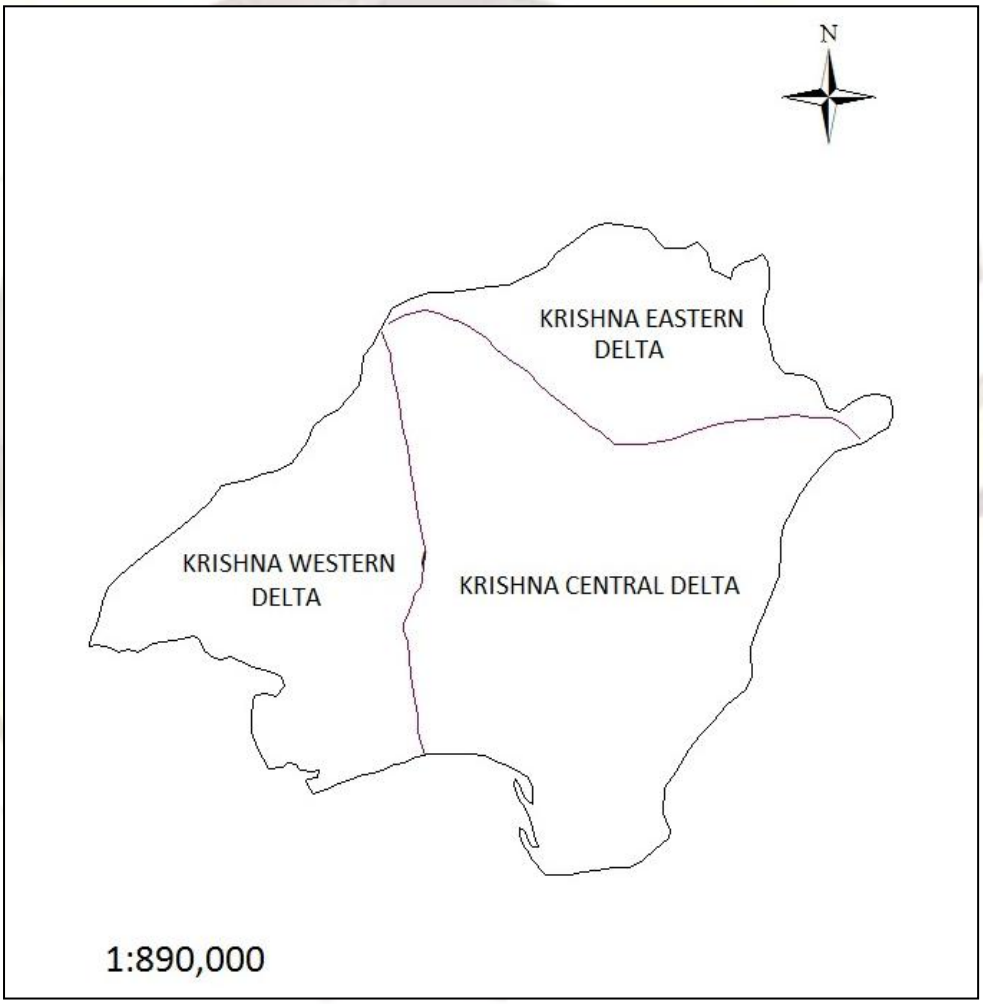
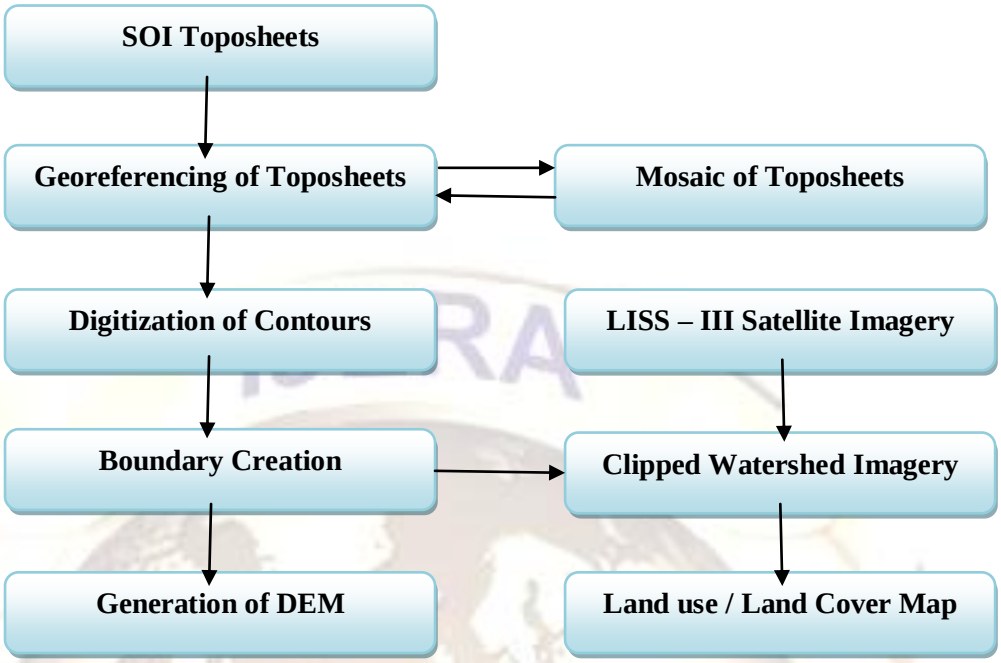


Fig. 2 Boundary of the Study Area

FLOW CHART OF METHODOLOGY:



4. METHODOLOGY:

The base map of the study area was prepared from the Topographic maps (1:50,000 scale), which were collected from the Survey of India. The SOI Toposheets were first rectified and then georeferenced to the Geographical Coordinate System. Then the georeferenced SOI Toposheets were mosaiced to form a single image of topomap for delineating the study area.

The mosiaced toposheet was further georeferenced and then considered for digitization of contours and the study area has been delineated correspondingly (Refer Fig No.2). The clipped topomap corresponding to the delineated study area is shown in Fig. No. 3. The Digital Elevation Model (DEM) (Refer Fig, No.4) has been generated for Krishna Delta with the utilization of contours which have been developed in the preceding.

Land use refers to man's activities and the various uses which are normally carried out on land. Land cover refers to natural vegetation, water bodies, rock/soil artificial cover. Information on land use/ land cover in the form of spatial information and statistics is vital for spatial planning, management and utilization of land for agriculture, forestry, pasture, urban, industrial, environmental studies, economic production etc., Therefore, land use/ land cover map (Refer Fig. No. 5) for the study area is prepared by using the satellite imagery with the help of ERDAS software using unsupervised classification.

The land use/ land cover map of the study area is supported by the corresponding soil map (Refer Fig. No.6), which in turn used for the estimation of runoff. Different types of soils pertaining to the study area include clay/silty clay/sandy silty clay/ sand/ gravel.

4.1 LAND USE/ LAND COVER:

Five land use/ land cover parameters have been selected to develop LU/LC map of Krishna Delta. The map have been characterized with the help of ERDAS and the following table provides the information regarding various land use/ land cover statistics corresponding to study area (Refer Table No. 2).

Table No. 2 Land use/ Land Cover Parameters of the study area

S.No.	Class Name	Area (Sq.Km.)	% of Total Area
1	Agricultural land	4802.94017	69.30649596
2	Forest/shrubs/vegetation	53.86420952	0.777261321
3	Waterbodies/wetlands	919.9766506	13.27527634
4	Built-up	1119.741426	16.15788494
5	Wastelands/others	33.4775	0.483080808

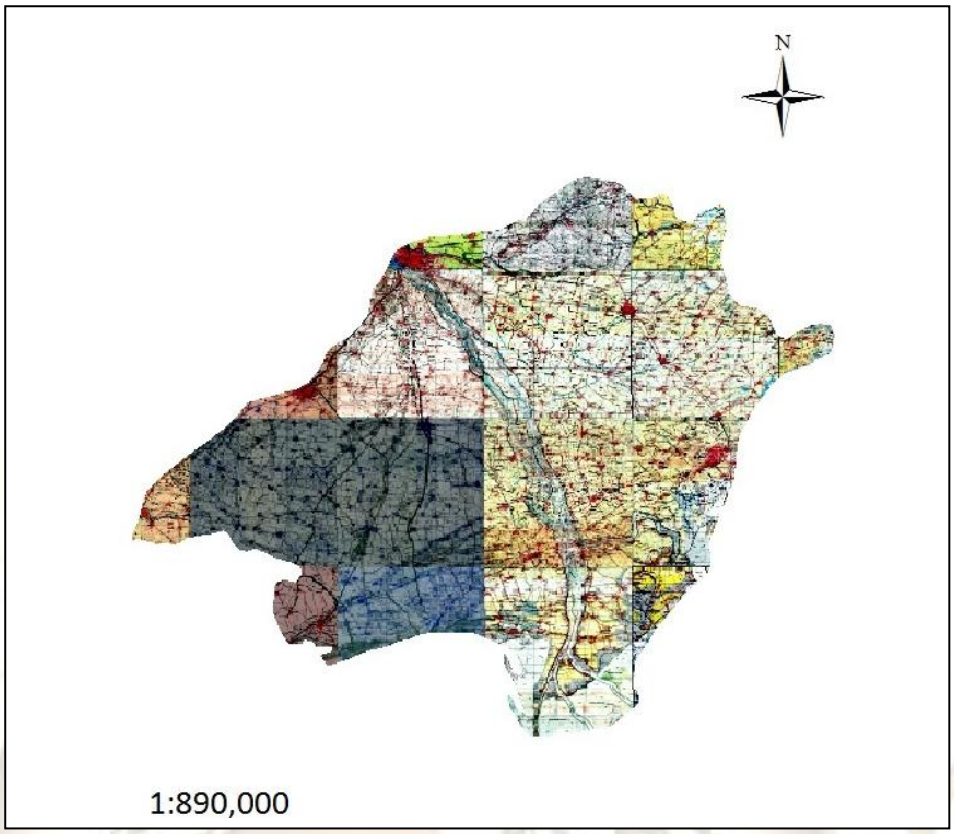


Fig. 3 Mosaiced Topomap of the Study Area

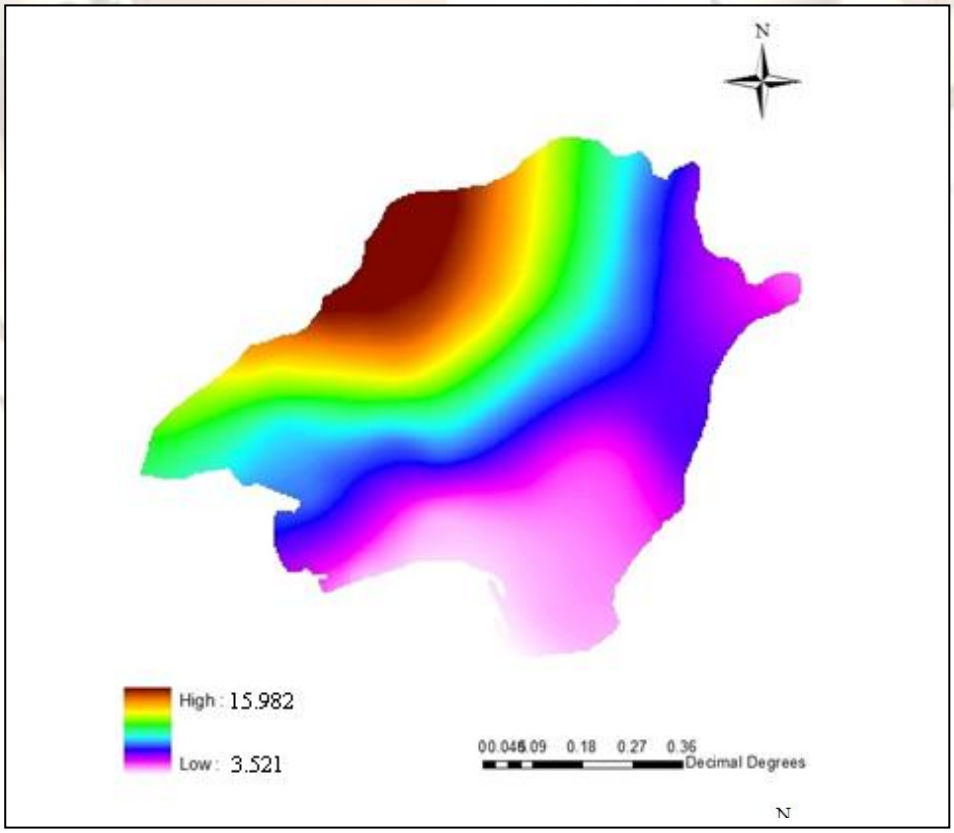


Fig. 4 Digital Elevation Model of the Study Area

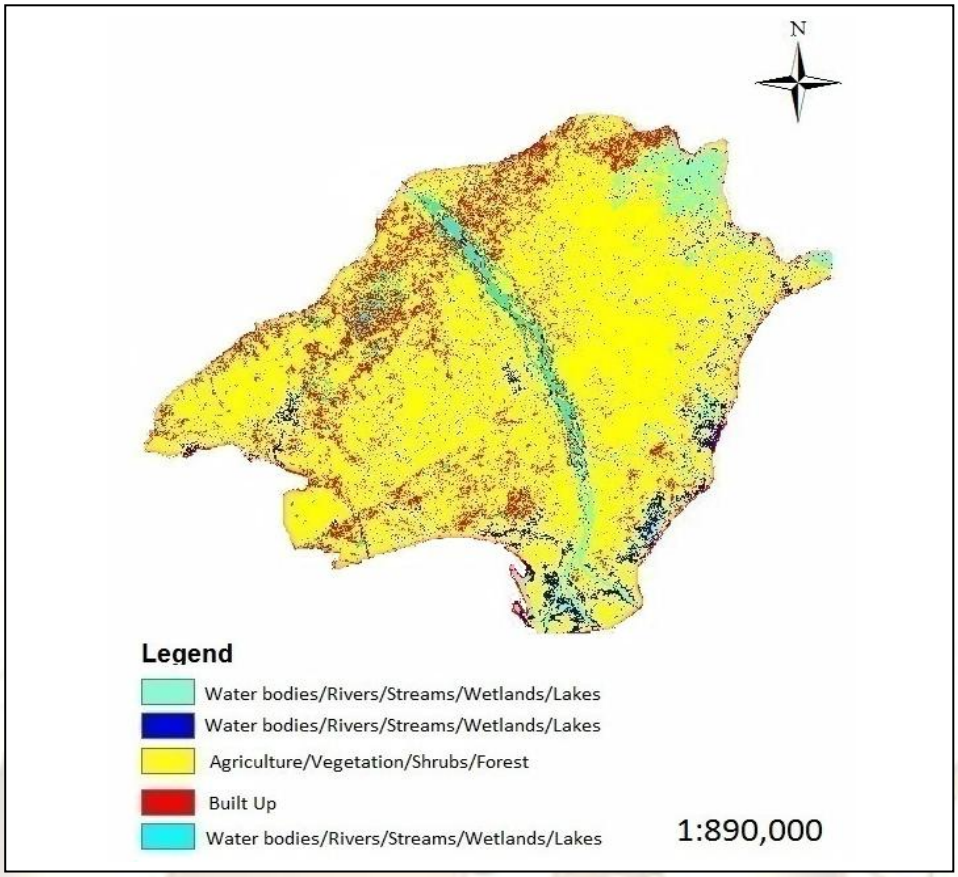


Fig. 5 Land use/ Land Cover Map of the Study Area

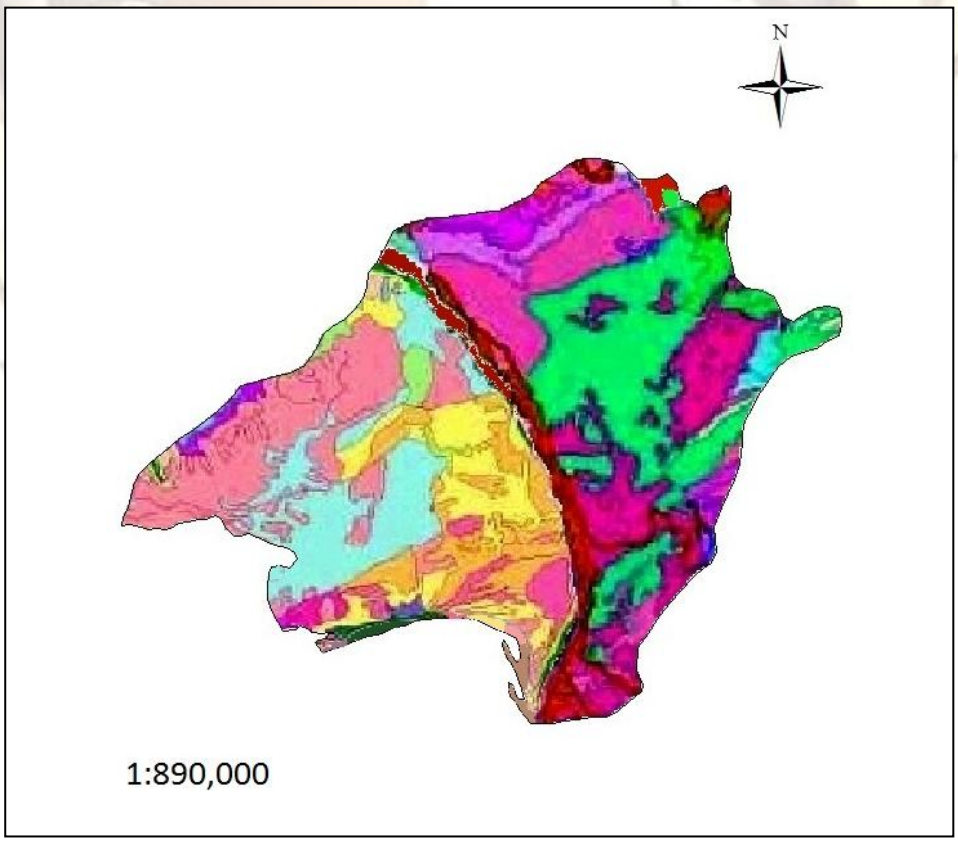


Fig. 6 Soil Map of the Study Area

5. CONCLUSION:

Satellite Remote Sensing data are of great use for the estimation of various hydrological data, when the conventional hydrological data are inadequate for the purpose of design and operation of water resources system. In the present study, the methodology for the development of watershed and generation of DEM using an integrated approach of remote sensing and GIS has been described. This approach may be applied for various other Indian watersheds for developing effective management scenarios.

The process of digitization of contours was performed on georeferenced mosaiced topomap from which Krishna Delta boundary has been delineated. With the use of contour map, Digital Elevation Model (DEM) was developed using ArcGIS. Consequently, land use/land cover map from the Indian Remote Sensing Satellite image was developed using ArcGIS and ERDAS software. From the study it is evident that, agricultural lands are predominant in the study area, and the areas of various categories of land use/ land cover are obtained through the usage of the software.

Further more, soil map has been prepared for the study area, as soil mapping is an important phase in the hydrological analysis and design. The soil mapping enables the hydrologist to arrive at the hydrologic soil group of a study area, which in turn helps in evaluation of curve numbers in the runoff computations.

REFERENCES

[1] Maidment, D., and D. Djokic, Hydrologic and Hydraulic Modeling Support with Geographic Information Systems, ESRI Press, Redlands, CA, 2000.

[2] Garbrecht J., Ogden F.L., Debarry P.A. Debarry and Maidment D.R., "GIS and Distributed Watershed Models – Data Coverages and Sources", Journal of Hydrologic Engineering, 6(6):506-514, 2001.

[3] Biswas S., Sudhakar S., and Desai V.R., "Remote Sensing and Geographic Information System Based Approach for Watershed Conservation", Journal of Surveying Engineering, 128(3):108-124, 2002.

[4] Gosain A.K., and Sandhya Rao, "GIS based technologies for watershed management", Current Science, Vol.87, No.7, 10 October, 2004.

[5] Choi, Jin-Yong, Bernard A. Engel and Richard I., Farnworth. "Web based GIS and spatial decision support system for watershed management", Journal of Hydroinformatics, 7:165-174, 2005.

[6] Robert A. Laura, P.E., CFM; Craig Mesimer; and Tim Brink, "GIS-Based Watershed Modeling", Watershed Management Conference 2005, Williamsburg, Virginia, United States, ISBN (print): 978-0-7844-0763-9, American Society of Civil Engineers, July 19-22, 2005.

[7] Semmens, D.J., M. Hernandez, D.C. Goodrich, and W.G. Kepner, Hydrologic model uncertainty associated with simulating future land-use/cover scenarios, Proceedings of the Second International Conference on Research in the Watersheds, Otto, NC, May 16-18, 2006.

[8] Prakasa Rao B.S., Pernaidu P.,Sathi Devi K., Jagadeeswara Rao P., "Runoff and flood estimation in Krishna River Delta Using Remote Sensing & GIS", Journal of Ind. Geophys. Union, Vol. 15, No.2, pp.101-112, April, 2011.