Watershed Delineation for Varahanadhi Basin Using Opensource Geospatial Technology

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***Abstract* - Water is the foremost thing for all living being to survive in this world. The main source of water is from rainfall. We are not storing the water for future use and when drought strikes us, we think for storage of water. Watershed is an area of land where all of water i.e., under it the drains off of it goes in to the same place. So, aim of this is to throw a light on the importance of watershed management using Geospatial techniques. Here we analyse the slope, contour and terrain profile of study area and behavior of stream segments, drainage direction, flow accumulation etc. There are 34 river basins in Tamilnadu including Parambikulam Aliyar. For hydrological studies and water resources planning purposes they are grouped into 17 river basins, among that Varahanadhi basin for has been selected project study. The spatial extent of the basin is 11°50' to 12°28' and 79°8' to 18°10'. The above mentioned works are carried by QGIS 2.6 open source technology.**

***Keyword* - Visual interpretation, Eco watersheds, Hydrologic process**

I. INTRODUCTION

Watersheds are natural hydrologic entity where water flows in a definite path. Watersheds can be defined based on many parameters like geology, geomorphology, land use, soils, etc. Analysis of large watersheds is quite tedious and time consuming. Remote Sensing data provides a fast and economic way to analyze large watersheds by virtue of synoptic and repetitive coverage. GIS is a tool which helps in analyzing multi-layer data. The present study aims at delineation of eco watersheds by considering different variables e.g. land use/ land cover, hydro geomorphology, elevation and slope in watershed of varahanadhi river basin in tamilnadu by integration of Remote Sensing and GIS. Larger drainage basin or a large watershed consisting of several sub watersheds. Each sub watershed then drains to a single outlet on a stream which is a part of the basin's drainage network and is hydrologically connected to the other sub watersheds of the basin through this network. Geographic Information Systems or GIS, when integrated with hydrologic process models, provide the basis for the development of such a framework.

The GIS layers include the watershed boundary, contours, streams, habitations, soils, land use, and geology. A digital elevation model of the area was also generated in QGIS using the contours and streams layers. Using the DEM and streams layers, the watershed was delineated using GRASS.

OBJECTIVE

At the end of this project people would be know the importance of watershed and needs of it to living creatures. The watershed which is contributed to store the water at one particular area, allows water to percolate into the ground. In this study, it is aimed to ensure the existing water bodies in the area studied or considered as well as create the new hydrological features. If the capacity of stream is known it helps in optimizing the usage of water. Thereby increase the water Table in a particular area. Finally the aim is too useful for conserving water to the future generation.

SCOPE

Scope of this project is the engineering features which are involved in hydrological process are known. The creation of watershed is made based on the profile of the area like slope, contour, permeability, soil properties, etc. The gathered knowledge is useful in the application of future hydrological studies.

II. LITERATURE REVIEW

1. *Prof.Kavas Kapadia, Former Head Department of Urban &regional planning, in Institute of town planner India(ITPI),* This paper brings into focus the transformation of ideologies taken place during the early period of independence to the present days and its impact on planning and development of Indian cities. As from Gandhian philosophy of self-control, honest, pride and poverty an integral part of our life, to self-centric, money making, wealth accumulating and showoff society. The author after explaining the complex phenomena of urban fabric prescribed the development guidelines for reshaping the city in present context. The paper also discusses about the 'city prosperity index', in order to respond the local and global crisis faced by the cities.

2. *A. Madhan (P.G student), P. Revathy (P.G student), Dr. S. Lakshmi (Prof HOD), Dr. K. P. Subramaniam (Formal Prof & head), Anna university chennai,* Bus stop locations and layout is recognized as a crucial element in the drive to improve the patronage of bus service. Planning of bus stop location is a tool for improving accessibility and consistency in design and provision that make it safe, comfortable, attractive and easy to use. This article explains the methodology for rationalizing bus stops by using ranking analysis with the application of GIS for a selected corridor in Chennai.

3. *Shubhasamita Sahani, Hari Shankar Prasad (student), Dr. V. Renghavasaamy (Deputy director NSRC/ISRO hydrabad),* Cities and towns are growing rapidly because of increasing population, which is not always contributing to the growth and prosperity of cities and towns, but also contribute to their associated problems, like waste generation and its management. This is directly questioning the sustainability of urbanization. On the other, quantity of waste is increasing with increasing population, is a serious issue which requires proper planning. A number of processes are involved for management of solid waste, like siting, monitoring, collection, transportation, processing and disposing. However, foremost after collection of solid waste, a site is required for disposing and processing. The present study attempts to use remote sensing and GIS coupled with MCDA method for analyzing and identifying a dumping site for solid waste disposal in Madanapalle Municipality in Andhra Pradesh.

4. *Ravainter (pursuing Ph.D.), Dr. S.P. Kaushik Ph.D.(Prof), Dept of geography, Kurakshetra university, Kurakshetra Haryana,in ITPI,* In this paper, by using GIS techniques an attempt has been made to study the changes in urban land-use pattern of kaithal town over a period of 36 years. Multi source data and maps were used to achieve the objectives. Results of the study indicate that the casual potential factors are governing physical growth and change in town, through different time periods. The study shows that the town's area was not significantly increased during 1974-1990 period, while urban growth process has gained momentum with the up-gradation of the administrative setup of town after 1990. The noticeable impact of land-use changes observed the loss of rich agricultural land and natural water bodies. The maximum increase in built-up area both formal as well as informal development are found towards north-eastern parts of town.

5. *Dr. V. Devadas (Prof., IIT Rorkee), Dr. Najamuddin (Prof., IIT Rorkee), in ITPI,* Haridwar city is one of the key contributors to the development of uttarakhand state. The city contributes about 25% of the state's GDP; however, in the wake of latest developments, the city is facing a series of problems owing to the ever growing floating population visiting its holy ghats and a continuous influx of migrants from other parts of the state and the country. In this paper, an attempt has been made to analyse Haridwar city in various aspect, which include its physical setting, demographic pattern, land use, climate change, and infrastructure (physical, social and economic) facilities available in the system; analyse the deficiency in the system in the year 2031 A.D.; and also suggested spatial planning postulates for sustainable development of Haridwar city.

6. *I.Wienand, U.Nolting and T.Kistemann* The last two decades have witnessed high population growth in India's urban areas. Urban centres are the hub of the manufacturing, services and trade. As a result, more people are migrating from rural areas to urban centres, making municipal governance a very complex issue. The complexity is more pronounced in states like West Bengal which has one of the highest population densities. One of its towns, Kalyani is a planned industrial town but with large unplanned settlements in form of slums. It has a university and number of colleges. It is part of the Kolkata Metropolitan Development Authority and is surrounded by villages. It is situated on the bank of river Ganges on its natural levee. Proper GIS database provides crucial planning input for infrastructure planning, land use planning, environmental planning, slum development planning, local economic development, livelihood support and planning related to health and education.

7. *Y. Pari, N. Srinivasa Murthy, P. Sreetharan , J. Sathish Pandiyan , M. Ravi and K. Kiran Kumar,* Construction is one of the major industries that deal directly with geography/nature for its productivity. Though the type of constructions are varying like Buildings, Factories, Roadways, Railways, Metros, Ports, Power transmission, Solar energy, Water supply, Effluent treatment, Hydro & Nuclear Power generation, etc. The unplanned and haphazard production of infrastructure/building construction causes imbalanced and unfriendly relation to environment and this creates a big threat to peace, prosperity, health and quality of human-environment interactive arena. GIS is an acronym of Geographic Information System and it is one of the technologies that have been arrived from the discipline of geography. It is a multidisciplinary technology that integrates spatial and aspatial information from various other technologies like Global Navigation Satellite System (GNSS), Database, Survey, Satellite and Aerial Remote sensing etc.

III. SOURCE OF DATA

The following data's are,

- Boundary map (Fig 1)
- DEM (Fig 2)
- Land use (Fig 3)
- Soil map (Fig 4)
- Geology (Fig 5)
- Geomorphology (Fig 6)

A. BOUNDARY MAP

- The Varahanadhi basin is one of the 17 major river basins in Tamil Nadu.
- Total area of basin = 4498.5 sq.km.

- Slope of terrain generally East and Southeast direction.
- The Basins covers following districts
  - Villupuram
  - Kanchepuram
  - Thiruvannamalai
  - Cuddalore
  - Pondicherry state of union territory
- The Varahanadhi basin is surrounded by Bay of Bengal in the east, Palar basin in the north and Ponnaiyar basin in the south and west.
- Spatial extend,
  - Longitude - 79.12˚ to 80.15 ˚ (East)
  - Latitude - 11.74 ˚ to 12.6 ˚ (North)

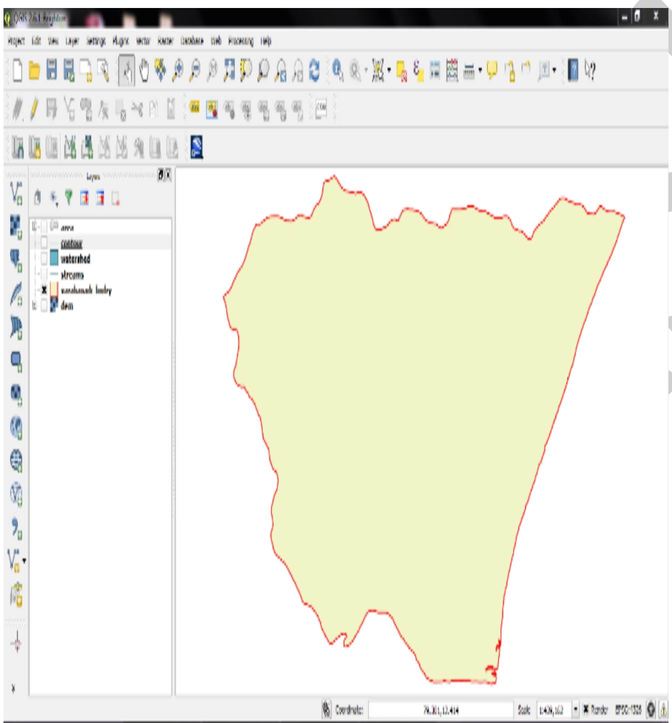


Fig. 1. Boundary map

B. DEM

DEM refers digital elevation model. It contains elevation details about Study area. These data generated by QGIS on the basis of geographical information. It is very important data to analyze the particular region.

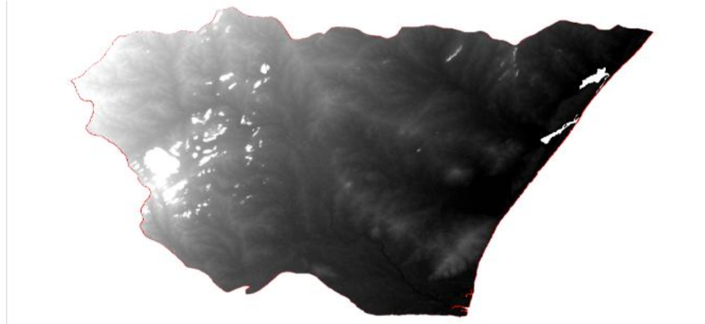


Fig. 2. Digital elevation model

C. LAND USE

Land use map of Varahanadhi basin was prepared using the LISS III FCC data Jan.1998 on 1: 250,000 scale by visual interpretation and also digital image processing by classification methods.

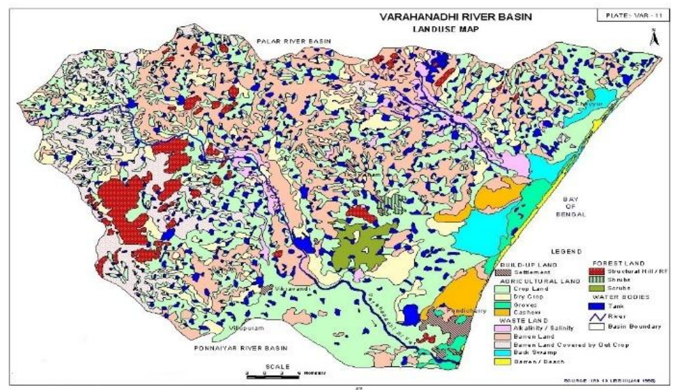


Fig. 3. Land use map

TABLE I

LAND USE TYPES

Si. No	Land use Category	Percentage
1	Built up Land	0.90
2	Crop land	48.43
3	Forest Land	5.66
4	Waste Land	34.51
5	Water Bodies	10.5

D. SOIL MAP

Soil is one of the natural resources, which has the most direct impact on agricultural development. In an agrarian country like India, it becomes necessary to take steps for its proper conservation and management. Soil surveys provide nature of soils, their extent physico chemical characteristics etc.

The soils of the Varahanadhi basin have been shown in Plate-VAR-15. The major soils types found this river basin is Inceptisols, Alfisol, Entisol and Vertisol. Due to different stage of weathering of parent material, the above soil types are met with in combination. The types of soils as per the classification by TamilNadu Agricultural University (TNAU) along with their sub groups are described as below

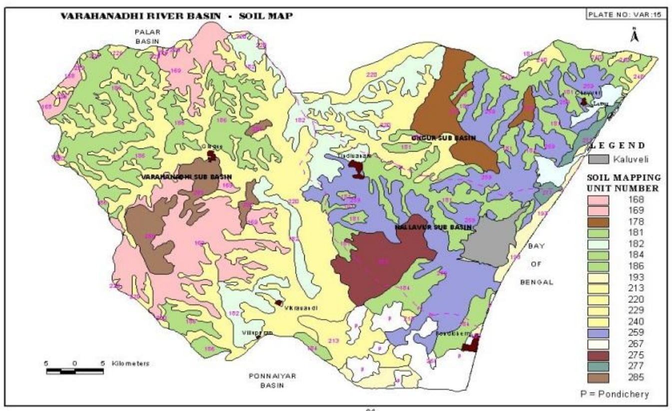


Fig. 4. Soil map

TABLE II

SOIL PROPERTIES

Unit	Drainage	Ground water Depth (m)	Surface texture	Available water (mm/m) (**)	Depth (cm)
182	Well	>5	Cl	50-150	100-150
184	Well	>5	Scl	50-150	100-150
193	S.W.Exces	>5	Sl	50-100	50-150
168	Well	>5	C	150-200	100-150
169	Well	>5	C	150-200	100-150
178	Well	>5	C	150-200	100-150

Unit	Drainage	Ground water Depth (m)	Surface texture	Available water (mm/m) (**)	Depth (cm)
181	Well	>5	C	150-200	100-150
186	Well	>5	C	150-200	100-150
213	Well	>5	Scl	50-150	100-150
220	Well	2-5	C	<50-150	100->150
229	Imp	2-5	C	<50-150	100-150
240	Well	>5	C	<50-150	>150
259	Mod.Well	>5	C	<50-150	>150
267	Imp	2-5	C	<50-150	>150
275	Mod.well	>5	C	<50-150	>150
277					
281					
285					

E. GEOLOGY

The Varahanadhi basin consists of hard crystalline rock masses of Archaen age for the most part of the area (84%) on the western portion and sedimentary rocks of Upper Gondwana, Cretaceous, Teritary and Quatenary age on the eastern portion (16%). the surface geology has been studied in the landsat imageries and contact between various formations has been demarcated on 1:250,000 scale map (Plate-VAR-07).

HARD CRYSTALLINE ROCK

- Basic Dykes
- Migmatite
- Granitoid Gneiss
- Granolite
- Biotite Gneiss
- Gingee Granite
- Magnotite Quartzite
- Pyroxene Quartzite
- Chamookite
- Settlement

SEDIMENT ROCK

- Limestone
- Sandstone
- Alluvial
- Clay & Shale
- Limestone & calcareous shale
- Laterite
- Argillaceous sandstone & calcareous sandstone
- Conglomerate & sandstone

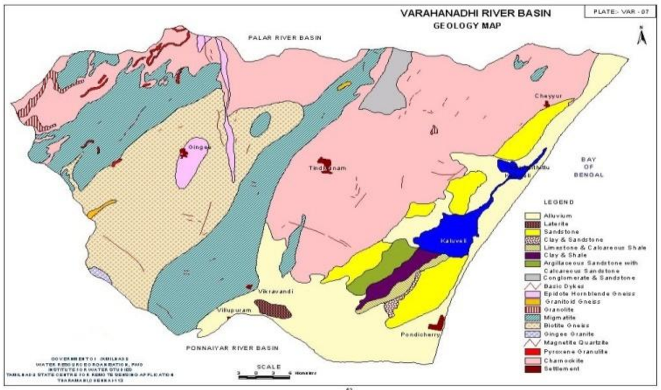


Fig. 5. Geology map

F. GEOMORPHOLOGY

In Varahanadhi basin geomorphology landforms act as synthesis with related components like soil, lithology, structures, lineament, and other related hydrological information available in this basin.

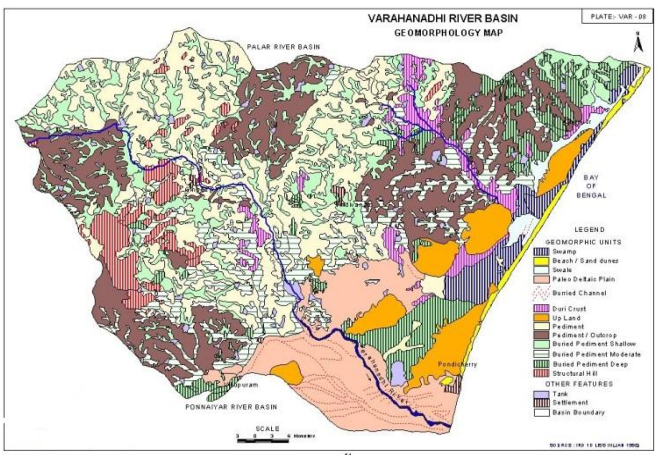
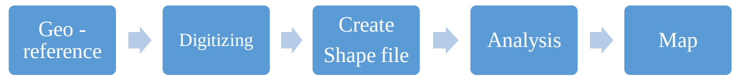


Fig. 6. Geomorphology map

List of Geomorphic details

1. Alluvial Plain (Flood plain & Interfluvials plain)
2. Sand dune
3. Old river course
4. Duri dust
5. Upland (tertiary)
6. Pediment
7. Pediment covered by outcrop
8. Shallow buried Pediment
9. Buried pediment moderate
10. Deep buried pediment
11. Structural hill
12. Settlement
13. Tank / River / Reservoir

IV. WORK SEQUENCE



A. GEO REFERENCE & DIGITIZING MAP

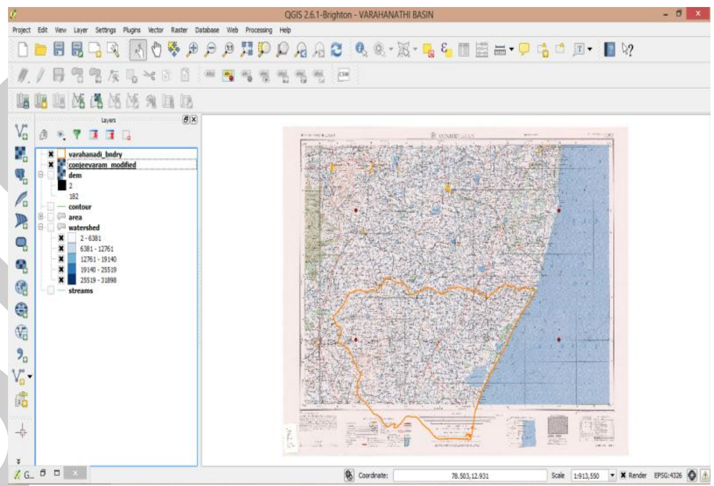
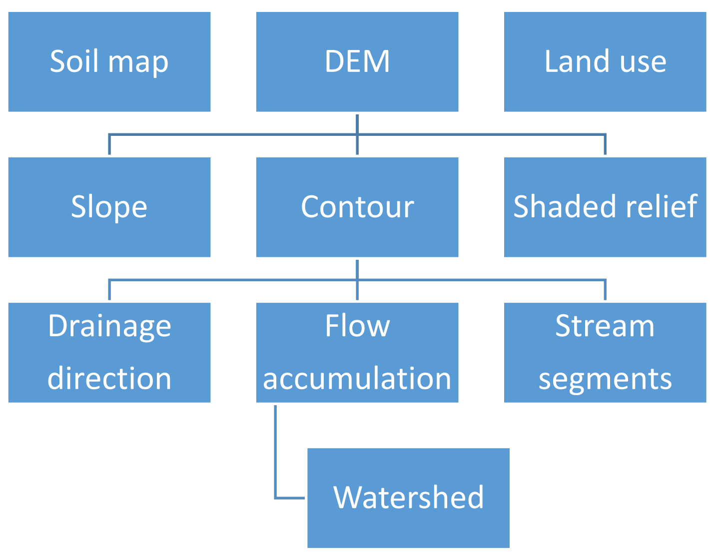


Fig. 7. Georeferenced map

ANALYSIS



A. SLOPE

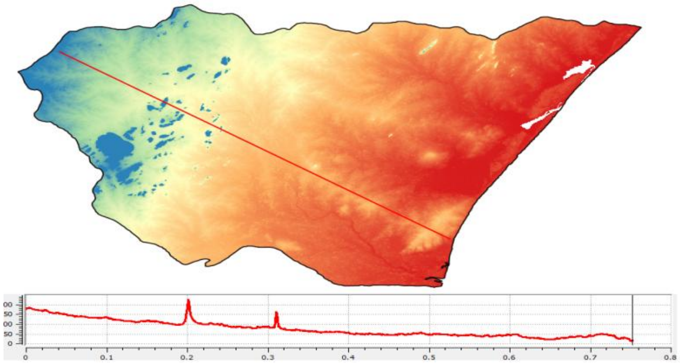


Fig. 8. Slope map

B. CONTOUR MAP

Contour lines connect a series of points of equal elevation and are used to illustrate topography, or relief, on a map. They show the height of ground above Mean Sea Level in either feet or meters and can be drawn at any desired interval.

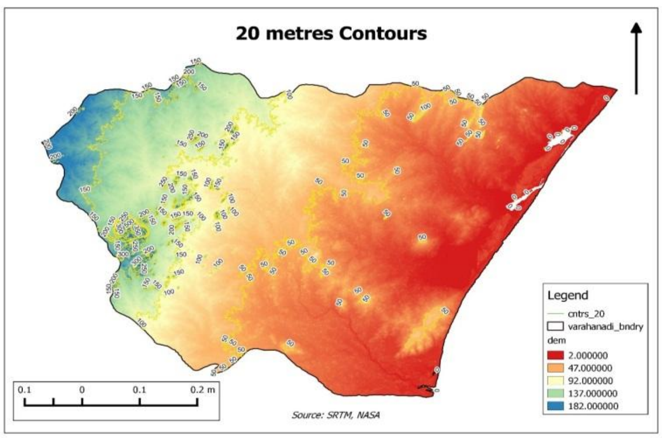


Fig. 9. Contour map

C. SHADE RELIEF

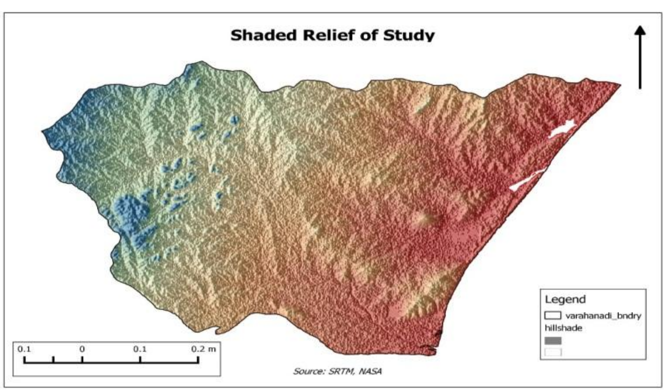


Fig. 10. Shaded relief map

D. FLOW ACCUMULTION

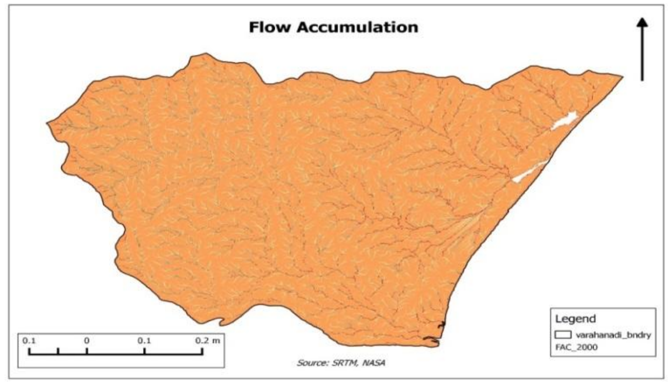


Fig. 11. Flow accumulation

E. STREAM SEGMENTS

Streams, including those that don't flow all of the time, make up the majority of the country's waters. They could be a drizzle of snowmelt that runs down a mountainside crease, a small spring-fed pond, or a depression in the ground that fills with water after every rain and overflows into the creek below. They protect against floods, filter pollutants, recycle potentially-harmful nutrients, and provide food and habitat for many types of fish.

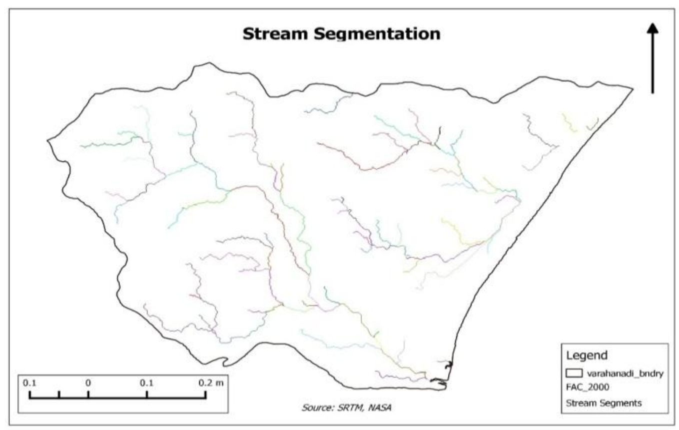


Fig. 12. Stream segments

G. WATERSHED

A watershed describes an area of land that contains a common set of streams and rivers that all drain into a single larger body of water, such as a larger river, a lake or an ocean. A watershed can cover a small or large land area. Small watersheds are usually part of larger watersheds. All the streams flowing into small rivers, larger rivers, and eventually into the ocean, form an interconnecting network of waterways.

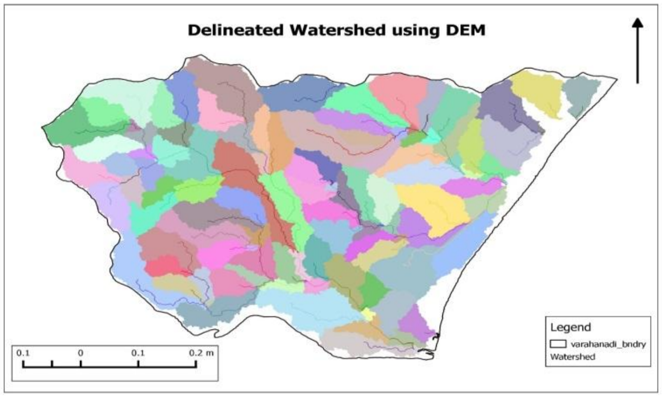


Fig. 13. Watershed map

V. COMPARATIVE STUDY

A. COMPARISON OF CONTOUR LINES WITH TOPO SHEET

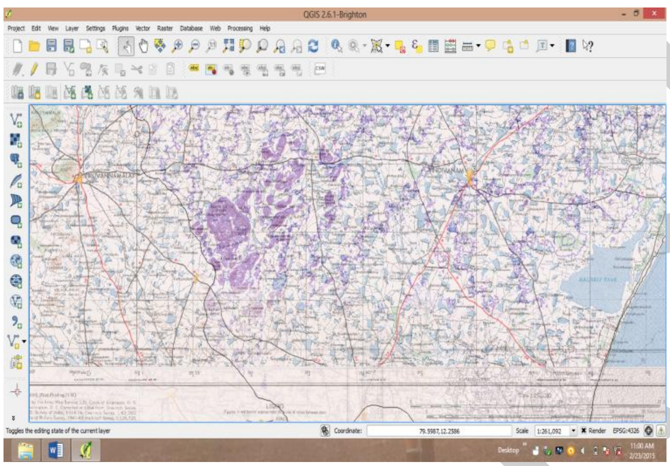


Fig. 14. Comparison of toposheet and contour lines

B. COMPARISON WITH GOOGLE EARTH

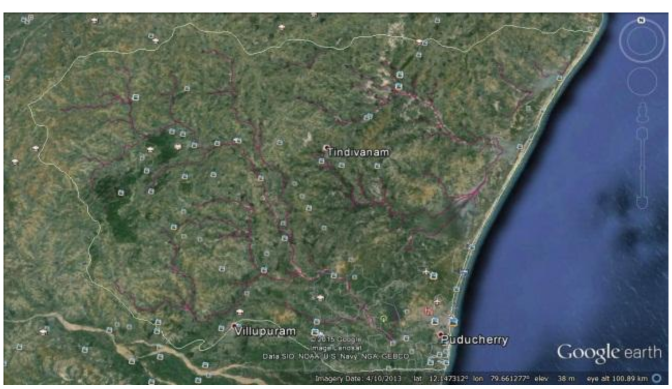


Fig. 15. Map shows boundary of varahanadhi basin

VI. CONCLUSION

In the present study on varahanadhi river basin is done by using software QGIS based on digital elevation model.

In addition to that various factors like Rain fall, soil condition, geological study and geomorphology of our study area have been analysed.

- The topo sheet has been georeferenced with respect to spatial reference and Digitizing work also carried out.
- The necessary map has done by GRASS tool.
- A result with Google earth as well as topo sheet has been compared. It is found that some of water bodies have been encroached which resulted in Water demand.

The awareness of creating watershed at necessary places to use the rainwater efficiently has been created.

Importance of geo informatics and its application in civil engineering has been known by this project.

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