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Anatomization of Drainage System of Thanjavur Delta Using GIS

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Abstract— *Water is a precious natural resource and at the same time complex to manage. Hence the drainage basin management approach has emerged as a holistic and an integral way of research. Drainage Basin is not simply the hydrological unit but also socio-political and ecological entity which plays a crucial role in determining food, social and economical security and provides life support services to rural people. In this study a standard methodology is proposed to determine drainage pattern using integration of RS & GIS technique. The composite map is generated using ArcGIS tools. The criteria for selecting drainage basin size also depend on the objectives of the development and terrain slope. Conservation of natural resources is essential to sustain any developmental activity. The global climatic conditions as well as the land mass locality are varying in an irregular manner. Hence for the development of land and water resources and to arrest land degradation process to preserve environment and ecological balance. In order to achieve this plan, require scientific knowledge of soils, surface water, ground water and land cover have been generated as a multi-spectral and social economic data in a GIS for the sustainable development of land and water resources. The use of suggested methodology is demonstrated for a selected study area in Thanjavur delta and rural area around it of Tamil Nadu state. This watershed management information in the form of digitized map will be useful for effective identification of spatial variations in land and water resources.*

Keywords— *Drainage basin, Socio-economic, Delta region, Drainage pattern, Spatial data, Land variation, Digitized map, ArcGIS.*

I. INTRODUCTION

Water is the most essential element to life on Earth. Water on earth moves continually through the water cycle of evaporation and transpiration, condensation, precipitation and run off usually reaching the sea. Approximately 70% of the fresh water used by humans goes to agriculture. However, some observers have estimated that by 2025 more than half of the world population will be facing water based vulnerability. A report stated that “there is enough water for everyone but the access to it is hampered by mismanagement and corruption”. Hence the emergence of watershed management is needed.

The term watershed refers to the geographic boundaries of a particular water body, its ecosystem and the land that drains to it. A watershed also includes groundwater aquifers that discharge from streams, wetlands, ponds and lakes. The goal of watershed management is to plan and work towards an environmentally and economically healthy watershed for the benefit of the biotic community. Watershed management essentially relates to soil and water conservation in the watershed, which means proper use of land and the protection of land from all deterioration. The watershed management data arrived through RS & GIS will be effective, since the results will be more accurate and in the form of digitized thematic map. These days, remote sensing specialist and hydrologists confirm that remote sensing data & GIS are only used rudimentarily in their daily routine. For this reason it is important to demonstrate the value of remote sensing data and GIS technology for drainage pattern mapping. The fast emerging spatial information technology remote sensing and GIS have effective tools to overcome most of the problems of land and water resources planning and management rather than conventional methods of data process [1]. The analysis of the drainage basin is aimed to accurate data of measurable features of stream network of the drainage basin [2]. The main goal of this study is to map drainage pattern based on terrain, hydrological & geological parameters employing multi criteria approach.

II. SCOPE

- To monitor the drainage basin.
- To arrest land and water degradation.
- To generate estimates of water and sediment yield.
- Manage watershed management system.
- To estimate final resources.
- To locate water harvesting structures.
- Field based ecological research.
- Possibility of flood hazard

III. STUDY AREA

Thanjavur, formerly Tanjore, is a city in the south Indian state of Tamil Nadu. The city is an important agricultural centre located in the Cauvery Delta and is known as the "Rice bowl of Tamil Nadu". Thanjavur is located at10.7870ó N, 79.1378ó E [3]. Total geographical area of the district is 3,602.86sq.km. This constitutes just 2.77 % of the area of the State. It is further divided into taluks, namely, Thanjavur, Thiruvaiyaru, Peravurani, Thiruvidaimaruthur, Pattukkottai, Kumbakonam, Papanasam and Orathanad. The district forms part of Cauvery river basin and Vennar and Vettar sub basins. The Kollidam River forms the northern boundary and flow from west to east. The Grand Anaicut is located at the western boundary, at this point Cauvery splits into Cauvery and Vennar. A regulator at Thirukkatupalli splits

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Cauvery into Cauvery and Kodamurti rivers. At Thenperumbur anaicut Vennar splits into Vennar and Vettar.

A. Administrative Profile:

Administrative profile of the district is given in the table below.

Number of taluks	8
Number of revenue villages	906

TALUK	REVENUE VILLAGES
Kumbakonam	124
Orathanadu	125
Papanasam	120
Pattukkottai	175
Peravurani	91
Thanjavur	93
Thiruvaiyaru	89
Thiruvidaimarudur	89

Table 1

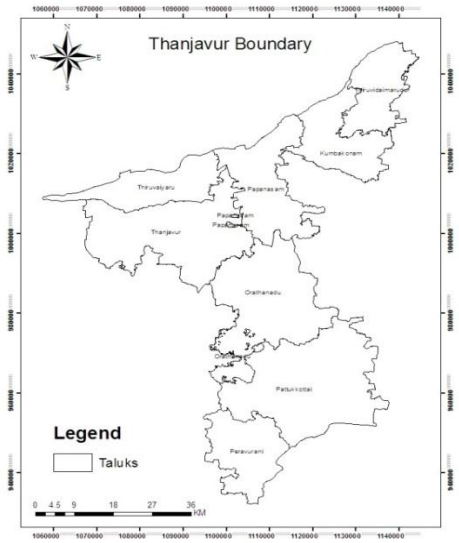

Fig. 1

IV. METHODOLGY

The methodology adopted for the study is given below (fig.2). The toposheets in a scale of 1:250,000 and satellite image that cover the study area was collected. The sources of spatial and non spatial data are utilised for this study. By assimilating the toposheets and satellite image the basemap was prepared with displaying all geographic features. With the help of this base map using ArcGIS software the boundary of Thanjavur district was extracted. In drainage pattern analysis, using point pattern the discharge level of drainage basin is plotted[4].

Based on discharge the drainage basins are classified into different levels. It has been considered that the discharge in Level 1- more than 500m , Level 2- 250 to 500m , Level 3 – less than 250m. By considering the analysed pattern the thematic map of drainage basins for Thanjavur has been arrived using ArcGIS

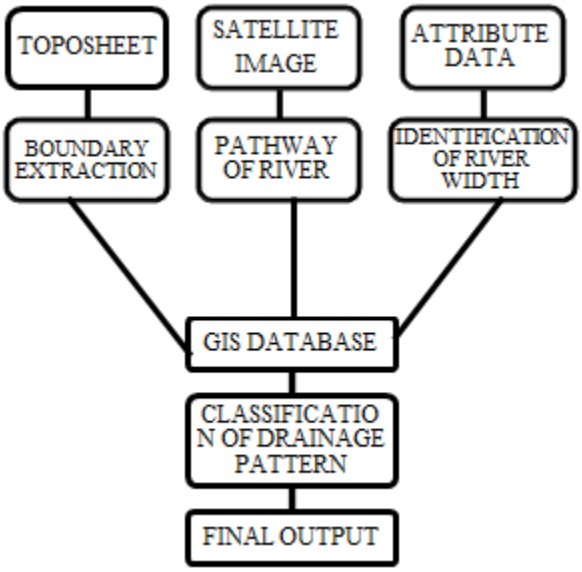

Fig. 2

V. RESULTS & DISCUSSION

A. Drainage Pattern:

The river Cauvery and its tributaries are the most remarkable features of Thanjavur district. The river flows from Karnataka State and passes through Dharmapuri, Salem, Erode, Thiruchirappalli, Thanjavur, Thiruvarur and Nagapattinam districts covering a distance of about 770 km draining an area about 72.800 sq.km in all. After Grand Anaicut, the Cauvery divides into numerous branches and covers the whole delta with a vast network of irrigation channels. The main branches of the Cauvery are the Vennar, Kodamurutiyar and the Arasalar and these again branch out into smaller rivers. The Vennar gives off two branches called Vadavar and Vettar in Thanjavur taluk. The Vadavar flows through Thanjavur and Papanasam taluks. The Vettar flows through Papanasam, and enters into Thiruvarur district. Still further down, the Vennar supplies two more branches namely, the Pandavayar and the Vellayar, flowing through Mannargudi taluk of Nagapattinam district. Muniyar and its branches, Adappar and Hari- Chandramathi, are distributaries of the Koraiyar flowing through Tiruchirappalli[5] .There are altogether 36 main rivers covering a distance of 1600 Kilometres. There are 29,881 channels, totaling 24,000 kilometres in length, serving the delta below the Grand Anaicut[6].

These are the major eight taluks in thanjavur district which covers the area in the boundary are tabulated below:

S. No	Name Of Taluks	Area (km^2)	Area In Percentage
1.	Thiruvidaimarudur	248.8457	7.3%
2.	Kumbakonam	290.1281	8.5%
3.	Papanasam	381.8115	11.2%
4.	Thiruvaiyaru	272.5098	8.01%
5.	Thanjavur	609.8383	17.9%
6.	Orathanadu	585.3602	17.2%
7.	Pattukottai	725.7605	21.3%
8.	Peravurani	286.8858	8.4%

Table 2

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B. Classification:

Based on discharge the drainage basin is classified into three levels.

LEVEL – 1

Kollidam River forms the northern boundary of Thanjavur district. The width of the river is more than 500m; thereby it comes under the category of level-1. The total length of the river Kollidam, level-1 is about 98502.604m. It serves about 3, 08,608 million cubic feet of water supply annually. The following table gives a detailed description about the length covered by Kollidam River in taluks of Thanjavur:

Name of Taluks	Length (m)	IN %
Thiruvaiyaru	43754.181995	44.42
Papanasam	21904.749225	22.24
Kumbakonam	15470.65563	15.71
Thiruvidaimaruthur	17373.017687	17.64

Table 3

LEVEL – 2

River Kollidam splits into Vennar, Kodamurutiyar and Arasalar which comes under level-2. The width of the level-2 is between 250m to 500m. The Vennar, Kodamurutiyar and Arasalar rivers rise to several branches run along the taluks of Kumbakonam and Papanasam about 279401.14m of length.

The run lengths of rivers belonging to level-2 crossing in different taluks are tabulated below:

Name of Taluks	Length (m)	IN %
Thiruvaiyaru	78824.55106	28.2
Papanasam	37599.27841	13.46
Kumbakonam	21718.67794	7.77
Thiruvidaimaruthur	15806.42886	5.66
Pattukottai	46981.24677	16.81
Peravurani	6915.332242	2.48

Table 4

LEVEL – 3

Vennar river branches into Vadavar and Vettar, Kodamurutiyar river branches into Thirumalairajanar and Mudikondan which further subdivides into Puttar and Sholasudamaniyar and finally Kirtimannar and Veerasholavar are the tributaries of Arasalar, were Kiritimannar is the branch of Nattar. The width of the river level-3 is less than 250m. The length of the river level-3 is about 464397.0471m.

The river of level-3 covers a major distance and helps in the development of the Thanjavur. The total length has been explained in the following table:

Name of Taluks	Length (m)	IN %
Thiruvaiyaru	8880.536412	1.91
Thanjavur	96968.56793	20.88
Papanasam	56449.2741	12.16
Thiruvidaimaruthur	4785.978919	1.03
Kumbakonam	94057.09449	20.25
Orathanadu	98669.01553	21.25
Pattukottai	43303.66985	9.32
Peravurani	26758.8551	5.76

Table 5

From this the distance of river basin flow through thanjavur district according to levels are tabulated below:

S. No	Based On Discharge Level	Distance (m)
1.	Level – 1	98502.6021
2.	Level - 2	279401.1421
3.	Level – 3	464397.0471

Table 6

Using the spatial data the mapping of drainage pattern based on the considered level with help of ArcGIS are shown below:

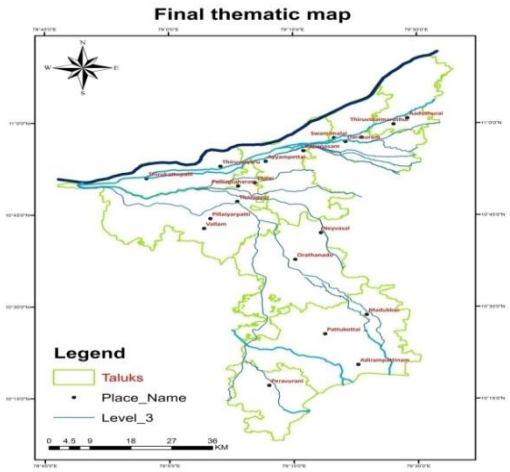

Fig. 3

VI. CONCLUSION

The Cauvery is the major river which passes through Thanjavur delta. It divides into several branches and gives water to all the regions of Thanjavur district. Based on the width of the river we divided it into three categories as level 1, level 2 and level 3 for the work of mapping aided by ArcGIS. It is the software which is usually used to arrive the thematic results in a digitized form. The results will be more accurate. Hence the analysis of drainage pattern has been done with this software and the rivers are plotted by point pattern analysis. As a result the length of the rivers along the level 1,level 2,level 3 are 98502.6021m, 279401.1421m, 464397.0471m respectively. These data are arrived as a thematic map which will be helpful for the reference of land cover identification, discharge calculation of drainage, flood prediction and flood prone areas and so on.

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