Prediction of Cauvery River Meandering And Fluctuation of Water Level In Salem District Using GIS

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Abstract- *Ground water is one of the major sources for water supply in many parts of the country. Especially in development areas ground water is largely being utilized as a drinking water resource, mainly because of the insufficiency of the Cauvery water share for Salem. A particular amount of ground water is replenished regularly through rainwater infiltration. Sustainable use of ground water means withdrawal of ground water at a rate at which it is replenished through recharge. Faster withdrawal rates would lead to fall in water table and finally depletion of ground water with meandering. This project describes the concept of the model and gives an example of a developed based on GIS recharge map for the parts of Salem districts. The quantity determined for each process is consequently limited by a number of constraints. It integrates a water balance in a Geographical Information System (GIS). Groundwater level fluctuation analysis shows that some of the places have deeper water levels during southwest monsoon season. Groundwater starts to replenish the shallow aquifers during northeast monsoon season and reaches high during post-monsoon period when plants are dormant and evaporation rates are less. The water levels remain stable only up to November but during January to May, the water level declines gradually due to Cauvery river flow in the study area were concluded.*

I. INTRODUCTION

Salem district is drained by tributaries of Cauvery and Vellar rivers. Cauvery river,which is perennial in nature, flows along the western and southern boundaries of the district. Sarabanga and Tirumanimuttar are important tributaries of Cauvery river and originate in the Shevroy hills. The Swetha and Vasishtarivers are tributaries of Vellar river. The SwethaRiver originates in the Kollimalai and flows eastwards and joins the Vellar river. The Vasishta River originates in the chitteri hills and flows southwards and joins the Vellar river. This project describes the concept of the model and gives an example of a developed based on GIS recharge map for the parts of Salem districts. The quantity determined for each process is consequently limited by a number of constraints. It integrates a water balance in a Geographical Information System (GIS). Groundwater level fluctuation analysis shows that some of the places have deeper water levels during southwest monsoon season. Groundwater starts to replenish the shallow aquifers during northeast monsoon season and reaches high during post-monsoon period when plants are dormant and evaporation rates are less. The water levels remain stable only up to November but during January to May, the water level declines gradually due to Cauvery river flow in the study area were concluded.

a. Methodology

The methodology employed is summarized in the flow chart below. It involves digital image processing for the extraction of lithological and linear features, evaluation of digital elevation model (DEM) as well as field studies. The field studies are comprised of hydrogeological and structural investigations. The DEM was used to extract lineaments and to map drainage systems and landforms. All data were integrated in a Geographic Information System (GIS).

b. Objective

- The main objective of the study area.
- To understand the water level fluctuation in Salem.
- To predict the Cauvery river meandering, widening/shortening of catchment area.
- To delineate groundwater potential zones for artificial recharge to sustainable groundwater development.
- To prepare thematic maps of the area such as lithology, lineaments, landforms and slopes from remotely sensed data and other data sources like DEM.
- To assess groundwater controlling features by combining remote sensing, field studies and DEM.

- To identify and delineate groundwater potential zones through integration of various thematic maps with GIS techniques.

c. Overview

The project attempts to characterize several parameters have been considering for the study such as river flow, drainage density, elevation, geology, geomorphology, land use and land cover, lineaments, dykes, rainfall pattern, slope gradient and soil texture. The spatial variation in the recharge due to distributed land-use, soil type or texture, slope, groundwater level, meteorological conditions, etc., The entire work from the beginning till the end was split up into various levels and each level was assigned with many activities. The various levels of work for the characterization of mapping the fluctuation in pre-monsoon and post-monsoon season.

II. THE STUDY AREA AND DATA COLLECTION

A. Geography Of Study Area

The total study area spreads over 186 km2, area covered between latitude 11°27'02" N to 11°30'58" N and longitude 77°40'44" E to 77°41'41". The area occupies about 5207 sg.km with a mean altitude of 1,300 M.S.L. Salem district is having administrative divisions of 9 taluks, 20blocks, 376 Panchayats and 631 Revenue villages. The climate of the study area is semi-arid, with annual precipitation ranging from 504.6 - 920.8 mm. The mean annual temperature varies between 20 and 35° C. The Salem district, located in semi-arid southeast India, is an important industrial and agricultural centre. In recent years rapid development has created an increase in demand for groundwater.

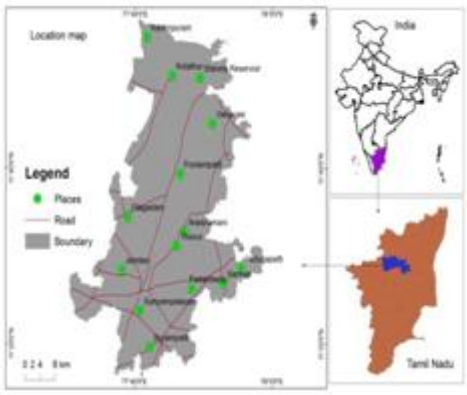


Fig. 2 Study Area and Its Location

B. Toposheet

In modern mapping, a topographic map is a type of map characterized by large-scale detail and quantitative representation of relief, usually using contour lines, but historically using a variety of methods. Traditional definitions require a topographic map to show both natural and man-made features. A topographic map is typically published as a map series, made up of two or more map sheets that combine to form the whole map. A contour line is a line connecting places of equal elevation.These maps depict in detail ground relief (landforms and terrain), drainage (lakes and rivers), forest cover, administrative areas, populated areas, transportation routes and facilities (including roads and railways), and other man-made features.

Our study area fall in the topo sheet of 58I/2,58I/3 indexed sheets of GSI (Geological survey of India).By using this map we digitized the Proposed study consist of road,settlement etc…the scale of the map is 1:25000.

Fig. 3 ToposheeT

C. Satellite Images

Satellite imagery is images of earth or other planets collected by imaging satellites operated by governments and businesses around the world.Satellite imaging companies sell images by licensing them to governments and businesses such as Apple Maps and Google Maps.

All satellite images produced by NASA are published by NASA Earth Observatory and are freely available to the public. Several other countries have satellite imaginary programs, and a collaborative European effort launched the ERS and Envisat satellites carrying various sensors. There are also private companies that provide commercial satellite imagery. In the early 21st century satellite imagery became widely available when affordable, easy to use software with access to satellite imagery databases was offered by several

companies and organizations. Fig 4.3 shows study area images. It is IRS 1D LISS III images with scale of 1:25000 km /Sq.

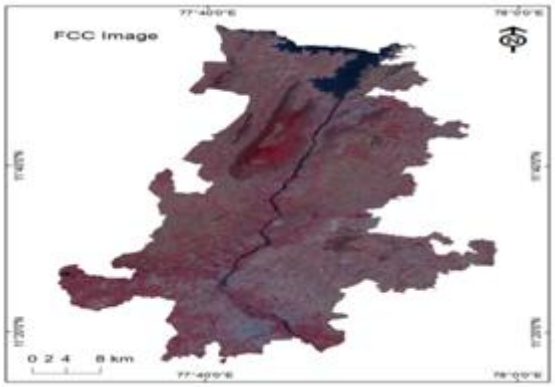


Fig. 4 Satellite Image

D. GIS Software

The choice of software package selections generally based on the user requirement. There are standard commercial GIS packages now available in the markets (Arc GIS 9.3+). The criteria of GIS software are more-so-ever standardized. The details of criteria are as follows: 1. Data entry: digitizing, scanning, automated data capture, interface with existing digital formats, manual keyboard entry. 2. Analysis: map overlay analysis, proximity analysis, mathematical modeling, enclosure, buffer generation, measurements, attribute analysis and interpolation. 3. Surface modeling: 3-D surfaces, slope analysis and draping.

Advantages Of GIS:

- All data can be stored in digital formats
- It occupies less space in contrast to very larger maps and data sheets.
- Data/maps don't get shrink or damaged
- Data searching and retrieval is easy
- Preferential filtering of selective data is possible
- Manipulation of data possible, time series analysis is possible

Application Of GIS:

- Groundwater Resources Management
- Oceanographic Studies
- Oil and Natural Gas Exploration studies
- Environmental Assessment
- Urban and Town Planning
- Wasteland development
- Land Information Systems
- Forestry and Wild Life Management

III. THEMATIC MAPS AND INTEGRATION

A. Drainage

A drainage system is described as accordant if its pattern correlates to the structure and relief of the landscape over which it flows are Dendrite, parallel, Trellis, Rectangular, Centripetal, Deranged, Annular, Angular pattern etc..In our study are the above said all types of drainage patterns are found hence the density will be more shown in Fig 1.When there is more density more

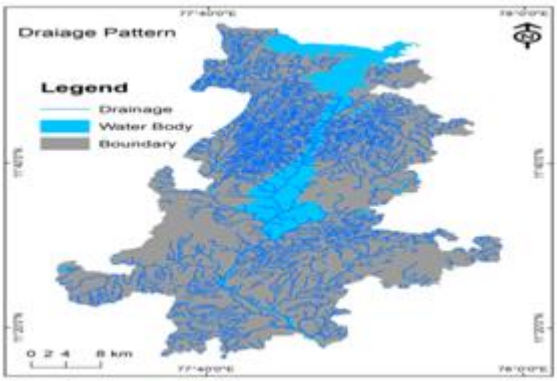


Fig. 5 Drainage pattern Map

accumulation of water we can predict it. Drainage is combination of number of streams. When the first, second,third and fourth order stream combine together to form a river.

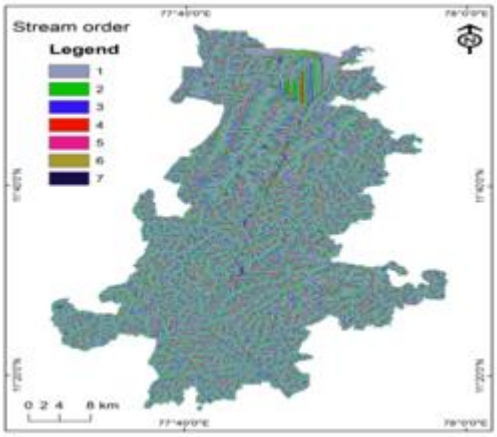


Fig. 6 Stream Order map

Drainage density is the total length of all the streams and rivers in a drainage basin divided by the total area of the drainage basin. It is a measure of how well or how poorly a watershed is drained by stream channels. It is equal to the reciprocal of the constant of channel maintenance and equal to the reciprocal of two times the length of overland flow.

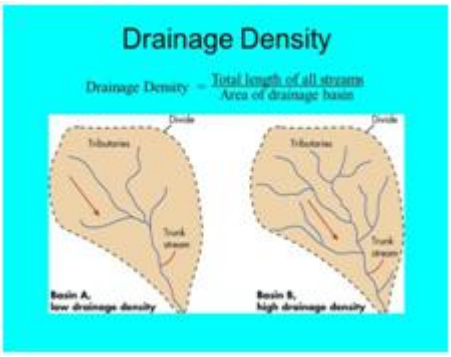


Fig. 7 Drainage density calculation

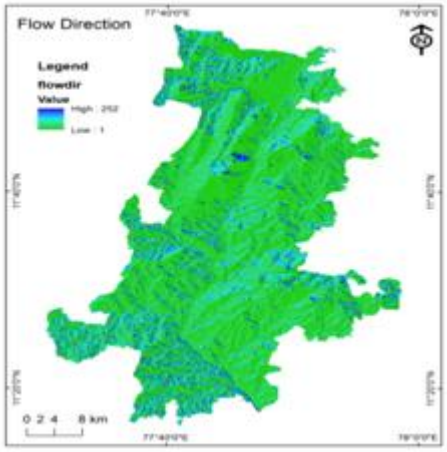


Fig. 9 Flow Direction Map of our study area

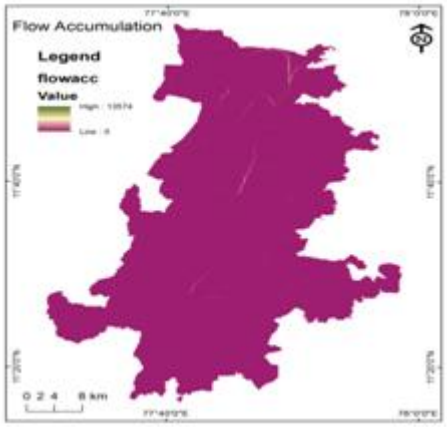


Fig.10 Flow accumulation Map of our study area

B. Slope Map

Slope is the measure of steepness or the degree of inclination of a feature relative to the horizontal plane. Gradient, grade, incline and pitch are used interchangeably with slope. Slope is typically expressed as a percentage, an angle, or a ratio. The average slope of a terrain feature can conveniently be calculated from contour lines on a topo map. To find the slope of a feature, the horizontal distance (run) as well as the vertical distance (rise) between two points on a line parallel to the feature needs to be determined. The slope is obtained by dividing the rise over run. Multiply this ratio by 100 to express slope as a percentage. The slope angle expressed in degrees is found by taking the arctangent of the ratio between rise and run. In our study slope will be north east to south west with 0 to 56 degree angle maximum. Maximum slope in the area of mettur and poolampatii that is the reason why water get meandering in more show in Fig 11

C. Geomorphology

A number of hill ranges are located in the northern and northeastern parts of the district, whereas the southern, western and eastern parts of the district are gently undulating and dotted with a few isolated hillocks. The important hill ranges in the district are Yercaud hills, Kanjamalai hills, Godumalai hills and Pachamalai hills.

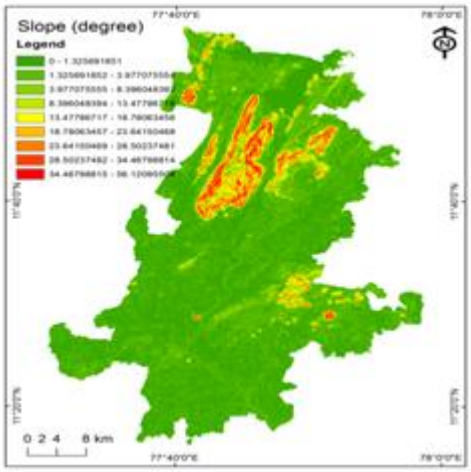


Fig 11 Slope map

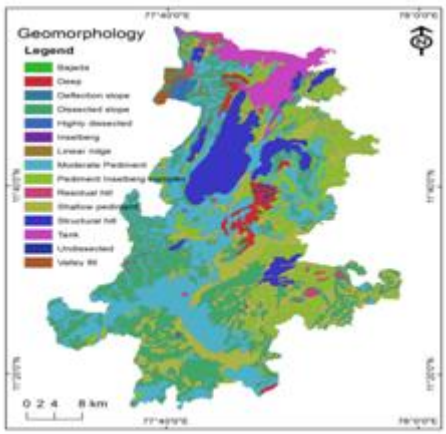


Fig 12 Geomorphology Map

D. Geology

Geology is an earth science concerned with the solid Earth, the rocks of which it is composed, and the processes by which they change over time. Geology can also refer to the study of the solid features of any terrestrial planet or natural satellite, (such as Mars or the Moon). Our study area comprises of Archaean rock types of Granite, Gneiss, schist, Alkaline, Quartz and ultramafic rocks etc… It shows that the study area is composed of hard rock terrain hence the meandering and water level fluctuation is more show in Fig 13

Fig 13 Geology Map of our study area

E. Digital Elevation Model (DEM)

Satellite remote sensing can provide operationally digital elevation models (DEM) through radar interferometer or stereoscopic optical satellite images and is further analyzed through Geographical Information System (GIS) technology to define watersheds, stream-networks and order. Moreover, the DEM many significant values like slope, direction, flow length and good visual effects for the common people too. Elevation information of each contour was defined in geographic information system and according to these values; three-dimensional modeling of the field was gained at 10 m elevated

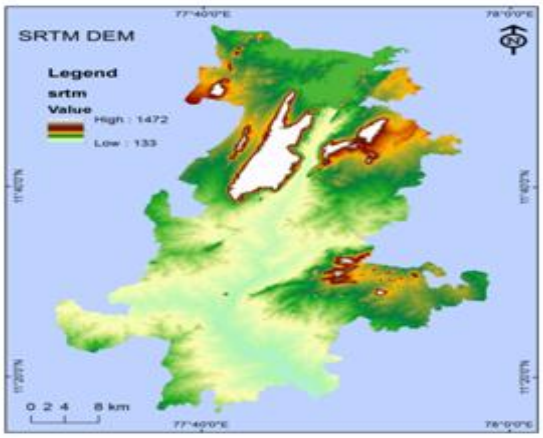


Fig 14 SRTM DEM Map

IV. WATER LEVEL FLUCTUATION AND RIVER MEANDERING

The water table is the upper surface of the zone of saturation. The zone of saturation is where the pores and fractures of the ground are saturated with water. The water table is the surface where the water pressure head is equal to the atmospheric pressure (where gauge pressure = 0). It may be visualized as the "surface" of the subsurface materials that are saturated with groundwater in a given vicinity.

A. Seasonal Rainfall Data

The daily rainfall data for the period of 1990-2012 have been collected from Regional Meteorological Department, Chennai and tabulated as to calculate monthly and seasonal rainfall for the respective rain gauge stations (Jagannadhasarma 2005). The average annual rainfall of the study area is calculated for the period of twenty three years (1990 - 2012) from the record of 13 rain gauge stations. Kolathur rain gauge station shows the maximum average annual rainfall of 999.58 mm followed by salem (993 mm) and omalur Junction (960.20 mm). Compared to the annual normal rainfall (920 of Tamil Nadu state, kolathur and salem stations have more rainfall whereas Salem Junction shows slightly lesser rainfall than the state's. To achieve the framed objectives, the collected rainfall data are categorized into four major seasons and finally, the data were interpreted by preparing various charts and diagrams using GIS (Anandakumar et al 2007).

B. Mean Annual Rainfall

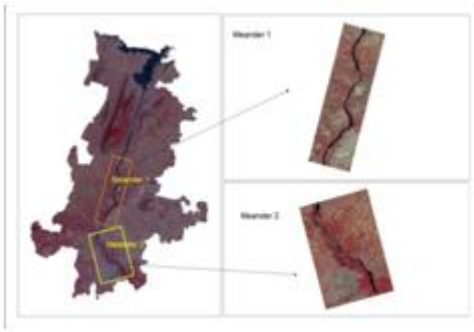
The mean annual rainfall is the sum of twelve month long term monthly average is computed. The annual average rain fall of the study area is 879.6 mm; the annual mean varies from 476.20mm to 1701.60mm. Southwest and northeast monsoon shares 80 percent of rainfall and summer contributes by 18 percent and winter shares 1%. The mean annual rainfall for the all stations shown in table 6.1 and figure 6.1 illustrates the mean annual rainfall of the study area.

Table 1 Seasonal Rainfall Data

Sl. No	Station	Winter	Summer	South west Monsoon	Northeast Monsoon	Mean Annual
1	Salem Junction	7.50	160.20	461.60	286.70	916.00
2	Salem	5.90	173.00	502.30	312.10	993.30
3	Attur	7.91	108.36	314.03	333.25	763.55
4	Omalur	8.70	176.00	465.70	309.80	960.20
5	Mettur	9.20	196.50	375.70	307.50	888.90
6	Edappadi	4.60	245.70	315.20	374.10	939.60
7	Pottaneri	0.60	163.70	403.90	316.00	884.20
8	Kolathur	6.25	192.28	242.47	558.58	999.58
9	Sankari	8.30	153.00	326.50	283.20	771.00
10	Ammapet	10.46	181.98	271.92	344.98	809.34
11	Kumarapalayam	11.34	137.77	274.65	289.50	713.26
12	Kullampatti	15.10	196.40	345.80	299.46	856.76
13	Pillukurichi	15.00	178.80	308.10	437.80	939.70
	Average	**8.52**	**174.09**	**381.05**	**342.54**	**879.6**

C. River Meandering

A river or stream is dynamic through time. The most significant morphological property of a river is the meandering process, which is dominated and governed by hydraulic, hydrologic and topographic characteristics of the river and its drainage area. In a meandering river, the length of the river keeps on increasing by eroding the outer bank of a bend. The present study has been conducted to investigate the meandering parameters of Cauvery River using Geographic information system. It is one of the important criteria consider in the work because the meandering will cause drought and water level fluctuation.



V. CONCLUSION

Groundwater is a major and most valuable natural source for irrigation, drinking, and other purposes of water requirements in many parts of India. More than 90 % of rural and nearly 30 % of urban population depend on it for drinking water (NRSA 2008). The role of remote sensing technique and generation of various thematic maps are discussed. The classified outputs are explained in detail along with the respective application terms of generation of thematic maps. From remote sensing data, the thematic maps like geology, geomorphology, lineament density, drainage density, land use and land cover and soil were generated. The different thematic maps were reclassified and integrated for generation of groundwater level fluctuation and river meandering map through GIS technique are recommended and concluded that to increase the plantation like tress etc… will protect level fluctuation and meandering of the river which cause water drought through our study.

A. Recommendations

As the development of ground water has already reached an alarming stage in many blocks of this district, further development of ground water for creation of additional irrigation potential has to be carried out with extreme caution. The heterogeneity of crystalline formation and poor yield prospects make the availability of ground water for further development site specific and scientific methods may employed for siting of wells. On the basis of experiences in execution of Central Sector Scheme and Demonstrative Projects on artificial recharge, the desilting of existing ponds/tanks will be the most cost effective structures. The provision of recharge wells/shafts in percolation ponds/check dams will enhance the efficiency of these structures. Rainwater Harvesting has already been made mandatory by the Govt. of Tamil Nadu and people have already made provision for roof top rainwater harvesting. However, efforts may be made to apply corrections if required to make these structures effective.

Further, operation and maintenance of artificial recharge structures are essential to make them efficient and priority may be given to this activity so as to make these structures effective. A concerted effort involving various Government agencies and NGOs can create the necessary awareness among the rural masses. Action plan in this direction with participation of state and central agencies and industrial establishments is recommended.

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