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GIS and 3D VISUALIZATION OF GROUNDWATER RESOURCE STUDIES IN AND AROUND NEYVELI LIGNITE MINE ENVIRONMENT, TAMIL NADU, INDIA

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Water levels vary season wise and also with respect annually. The rainfall maxima was noticed during northeast monsoon and ended up it in summer season. It is high at the wet season and low at the end of the dry season; likewise, they are high at the end of a wet year and low at the end of one or more dry years. Nevertheless, on a long-term basis, naturally occurring groundwater levels tend to be steady, i.e., they undergo very little change. Water is charged in the upstream and discharged downstream. Recharge areas are close to mountain peaks, where precipitation is likely to be higher than in the adjacent lowlands. This paper is aimed for the identification of spatial domain, where the rainfall is more and where the water level is deep in 3D form. The Geology, recharge and discharge map with geomorphology is integrated to see the best site with respect to the said theme. The final map and its details are given in this paper. The results were derived by using the GIS platform. The suitable site were located and displayed.

Key words: Recharge area, Water level and Rainfall.

INTRODUCTION

Water is so common on earth; we rarely pause to appreciate how rare it is in our solar system and how unique it makes our planet. Water has literally shaped the Earth's surface and enabled life to exist here. Freshwater is a vital natural resource. To successfully and efficiently tap a groundwater supply, hydrogeologists to look it in various aspects of groundwater study. Knowledge of the quantity of groundwater that can be extracted from a given area is prerequisite in scientifically managing a groundwater basin. This basically involves the evaluation of the elements contributing the hydrological cycle such as surface and subsurface inflows, precipitation and changes in surface and groundwater storage (Todd 1980). Since changes in groundwater storage, reflecting the groundwater balance in a basin is the difference between groundwater recharge and discharge, estimation of the recharge and discharge are the two main components in a groundwater balance study of a basin. The simple method of estimating groundwater recharge is by using the rainfall percentage factor (GWREC, 1997). Hydrogeomorphological studies coupled with hydrogeological and structure/lineaments have proved to be very effective tool to discern ground water potential zones in the watershed (Bahuguna et al., 2003). Based on lineament density, hydrogeological, geomorphological and drainage conditions, the landforms such as bajada shallow, channel bar, pediplain deep, pediplain moderate and pediplain shallow are identified as potential zones (P. Jagadeeswara Rao et al., 2004). In the present study, the meteorological behaviour, water level was assessed in 3D visualization mode. The groundwater potential was assessed by integrating the geology, recharge and discharge map with Geomorphology was used.

Study Area

The present study area of investigation belongs to neyveli in cuddalore district, Tamil Nadu. The area falls between latitudes 11^0 25' -11^0 45'and longitudes 79^0 20' – 79^0 40' covering an area about 1033 Km^2 approximately. Bay of Bengal is near to the present study area.

Methodology

The work flow of the present investigation is given below in the form of flow chart (Fig 1).

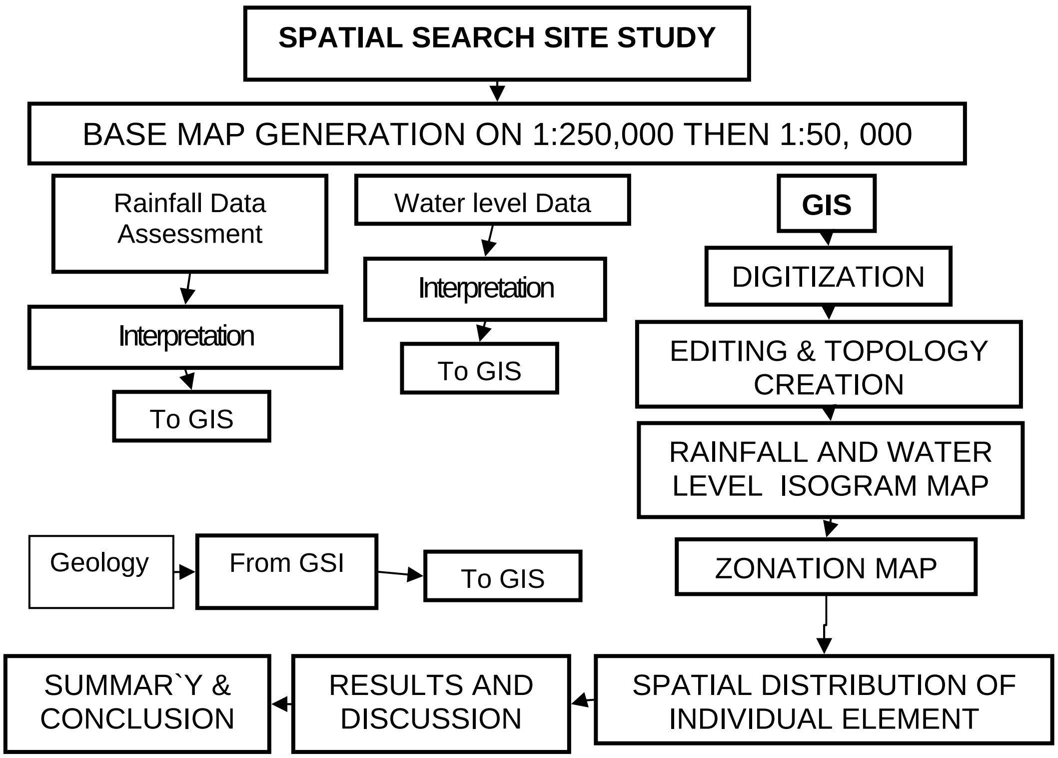

Fig 1 - Flow chart - Methodology adopted in the study

Results and Discussion

The annual average rainfall collected from Central Groundwater Board (CGWB) for past 70 years (1901-1970) is given in the Table 1. The average annual rainfall data collected from Public Works Department (PWD) for the past five years from 1998 to 2003 are given in the Table 2. The monthly rainfall data collected from NLC for the past five years from 2000 to 2004 and its annual average is given in the Table 3.

Table 1 – Average Annual Rain fall data in mm (1901 – 1970)

S.No	Location	Average Rainfall
1	Cuddalore	1378.4
2	Kurinjipadi	1223.4
3	Panruti	1185.8

Table 2 - Average Annual Rain fall (mm) data (1998 to 2003)

Stat	Ave Rain
Panruti	1491
Vridhachalam	1368
Cuddalore	1264
Parangipettai	1352

4	Parangipettai	1389.2
5	Srimushnam	1119.6
6	Vriddhachalam Anicut	1193.0
7	Vriddhachalam Taluk office	1080.2

Kurinjipadi	1356

Table 3- Average Annual Rainfall (2000-2004) in mm

Location I Mine		
S.No	Year	Average
1	2000	988.70
2	2001	1166.65
3	2002	803.45
4	2003	858.50
5	2004	1058.95

Location CARD		
S.No	Year	Average
1	2000	987.20
2	2001	955.30
3	2002	1060.50
4	2003	1256.50
5	2004	-

Location CARD		
S.No	Year	Average
1	2000	987.20
2	2001	955.30
3	2002	1060.50
4	2003	1256.50
5	2004	-

Location Mine -II		
S.No	Year	Average
1	2000	931.05
2	2001	707.85
3	2002	1008.75
4	2003	916.30
5	2004	1412.60

The amount of total 70 years average annual rainfall varies from 1080.2 to 1389.2 mm. The average seasonal rainfall in the mine I, is minimum of 803 and maximum of 1058.9 mm was observed, in the CARD it is 955.3 to 1256.5 and in the mine II area varies from 707.85 mm to 1412.60 mm was observed in the last five years. The rainfall is varied from minimum of 233 to maximum of 1491 mm during 1998 to 2003. Similarly it varies from 233 to 335 mm in premonsoon 1264 to 1491 mm during post monsoon seasons. The study area receives maximum rain fall during October to December is noted. It shows the declining trend of rainfall in the recent years.

The maximum rainfall was observed in Kurinjipadi and minimum in Vriddhachalam during premonsoon. Similarly the maximum rainfall in Panruti and minimum in Srimushnam was noted during post monsoon. It is also reveals that variation in the rainfall is found to be the maximum during October to December after December there is decreasing in trend is found and gradually increasing trend starts from June to September. The flow pattern of the above interpretation is shown in the following diagram (Fig 2) .

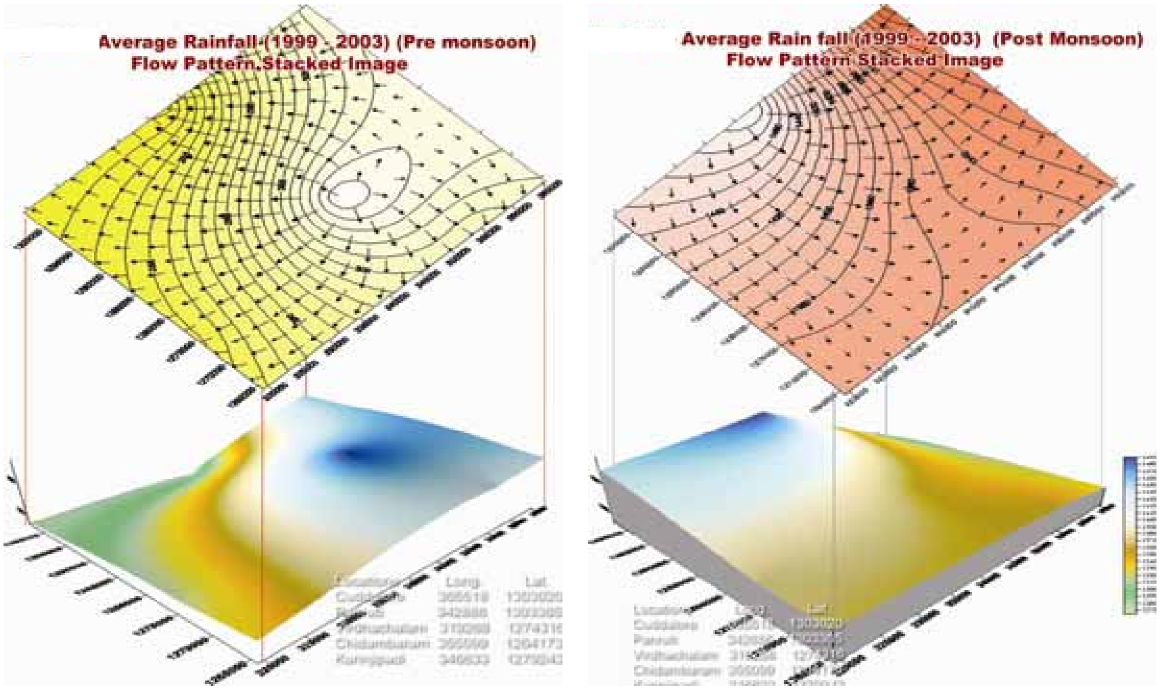

Fig - 2

The flow pattern of the rainfall during premonsoon season (1998 to 2003) shows that the study area receives maximum at Kuringipadi in the Eastern portion and moves towards West. There are two layers in this image, the bottom one is 3D image and the top layer is composed of contour map and also flow arrows. The flow arrow represents the movement of rainwater. Similarly post monsoon Average Rainfall (1998 to 2003) Flow Pattern Stacked Image was prepared. It also reveals that the maximum was noticed at panruti and virudhachalam. It is moving from the upland to the southwest and turning towards vellar.

The water table condition in the study area of sedimentary aquifer systems is declining day by day due to erratic rainfall and over exploitation of the water resources. The average water level in meters from 2000 to 2004 is given below (Table 4). The average depth to water level in meters of the study area varies from 6.70 to 54.65 mts. The water level was noticed at deeper depth in Neyveli and it is near to the surface in Srimushnam. A general overall view of the water level fluctuation suggests that the water level tends to rise during October to December to reach the peak and starts receding from February onwards to end of August to September.

Table 4 - Average Depth to Water Level Data in mts. (2000 - 2004)

Location	Average Water Level		
	Post monsoon	Premonsoon	Average water level
Kopuvanur	7.60	9.50	8.55
Palakollai	10.10	19.72	14.91
Aladi	6.60	18.80	12.70
Neyveli	32.40	54.65	43.53
Virdhachalam	31.70	44.10	38.40
Sattamangalam	17.10	12.30	14.70
Srimushnam	6.70	9.78	8.34
Ramanathapuram	6.80	15.10	10.95

Kurunjipadi	10.80	29.60	20.20
Vadalur	11.20	19.26	15.23
Puduchatram	15.50	6.90	11.20

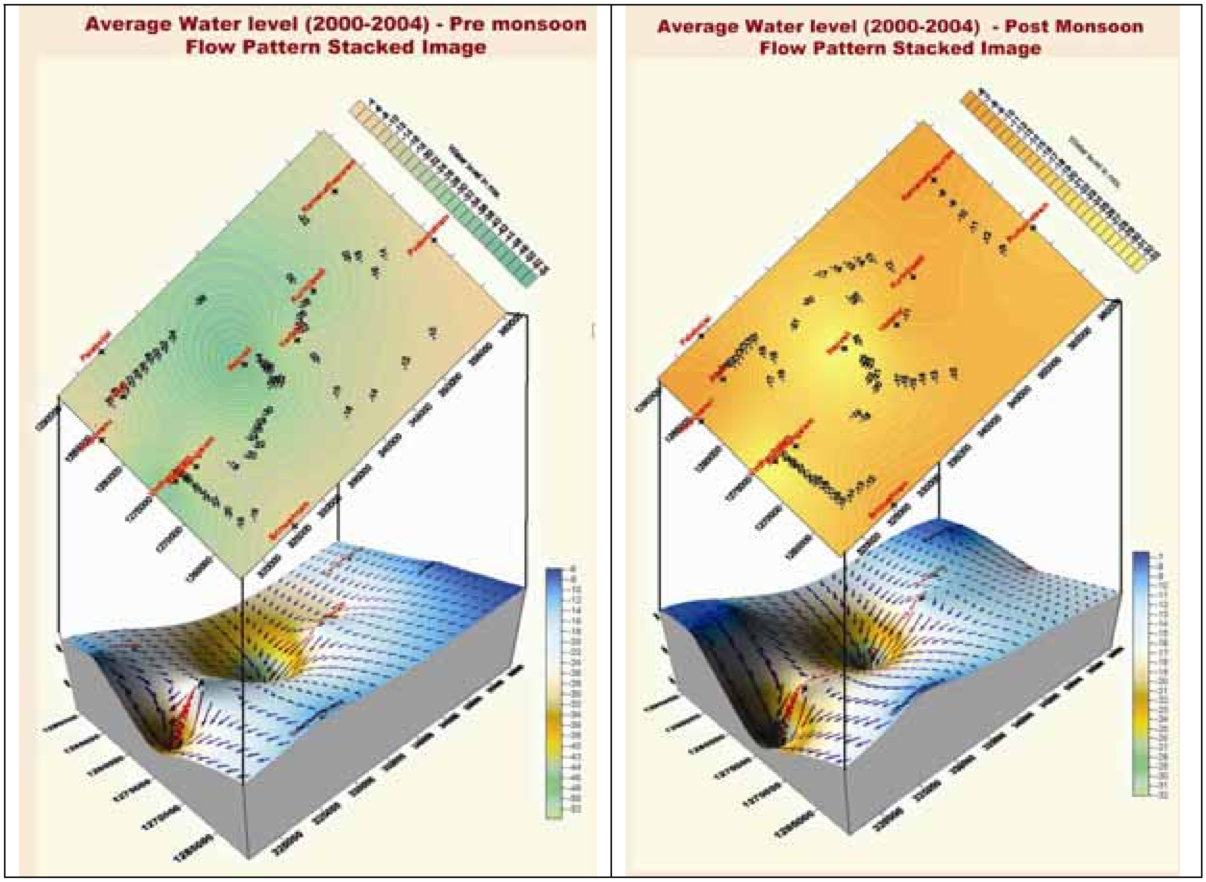

Fig – 3

The water table contour maps are prepared for post and pre monsoon seasons with a view to find out the groundwater flow direction and to locate the probable recharge and discharge areas. These water table contour maps indicate the groundwater flow direction from north to south (Srinivasa Gowd et al., 2000). The spatial pattern of groundwater utilization shows good correspondence with dynamic groundwater level pattern in the area. A comparison of the two indicates the possibility of the presently existing groundwater through enlarging and moving east words in the future, if the present day pattern of groundwater abstraction continues (Ballukraya 2004).

The Average Water Level of 1999-2004 (Pre monsoon) flow pattern stacked Image (Fig 3) was generated to interpret subsurface water level movement. The top layer represents the water table contour map. The bottom layer is the inverse relation of water level with respect to the depth represented in the form of 3D image, and its flow pattern by means of arrow. Similarly during post monsoon season water level flow pattern stacked image also reveals the same flow pattern trend.

To find out the groundwater potential zone, Geology, Recharge and discharge zone and geomorphology map was superposed one over the other in GIS platform. The final map is given below.

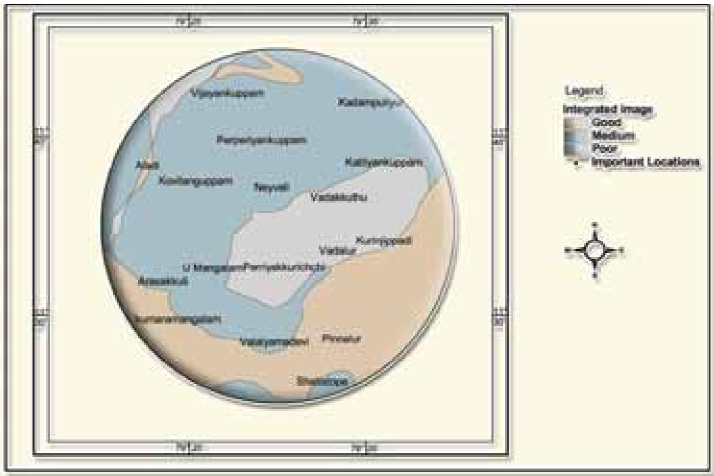

Fig -4 Integrated Groundwater Potential Zone map

Conclusion

GIS and 3d visualization of groundwater resource studies in and around neyveli lignite mine environment, Tamil nadu, India. In 3D model, the rainfall and water level flow pattern is clearly displays. The integration of geology, recharge and discharge map with geomorphology final map is given in this paper gives the final groundwater potential zones. The result is given in the following table 5.

Table 5 – Groundwater potential zones – GIS Output.

Groundwater potential zone	Polygons count	Area in Km^2
Good	3	303
Medium	6	543
Poor	3	187

It shows that the medium groundwater potential zone occupies more and in the second dominant zone is good groundwater potential zone and finally the poor groundwater potential zones follows.

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