RESEARCH PAPER | Geology | Volume : 6 | Issue : 2 | FEBRUARY 2016 | ISSN - 2249-555X

Geospatial and Temporal Variations of Groundwater Level In the Nagavathi Watershed, Cauvery River Dharmapuri District, Tamil Nadu

KEYWORDS: Geospatial analysis, Groundwater levels, GIS, Rain fall, Nagavathi watershed.

R. Kannan
Hydrogeology Lab., Dept. of Geology, Periyar University, Salem.

S. Venkateswaran
Hydrogeology Lab., Dept. of Geology, Periyar University, Salem.

ABSTRACT *Groundwater and water resources management plays a key role in conserving the sustainable conditions in semi-arid region. Nagavati watershed is located in part of Dharmapuri district of Tamil Nadu. It lies between latitudes 11°45'N to 12°15' N and 77°30' E to 78°30 E longitudes. Nagavathi is a major river which is ephemeral stream flowing from northeast to southwest direction and has 32 km length and surrounded by west part Masakkallu reserve forest, eastern part Thamboran malai and central part Elagiri reserve forest in the south west by Mettur Stanley reservoir. The Dharmapuri district receives average annual precipitation ranging from 760 to 910 mm. Geospatial and temporal analysis of seasonal (Pre monsoon, Post Monsoon, Southwest and Northeast monsoon) groundwater level fluctuations of 5 wells monitored during 10 (2003-2014) years was carried out. The groundwater level data were classified depth of water level and it is used for interpolation study in GIS environment for the winter, summer, southwest, northeast and average annual monsoon season water level thematic maps were generated. In thematic maps the depth of water level was categorized into shallow depth of water level, medium depth of water level and high depth to water level.*

INTRODUCTION

Groundwater is a highly valuable resource to the country as majority of the agricultural, domestic, and industrial activities depends on it. Groundwater is acquired by constructing and functioning extraction wells and boreholes. The measurement and analysis of groundwater levels is needed for maintaining groundwater availability. The behaviour of groundwater in the Indian sub-continent is highly complicated due to the occurrence of diversified geological formations[1]. The Dharmapuri district receives average annual precipitation ranging from 760 to 910 mm. with the coefficient of variation ranging from 22 to 36%. Rains are received during both Southwest (June to September), northeast (October to December), Post monsoon (January and February) Pre monsoon (March to May) seasons [2]. Groundwater Level and Rainfall Variability Trend Analysis using GIS in parts of Jharkhand state India for Sustainable Management of Water Resources [3]. Evaluation of aquifer parameters is an important aspect of all groundwater resource assessment. Groundwater is basically a dynamic resource, which may be expressed as the quantity of water measured by the difference between optimum and minimum water table within the aquifer. This annual periodic fluctuation of water table results from the natural annual hydrological cycle where groundwater-yielding aquifer is principally recharged through rainwater[4].The distribution of rainfall depends upon various factors. Rainfall is a single most important factor for success of crops in the farming areas. Major parts of India get rainfall due to southwest monsoon (June – September). The northeast monsoon is also called Retreating monsoon. It occurs during October to December, and it pours additional rainfall apart from conventional rainfall during summer [5]. Rainfall climatology brings out the general pattern and characteristics of rainfall of a particular region [6].

STUDY AREA

Nagavati watershed is located in part of Dharmapuri district of Tamil Nadu in South India. It lies between latitudes 11°45'N to 12°15' N and 77°30' E to 78°30 E longitudes. It falls in Survey of India map in 57H/16, 57L/4, 58E/13, and 58I/1 covering an area of about 500 sq.km (Fig.1). The climate of the Dharmapuri district is generally warmm. The hottest period of the year is generally from the months of March to May, the highest temperature going up to 38 C in April. The Climate becomes cool in December and continuous so up to February, touching a minimum of 17 C in January. The Soil type ranges from black to mixed loam, Red sandy soils and Black and loam soil are found in the watershed. Generally the soil is low in Nitrogen and Phosphate content.

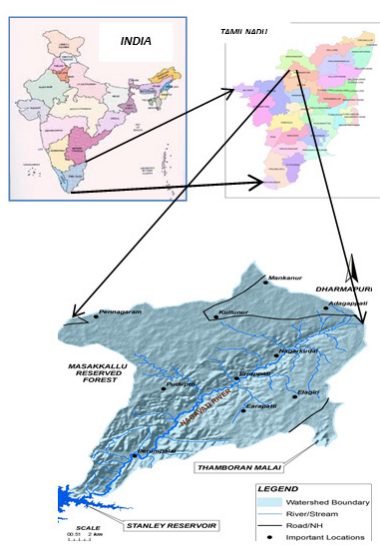

Figure1: Study area location map.

GEOLOGY

Geology of area is underlined by a wide range of igneous and metamorphic rocks. The geological formations of the study area are under Archean group representing Champion gneiss , charnockite, syenite, pink pegmatite and pyroxene granulite . The charnockites and associated pink migmatities mostly occupy the study area. Champion gneiss is dominant rock in the study area. It is highly pink migmatized at many places and show deep weathering.

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MATERIAL AND METHODS

In this study, Survey of India topographical sheets on 1:50,000 scales were used to delineate the watershed boundary. For analysing the average depth to water level, and its variability in the study area, the water level (WL) data of 10 years (2004-2014) recorded at 5 water level observation wells was obtained from Tamil Nadu Water Supply and Drainage Board (TWAD). To calculate the average rainfall and the increase or decrease in rainfall amount, the rainfall data of 10 years (2003-2014) for the same places was procured from the Indian Meteorological Department (IMD).To investigate the changes in rainfall for different seasons. Rainfall analysis was carried out for all the seasons as well as the whole year separately. The collected daily rainfall data has been arranged, interpreted by preparing average seasonal variation map. The water level fluctuation was analyzed for the four seasons. [7]. In this present, estimating the trend of groundwater level and there after the water level fluctuation the trend. The rainfall data was calculated using average values of water level and rainfall, using Microsoft office Excel 2010. The spatial variations of groundwater level fluctuations are prepared using Arc GIS [8].

RESULTS AND DISCUSSION

SEASONAL VARIATION OF RAINFALL

The seasons in the study area has been classified as pre monsoon (March-May), SW monsoon (June-September), NE monsoon (October –December) and Post monsoon (January February). The Seasonal Variation of Rainfall pattern recorded for the period of ten years (2003-2014) has been analysed for 5 rain gauge station. Descriptive statistics in rainfall Data (Table.1). The southwest monsoon of 30.56 % (711.22 mm) , Northeast monsoon of 40.71 % (854.21 mm) ,Pre monsoon of 23.75% (474.98 mm) and the post monsoon of 4.98 % (14.75 mm) of the total mean annual rainfall. During NE monsoon period, the station Pennagaram recorded the maximum average rainfall (Fig.2) of 990 mm and Perumbalai recorded the minimum of 435 mm. SW Monsoon the second highest precipitation was received in the Dharmapuri and Perumbalai rainfall stations during the study period (2003-2014). Pre monsoon season highest precipitation was received in the year of 2006 and lowest precipitation received in the year of 2009. Post monsoon lowest precipitation received in the year of 2003 – 2014.

TABLE-1
DESCRIPTIVE STATISTICS IN RAINFALL DATA

Sl.No	Post monsoon	Pre monsoon	Southwest Monsoon	Northeast Monsoon
Mean	14.75	474.98	711.22	854.21
Median	10.55	527.18	742.55	945.87
Standard Deviation	16.09	224.18	237.58	235.10
Kurtosis	4.30	-2.66	3.00	4.88
Skewness	2.03	-0.36	-1.61	-2.20
Range	39.50	492.97	610.85	554.61
Minimum	3.50	200.33	310.98	434.93
Maximum	43.00	693.30	921.83	989.54

Note: Rainfall in mm

SPATIAL VARIATION OF PRE AND POST MONSOONS

This change in water level is due to the remarkable recharge in groundwater in this region by the means of weathered and fractured zones present in the study area. Over exploitation of groundwater for agriculture and domestic purpose is very high by the means of both bore well and open well as soon as the monsoon rainfall occurred. The Pre and Post monsoon depth of water levels monitored during range between 4.07 to 8.66 and 3.31 to 5.67 m Below Ground Water level (BGL). The spatial variation of seasonal water level distribution of post monsoon, pre monsoon is shown in Fig.3 and 4 respectively. From the post monsoon map it is noted that the deep water (186.067 Sq. Km), Medium (209.361 Sq. Km), Shallow (27.715 Sq. Km), very deep (58.233 Sq. Km),of study area received the water level fluaction and the center part covers in deep water level. During the pre-monsoon period, central portion of area which includes Chinnampalli and Nogarkudal , very deep water level (54.893 Sq. Km) of total study area in the range of maximum of more than 8.66 m bgl and spatial of deep water (254.364 Sq. Km), Medium (138.353 Sq. Km), Shallow (33.765 Sq. Km).

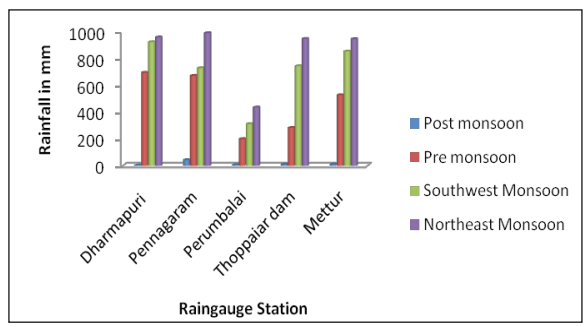


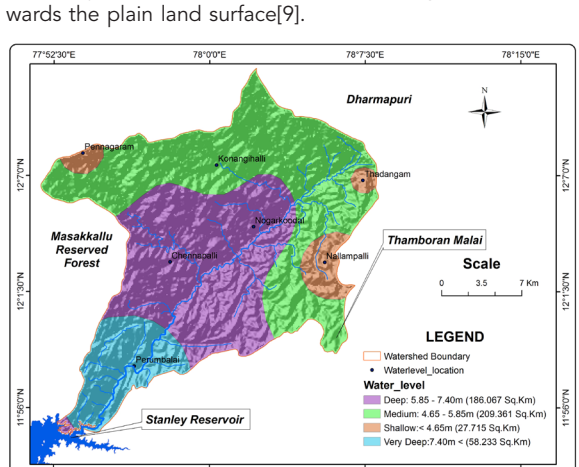
Figure 2: Season wise graph of rainfall data for the period of 2003-2014

SPATIAL VARIATION OF SW AND NE MONSOONS

The spatial variation of seasonal water level distribution of SW monsoon, NE monsoon is shown in fig.5 and 6 respectively. From the SW monsoon map it is noted that the deep water (240.933 Sq. Km), Medium (179.013 Sq. Km), Shallow (35.983 Sq. Km), very deep (25.386 Sq. Km),of study area received the water level fluaction and the south west part covers in deep water level. During the Ne monsoon period, central portion of area which includes Chinnampalli and Perumbalai , deep water level (54.893 Sq. Km) of total study area in the range of maximum of more than 5.67 m bgl and spatial of deep water (254.364 Sq. Km), Medium (138.353 Sq. Km), Shallow (33.765 Sq. Km)(Table.2).

In general the groundwater has been recharged by the monsoon rainfall to a considerable extent which has been reflected by the water level maps.

The geological features in the surface and subsurface of the study area favour the rainwater recharge and flow towards the plain land surface[9].



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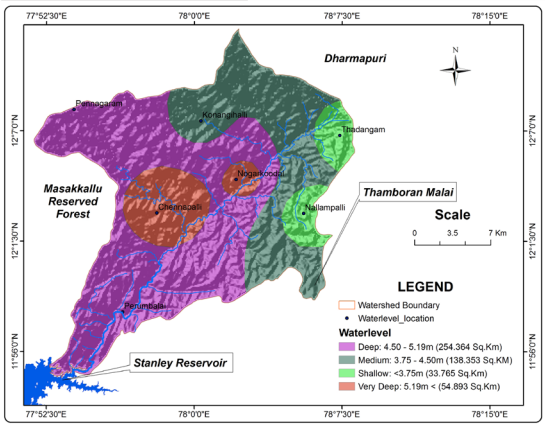
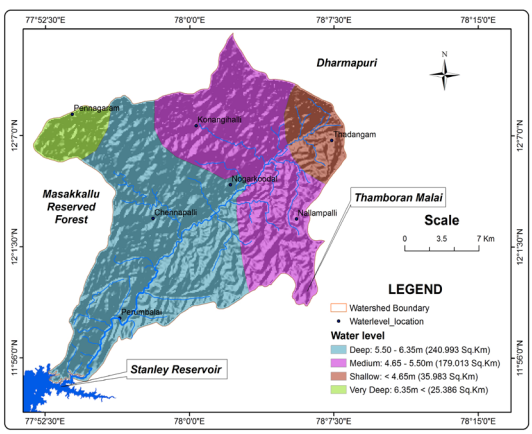


Figure 3: and 4 Spatial variation of Pre and Post Monsoon Maps



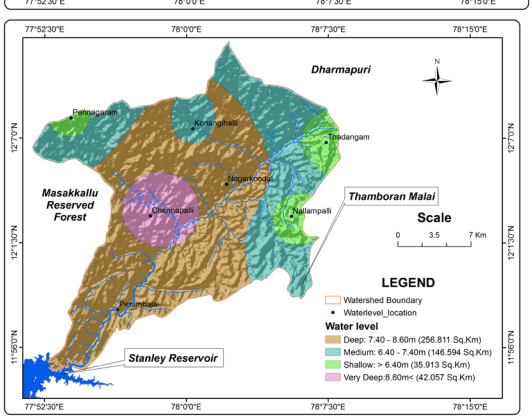


Figure 5: and 6 Spatial variation of NE and SW Monsoon Maps

SPATIAL VARIATION ANNUAL AVERAGE WATER LEVEL

It is however observed that in spite of the average water level being lower than 4.70 m bgl , there is arise in parts of central, southern, and SE regions of upto 5.80 m bgl and deepening below 4.70 m bgl in eastern, western and northern regions (Fig.7). The rise and fall depends upon the amount, duration and intensity of precipitation, depth of weathering, specific yield of the formation etc. The water level is deeper in topographically elevated regions and shallower in plain surface terrain [10].

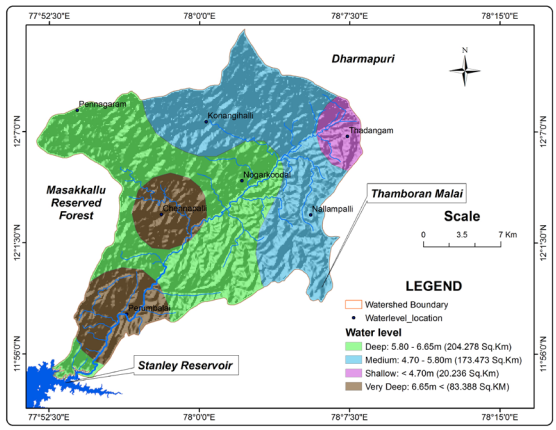


Figure 7: Spatial variation of annual average water level Map

TABLE-2
DESCRIPTIVE STATISTICS IN WATER LEVEL DATA

Sl. No	Post monsoon	Pre monsoon	Southwest Monsoon	Northeast Monsoon
Mean	4.56	5.83	7.41	5.49
Median	4.80	5.42	7.27	5.50
Standard Deviation	0.91	1.64	1.46	1.05
Kurtosis	-1.30	-0.25	-0.40	1.58
Skewness	-0.38	0.78	0.74	-0.99
Minimum	3.31	4.07	5.96	3.53
Maximum	5.67	8.66	9.89	6.79

CONCLUSION

The southwest monsoon of 30.56 % (711.22 mm) , Northeast monsoon of 40.71 % (854.21 mm) ,Pre monsoon of 23.75% (474.98 mm) and the post monsoon of 4.98 % (14.75 mm) of the total mean annual rainfall. Seasonal rainfall analysis shows that maximum rain showers are recorded during the month of October and the lowest rainfall intensity is usually recorded during January at all the rain gauge stations located in the study area. The Pre and Post monsoon depth of water levels monitored during range between 4.07 to 8.66 and 3.31 to 5.67 m bgl. the SW monsoon map it is noted that the deep water (240.933 Sq. Km), Medium (179.013 Sq. Km), Shallow (35.983 Sq. Km), very deep (25.386 Sq. Km),of study area received the water level fluaction and the south west part covers in deep water level. The groundwater levels remain stable for the entire season and a few locations there is a variation of levels due to rainfall variation during post monsoon season.

REFERENCE

[1]Manimaran D.(2012) Groundwater Geochemistry Study Using GIS in and Around Vallanadu Hills, Tamilnadu, India, Res.J.Recent Sci., 1(7), 52-58. [2]GGWB (2009) District Groundwater Brochure Dharmapuri District, Tamil Nadu. [3]Tirkey Anamika Shalini (2012)Groundwater Level and Rainfall Variability Trend Analysis using GIS in parts of Jharkhand state (India) for Sustainable Management of Water Resources. Inter. Research Jour. of Environment Sciences. Vol. 1(4), 24-31. [4]Satyajit Biswas., (2003) Groundwater direction and longterm trend of water level of Nadia district, West Bengal; A statistical analysis, J. Geol. Soc. India, Vol.61, pp 22 – 36. [5] Ishappa muniyapparathod, S. Aruchamy (2010) "Rainfall Trends and Pattern of Kongu Upland, Tamilnadu, India using GIS Techniques," International Journal of Environmental Sciences, 1(2), pp. 109-122. [6] A.S.R.A.S. Sastri, Divakar Naidu, Somnath Choudhury (2009) "Agro-topo Climatological Studies for Crop Planning -A Case Study for the Northern Hills Agroclimatic Zones of Chattisgarh State," Journal of Agrometeorology, 11(1), pp. 33-36. [7]Lohman, S.W., (1979) Definition of selected groundwater terms – revision and conceptual refinements, USGS water report, 21 p. [8]Ram Mohan.H.S., (1984) A climatological assessment of the water resources of Tamilnadu. Jour. Power and river valley level., pp 58 – 63. [9]Todd, D.K., (1980) Groundwater Hydrology, John Wiley and Sons, New York, 535 p. [10]Vekateswaran.S and Vijay Prabhu.M, (2012) Assessment of Rainfall Variability in GIS Environment at Sarabanga Sub-Basin Cauvery River South India. Inte. Jou. of Geology, Earth and Environmental Sciences Vol. 2 (2),pp.18-24.