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A Study on Groundwater Quality and Spatial Distribution of Gandarvakottai Taluk by Using GIS

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Abstract **- The present study investigates the hydro geochemical characteristics of groundwater quality in** Gandarvakottai Taluk **of the pudukottai district, Tamil Nadu, India. The Secondary data were collected from the CGWB office Chennai, tharamani during pre-and post-monsoon periods of 2010. The groundwater quality assessment has been carried out by evaluating the physicochemical Parameters such as pH, EC, TDS, $HCO3^-$, Cl^-, SO4, Ca2+, and Mg2+ for both the seasons. Based on these parameters, groundwater as been assessed in favour of its suitability for drinking and irrigation purpose. Dominant cations for Pre and Post the seasons are in the order of $Na^+ > Mg^{2+} > Ca^{2+} >K$, and $Mg^{2+}Na^+ >Ca^{2+}>K$ while the dominant anions both post monsoon and pre monsoon have the trends of $HCO_3^->Cl^- >CO_3>Fl^-$, respectively. Analytical results observed from various indices reveal that the groundwater quality is good in some places recently polluted by the waste materials. The observed chemical variations in pre-monsoon and post-monsoon seasons may be the effect to rock-water interactions, ion-exchange reactions, and runoff of fertilizers from the surrounding agricultural lands.**

Keywords: **groundwater quality; geochemical analysis; seasonal variation; Gandarvakottai taluk; India.**

I. INTRODUCTION

Groundwater is one of the major sources of exploitation in arid and semi-arid regions. particularly for irrigation, industrial and drinking purposes in large parts of the India due to frequent failures of monsoon, which in turn affects the surface water sources such as rivers and lakes. Rapid urbanization and industrialization also tremendously increase the groundwater demand. Now it is recognized that the quality of the groundwater is just as important as its quantity. Over exploitation of groundwater can affect both quantity and quality of groundwater. Variations in ion chemistry of groundwater are used to India and several parts of the world to find out the suitability of groundwater for drinking, irrigational and other domestic purposes (Ramesh and Elango, 2012; Raju etal., 2011; Subramani et al., 2005; Srinivasamoorthy et al., 2010). Similar types of studies were carried out in the Kanyakumari district by Subramanian (2011), Perumal and hamarai (2008). But this study predicts the overall groundwater qulity and geochemical charecteristics of gandarvakottai taluk not focused to earlier studies. The aim of the study is to assess the geochemical processes controlling the water composition and to assess the spatial distribution of various Hydrogeochemical parameters for suitability of groundwater resources.

II. STUDY AREA

The study area is fall in the border of Tanjore and Pudukottai District, Gandarvakottai taluk southeastern part of the SE part of the Tamil Nadu India. The total region of Gandarvakottai taluk covers the 421.5 Sq.km. It lies between the 78°24'to 78°92' and North latitudes, 78°24'to 78°92' and 10°42' to 10°70' East longitudes (Fig.1). It occurs within the Survey of India topographical sheet or the Topographical Map 58 J 14 &15, 58 N2, N3. The study area also comprises of different lithologies, along with semi confined aquifer sandstone alluvium and river vellar and agniyar . The average annual rainfall in the district during this century is around 940 mm.

III. PHYSIOGRAPHY OF STUDY AREA

Fundamental characteristic of the terrain of Pudukkottai District is the general flatness, interspread with small rocky hills which are numerous in the south western parts of the district. Within this general flat terrain, depressions and slopes have created seasonal rivers and jungle streams, and have made it possible to construct tanks across slopes and irrigate lands under these tanks for many centuries.

There are rivers like Vellar, Agniar etc. The months between April and June are generally hot with temperatures going up to a maximum of 40°C. In winter (December - January) the minimum temperature is 20°C. The maximum and minimum temperature is 38.6°C and 21.0° C respectively.

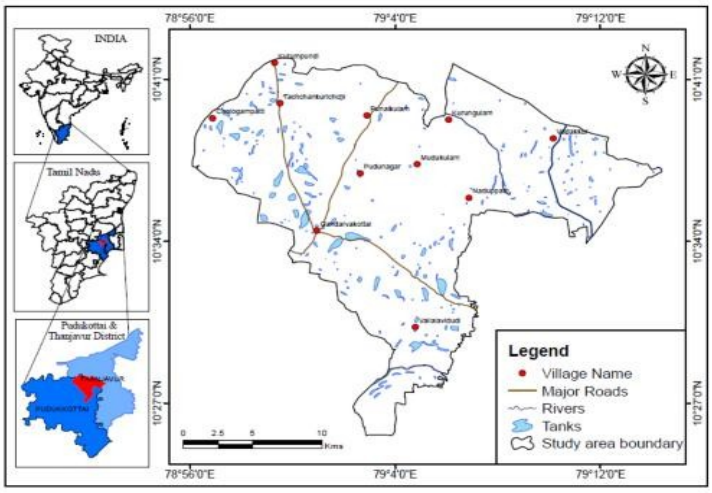


Fig.1 Major Location Map of the Study Area

Fig.2 Geology map of the study area.

The Palar River flows from the northwest to southeastern part of the study area. The subsurface lithology of the study area shows different types of formations which include sand, clayey sand with weathered Charnockite in west. Archean basement at the bottom, which is made up of charnockites, and is overlain by recent alluvium (Singh et al.2004;Singh and Saxena 2004).

The depth of hard rock varies from 12.9 to 46.0 m below the ground surface. The bedrock is shallow on the northern and western side and deeper in the central region. The weathered/fractured Charnockite and alluvium form the major aquifer system. The thickness of alluvium is more on the southern and eastern sides, and lenses of clays were encountered in alluvial formations (Karmegam et.al, 2010). Sand formations vary from 3 to 12 m in thickness and constitute a shallow unconfined aquifer.

IV.METHODOLOGY

The 33 Locations are selected for the groundwater quality analysis in the purchased data from borewell, dug well, tube well and open well of 2010 representing both the Post and Premonsoon seasons respectively. Some of the thematic maps are prepared by the GIS Software Arc GIS 9.2 and the mapinfo 8.5 and Vertical Mapper. Data's was analyzed for the physico-chemical parameters as pH, electrical conductivity, bi-carbonate, chloride, sulphate, calcium, magnesium, sodium and potassium using the standard procedures as per APHA (1989). The hydrogen ion concentration (pH) and electrical conductivity were measured using Eutech digital portable meters *in situ*; the instruments are calibrated as manufacturer guidelines.

The study is aimed with the following objectives are

1. To determine the variation of water quality with space and time(spatial Distribution).
2. To Register the jpeg image by the way of MapInfo professional method.
3. To edit the latitude and longitude for the some of the location within the Study area or the boundary file.
4. To input the purchased data by the way of attribute data storage into Locations.
5. To analyse the numerical stored data by the method of spatial distribution Contour using vertical mapper.

Drainage of the Study area

Vellar is the major river, which flows in an east southeasterly direction and confluences with the Bay of Bengal near Manamelkudi. Agniar, Ambuliyar, Koraiyar, Kundar and Pambar are the other important rivers draining the Pudukottai district.Almost all the rivers are ephemeral in nature causing floods during rainy seasons,which are structurally controlled.The drainage pattern of the region is generally sub- dendritic (Fig.2.2). The river is seasonal and carries substantial flows during monsoon period.

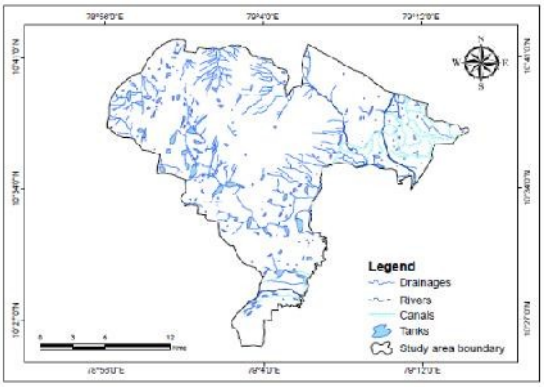


Fig.3 Drainage map of the study area.

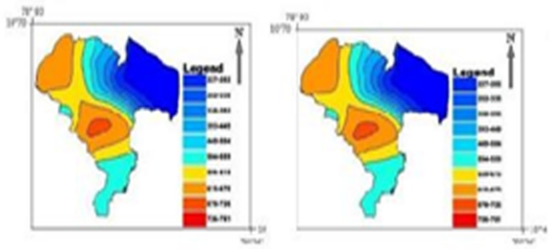
The seasonal variation of major chemical parameters in the groundwater is spatially depicted in the figures (Figs.4a-l) prepared using the Mapinfo Professional 8.5 and vertical mapper.

Depending upon some specific standards the groundwater quality can be determined for its suitability for different purposes. In our study the standards were derived from standards of World Health Organization (WHO, 1997) and Bureau of Indian Standards (BIS,1991) guidelines to assess the drinking water quality of the groundwater. The ranges of chemical parameters and their comparison with the WHO and the Indian standards for drinking for the post monsoon in table.I.

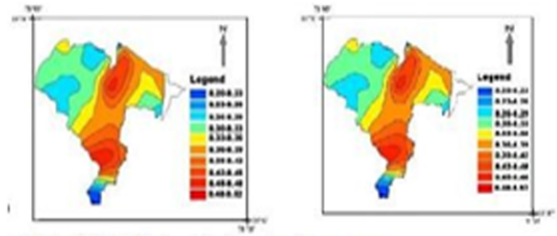
TABLEI GENERAL GROUND WATER QUALITY STANDARDS FOR REFERENCE.

S.No.	Parameters	Maximum	Minimum	Premisable Limit
1	pH(mg/l)	8.7	8	6.5 8.5
2	EC(µs/cm)	783	228	1000-1500
3	TDS(mg/l)	459	141	500 1000
4	Ca(mg/l)	39	11	75 200
5	Mg(mg/l)	44	4	50-150
6	Na(mg/l)	118	8	200
7	K(mg/l)	16	1	
8	cl(mg/L)	163	7	200
9	No_4(mg/l)	17	1	200 400
10	HCo_3(mg/l)	216	47	-----

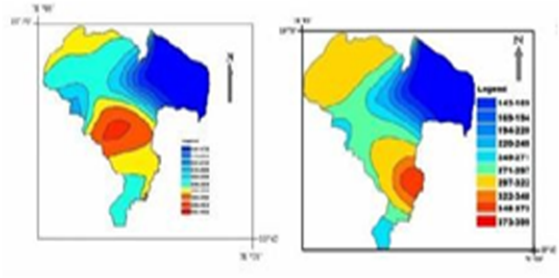
The spatial diagrams show the variation of the different chemical parameters spatially over the study area. The total ionic budget is found to be more in the post-monsoon season when compared with the pre-monsoon season. The pH in the post –monsoon water samples varies from 8 to 8.6 and in the pre – monsoon samples vary from 8.2 to 8.7 indicating alkaline nature. As per ISI (1991) standards eighty-eight and sixty- eight percentages of the samples in the pre – monsoon and post–monsoons respectively are within the recommended limits (6.5 to 8.5) for human being consumption. The total dissolved solids spatial maps show that there is no major change in the overall Distribution of the TDS. But comparing with the post- monsoon



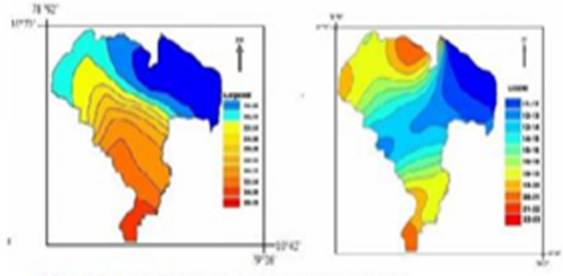
(a) Spatial distribution of Electrical conductivity post and pre monsoon



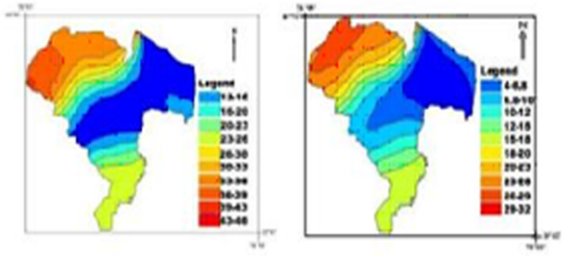
(b) Spatial distribution of pH post and pre monsoon.



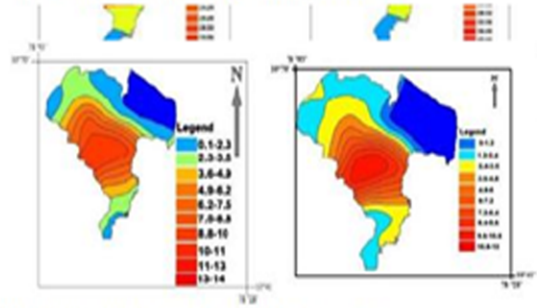
(c) Spatial distribution of TDS post and pre monsoon



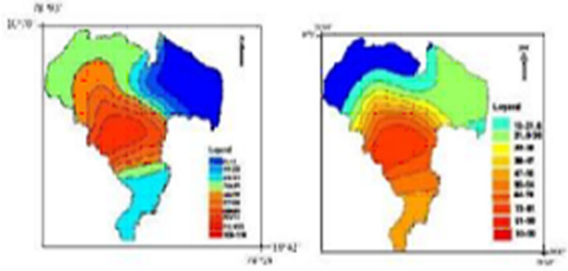
(d) Spatial distribution of Ca post and pre monsoon



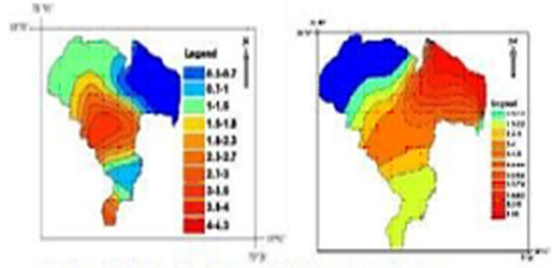
(e) Spatial distribution of Mg post and pre monsoon



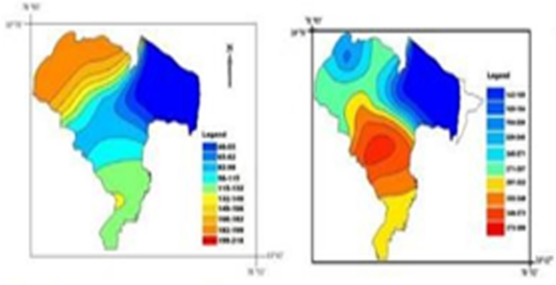
(g) Spatial distribution of k post and pre monsoon



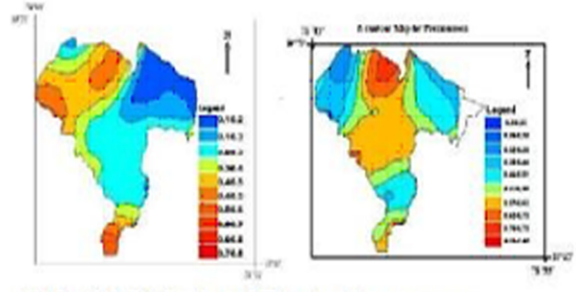
(f) Spatial distribution of Na post and pre monsoon



(l) Spatial distribution of SAR post and pre monsoon



(i) Spatial distribution of HCo3 post and pre monsoon



(j) Spatial distribution of Fl post and pre monsoon

season,the TDS is considerably less the post-monsoon season. The sodium distribution maps are also similar in both seasons. Comparing both the seasons, the sodium concentration is low in the pre- monsoon season. In the case of K spatial maps the overall distribution illustrates that the distribution of potassium is higher in the pre-monsoon season. In majority of wells the potassium is found to be higher than the permissible limits.

Calcium in groundwater of the study area is generally within the permissible limits the case of both the seasons. In the post monsoon season fewer wells in the southern side of the study area show very High concentrations of calcium. Mg distribution maps also depict that majority of the samples in the Study area have permissible amounts of magnesium except two or three samples. Sum of calcium and magnesium content is expressed as the hardness of the groundwater.

The hardness of the groundwater may be mainly from surface water (Hounslow, 1995), which shows that anthropogenic activities is also the reason for high calcium and magnesium concentrations. In the case of anions, chloride concentration is higher in the middle part of the post and pre-monsoon season the southern side of the study area. The southern side regions agniyar is flow are showing higher concentration of chloride crossing the permissible limits. Few of the ground water samples has comparatively elevated concentrations of Fl in both seasons. The rainwater is also a major source for chloride ions in the groundwater (Hounslow, 1995).

V.CONCLUSION

The study area is having the different seasonal changes and natural activities like premonsoon and post monsoon season. It is mainly based on the natural process such as the Weathering, Transportation, Deposition, Rainfall, Infiltration, rock exposure and the aquifer system. The study area having the annual rainfall for the year 2010 is 821mm. These are the clearly identified for the study of ground water quality and some of the parameters to correlate with WHO(WORLD HEALTHORGANISATION). It is very important for the water quality standards. In our study area all the parameters are within the permissible limit. So we can use for the water from our area many purposes like drinking, domestic irrigation and etc. Main objective of this project is Using GIS for the ground water quality analysis by the method of Spatial Distribution. The different software's was used such as Arc GIS and MapInfo Professional 8.5. It is the very easiest method for to store the data, Digitization of the spatial entity (Point-Location of the study area/ village name, Line-Major River, Road and Railway network, Polygone-Study area Boundary, Tanks (surface water body) etc. All the water quality data are the input into the MapInfo Professional 8.5. These inputted data's are analysing the Vertical Mapper using grid manager drawing tools by the using of Interpolation Method distribution of water quality parameters.

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