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RESEARCH ARTICLE

HYDRO GEOCHEMICAL STUDIES BASED ON CALCIUM (CA) AND MAGNESIUM (MG) CONCENTRATION IN AND AROUND OF SALEM DISTRICT

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ABSTRACT

Groundwater chemical quality studies were carried many watersheds in India. In this study sixty groundwater samples were collected out in from dug and bore well during pre and post monsoon seasons. The samples were analyzed for various water quality parameters such as pH, Electric Conductivity, Total dissolved solids, Calcium, Magnesium, Sodium, Potassium Bicarbonate, Carbonate, Sulphate and Chloride. The present study have concentrated in hydrogeochemical comparative studies in Calcium and Magnesium concentration in and around of the Salem district, Tamil Nadu, using Geospatial Techniques.

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INTRODUCTION

Characterization of groundwater in terms of geochemical types is an essential component of scientific management of groundwater resources in order to monitor the quality of groundwater in an aquifer, and also for identified of recharge areas. Moreover, Geochemistry of Groundwater is also related to the nature of host rock as well as the overlaying rock types.An understanding of chemical quality of water is essential in determining its usefulness for drinking purpose. Presentation of geochemical data in the form of graphical charts such as piper's hill diagram and Gibb's diagram etc. will help in recognizing various hydro geochemical types in a groundwater basin. The following discussion describes the hydrogeochemistry of the groundwater in the study area with specific emphasis on the control exercised by lithology. Proper management of this vital resource needs special attention through continuous monitoring and identification of the problem area as well as delineation of safe zone. GIS has been used extensively in analyses of result where groundwater quality is being monitored. In the present study, detailed investigation of water chemistry, from wells were carried out for groundwater quality.

Study area

The study area Salem district is in the environment of rocks of late Precambrian that are also characterized by maximum of Fissured Hornblende Biotite Gneiss, Charnockite, Syenite present in the western parts of the study area and the Ultramafic complex present in the foot hills of Shevaroys in the eastern part of the study area (Map-1). The Salem district receives the rain under the authority of both southwest and northeast monsoons. The northeast monsoon chiefly contributes to the rainfall in the Salem district. The hot weather begins early in March, the highest temperature being reached in April and May. Weather cools down progressively from about the middle of June and by December, the mean daily maximum temperature drops to 30.2°C, while the mean daily minimum drops to 19.2°C and 19.6°C in January in Salem and Mettur Dam respectively. 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 soils can be broadly classified into 6 major soils types, Red Colluvial Soil, Black Soil, Brown Soil, Alluvial and Mixed Soil. Major part of the district is covered by Red insitu and Red Colluvial soils. Weathered and fractured crystalline rocks and the Recent Colluvial deposits constitute the important aquifer systems in the district. Colluvial deposits represent the porous formations in the district.

Geomorphology and Geology

Salem district forms part of the upland plateau region of Tamil Nadu with many hill ranges, hillocks and undulating terrain with a gentle slope towards east.

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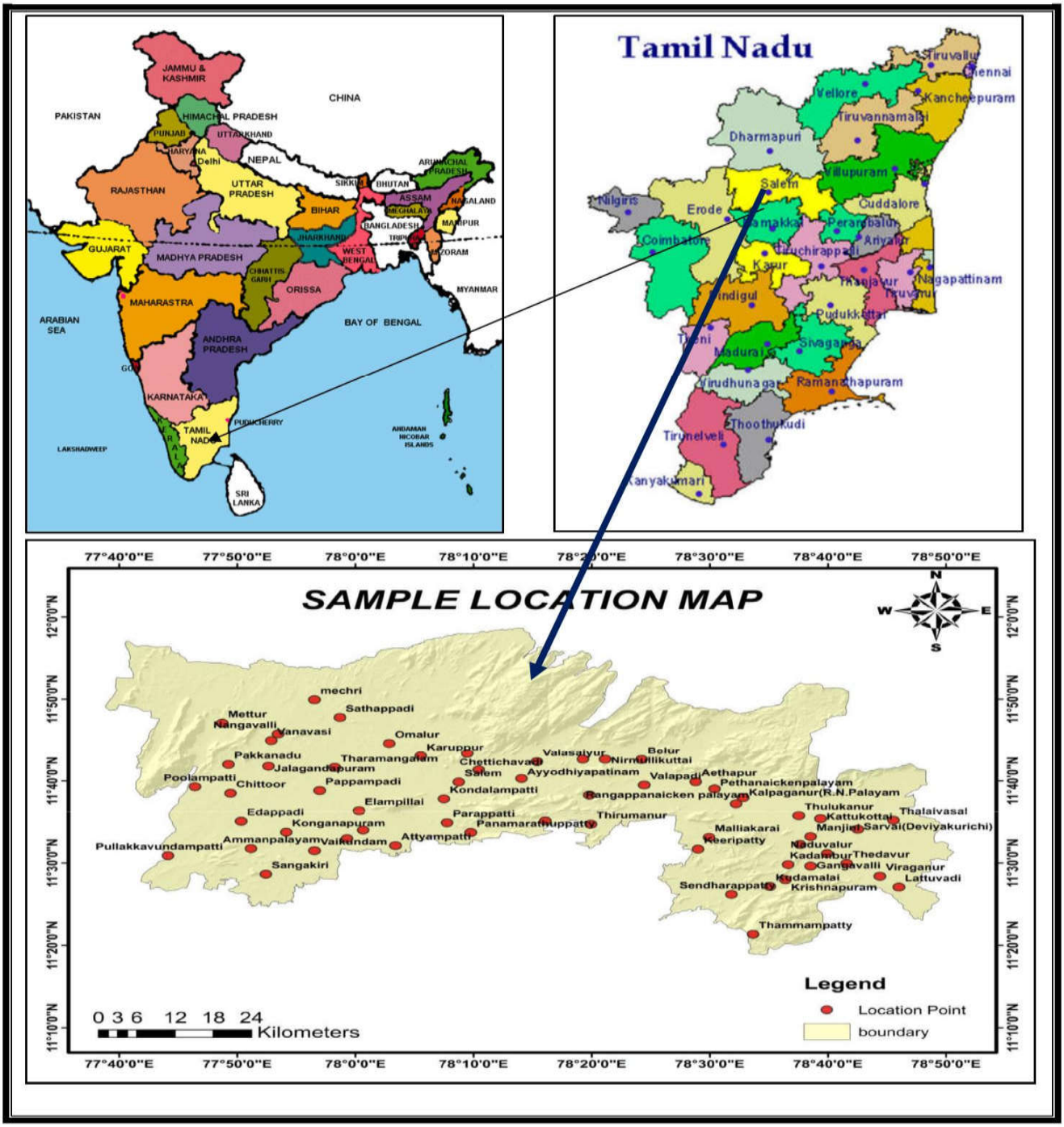


Map 1. Study area

The prominent geomorphic units identified in the district through interpretation of Satellite imagery are 1) Plateau (fairly high ground) , 2) Structural hills(ridges and vallys), 3) Bazada zone (alluvial cones and fans), 3) Valley fill (vicinity and intermountain), 4) Pediments (outcrop in without soil), 5) Shallow Pediments (weathering and intermediate pediments) and 6) Buried Pediments.

Salem is one of the best-known geological formation of rocks and mineral deposits in southern part of Tamil Nadu. Crystalline metamorphic rock is mainly distributed in Salem district. Older granite is present in the most of the areas.Meta sediments are presented as isolated in central part of Salem in Kanjamalai and near places of Yercaud and Mallasamuthiram. Younger granite in west and west eastern part of Salem and intrusive ultramafic rocks are seen in theseareas.

Aim and Objectives

The present study, aims to investigate the hydrogeological conditions of the area and to generate and integrate the data on groundwater resources by identifying quality and quantity using various scientific methods, for integrated water resources management.

- To assess hydro geochemical, hydro geomorphological, geology, Soil characteristics of the study area.
- To Determine the major calcium and magnesium the groundwater.
- To determine the quality of groundwater to evaluate the suitability for domestic, irrigational industrial purposes and to identify the hydro chemical patterns.

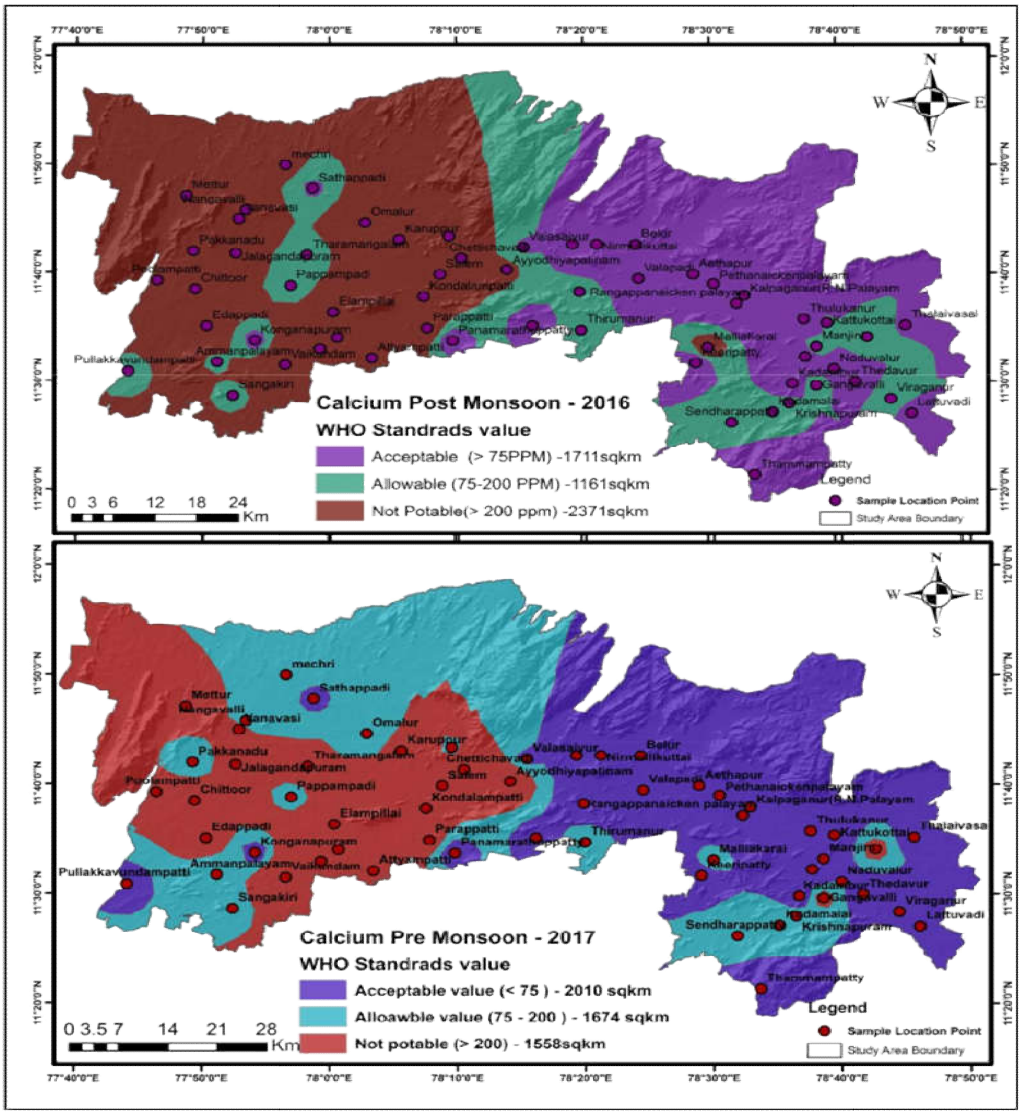
- To integrate various thematic maps using ARC GIS software version 10.3 and Surfer 13 to demarcates groundwater quality of the study area.

MATERIALS AND METHODS

GIS is now emerged as modern tool in any hydro geological studies. Geo chemical and physical characteristics of the groundwater were determined with respect to WHO (World Health Organization) standard of the drinking and irrigation purposes of the study area. Salem district covers 5245 sq.km. Salem district is chracteritised by the various rock types and mineral deposits are mainly controls the water quality in this area are following as Magnetite, Bauxite, Granite, Limestone, Quartz and Iron ore.

RESULTS AND DISCUSSION

Characterization of groundwater in terms of geochemical types is an essential component of scientific management of groundwater resources in order to monitor the quality of groundwater in an aquifer, and also for identified of recharge areas. Moreover, Geochemistry of Groundwater is also related to the nature of host rock as well as the overlaying rock types. An understanding of chemical quality of water is essential in determining its usefulness for drinking purpose. Presentation of geochemical data in the form of graphical charts such as piper's hill diagram and Gibb's diagram etc. help in recognizing various hydro geochemical types in a groundwater basin. The following discussion describes the hydro geochemistry of the groundwater in the study area with



Map 2. Calcium Post and Pre-Monsoon

The hydrogeological study included 60 groundwater samples which were collected for hydrogeochemical study in the area during pre and post monsoon seasons of 2016 and 2017 and the samples were analyzed to identify pH, EC,TDS, calcium, magnesium, sodium, potassium, chloride, fluoride, nitrate, iron etc., Then the geochemical data were interpreted and compared with WHO standards. Chemical concentration values are taken into GIS platform to prepare the GIS spatial distribution maps and tables. Finally, the groundwater quality for drinking purposes and irrigation purposes has been found.

specific emphasis on the control exercised by lithology. GIS has been used extensively in analyses of result where groundwater quality is being monitored.

Calcium (Ca)

Calcium is the second dominating ion in the study area. During Post-Monsoon calcium concentration in the groundwater of the study area Calcium ranged from to minimum value of 16 ppm (Thammampatty) to maximum values of 342 ppm,

(Vempadidhalam) with an average value of 111 ppm. During Pre-Monsoon calcium concentration ranged from to minimum of 16 (Thulukanur) to maximum of 410 ppm, (Vempadidhalam) with an average value of 215 ppm.

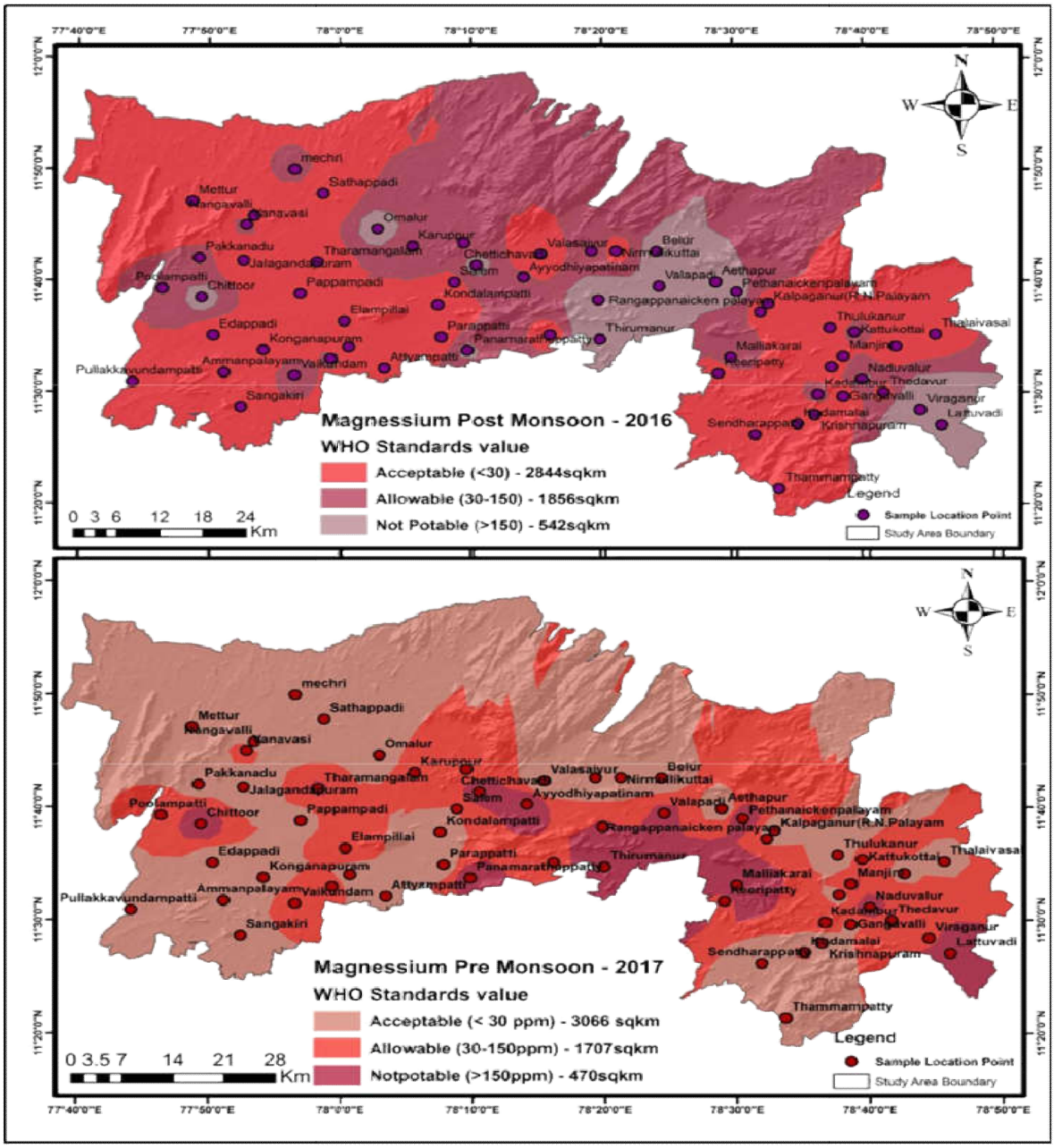
The highest value was observed in Omalur and Kannankuruchi areas and the lowest values were recorded in Thammampatty, Gangavalli and Belur areas. Most of the samples fell within the acceptable and allowable limit Values, only few samples fell

Table 1. Calcium limiting values with respect of WHO standards Post and Pre-Monsoon

S.No	Limiting values	Portability nature	Open well location	Open well Location
			Post-Monsoon	Pre-Monsoon
1	75	Acceptable limit	11,28,31,33,34,36,39,42,43,45,46,47,48 ,50,51,52,53,59,60	11,30,31,33,34,36,39,41,43,45,46,47, 48,49,50,52,53,54,56,57,59,60
2	75-200	Allowable Limit	1.2.3.4.5.6.8.9.10,12,13,15,16,17,20,21, 23,24,25,26,27,29,30,32,35,37,38,40,41 44,49,54,55,56,57,58	1,3,4,5,6,7,8,9,10,12,13,15,17,20,21, 23,25,26,28,29,32,35,37,38,42,43,51, 58
3	200	Not Potable	\ 7,14,18,19,22	2,14,16,18,19,22,24,27,40,55

Table 2. Result of GIS Spatial distribution of Calcium valuesduringPost and Pre-Monsoon

Portability Nature	Limiting values	Post-Monsoon		Pre-Monsoon	
		Area in Km²	Percentage of the area	Area in Km²	Percentage of the area
Acceptable Limit	75	2010	32	1711	37
Allowable Limit	75-200	1674	60	1161	47
Not potable	200	1558	8	2371	16



Map 3. Magnesium Post and Pre-Monsoon

Table 3. Magnesium limiting values with respect to WHO Standards of Post and Pre-Monsoon

S.No	Limiting Values	Portability Nature	Open well location	Open well Location
			Post Monsoon	Pre-Monsoon
1	30	Acceptable Limit	25,28,33,34,38,40,53,55	28,30,34,35,38,53
2	30-150	Allowable Limit	1,2,3,4,5,6,7,8,9,10,11,12,13,14, 15,16,17,18,19,20,21,22,23,24, 26,27,29,30,31,32,35,36,37,39, 41,42,43,45,46,47,48,49,50,51, 52,54,55,56,57,58,59,60	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16, 17,18,19,20,21,22,23,24,25,26,27,29,3,1 ,33,36,37,39,40,41,42,43,4445,46,47,48, 49,50,51,52,54,55,56,57,58,59,60
3	150	Not Potable	44	32

Table 4. Result of GIS Spatial distribution of Magnesium during the Post and Pre-Monsoon

Portability Nature	Limiting values	Post Monsoon		Pre-Monsoon	
		Area in Km²	Percentage of the area	Area in Km²	Percentage of the area
Acceptable Limit	30	3066	13	2844	10
Allowable Limit	30-150	1707	85	1856	88
Not potable	150	470	2	542	2

above the WHO limits. It is because of the rate of decay of Quartz and Feldspar group of minerals (Hem, 1985). The desirable limit of calcium in drinking water is 75ppm. If the presence of calcium is more in drinking water, it will cause formation of renal calculi (Kidney stone). In the study area, by using remote sensing and GIS the distribution of calcium (Ca) during Post and Pre – Monsoon season maps are shown in (Map- 2) and the results are shown in the Table 1 &2 are given.

Magnesium (Mg)

The allowable limit of magnesium in drinking water is 150 ppm (WHO, 1983). Magnesium is the third dominating ion in the groundwater. During Post-Monsoon Magnesium concentration in the groundwater of the study area was ranged from to minimum value of 10 ppm (Thulukanur) to maximum values of 226 ppm, (Viraganur) with an average value of 60 ppm. During Pre-Monsoon Magnesium concentration ranged from to Minimum17.5 (Valasaiyur) to Maximum 231 ppm, (Malliakarai) with an average value of 176 pp min the study area.By using remote sensing and GIS the distribution of Magnesium (Mg) during Post and Pre – Monsoon season maps are shown in (Map-3) and the result are shown in the table 3&4 are given.

Conclusion

The quality of groundwater of the study area is inferred during Post and Pre- monsoon seasons of 2016 and 2017 respectively. The quality parameters were compared with WHO & BIS standards. The data obtained by chemical analyses were evaluated in terms of its suitability for domestic use, irrigation, agricultural and industrial use. The Ca ionic concentration during Post Monsoon-2016 season of the study area, 32% (2010 km²) of the water samples are within Acceptable limit and 60% (1674 km²) of the water samples are within Allowable limit. During Pre Monsoon-2017season of the study area,Ca ionic concentration indicates 37% (1711km²), 47% (1161 km²) of the water samples are within Acceptable and Allowable limits respectively. As per the Mg concentration is concerned during Post Monsoon-2016 season of the study area, 85% (1707 km²) of the water samples are within allowable limits and 13% of (3066 sq.km) of the water samples are not potable limits.

During Pre Monsoon-2017 season, 88%(1856km²) of the water samples are within allowable limits and10% (2844sq.km) is not in potable limits.

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