Ground Water Quality Mapping for Pimpri Chinchwad Region

[1]Shet Deepen, [2]Patil Omkar, [3]Ashwini Salunkhe
[1]Student, [2]Student, [3]Professor
Dr. D. Y. Patil institute of Technology

Abstract - **Intensive agriculture by indiscriminate use of agrochemicals, sewage water, and polluted drain water has posed a serious threat to groundwater quality in some peri-urban areas of Pune like Pimpri Chinchwad area. The objective of the study was to determine the groundwater quality and to map their spatial variation in terms of suitability for irrigation and drinking purpose. Ordinary method was used for preparation of thematic maps of groundwater quality parameters such as electrical conductivity, sodium adsorption ratio, bicarbonate, magnesium/calcium ratio, total dissolved solids, chloride, nitrate and hardness. The present study has analyzed post-monsoon physicochemical data of groundwater samples from bore wells spread over the entire area. In this project samples of ground water are collected and then tested. Physical and chemical parameters of groundwater were determined. Groundwater in the area is generally very good, pleasant, and fresh to brackish, average to very low saline and low alkaline in nature and fit for drinking purposes. Permissible average total hardness and TDS in all places of the study area identify the suitability of groundwater for drinking. Based on the TDS value, the groundwater in these areas is of bicarbonate/ calcium chloride/sodium chloride type.**

keywords - **Groundwater pollution, drinking-water, physio-chemical parameters, spatial interpolation.**

I. INTRODUCTION

Groundwater is one of earth's most vital renewable and widely distributed resources as well as an important source of water supply throughout the world. The quality of water is a vital concern for mankind since it is directly linked with human welfare. In India, most of the population is dependent on groundwater as the only source of drinking water supply. As the ground water is much cleaner than surface water it is directly used for drinking in rural areas. Quality of groundwater is equally important to its quantity owing to the suitability of water for various purposes. Water quality analysis is an important issue in groundwater studies. Variation of groundwater quality in an area is a function of physical and chemical parameters which are greatly influenced by geological formations and anthropogenic activities. Water quality analysis is one of the more important issues in groundwater studies. The hydro geochemical study reveals the zones and quality of water that are suitable for drinking, agricultural and industrial purposes. Further, it is possible to understand the change in quality due to rock water interaction or any type of anthropogenic influence. Groundwater often consists of seven major chemical elements- Ca^{+2}, Mg^{+2}, Na^{+1}, K^{+1}, Cl^{-1}, HCO_3^{-1} and SO_4^{-2}. Hence, hydro geochemical studies can be conducted by analyzing water samples based on these components. The study area for the present work is the Pimpri Chinchwad of the Pune district of Maharashtra (Fig. 1). In the present study, post-monsoon water samples were collected (October 2018 to March 2019) from various locations. The physical parameters taken into consideration are PH and Total Dissolved Solids (TDS) . The purpose of the study is to understand the groundwater quality in the basin and pictorially represent it using the Geographic Information System (GIS). GIS is an effective tool for storing large volumes of data that can be correlated spatially and retrieved for the spatial analysis and integration to produce the desirable output. GIS has been used by scientists of various disciplines for spatial queries, analysis and integration for the last three decades (Burrough and McDonnell 1998). Several studies were conducted to determine potential sites for groundwater exploration in diverse geological set ups using remote sensing and GIS techniques.

Figure 1. PCMC Map

II. MATERIALS AND METHODS

Pimpri chinchwad is a fast-developing city in west of Maharashtra state of India. The City is situated at Latitude of 18.6298°N and Longitude of 73.7997°E at the mean sea level of 530 m and referred in topographic sheet No. 56 C/SE (Figure 1). It spreads to an area of 181 sq. km and has a population of 1.72 million. Average annual rainfall is about 722 mm and the mean daily

temperatures for the same period range from 12°C to 30°C in winter to over 35°C to 42°C in summer. The study area is identified as chronically drought prone district of the Maharashtra state, due to less and variable occurrence of annual rainfall which puts onus on exploitation and management of the sub surface water. As of now there is no effort by municipal authorities to supply treated groundwater or at least to inform which of the bore wells have water fit for drinking purpose as per WHO standards. There is no record of the number of private bore wells in the city. Dependency on groundwater is currently very high and it is preferred for drinking purpose by large number of the population. Because of the inadequacy and concern over quality of tap water, ground water will continue to be a significant source of domestic water supply for this city.

III. GROUNDWATER SAMPLE COLLECTION AND ANALYSIS

As part of the study, groundwater samples are collected from various bore wells, representing one from each zone/ward of the city. The samples taken during October 2018 were analyzed for various Physio-chemical parameters. Bottles used for water sample collection are first thoroughly washed with the water being sampled and then were filled. After collection of the samples, the samples are preserved and shifted to the laboratory for analysis. Physicochemical analysis was carried out to determine Ca+2, Mg+2, Na+1, K+1, Cl-1, HCO3-1 and SO4-2 and compared with standard values recommended by World Health Organization (WHO, 1993) and Indian Standards Institution (ISI, 1991) (Table 1).

Table 1. Desirable limits

Parameter	ISI (Desirable limit)
pH	6.5-8.5
Total Dissolved Solids	500(mg/L)
Alkalinity as $CaCO_3$	200(mg/L)
Total Hardness as $CaCO_3$	300(mg/L)
Calcium as Ca	75(mg/L)
Magnesium as Mg	100(mg/L)
Chlorides as Cl	250(mg/L)
Sodium	-
Potassium	-

IV. COLLECTION OF SAMPLES AND DRAFTING POINT SOURCE MAP

The point source data in table - 2 was followed to develop a groundwater quality classification map from thematic maps based on the ISI (1991) standards for drinking water. We obtained the location of various wells all over the study area. GPS technology proved to be very useful for enhancing the spatial accuracy of the data integrated in the GIS. We utilized Mapinfo Professional software in our study. Based on the location data we obtained, we prepared point feature showing the position of various wells (Figure 2). From these wells, we collected and analyzed groundwater samples for the study area. The water quality data thus obtained forms the nonspatial database. It is stored in excel format and linked with the spatial data by join option in Mapinfo Professional software. The spatial and the nonspatial database formed are integrated for the generation of spatial distribution maps of the water quality parameters.

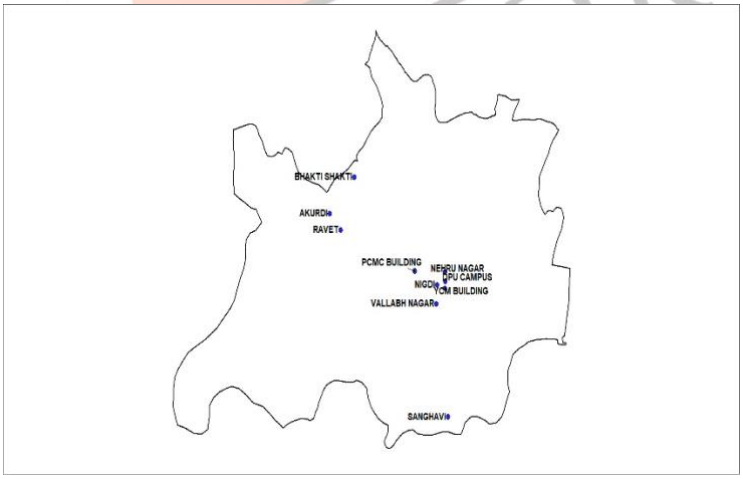

Figure 2. Sampling Location

Table 2. Location of Samples.

Sr. no	Locaion	Sample ID	Laitude	Longitude
1	Akurdi	AK1	18.6505555	73.759444
2	Nigdi	NI2	18.623055	73.816666
3	Ravet	RA3	18.6441666	73.765277
4	Sanghavi	SA4	18.57229	73.82248
5	Bhakti Shakti	BS5	18.664551	73.772554

6	PCMC building	PC6	18.628305	73.804771
7	vallabhnagar	VN7	18.615824	73.816165
8	Nehru Nagar	NN8	18.627931	73.820795
9	Ycm Hospital	YCM9	18.621693	73.820873
10	Dpu Campus	DPU10	18.624435	73.821018

V. GROUNDWATER QUALITY TESTING AND MAPPING

The testing of sample is carried out by standard procedure given in IS code. The graph is drawn for various samples. The chemical parameters are shown in this bar graph.

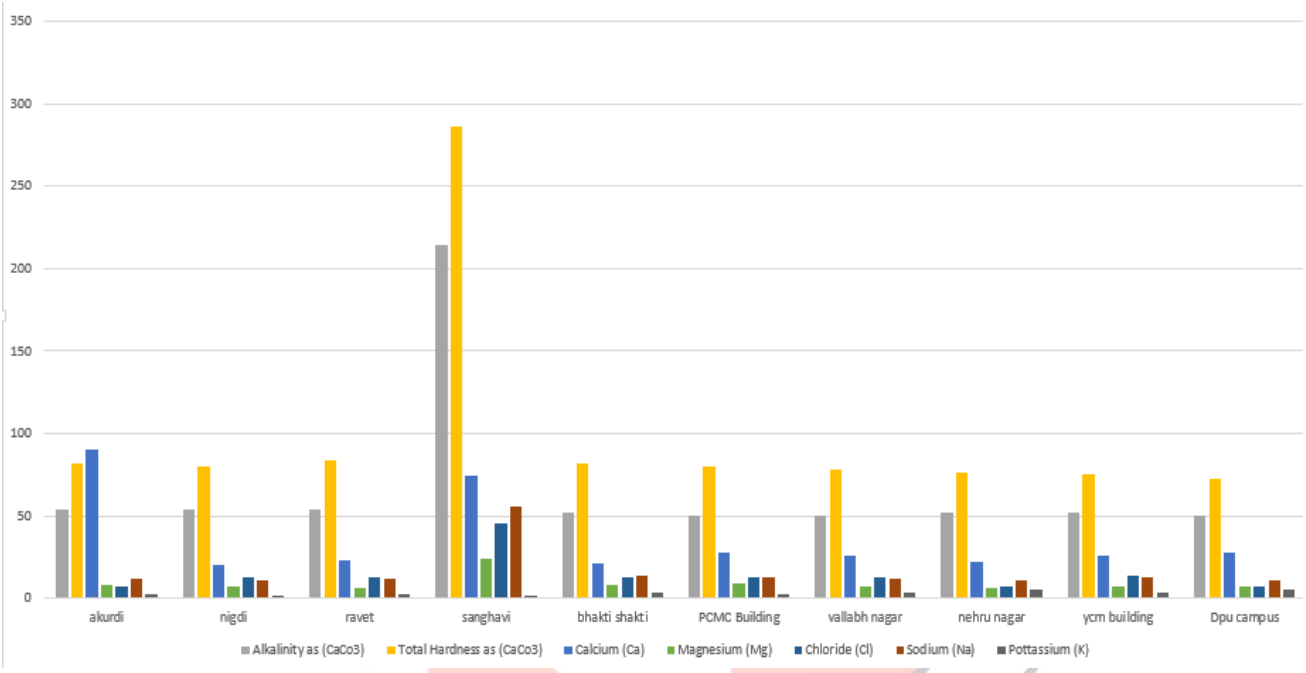

Figure 3. Bar Chart

The physical parameters such as PH and TDS are shown on counter map.

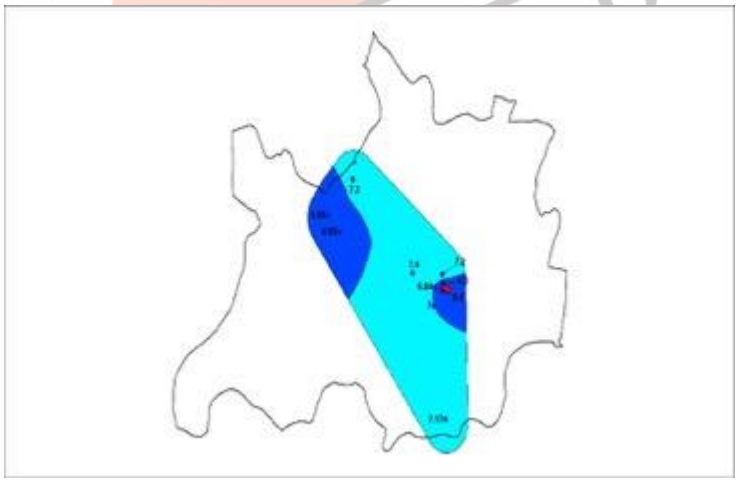

Figure 4. pH

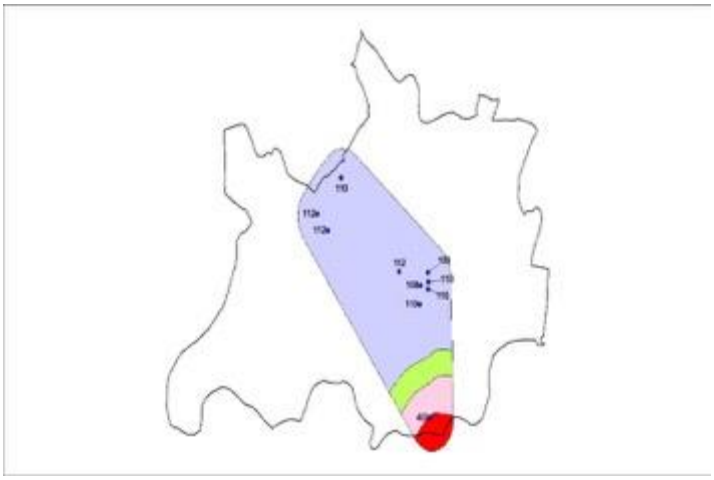

Figure 5. TDS

VI.CONCLUSION

In the present study, the GIS technique has successfully demonstrated its capability in groundwater quality mapping of the Pimpri chinchwa. The final output has given the pictorial representation of groundwater quality suitable or unsuitable for drinking and irrigation purposes in the basin. From the hydrogeochemical analysis, it is inferred that the excess concentration of all the compound is found in excess at sanghavi sample. It is unfit for drinking. Chloride, TDS and hardness at some locations has determined an undesirable quality for drinking purposes. At remaining location water is fit for drinking and within permissible limit. Similarly, considerable areas in the basin are having high salinity hazards. Such zones require special care and an alternative salt tolerance cropping pattern. The reasons for excess concentration of various elements and salinity levels require further detailed investigation.

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