International Journal of Engineering Science Invention Research & Development; Vol. III, Issue IX, March 2017
www.ijesird.com, e-ISSN: 2349-6185

A Groundwater Quality Analysis of GIDC Naroda

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***Abstract*— World's 71% area is covered with water. Out of which 96.5% is in the oceans, while the remaining 3.5% is in freshwater lakes and frozen water locked up in glaciers and polar icecaps. Out of all the freshwater, 68.7% is in the form of glaciers and icecaps, 1.2% as surface freshwater, while the remaining 30.1% as groundwater.**

Good groundwater quality is essential for crop yield, soil productivity, environmental purposes, drinking purposes, domestic use and industrial purposes. In India out of the 1,123 BCM/year useable water, the share of surface water and ground water is 690 BCM/year and 433 BCM/year respectively. Setting aside 35 BCM for natural discharge, the net annual ground water availability for the entire country is 398 BCM.

The overall contribution of rainfall to the country's annual ground water resource is 68% and the share of other resources, such as canal seepage, return flow from irrigation, recharge from tanks, ponds and water conservation structures taken together is 32%. Due to the increasing population in the country, the national per capita annual availability of water has reduced from 1,816 cubic meter in 2001 to 1,544 cubic meter in 2011. This is a reduction of 15%.

Suitability of groundwater for irrigation purposes is determined by its geochemistry. Groundwater geochemistry explains the links between chemical composition of groundwater and subsurface geological and non-geological pollutants.

The groundwater samples will be analysed for physio-chemical parameters. GIS can be a powerful tool for developing solutions for water resources problems for assessing water quality, determining water availability, preventing flooding, understanding the natural environment, and managing water resources on a local or regional scale (Collet 1996). Spatial analysis module in Arc GIS (version 10.2.2) software has been used for the present study.

***Keywords*—** Groundwater, GIDC Naroda, physio-chemical parameters, Spatial mapping, GIS.

1. INTRODUCTION

1.1 INTRODUCTION

The term groundwater is usually referred for the subsurface water that occurs beneath the water table in soils and geologic formation that are fully saturated. Ground water plays a vital role in the development of arid and semi-arid zones. It is believed to be comparatively much clean and free from pollution than surface water.

In India, the availability of surface water is greater than ground water. However, owing to the decentralized availability of groundwater, it is easily accessible and forms the largest share of India's agriculture and drinking water supply. A little attention has been paid towards the groundwater pollution as it is not easy to notice. But being limited in amount and having immense importance in the present times, check on ground water pollution has been given priority. Polluted groundwater is less visible, but more difficult to clean, than polluted rivers or lakes.

Ground water contamination is the result of polluted water infiltrating through the soil and rock and eventually reaching the groundwater. This process might take many years and might take place at a distance from the well where the contamination is found. Groundwater is very difficult to remediate, except in small defined areas and therefore the emphasis has to be on prevention. So the knowledge of extent of pollution and the status of water become essential in order to preserve the valuable source of water for future generation. [1] Prolonged discharge of industrial effluents, domestic sewage and solid waste dump causes the groundwater to become polluted and create health problem. Most of the industries discharge their effluent without proper treatment into nearby open pits or pass them through unlined channels resulting in the contamination of groundwater. [2]

1.2 NEED FOR STUDY

Ever since the industrialization, our country has seen rapid increase in pollution of water. It has been usually limited up to surface water resources. But with the recent change in policies of the government, there has been surge in pollution of ground water.

Maximum domestic requirement of Indian households is fulfilled by ground water only and according to WHO, 80% of the diseases are caused due to water, directly or indirectly. [1]If once the ground water is contaminated, its quality cannot be restored back easily. That's why it is necessary to control the pollution of groundwater.

1.3 OBJECTIVES

- To analyse the ground water quality of GIDC Naroda.
- Interpreting various groundwater quality parameter using GIS.
- To determine the percentage of population dependent upon the ground water for their day to day use in that same area.

1.4 SCOPE

The scope of work is restricted to analysing the groundwater quality of GIDC Naroda, to carry out survey in residential part of that area and mapping the results on GIS. For ground water analysis, following parameters will be taken into consideration and experiments on the samples will be carried out for:

pH, EC, Chloride, TDS, Total Hardness, Calcium Hardness and COD.

1.5 STUDY AREA PROFILE

Ahmedabad is a city located on the western part of India in the state of Gujarat. Geographical location of Ahmedabad city is 22°58´N and 72°58´E. Ahmedabad is one of the most dynamic cities of India with one of the fastest growth rate due to immigration from various parts of Gujarat and other states. Its estimated population is around 8 million by 2021.

GIDC is the zoned area provided specially for industrial development purpose. GIDC Naroda is located at 23^0 05'N $72^0$40'E. GIDC Naroda has been divided into four phases. It has a total of 9 bore wells from which water is drawn from the ground for various purposes. Along with industries, certain amount of population also resides in the phase 1 of GIDC Naroda.

2. LITERATURE REVIEW

2.1 STUDY OF GROUNDWATER QUALITY WITH GIS APPLICATION FOR COONOORTALUK IN NILGIRI DISTRICT, BY T. SUBRAMANI. [6]

The increase in population and urbanization necessitates growth in the agricultural and industrial sectors which results in demand of more fresh water. When surface water is the non-available, then the alternative is to depend on ground water. The dependability on ground water has reached all-time high in recent decades due to reasons such as unreliable supplies from surface water due to variation of monsoon, increase in demand for domestic, agricultural and industrial purposes. This has resulted in over exploitation of ground water all over the country and in certain places it has reached critical levels like drying up of aquifers. In Coonoor area the groundwater could be spoiled due to waste disposal and Improper Agricultural practices.

It is situated in the western part of Tamil Nadu. Out of total geographical area of 2366.89 sq.km. Coonoor Taluk lies between North latitudes 11˚ and 11˚ 55' East Longitudes 76˚ 13' and 77˚ 2'.

The water quality parameters were tested in the laboratory. The Lab Test Procedure was done as per Indian standard code of Practice. The water quality parameters are given in the data base to GIS. The Coonoor map was scanned and digitized. Digitization was done by Surfer–8. The spatial variation was done. Finally, integrated ground water quality map was created using ARC GIS 9.3.

8 parameters, namely, pH, TDS, Total hardness, Sulphate, Chloride, Calcium, Turbidity and Temperature.

The Software used are Surfer – 8 and Arc GIS – 9.3.

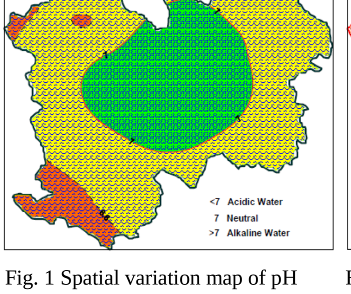

Fig. 1 Spatial variation map of pH

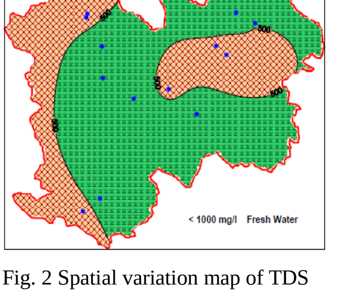

Fig. 2 Spatial variation map of TDS

Coonoor area is under threat due to the critical issues of environmental pollution and water scarcity problems. The groundwater quality in

CoonoorTaluk has been reduced due to pollution. Hence monitoring the groundwater quality is indispensable. This groundwater quality analysis can be extended to ground water modelling and the present study can be kept as basic data for future investigation for analysing various parameters of Ground water studies.

2.2 GROUNDWATER QUALITY ASSESSMENT OF DHANKAWADI WARD OF PUNE BY USING GIS, BY PROF. PRITI SINGH. [4]

This paper aims to assess and map the spatial distribution of ground water quality of the Dhankawadi ward of Pune by using the Geographical Information System (GIS). Dhankawadi is experiencing rapid urbanization, this made people to depend on groundwater resources. Google earth has been used for preparation of Land use and Land class (LULC) image. Results of WQI are interpreted with respect to the LULC.

The study area is Dhankawadi ward, which is the southern part of Pune metropolitan Area. The latitude of study area ranges from 18°25'30" N to 18°28'30" N and longitude ranges from 73°50' E to 73°53' E, with area of coverage 1160 hectares.

The boundary of the Dhankawadi ward is digitized from the Pune Municipal corporation ward map. The location of the groundwater samples collected with the help of 12 channel Garmin hand held GPS, while collection of groundwater samples, interviews were performed with the local people to understand why they are utilizing the groundwater. It was noticed that the utilization of groundwater is observed mainly in the places where there is a shortage or no supply of municipal corporation water.

10 parameters, namely, pH, EC, Alkalinity, TDS, Total hardness, Calcium, Magnesium, Nitrate, Chloride and Sulphate. The Analysis was been Done Using Statistical Analysis and GIS.

WQI in the study area and it is varying from 23.755 to 55.621. High value of WQI has been observed in Bharti Vidyapeeth University campus Upper Katrajnagar and AmbegaonBudurk. Low values of WQI were observed in surrounding area of behind Katraj dairy, Katraj junction and Dattnagar. Areas surrounding Institute of Environment, BVU and R Residency, Upper katraj are not potable.

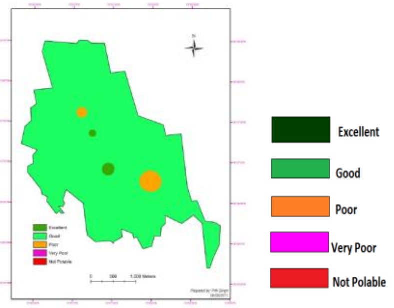

Fig. 3 Spatial distribution of WQI

2.3 ASSESSMENT OF GROUND WATER QUALITY USING GIS: A CASE STUDY WALAYAR WATERSHED, PARAMBIKULAM-ALIYAR-PALAR BASIN, TAMILNADU, INDIA, BY K. BALATHANDAYUTHAM. [2]

Groundwater resources are highly essential to the survival of human beings, particularly in areas where other sources of potable water are lacking. The major sources of spot and dispersive contaminants arising from human activities on the ground and penetration of these contaminants into the ground tend to reduce the quality of the ground water. Therefore, preventing the ground water from contamination is essential to the management of ground water resources. In a drinking water quality assessment, the decision-making based on water quality data is a crucial issue because number of parameters compromises its quality.

Walayar watershed is one of the three sub-basins in Parambikulam-Aliyar-Palar basin situated in Coimbatore district, Tamil Nadu, India and lies between 10°40’00” to 10°20’00” N latitude and 76°50’00” to 77 °20’00” E longitude. It is spread over an area of 877.49 km^2.

As part of the study, the groundwater samples from open and bore wells of various locations (18 sites) which are extensively used for drinking and also irrigation purposes in the Walayar watershed area were collected during the year of 2011 to 2014. Collected samples were brought to the laboratory.

11 parameters, namely, pH, EC, TDS, Chloride, Sulphate, Calcium, Magnesium, Fluoride, Bicarbonate, Total Hardness, Nitrate.

Software used areStatistical Analysis and Arc GIS.

Results obtained gave the necessity of making public, local administrator and the government to be aware of the crisis of poor groundwater quality prevailing in the area.

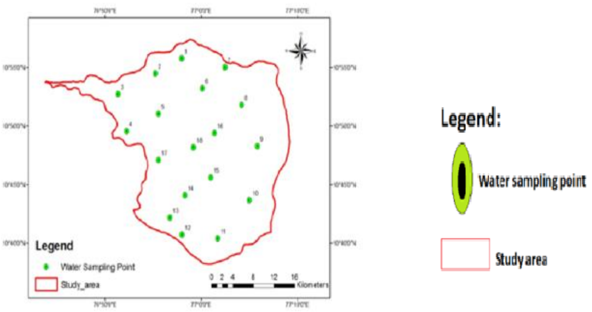

Fig. 4 Sampling Stations

3. METHODOLOGY

3.1 DATA COLLECTION

Table 1 Geographical location of bore wells

Location	Latitude	Longitude
Bore well 1	023^{0} 05.917’	072^{0} 40.451’
Bore well 2	023^{0} 05.874’	072^{0} 40.131’
Bore well 3	023^{0} 06.104’	072^{0} 40.382’
Bore well 4	023^{0} 06.032’	072^{0} 40.713’
Bore well 5	023^{0} 05.590’	072^{0} 40.012’
Bore well 6	023^{0}04.904’	072^{0}39.995’
Bore well 7	023^{0} 05.156’	072^{0} 40.065’
Bore well 8	023^{0} 04.898’	072^{0} 39.954’
Bore well 9	023^{0} 05.482’	072^{0} 39.902’

Sample of groundwater were collected through 9 bore wells, which are located across GIDC, Naroda. Latitude and Longitude of the location of these bore wells were found using Garmin Hand-held GPS.

Total No of Industries registered with NIA: 650

Various types of Industries

- Air Compressor & Space Parts : 6
- Banking : 2
- Bulk Drugs & Pharmaceutical Industries : 18
- Ceramics : 24
- Chemical : 182
- Electrical & Electronics Industries : 17
- Engineering Industries : 111
- Fabricators & Engineering : 16
- Food Industries : 59
- Furnace & Foundry : 8
- Furniture & Fixtures : 3
- Generals / Supports / Utility Service / Tools Travels : 57
- Ice : 7
- Insulation : 3
- Metal & Pipes : 10
- Packaging Industries : 25
- Paints : 6
- Plastic Industries : 30
- Printers : 6
- Pumps & Space Parts : 25
- Rubber & Rubber Products : 11
- Textile Industries :33
- Water Treatment Plant : 1
- Weighing Machines : 253

Garmin Hand-held GPS

Fig. 5 Garmin Hand-Held GPS

Fig. 6 Garmin Hand-Held GPS used

First the person has to stand at the location whose co-ordinates are to be determined with GPS in his/her hand. After switching the GPS On, we have to wait for it to start receiving the signal from minimum 4 satellites. Then after, it automatically shows the latitude and longitude of that location.

3.2 DATA ANALYSIS

All the experiments were performed according to the procedure given in IS 3025-21.

4. RESULT AND ANALYSIS

Table 2 Final Readings

Sample No	pH	TDS (mg/L)	Turbidity (NTU)	COD (mg/L)	Total Hardness (mg/L as $CaCO_3$)	Calcium Hardness mg/L as $CaCO_3$)	Chloride (mg/L)	EC (mho)
1	7.05	1020	1.2	292.2	110	52.5	30	1.72
2	6.60	934	0.9	299.1	117	73.5	30	1.76
3	6.70	875	1.1	201.7	168	99.8	30	1.53
4	8.00	793	1.1	229.6	197	178.5	30	1.52
5	6.50	1310	0.7	198.3	129	105	30	2.28
6	9.25	959	0.9	201.7	150	89.2	30	1.52
7	8.77	793	1.2	229	162	94.5	40	1.48
8	9.04	789	0.6	177.4	134	115.5	40	1.45
9	9.02	897	1.0	205.2	128	78.5	50	1.73

pH

The range for pH specified in IS code is 6.5-8.5. It was found that the pH level of first 5 bore wells are well within the limits specified by IS code. Whereas the pH of last 4 bore wells is beyond the limits, in the alkaline zone.

TDS

The limit for TDS specified in IS code is 500 mg/L. TDS levels of the ground water in all bore wells is way too high and more than double the limit is few cases.

Turbidity

The limit for Turbidity specified in IS code is 1 NTU. Turbidity of all the ground water samples along all the bore wells is around that value, which is tolerable.

COD

The limit for Total Hardness specified in IS code is 200 mg/L. All the samples have that below the limits, except for bore well number 1 and 2.

Total Hardness

The limit for Total Hardness specified in IS code is 200 mg/L. All the samples have total hardness below the limit.

Calcium Hardness

The limit for Calcium Hardness specified in IS code is 200 mg/L. All the samples have calcium hardness below the limit.

Chloride

The limit for Chloride specified in IS code is 250 mg/L. The chloride levels of the ground water at all the locations are within the limits.

EC

The acceptable limit of EC specified in IS code for potable water is 2.5 mS/cm. All samples have EC below the limit.

5. DISCUSSION

Although, the residential population resides only in phase 1-2, ground water is used by tea stalls and slums for drinking purposes all around GIDC. So, it wouldn't be true to say that water quality as per IS code 10500 needs to be maintained only in first two phases. Rather, the quality of water provided all around the GIDC should fulfil all the criteria of potable water.

But the results of pH, TDS, Turbidity and COD tests show that the samples of ground water have them at excess which might cause certain health issues, like, nutritional deficiency, bitter or salty taste, incrustation, films, precipitate or corrosion on fixtures, harmful for peoples with compromised immunity, newborns or elderly and microbial diseases.

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