Seasonal Variation of Groundwater Quality in and Around Laharpur Reservoir Bhopal

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ABSTRACT

Water being a universal solvent has been and is being utilized by man kind time and now. Of the total amount of global water, only 2.4% is distributed on the main land, of which only a small portion can be utilized as fresh water. The available fresh water to man is hardly 0.3-0.5% of the total water available on the earth and therefore, its judicious use is imperative. Variations in availability of water in time, quantity and quality can cause significant fluctuations in the economy of a country the definition of water quality is very much depending on the desired use of water. Therefore, different uses require different criteria of water quality as well as standard methods for reporting and comparing results of water analysis. 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. Groundwater can become contaminated naturally or because of numerous types of human activities; residential, municipal, commercial, industrial, and agricultural activities can all affect groundwater quality Bhopal, the capital city of M.P. has an area of 284.9 km^2 and a population of over 14 lacs. Bhopal has a number of lentic water bodies and Laharpur reservoir is one of them. The Bagmugaliya residential area of Bhopal is situated near the Laharpur reservoir. This is a fast growing residential colony with densely populated human settlements. Every day new settlements in the form of new colonies are developing in the area. The Laharpur reservoir that is situated in the vicinity of the area receives wastewater from almost entire new Bhopal. . This study is an attempt to find out the pollution and to assess the pollution load caused in the groundwater of the area due to the stagnation of sewage in its close proximity.

I INTRODUCTION

Water is the key to life. The available fresh water to man is hardly 0.3-0.5% of the total water available on the earth and therefore, its judicious use is imperative. . The fresh water is a finite and limited resource The utilization of water from ages has led to its over exploitation coupled with the growing population along with improved standard of living as a consequence of technological innovations. 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.

Bhopal the capital city of Madhya Pradesh is home to a large number of lentic water resources including the famous Bhoj Wetland, the maiden Ramsar site of the state. Despite having a large number of water bodies in and around it, the city witness decreased water supply, especially during the drier months of the year. The majority of Bhopal's drinking water supply is met by two surface water sources: the Upper Lake and the Kolar reservoir. Besides, there are tubewells, hand pumps and a few large diameters dug wells. Bhopal also has an unaccounted number of privately owned dug wells and borewell.

Laharpur reservoir is situated in the southwest of Bhopal city in the state of Madhya Pradesh, with an objective to store water for irrigational purpose.. In last few years the lake became surrounded by habitations with the growth of the city. These developments resulted in anthropogenic pressures on the lake which accelerated the eutrophication process thereby making the water body unfit for human consumption. The higher concentration of bacterial contamination in the water of reservoir may\ possibly contaminates the ground water also. Therefore, the assessment of the variation of water quality parameter is the first and foremost task for the scientific management of reservoir and groundwater, and to find out the suitability of the water for multipurpose. It is in this light that the present study was undertaken to assess the seasonal variations of water quality parameters of underground water located around Laharpur reservoir.

II MATERIAL AND METHODS

Bhopal is popularly known as the city of Lakes. Bhopal gets this distinction because of a large number of lakes, tanks and ponds n the city. The city is relatively away from a dependable perennial lotic water source; hence the administrators had to construct ponds and reservoirs in order to cater the needs of the city. Laharpur dam was constructed in the southwest corner of the city with an objective to store rain water for irrigational use. Earlier the reservoir was in the outskirt of the city that came within the settlement due to gradual expansion of township and now settlement is heading in the command area of the reservoir. The reservoir was constructed for the purpose of storing water for irrigation and make supply to farmers of the command area. The micro-climate of the lake region is very pleasant, warm in winter and cool in summer. The sources of the runoff of the reservoir in the area are precipitation and rainy season provides more than 90% of the total rainfall during the months of July, August and September. The area has a warm climate and sufficient rainfall, suitable for the growth of various plants. The reservoir has multiple functions of irrigation water supply, climate regulating, flood regulating as well as recharging of ground water, aquaculture and aesthetic values. The part of new Bhopal is falling well within the catchment of the reservoir and is receiving untreated sewage through number of sewage fed drains. The surface drain carrying sewage and storm water passes from soil and stony strata get purified before joining to Reservoir. The travel distance is not less than 8 km. in case of Anna Nagar and Shahpura Nalla which provide sufficient retention period to settle down heavy matter and dead organic matter get decomposed before joining the Reservoir. In past decade tremendous development took place in this area and as a result number of private and government colonies came up even in the downstream of the reservoir. The inflow of untreated sewage in the reservoir culminated eutrophication .The identified major environmental problems are: soil erosion, silt and agriculture waste inflow, nutrient enrichment, fluctuation in water level, weed infestation, water quality degradation etc. The pollution level in the reservoir has crossed the threshold limit and self purification capacity.

III SAMPLE COLLECTION

The present study has been designed to take into account the spatial distribution of contaminants accumulating in the laharpur reservoir and their subsequent transfer in the subsurface aquifer of the neighboring areas. The residential areas adjoining the laharpur reservoir almost exclusively depend upon the groundwater to suffice the needs of potable and secondary uses of water.therfore it becomes pertinent to collect water samples from every important locality for the purpose of the study. It has been taken into account while designing the study to collect representative samples from all the major residential colonies.

IV FREQUENCY

In this study the seasonal variability of groundwater quality parameters of residential area in the upstream and downstream areas of Laharpur reservoir were investigated. Analysis was done for pre-monsoon and post-monsoon seasons of the years 2014 and 2015. The physicochemical parameters viz., pH, total hardness, calcium, magnesium, chloride, nitrate, total dissolved solids, iron, dissolved oxygen & total solids were analyzed.

V RESULTS AND DISCUSSION

The water to be used for drinking purpose must meet high standards of physical, chemical and biological purity. The quality of groundwater is mainly influenced by its physical, chemical and biological aspects which vary from place to place, with the depth of water table, and from season to season. The occurrence of groundwater is a natural phenomenon attributed to seepage of surface water into sub-surface layers of earth. While passing water through different strata comprises of clay, sand, alluvial soil, silt, rocks having bacterial flora etc acts as a natural filter for water and retains impurities that are present in dissolved and suspended form. Normally these impurities removed during trickling down of surface water through biophysical filters of natural soil media. The water retained in capillaries of sub-soil strata known as aquifer, which is quite useful in maintaining soil moisture. Because of this popular belief that the groundwater would be relatively uncontaminated it is being consumed without treatment, but accumulation of sewage and solid waste at the ground is constantly polluting the groundwater. The anthropogenic activity further deteriorates water quality, especially in case of urban water system. The increasing number of cases related

to water borne in people consuming the groundwater has caused a worry & made it necessary to assess quality of groundwater being used for potable turbidity point of view season The ground water is generally clear with no color during winter and summer seasons when viewed through normal eye but when compared with bottled water, there is some difference from turbidity point of view.

The pH values of groundwater range from 7.1-8.1 during dry and wet seasons respectively (Figure-1). The pH values during both seasons fall within the permissible range of 6.5 - 8.5. Fifty percent of analyzed samples have pH values below 8.0 during dry season while this increase to 80% during wet season. This indicates that there is more dissolution of pollutants during the rainy season

The total Hardness (TH) values during dry and wet seasons ranged from 182 to 376 mg/L l respectively (Figure-V) . 10% of the water samples fall under "moderate" class while 70%of water samples fall under "Hard" class during the dry season. During wet season of sample collection, 45 % fall under "moderate" class, 75 % fall under "Hard" class while the remaining 25 % fall under "very hard" class. This may be due to decay of organic matter and weathering of rocks and minerals. The hardness of water is not a pollution parameter, but it indicates water quality mainly in terms of calcium and magnesium. Water containing excess hardness is not desirable for potable purposes, as it forms scales on water heaters and utensils when used for cooking and consumes more soap during washing clothes

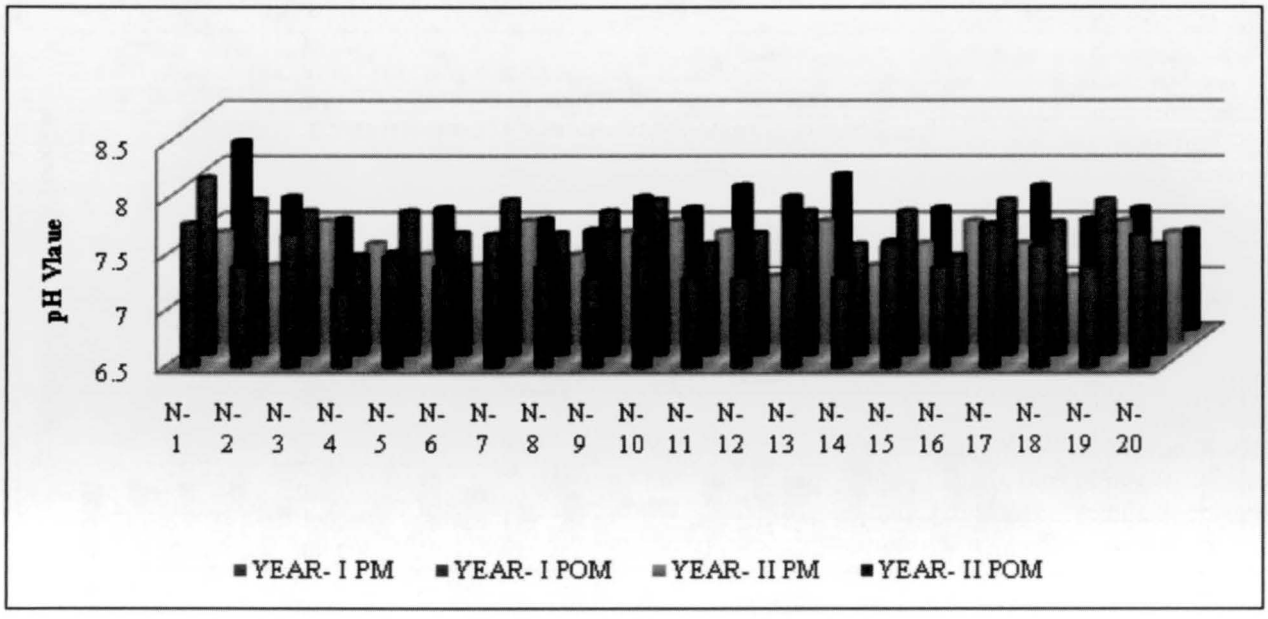

Fig.1 Seasonal variation in pH of groundwater

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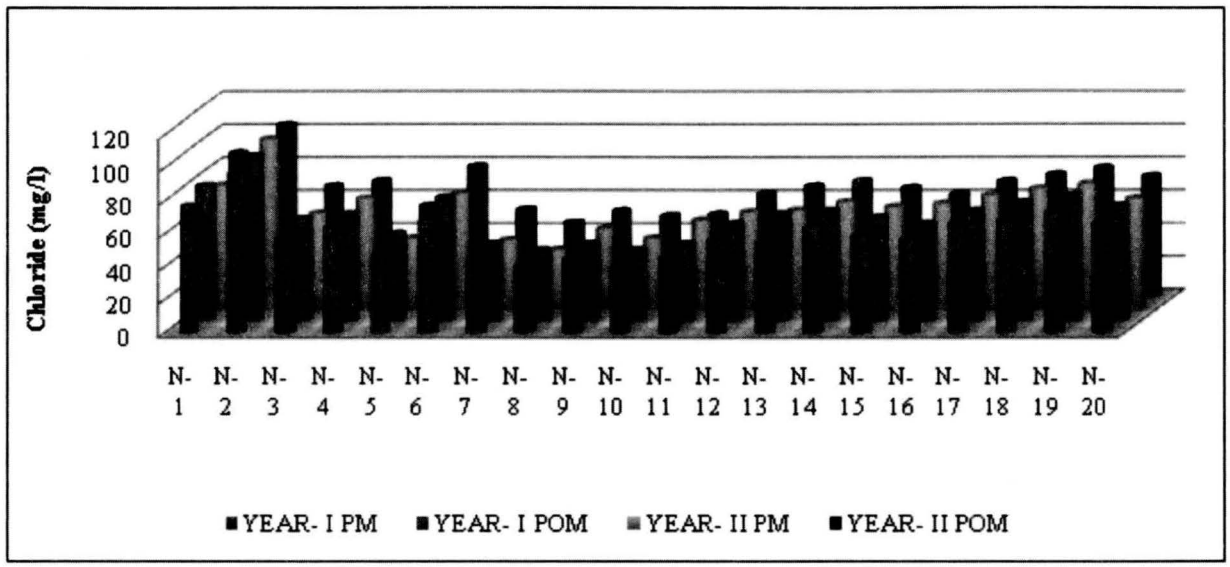

Fig. 2 Seasonal variation in chloride of groundwater

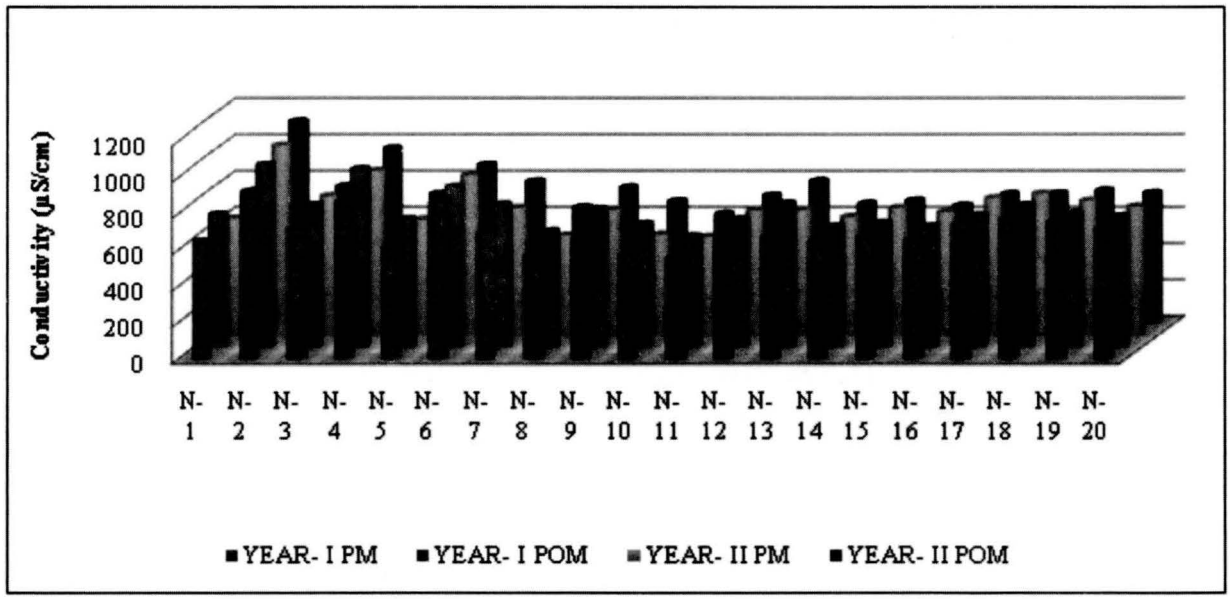

Fig. 3 Seasonal variation in conductivity of groundwater

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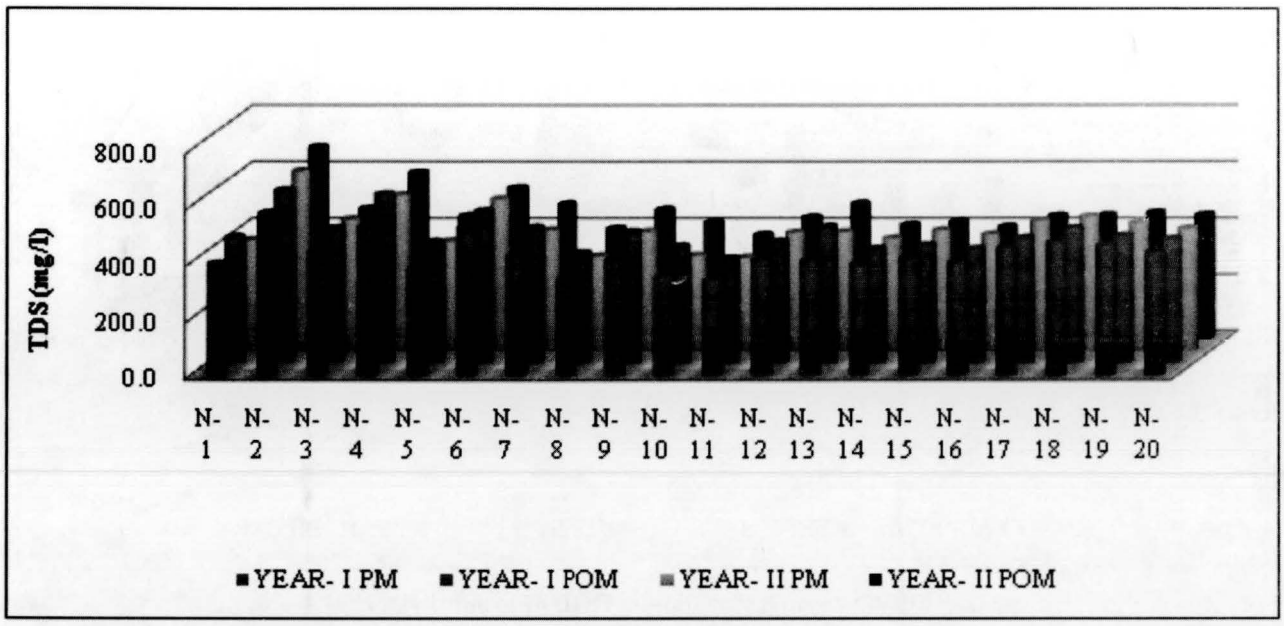

Fig.4 Seasonal variation in TDS of groundwater

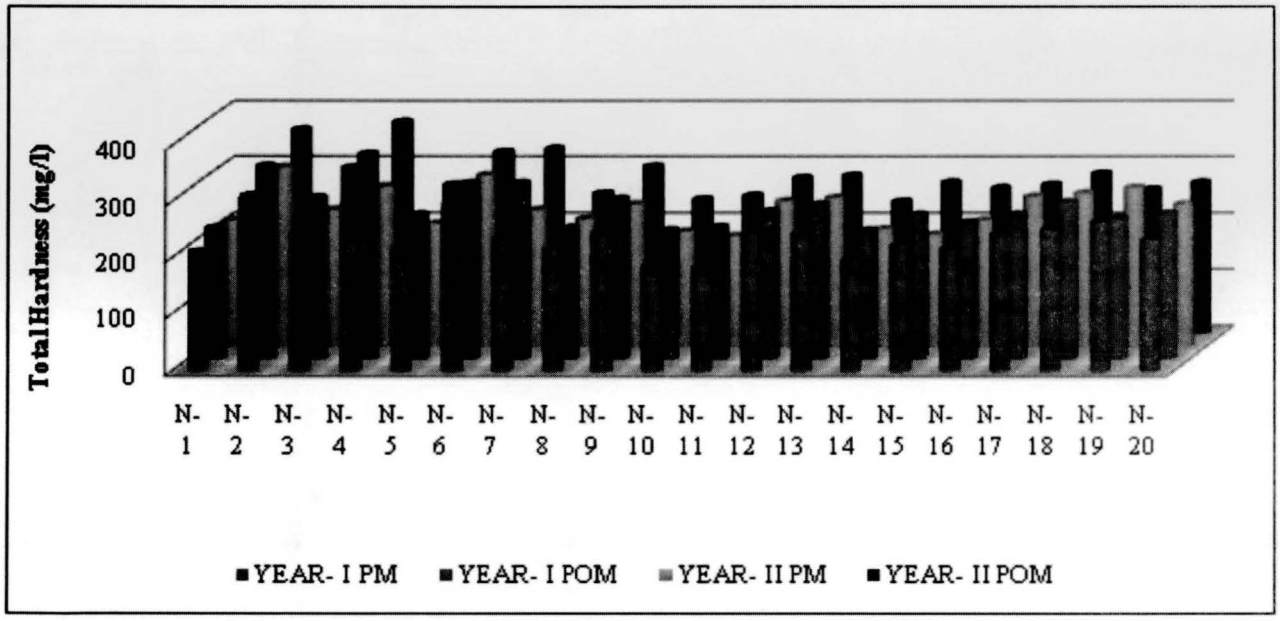

Fig.5 Seasonal variation in hardness of groundwater

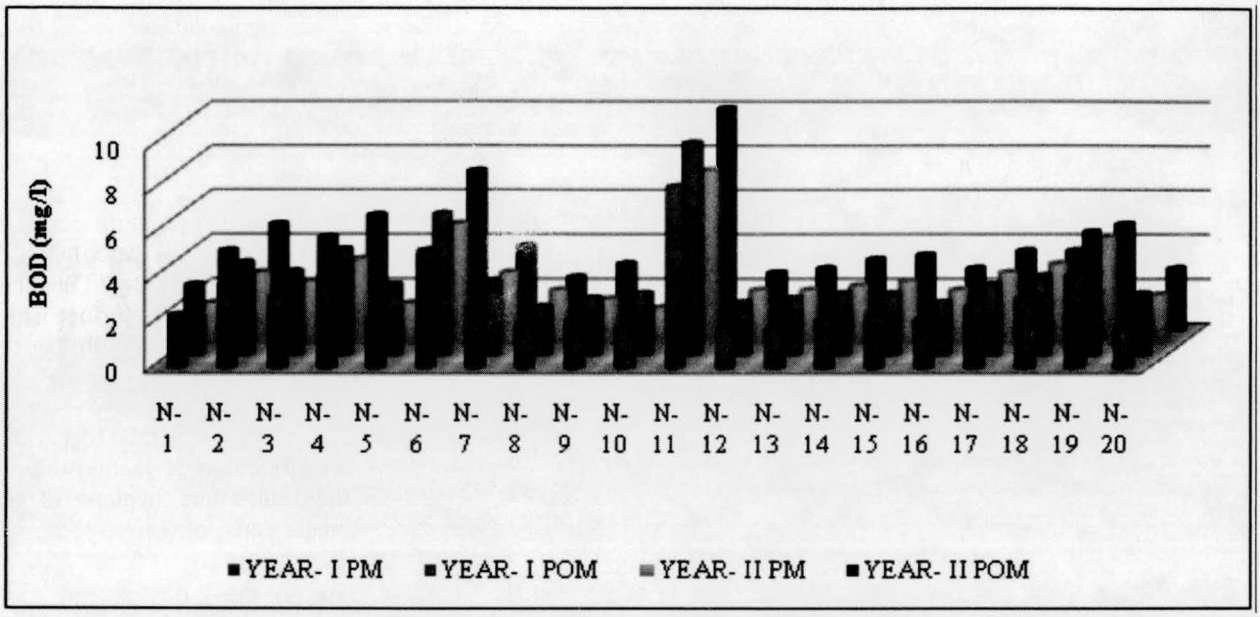

Fig. 6 Seasonal variation in BOD of groundwater

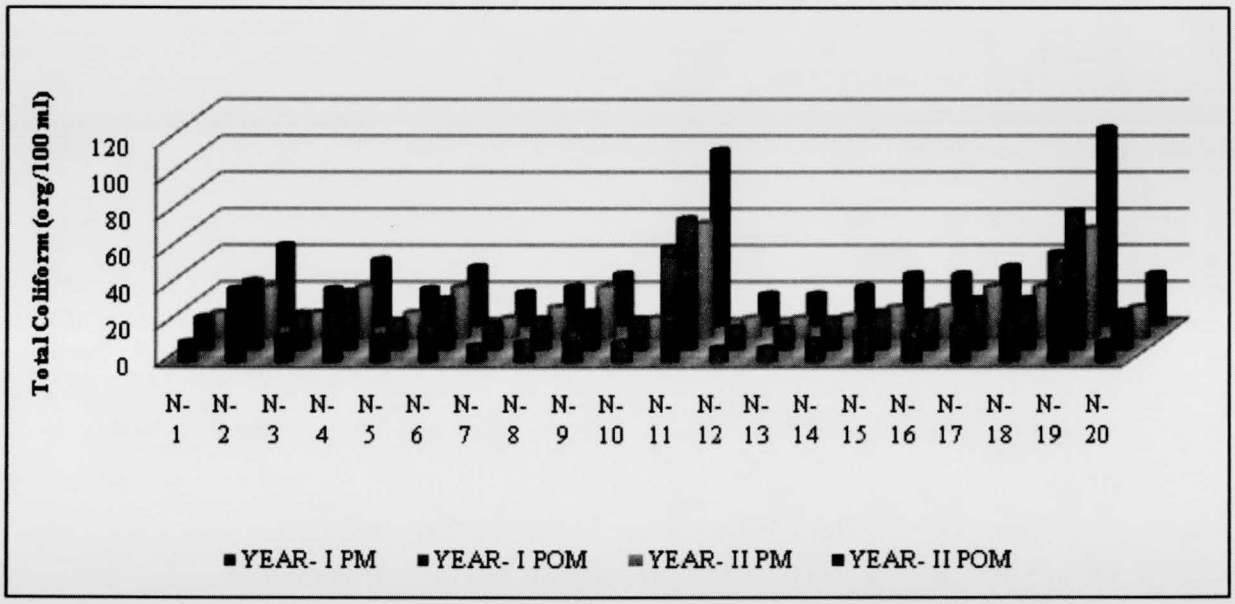

Fig.7 Seasonal variation in Total Coliform of groundwater

The chloride ion concentration values ranged from 39mg/l -103 mg/l during dry and wet seasons respectively and these were found to lie within the permissible level of 250 mg/L (Figure-2). The higher range of Chlorides can be attributed to higher temperature and the dilution of waste during wet season which increases its concentration in ground water samples.

The nitrate values during dry season ranged from 1.32 mg/L. However, during wet season, it ranged from 4.56 mg/L. Unpolluted natural water usually contains only minute quantities of nitrate. The groundwater samples in both seasons have their nitrate values lie below the limit of 50 mg/L Electrical conductivity values range from 558 µS/cm during dry season and 1112 µS/cm during wet season. (Figure-3) The highest value of conductivity

was due to the maximum concentration of soluble salts present in the N1 and N2 during rainy season of the year 2014-15.

The TDS values were 564 mg/l in dry season and 678 mg/l during wet season (Figure-4). This may be due to leaching of various pollutants through sides and bottom of unlined drain.

The concentration of BOD range from 1.8-2.4 mg/l in dry season and from 8.2 to 10 mg/l during wet season (Figure-6) . The higher concentration of organics can be due to mixing of sewage in groundwater. This concentration increases in rainy season due to increase in flow in the drains which causes dilution of solid waste and its percolation in the nearby aquifers.

The concentration of Coliform range from 11-63 org/100 ml in dry season and from 17 to 108 org/100ml during wet season (Figure-7). The major health hazard associated with the consumption of contaminated water is due to presence of pathogenic bacteria. The coliform group of bacteria especially fecal coliform inhibits in intestine of mammals including man and other warm-blooded animals and their presence in water sample directly reflects the mixing of sewage with groundwater. The high concentration of total coliform increases the possibility of presence of pathogenic strains of bacteria like Schigella, Salmonella, Streptococci, Vibrio, Staphylococcus aureus etc thus posing a serious health hazard to its consumers. Almost all water samples have reported high number of coliform count exceeding the desired count at all occasions. None of the samples fulfill the potable water quality criteria in terms of coliform. This renders the water unfit for human consumption for potable purpose and poses the threat of water borne disease to its consumers.

The residential area of the town is surrounded by agricultural area where agricultural activity and usage of fertilizers is very high throughout the year and also by aquaculture area. The open well water is available at shallow depth of 4-5 feet. So seepage of the fertilizers especially NO_3 PO_4 from agricultural field to the aquifer is possible resulting in the contamination of the well water. The very small amount of soluble leachates of organic compounds may also reach the groundwater aquifer whereas major portions of it may get absorbed by the soil during seepage. Thus, the groundwater aquifers were likely to be contaminated by the use of fertilizers. This may be due to increased hardness of the groundwater.

VI CONCLUSION

It revealed from the analysis results of groundwater samples indicate that certain parameters namely, EC, TH, TDS, BOD, chlorides, , were exceeding the desirable limit throughout the investigation period in all locations. This may be due to the percolation of contaminated water into the groundwater. Thus it is evident that stagnation of sewage in the surface water drains and there after in the reservoir is polluting the groundwater. The Bagmugaliya area and other residential colony in proximity of sewage fed drains and reservoir depend largely on groundwater for potable water. The contamination of groundwater is directly related to the health and hygiene of the people therefore it is major cause of worry.

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