A Case Study on physico Chemical Properties of Ground Water in ID- Bollaram Industrial area, Hyderabad (India) During 2010 Monsoon to 2013 summer

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Abstract:

A total of 45 groundwater samples for Nine representative seasons were collected from parts of ID Bollaram, Hyderabd, India to decipher hydrogeochemistry and groundwater quality for determining its suitability for drinking and agricultural proposes. Most of the parameters found in the water samples like Total Hardness (TH), Ca2+, Mg2+, Na+ and F^- are within the allowable limits. But the abnormal levels of metals are found in during summer season. As per the classification of water for drinking purpose, water is unfit for drinking purposes with minor exceptions irrespective of seasons.The major cause for the ground water conatmication is Bulk drug manufacturing industries arround the village.

Keywords: Hydrogeochemistry, Groundwater quality, ID Bollaram, India,Physico chemical properties.

1. Introduction

Ground Water is most dependable and renewable natural resource on this earth. Ground Water quality plays an important role in groundwater protection and quality conservation. Hence, it is very important to assess the groundwater quality not only for its present use but also from the viewpoint of a potential source of water for future consumption. But in the era of globalization ground water is contaminating because of Industrialization[1-3]. The utter most truth is the contamination of water with toxic elements of industrial effluents causing so many dangerous diseases. The WHO, government and semi government organizations monitoring ground water quality every year. In this study physico Chemical Properties of Ground Water in ID- Bollaram Industrial area reported and compared with **ISO (10500: 2012) Standards** during 2010 Monsoon to 2013

1.1 Study area

The study area coordinates are identified with GPS (make). The latitude and longitudes are given in table.1.The map of ID Bollaram was showed in Figure.1. 5 samples are collected from target location in 9 seasons during 2010 Monsoon to 2013 summer

Sample No	Latitude	Longitude
1	N 17° 33' 18.6961"	E 78° 20' 47.9379"
2	N 17° 33' 10.9628"	E 78° 21' 1.6879"
3	N 17° 33' 26.8712"	E 78° 20' 29.2053"
4	N 17° 33' 19.5063"	E 78° 20' 53.6156"
5	N 17° 33' 34.678"	E 78° 21' 0.5679"

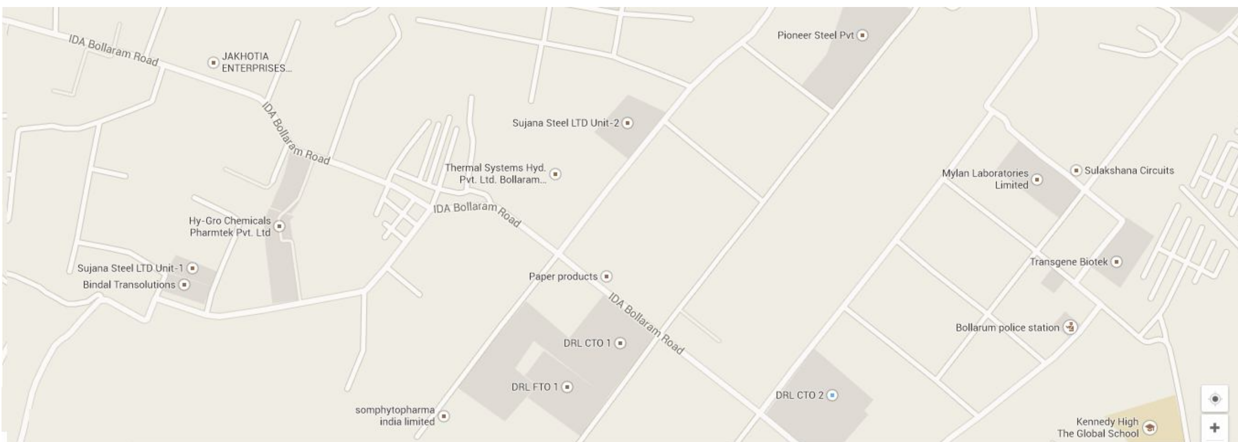


Figure.1 I D Bollaram Industrial Area map

1.3 Methodology

About 45 water samples were collected during in different seasons from bore wells and wells. Which are under use.

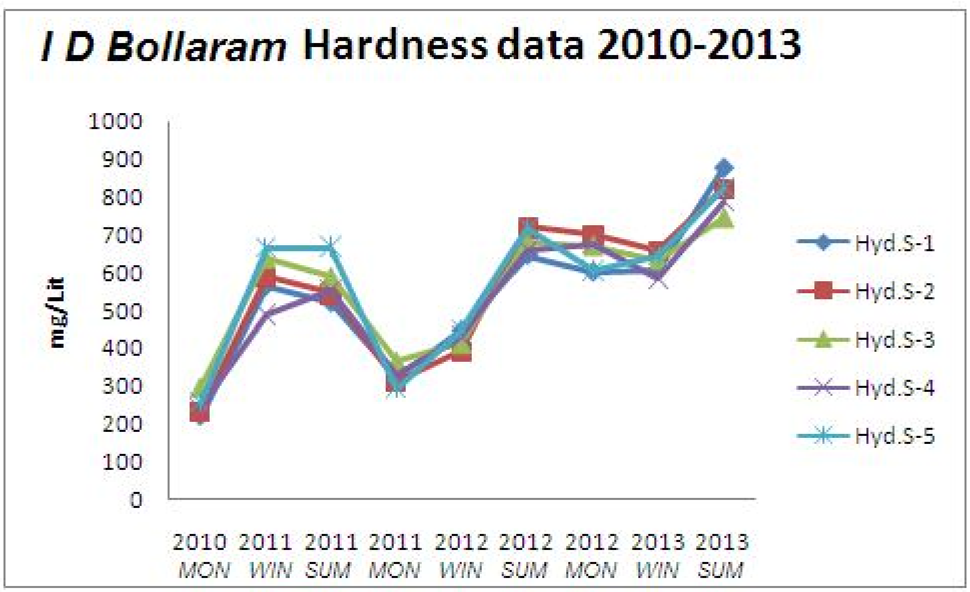
Various water quality parameters such as pH, total dissolved solids, total hardness, total alkalinity, calcium, magnesium, chloride, sulfate and heavy metals concentrations were measured. The techniques and methods followed for the collection, preservation, analysis, and interpretation are those given by ISO 10500: 2012 Standards.

1.4 Results and Discussion

The value of temperature in the study area ranged between 25.5^{o} and 38.2^{o} C. It is noted that high water temperature enhances the growth of microorganisms and may increase taste, odor, color and corrosion problems. The color ranged from 5 TCU which is within WHO and SON permissible limit. Color in drinking-water is usually due to the presence of colored organic matter associated with the humus fraction of soil or the presence of iron and other metals, either as natural impurities or as corrosion products. [4]

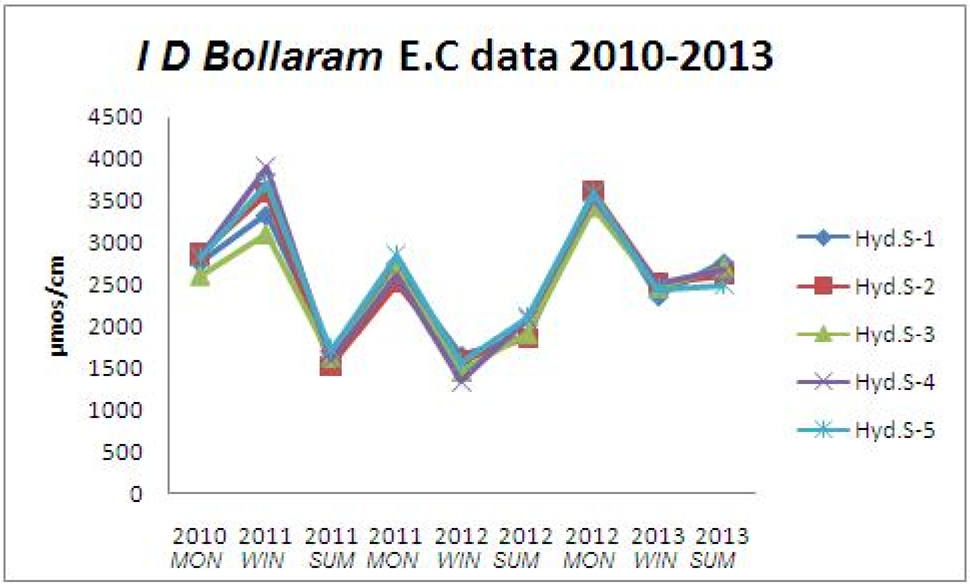
Average pH values of 6.7-8.0 were observed in all the seasons in the year 2011-13.These values are within the standard permissible limits of 6.5 – 8.5 (USEPA, 1990). It can be deduced that there are slight traces of dissolved acidic salts. The location study was contains high pollution due to industries and large civilization, the migration of salts from the surface of the soil to ground water might have occurred during seepage as ground water pollution can occur through seepage of pollutants and by migration of contaminants from the surface of the soil. This could be aided by the high infiltration and permeability of the soils which implies that any contaminant on the surface has the potential to leach or move fast into the subsurface, which could lead to ground water contamination. However, as ground water recharge occurs during the wet season due to continuous rainfall and deep percolation, increased dilution occurred thus yielding acceptable pH values during the wet season[5-9].

The values for Total Dissolved Solids (TDS) were found to be906mg/L and 2758mg/L. high TDS values were observed in summer season due to lowering of ground water level due to high surface temperatures and low rain fall. Low TDS was observed in monsoon season due to high ground water levels and low temperatures. Expect summer season of 2012 and 2013, remaining seasons under the study was found to be more than the permissible limit and less than the acceptable limit with the absence of alternative source as per ISO set for drinking water. The summer season of 2012 and 2013, TDS was found to be more than the acceptable limit. An average of 2177mg/L and 2646 in summer season of 2012 and 2013 respectively[10-15]. Total Dissolved solids (TDS) are fingerprints of industrial activity which is to a great extent in Hyderabad. The comparative graph was shown in Graph.1



Graph.1 TDS levels of Ground water in I D Bollaram (Hyderabad) during 2010-13

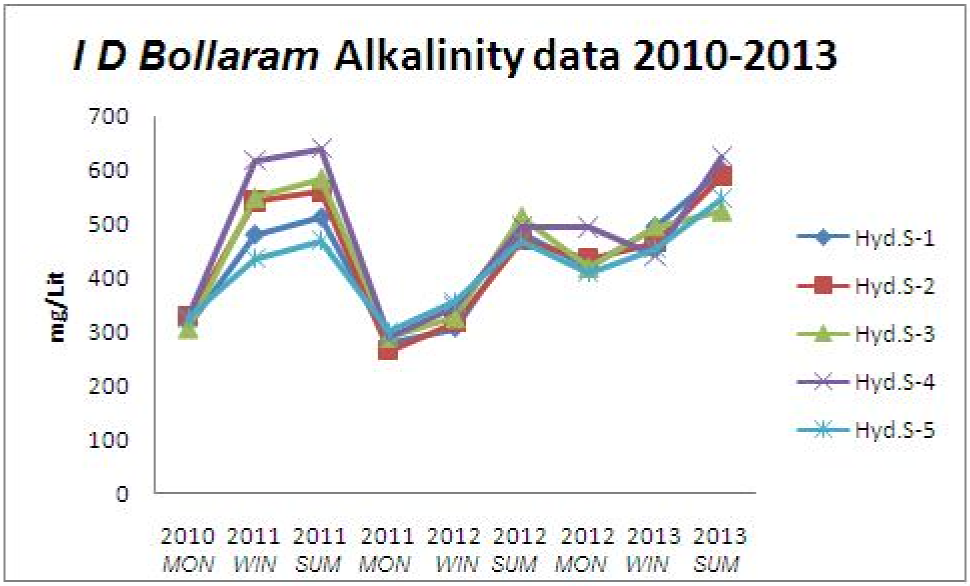
Conductivity almost goes together with TDS. The seasonal mean values for Conductivity were1516-3652µmos/cm in the samples under the study during 2011-13.A high conductivity was observed in winter season of 2011 and summer season of 2013. An average conductivity of 3524µmos/cm and 3652µmos/cm was found in winter season of 2011 and summer season of 2013 respectively. A very low conductivity was observed in monsoon season of 2011. A higher TDS means that there are more cations and anions in the water. With more ions in the water, the water become saline and increases the electrical conductivity[16-21]. Although all naturally occurring water has some amount of salt in it, the values around Hyderabad area can be linked to salts discharged from the industrial operations from the Flow station or the domestic usage. Results confirms that the water contains high electric conductivity and results were shown in Graph.2



Graph.2 EC levels of Ground water in I D Bollaram (Hyderabad) during 2010-13

The Biochemical Oxygen Demand (BOD) is reported to be a fair measure of cleanliness of any water on the basis that values less than 1-2mg/l are considered clean. 2-3mg/l fairly clean, 5mg/l doubtful and 10mg/l definitely bad and polluted. The BOD values relatively higher in (WHICH SAMPLE) some of the groundwater samples. The Chemical Oxygen Demand (COD) is an indication of organic matter susceptible to oxidation by chemical oxidant. Large value of COD shows that the water body will be in an oxidative stress. The mean value of COD in study area was found to be within the acceptable limit[22-24].

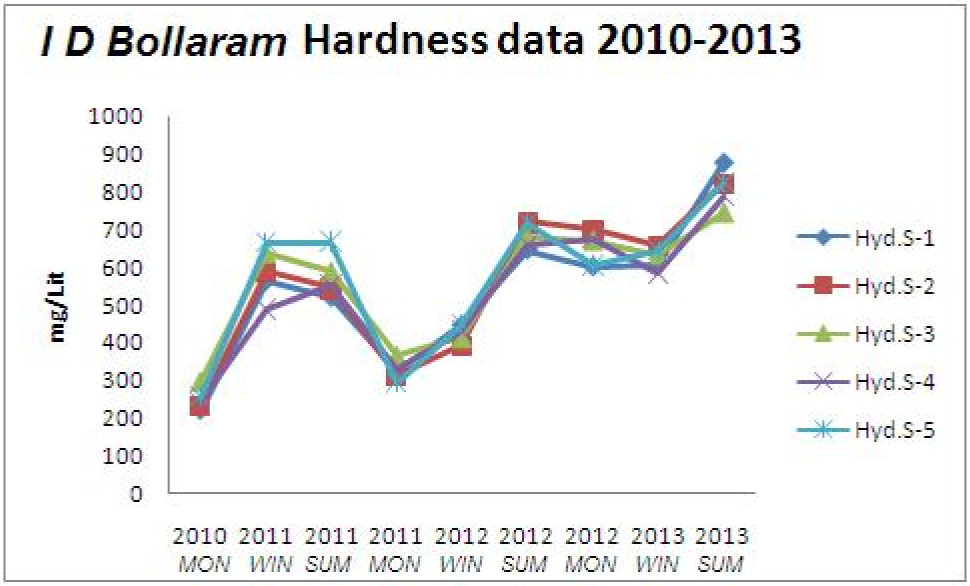
Alkalinity (as $CaCO_3$) is not a pollutant. It is a total measure of the substances in water that have acid neutralizing ability. It protects or buffers against pH changes i.e. keep the pH fairly constant and makes water less vulnerable to acid rain. The mean value for alkalinity was found to be very high in summer season of 2013 (576mg/L), summer season of 2011 (525mg/L) and low alkalinity was observed in monsoon of 2011 (285mg/L). The implication from this value is that there are geologic formations which may have carbonate, bicarbonate and hydroxide compounds. When water has high alkalinity it is concluded that it is well buffered. It resists a decrease in pH when acidic rain snowmelt, enters it. If water has an alkalinity below about 100mg/L as $CaCO_3$, it is poorly buffered and pH sensitive. [25] This could be harmful to the plants and was not suitable for drinking and domestic usage. Results were shown in Graph.3



Graph.3 Total Alkalinity of Ground water in I D Bollaram (Hyderabad) during 2010-13

The turbidity value of the study was found to be less than the acceptable limit and confirms that the water was clear. Turbidity in drinking water may be due to the presence of inorganic particulate matter in some groundwater or sloughing of bio film within the distribution system.. High turbidity value can protect microorganisms from the effects of disinfection thereby can stimulate bacterial growth. The value is within WHO and SON standard for drinking water[26].

The average range of hardness in a season was found to be 250mg/L -811mg/L and fell higher than WHO and SON standard of drinking water. High hardness in the ground water was observed in summer season and low hardness was observed in monsoon season. Monsoon season was found to be within the acceptance limit of hardness level and winter and monsoon seasons show more than the acceptance limit. Hardness caused by calcium and magnesium usually results in excessive soap consumption and subsequent “scum” formation. In some instances, consumers tolerate water hardness in excess of 500 mg/L. Depending on the interaction of other factors, such as pH and alkalinity, water with hardness above approximately 200 mg/l may cause scale deposition in the treatment works, distribution system and pipe work and tanks within buildings. Soft water, with a hardness of less than 100 mg/l, may, have a low buffering capacity and so be more corrosive for water pipes[27]. (WHO,:2003 ; SON 2007; WHO, 2008; WHO, 2011). Results are shown seasonally in Graph.4



Graph.4 Hardness of Ground water in I D Bollaram (Hyderabad) during 2010-13

Chloride in drinking-water originates from natural sources, sewage and industrial effluents, urban runoff containing deicing salt and saline intrusion. No health based guideline value is proposed for chloride in drinking-water by WHO and SON standard of drinking water. However, chloride concentrations in excess of about 250 mg/l can give rise to detectable taste in water and the observed range was found to be 341-1007mg/l. High chloride levels was observed in summer season of 2012.

SO_4^{2-}however has elevated concentration of 157-480mg/L seasonally in the duration under the study. The out-come of this elevated concentration maybe due to the fact that the Deltaic plain is a sequence of sands and silt with local intercalation of peat and sulphurrich clays. The dis-solution of sulphides such as pyrite from the interstratified material by percolating water produces SO^4 ions in water. SO_4occurrence could also be related to increasing heavy traffic flow and petroleum activities in Hyderabad. Gaseous emissions from vehicles contain significant amount of sulphur rich gases. The gas flares in the area are also major contributor of sulphur rich gases into the atmosphere. The relative calm atmosphere coupled with constant rainfall and high temperature in the area ensures that much of the emitted substances are not carried far from the vicinities before they are scavenged out of the atmosphere as acid rain.

The heavy metal toxicities causes nausea, persistent vomiting, diarrhea and abdominal pain are the hallmark of most acute metal ingestions. The concentration of Pb in water samples ranges from 0.01 to 0.04mg/l. The permissible limit of Pb concentration in drinking water is 0.01 mg/l (WHO, 2004), the samples collected in winter and monsoon season was found to be below the detectable limit and the samples in the summer season are in above the permissible limit of WHO and may inflict detrimental effects on the inhabitant's health. The main sources of Pb contamination of the ground water system are the industrial discharges from smelters, battery manufacturing units, runoff from contaminated land areas, atmospheric fallout and sewage effluents. Use of land pipes and plastic pipes stabilized with lead contribute higher levels of lead in drinking water. Permanent health hazards due to Pb toxicity cause nervous system, gastrointestinal, respiratory disorders and anaemia. Children are more sensitive to Pb poisoning, which may lead to damage of brain. [28-30] Pb taken into the body can be injurious to health. It may also

The concentration of Ni in the drinking water ranges from 0.01 to 0.04mg/L. The desirable limit for Ni is 0.02 mg/l for drinking water (WHO, 2004). Ni compounds induce nasal, laryngeal and lung cancer. Na concentration in water samples ranges from 48 to 134mg/L with desirable limit of < 20 mg/l (WHO, 2004). 100 % of the samples were above the desirable limit. Na is involved in transmission of nerve impulses and maintenance of water, acid-base balance. Excessive intake of very high doses of sodium may cause acute effects such as nausea, vomiting, inflammatory reaction in the gastrointestinal tract, thirst, muscular twitching, convulsions, and possibly death[31-32]. For long-term lower level exposures, the health effect of primary concern is hypertension. Central nervous system disturbances such as convulsions, confusion and pulmonary edema are possible (USEPA, 2003).

The concentration of Mg varied from 31 to 94mg/L with the mean of 95.02 mg/L, the permissible limit of WHO for Mg is 30 mg/L, and about 100 % of the samples exceed the permissible limits of WHO. Mg is a cofactor for some 350 cellular enzymes, many of which are involved in energy metabolism. The major cause of hypermagnesemia is renal insufficiency associated with a significantly decreased ability to excrete magnesium. Increased intake of magnesium salts may cause a change in bowel habits (diarrhoea), but seldom causes hypermagnesemia in persons with normal kidney function (WHO, 2009a). Excess magnesium concentration may lead to changes in mental status, nausea, diarrhoea, loss of appetite, muscle weakness, difficulty in breathing, extremely low blood pressure, and irregular heart beat. Few heavy metals like Mercury, Arsenic were found to be less than the detectable levels in all the samples under the study[33-35].

The above results indicate that ground water contamination by industrial activities takes a short period of time especially in areas with soils having moderate to high porosity, infiltration and permeability as was typical of soils within the study area. Furthermore, during the dry season the risk of contaminant accumulation is higher and poses a threat to the survival of the inhabitants of the area who depend on these water sources for their survival, but the risk is less during the wet season, as deep percolation of the high rainfall amounts received induces groundwater recharge and subsequent dilution of contaminant.

The implication of the finding is that groundwater quality improves away from industrial settings, traffic activities. This inference is instructive for water resource developers in Hyderabad. The recent drive towards industrialization and the attendant urbanization means a greater demand for groundwater in the area. New groundwater abstraction schemes are recommended.

Future success in understanding the dynamic nature of groundwater systems will rely on continued and expanded data collection at various scales, improved methods for quantifying heterogeneity in subsurface hydraulic properties, enhanced modeling tools and understanding of model uncertainty, and greater understanding of the role of climate and interactions with surface water.

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