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Physico-chemical analysis of underground water of Harihara Taluk of Davanagere District, Karnataka, India

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ABSTRACT

Ground water samples were collected from different villages of Harihara taluk (India). These water samples from 25 sampling points of Harihara taluk were analyzed for their physicochemical characteristics. Laboratory tests were performed for the analysis of samples for pH, Hardness, Chloride, Alkalinity, TDS etc. On comparing the results against drinking water quality standards laid by Indian Council of Medical Research (ICMR) and World Health Organization (WHO), it is found that some of the water samples are non-potable for human being due to high concentration of one or the other parameter. The usefulness of these parameters in predicting ground water quality characteristics were discussed. Thus an attempt has been made to find the quality of ground water in and around Harihara taluk, suitable for drinking purposes or not.

Key Words: Water quality, physiochemical parameters, pollution study, drinking water. Harihara taluk.

INTRODUCTION

Ground water is ultimate, most suitable fresh water resource with nearly balanced concentration of the salts for human consumption. Over burden of the population pressure, unplanned urbanization, unrestricted exploration policies and dumping of the polluted water at inappropriate place enhance the infiltration of harmful compounds to the ground water. Ground water occurs in weathered portion, along the joints and fractures of the rocks. In fact, industrial waste and the municipal solid waste have emerged as one of the leading cause of pollution of surface and ground water. In many parts of the country available water is rendered non-portable because of the presence of heavy metal in excess. The situation gets worsened during the summer season due to water scarcity and rain water discharge. Contamination of water resources available for household and drinking purposes with heavy metals, metal ions and harmful microorganisms is one of the serious major health problems. Studies regarding the ground water quality analysis has been made by many authors like B. K. Gupta and R. R. Gupta (1999), M. R. Rajan and I.

Paneerselvam. (2005), S. B. Thakare et al. (2005), Shikha Bisht et al. (2007). The recent research in Harihara taluk concluded that it is the high rate of exploration then its recharging, inappropriate dumping of solid and liquid wastes, lack of strict enforcement of law and loose governance are the cause of deterioration of ground water quality. The Urban and Rural areas of Harihara taluk facilitates the drinking water in limited area, alternate to this people keeps option as Bore wells and hand pumps etc and they consume ground water without biochemical treatment and the level of pollution has become a cause for major concern. The water used for drinking purpose should be free from toxic elements, living and non-living organisms and excessive amount of minerals that may be harmful to health. Since last few years it has been seen that the water quality of the alternative sources like hand pumps and bore wells has been deteriorating. Hence, it is highly essential to assess the quality of drinking water of Harihara taluk.

MATERIALS AND METHODS

2.1 Study Area: The state of Karnataka is situated in the southern peninsular India. Harihara is one of the taluk head quarters, situated about 15 km away from Davangere District (corporation city), Karnataka state. Harihara taluk is located between 14^0 25^1 E latitude and 75^0 30^1 N longitude. As a whole, the region has and dry and wet land also rocky areas with an average elevation of 700 meters above mean sea level. It comprises 84 villages with a total population of 2, 45,654 as per 2001 census.

2.2 Geology: Harihara taluk has a geographical area of 49866 hectares. The taluk comes under granite and gneissic formation which is generally called as "hard rock terrain". However, green stone belt consisting of chlorite-schist, micaschist along with clay formations have been observed in the hard rock formations of this region. Geographical location of study area is shown in the Figure 1.

Sl. No.	Location / Sample Number	Name of the Site/Village	Sl. No.	Location / Sample Number	Name of the Site/Village
1	S_1	Kondajji	14	S_{14}	Yekkegondi
2	S_2	Kenchanahalli	15	S_{15}	Bellodi
3	S_3	Saarathi	16	S_{16}	Haraganahalli
4	S_4	Chikkabidare	17	S_{17}	Hanagavadi
5	S_5	Deetoor	18	S_{18}	Holesirigere
6	S_6	Ganganarasi	19	S_{19}	Dhoolhole
7	S_7	Guttur	20	S_{20}	Yelavatti
8	S_8	Harihara (Kirloskar)	21	S_{21}	Gigali
9	S_9	Harihara (Birla)	22	S_{22}	Malebennur
10	S_{10}	Halasabalu	23	S_{23}	Hallihalu
11	S_{11}	Thimmalapura	24	S_{24}	Kokkanur
12	S_{12}	Hosahalli	25	S_{25}	Kadaranayakanahalli
13	S_{13}	Bhanuvalli			

2.3 Sample collection

Water samples from the selected sites were collected in pre-cleaned blue or black coloured carbuoys of 2 liter capacity with necessary precautions during February2008-January 2009. The samples after collection were immediately placed in dark boxes and processed within 6 h of collection.

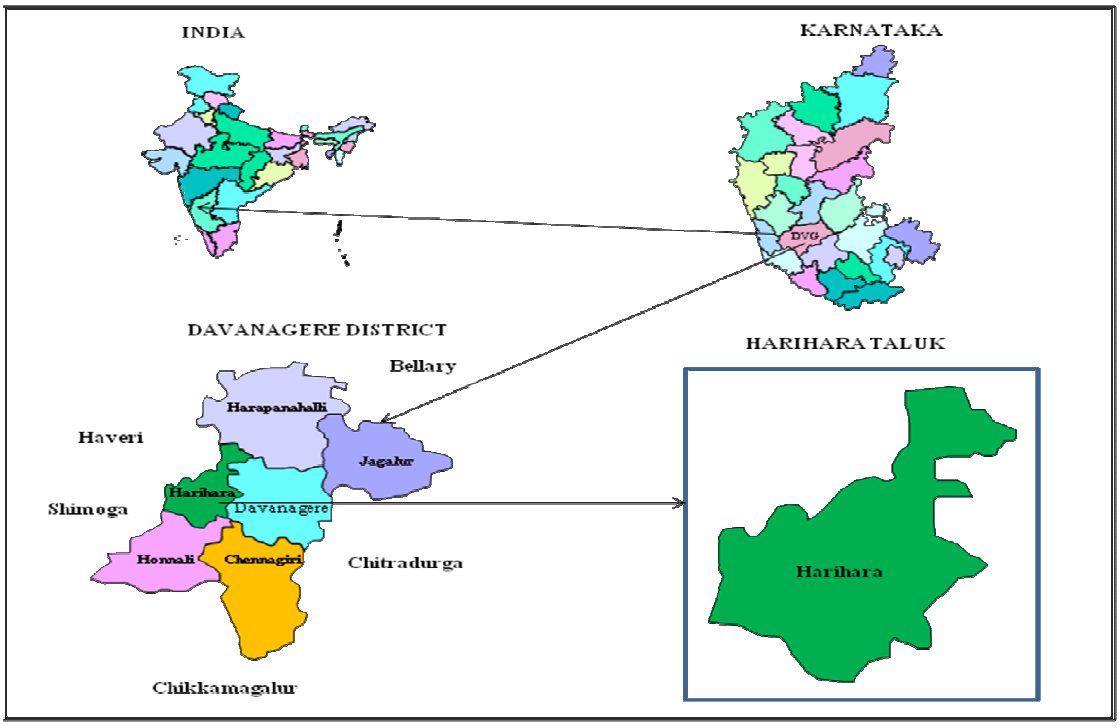

Fig.1: Map showing Geographical location of study area

3. Physico-Chemical Analysis

The collected samples were analyzed for different physico-chemical parameters such as pH, Electrical conductivity (EC), Total Dissolved solids (TDS), Total hardness (TH), Ca^{2+}, Mg^{2+}, $SO_4^{2+}$and Chloride as per the standard methods (APHA 1998), and the results were compared with the Indian Standards (ICMR) for potable water. The parameters present in the water sample can be calculated by using various methods. The pH of all the water samples was determined using a pH meter (Model no LI 127, Elico) Electrical conductivity was measured using a conductivity meter. The chloride, calcium, magnesium and total hardness were estimated by the standard methods of water

RESULTS AND DISCUSSION

A total of 25 water samples from hand pumps and bore wells of Harihara taluk were collected in pre-cleaned blue or black colored carbuoys of 2 liter capacity, which were being used mainly for the purpose of drinking and cooking and are brought to the laboratory with proper care. The water quality analysis of different ground water samples have been carried out for pH, Electrical conductivity, TDS, Total hardness, Ca hardness, Mg hardness, Ca ion, Mg ion, Chloride, and sulphate.

The temperature, pH, conductivity and dissolved solids of the water samples were determined on the spot using a thermometer; pH meter, conductometer and TDS meter. The samples were analysed using various analytical methods, APHA (1998), AWWA-WPCF (1995).Total hardness and calcium were measured by EDTA titrimetric method using EBT indicator respectively. Chloride was determined by Argentometric method using potassium chromate indicator. The chemical data were complied further to know location wise distribution. The data revealed that there were considerable variations in the examined samples from different sources with respect to their chemical characteristics. The results indicate that the quality of water considerably varies from location to location.In the present study the Samples collected at Halasabalu village (7.6)

and Kokkanur and Hallihalu (8.2) were slightly basic which can be seen from its pH and alkalinity values. Though pH has no direct effect on the human health, all the biochemical reactions are sensitive to variation of pH. For most reaction as well as for human beings, pH value 7.0 is considered as best and ideal. In the present study pH value of water samples varied in a narrow range within the permissible limits in all sources. The pH has showed significant positive relation with electrical conductivity and alkalinity. The variation of pH values are shown in Fig.2.

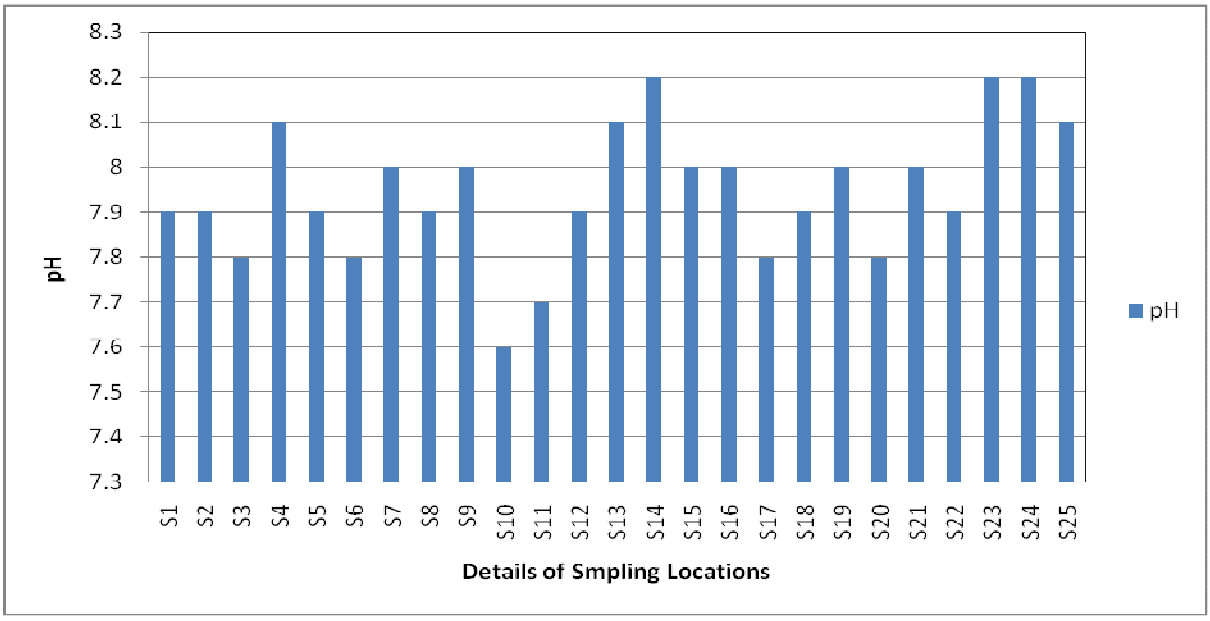

Fig.2: pH values of various water samples collected in Harihara taluk

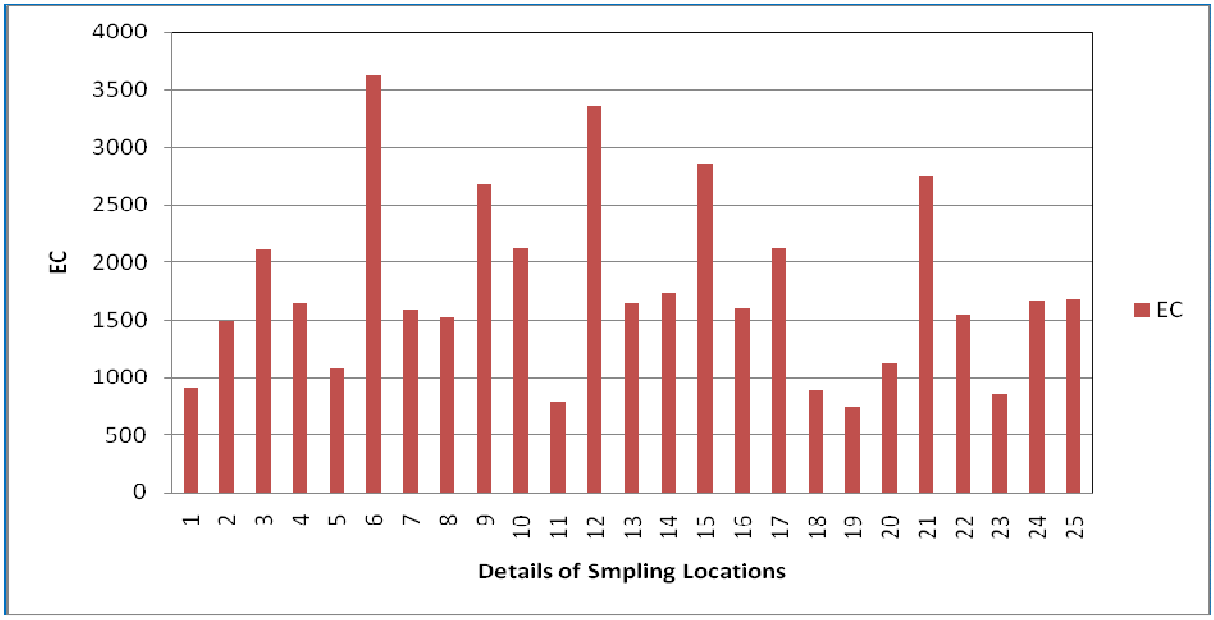

Fig.3: The EC values of various water samples collected in Harihara taluk.

In the present study The EC values were found higher at Ganganarasi village (3700 µmhos/cm) and very low conductivity was found at Dhoolhole.(741µmhos/cm).EC values can be used to estimate the dissolved solids concentration which may affect the taste of water and suitability for

various uses. Higher the conductivity values indicate higher the dissolved solids concentration in water. Higher the concentration of acid, base and salts in water, more will be the conductivity. The variation of pH values are shown in Fig.3.

TDS is commonly found as carbonates, bicarbonates, chlorides, sulphates and nitrates of calcium, magnesium, sodium, potassium, iron and manganese mineral containing rocks. The high content of dissolved solids increases the density of water and influences osmoregulation of fresh water organisms. The water samples Ganganarasi village (2098 mg/L) and Hosahalli village (1825 mg/L) were found to possess high TDS value when compared with the tolerance limit of 1500 mg/L (Obi et al., 2007). The TDS value is low for the water sample collected at Thimmalapura (382mg/L). Total dissolved solids have showed the significant positive relation with the electrical conductivity, chloride, alkalinity, sulphate, total hardness, calcium and magnesium. The results are given in Fig.4.

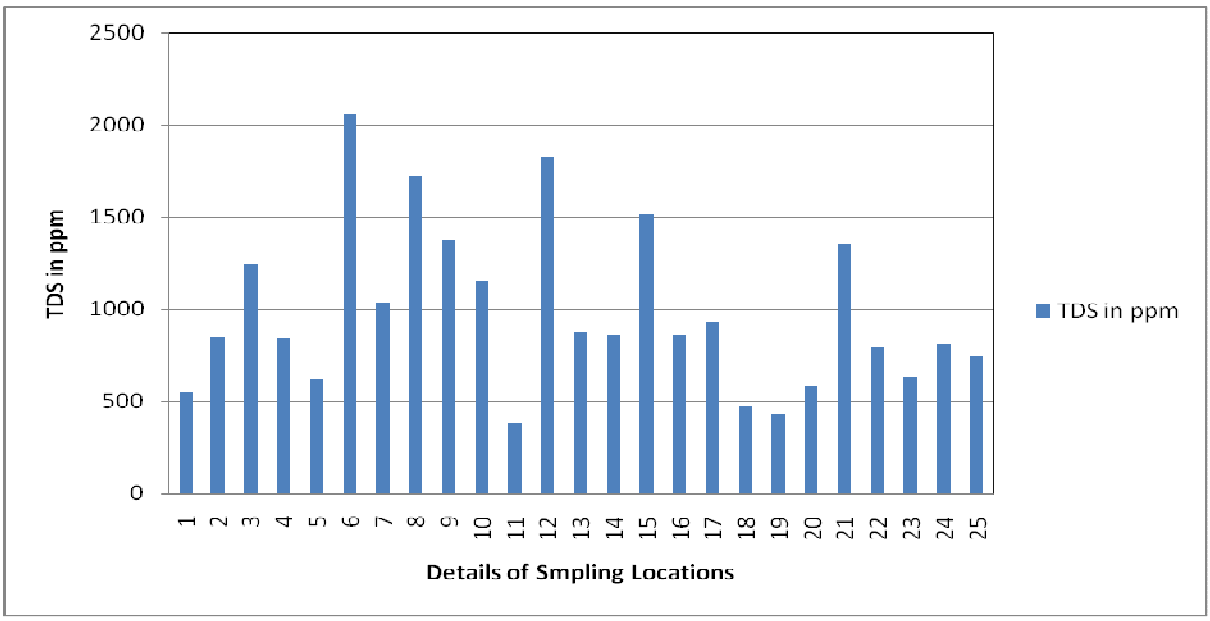

Fig.4: The TDS values of various water samples collected in Harihara taluk.

Hardness is the measure of the capacity of water to produce lather with soap or detergent. Hardness is one of the very important properties of ground water from utility point of view for different purposes. In the present study water was very hard and crossed the permissible limits. It is well known that hardness is not caused by a single substance but by number of dissolved metallic ions, predominantly calcium and magnesium ions and also due to other cations likes barium, iron, manganese, strontium and zinc also contribute. The high concentration of total hardness in water mainly due to the leaching of igneous rock and carbonate rocks (dolomite, calcite and limestone). Generally hard water originates in the areas where thick top soil and limestone formations were present and its seepage. As we know calcium and magnesium are the two principal ions. The concentration of total hardness in drinking water sources ranged between (S_4) 170mg/L and (S_4) 1230 mg/L (Shyamala et al., 2008) and (Gupta et al., 2009) showed the significant positive relationship with the concentrations of total hardness and pH. In Ganganarasi village bore well water showed high concentration of total hardness Fig 5.

In the present study The total hardness exhibited the significant positive relation with the calcium and magnesium and calcium has showed the positive relation with the concentration of the

magnesium. The strong correlation-ship between these parameters could be due to changes in land use namely deforestation etc.

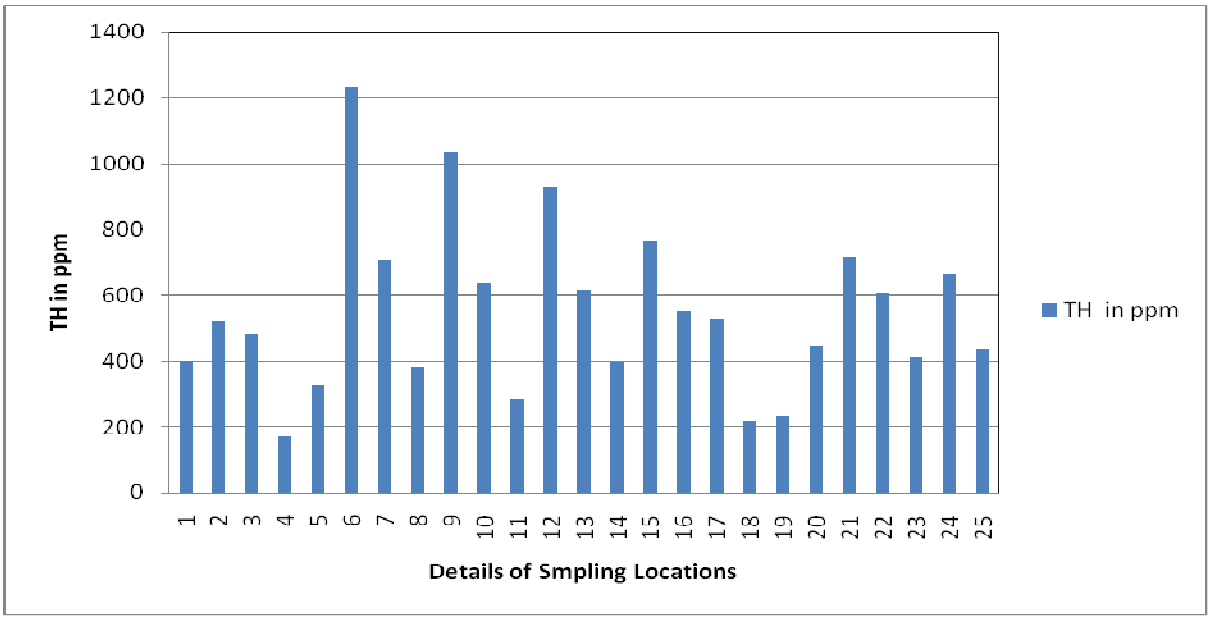

Fig.5: The Total Hardness values of various water samples collected in Harihara taluk.

Since calcium and magnesium are directly related to hardness and hence they are discussed in combined. The acceptable limits for calcium and magnesium for domestic use are 75 mg/L and 30 mg/L, respectively, in ground water. Whereas in case of non-availability of water sources, calcium up to 200 mg/L could be accepted. The water samples Ganganarasi village (710 mg/L) possess high calcium value and Chikkabidare village showed least calcium value (70mg/L) (Harish Babu et al., 2006). Similar variation of magnesium values can be seen like calcium ie S_6 has 130mg/L and S_4 has 20.5 mg/L Fig 6.

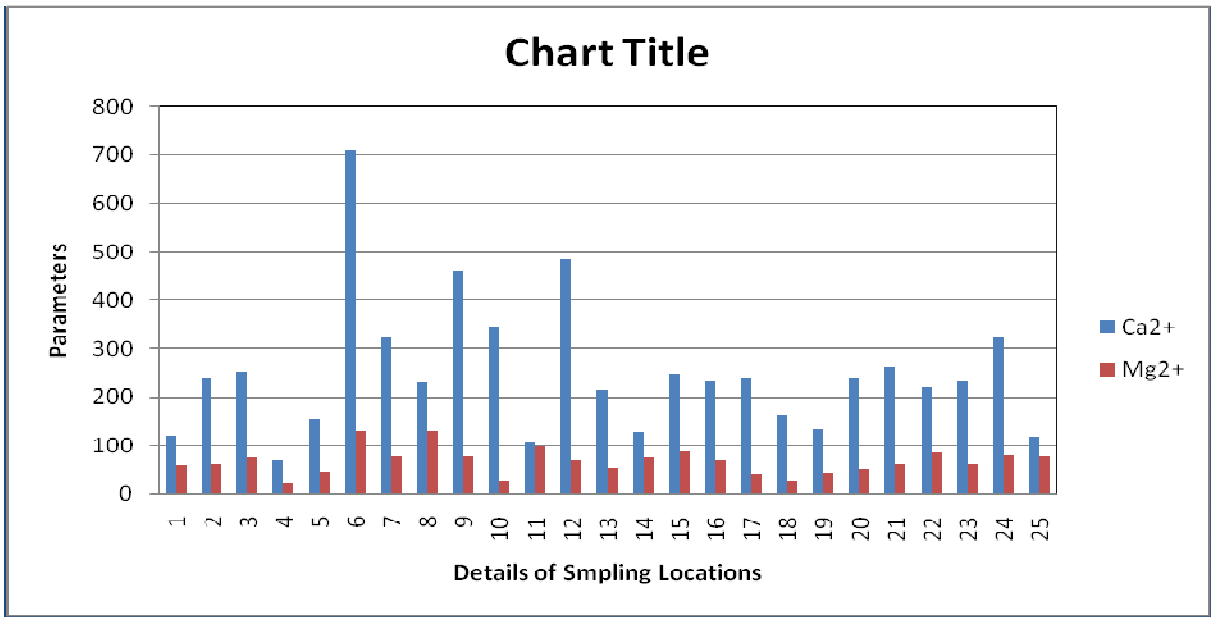

Fig.6: The Ca^{2+} and Mg^{2+} values of various water samples collected in Harihara taluk.

The Chloride ion concentrations are very high in water sample of Hosahalli village (712mg/L) and very low in water sample of Holesirigere and the variations are shown in the Fig 7.

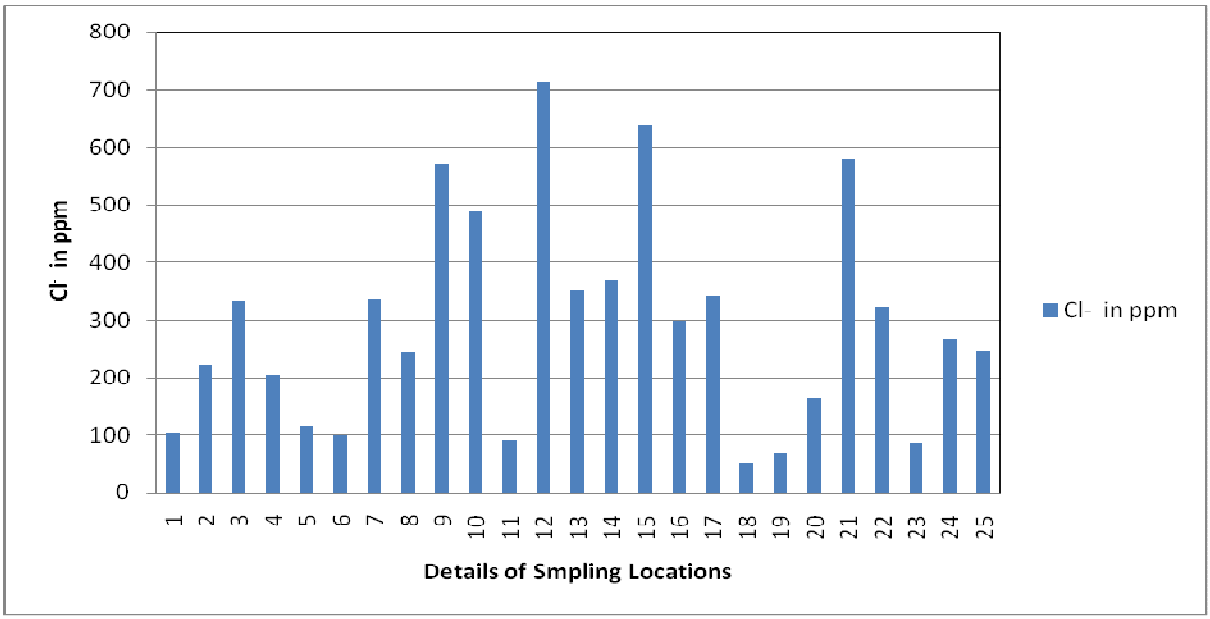

Fig.6: The Chloride values of various water samples collected in Harihara taluk.

CONCLUSION

In general ground water quality of Harihara taluk is not harmful to human beings, since the ground water which were taken from the various places of Harihara taluk were analyzed and the analysis reports that the water quality parameters like pH, EC, Cl^- ,TDS ,Ca^{2+}, Mg^{2+} and Hardness lies within the maximum permissible limit prescribed by WHO and ICMR. Except certain parameters like DO etc, few sampling sites have lower DO than permissible limit due to anthropogenic activities, but this value does not have any impact for the water to use for drinking purpose. Hence this report explains the ground water in Harihara taluk is suitable for drinking and agriculture purposes.

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