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Study of Physico-Chemical Characteristics of Ground Water Samples of Chikkadalavata Grampanchayat, Tumkur District, Karnataka, India

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Abstract: *About 30 years back rural areas in Tumkur district were getting drinking water from open wells. Due to extensive digging of bore wells, the ground water table receded alarmingly. Investigations have shown that ground water 60mts at below ground level is unfit for human consumption. This is a serious matter since ground water table has gone down to more than 200mts below ground level. Hence there is an urgent need to provide safe drinking water to the rural population. Water samples from bore wells/Hand pumps were collected from 9 villages belonging to Chikkadalavata Gram panchayath, Madhugiri Taluk, Tumkur district, Karnataka to study the water quality parameters. It is found that ground water in this area contains excess fluorides, Iron, and Alkalinity in general. Results of analysis for water quality parameters are presented in this paper.*

Key words: *Chikkadalavata Grampanchayat, Ground water, Physico-chemical Characteristics, water quality parameters,*

Introduction

There is a popular saying that health is wealth. 80% of human body contains water. Hence it becomes paramount importance to consume safe drinking water to preserve good health. Due to digging of bore wells, rapid recession of ground water table to depths over 200 mts below ground level has taken place. Rural populations use such water for drinking. The water from such a great depth has been found unfit for human consumption. Hence it becomes necessary to provide safe drinking water to rural population. At present drinking water in major part of Tumkur district is being provided either by hand pumps or by mini water schemes. Such water has been found to contain excess fluorides particularly in Pavagada, Madhugiri, Sira Taluks of Tumkur district.
Government of Karnataka, NGOs (Non-Govt organizations) such as BAIF(Bharatiya Agro Industries Foundation), India, have been implementing drinking water projects particularly in Pavagada, Sira, Madhugiri, Bagepalli and Mundargi taluks in Karnataka state to provide safe drinking water to village population. These projects essentially contain rain water harvesting by constructing structures such as Farm ponds, Check dams, gully plugs together with contour bunding in steep slopes. Roof top rainwater harvesting in villages has been found extremely successful for providing drinking water to rural population throughout the year.

Department of Mines and Geology, Government of Karnataka has been collecting water samples from test bore wells in Maiduguri taluk, Tumkur District bordering the state of Andhra Pradesh in the eastern part of Karnataka, India (Fig.1). Analysis of data Collected from Sira, Madhugiri, and Pavagada Taluks has shown that the groundwater contains excess fluorides and other impurities. This

paper presents results of investigations conducted in nine villages belonging to Chikkadalavata gram panchayat, Madugiri Taluk. The water samples collected from the villages have been analyzed to determine the water quality parameters such as Fluorides, Chlorides, Carbonate, Nitrates, Total iron, Sulphate, Total hardness, pH, Turbidity. This analysis has revealed that water samples from many villages contain excess fluorides, iron and other impurities which will harm health of people who consume such water.

Materials and method

Study Area:

The area selected for study of water quality parameters is Chikkadalavata Grampanchayat limits. This is situated in Madhugiri Taluk, Tumkur District, Karnataka state (Figure 1). The area of this Grampanchayat is covered under most backward areas of Karnataka declared by Dr. D. M. Nanjundappa's report. The total geographical area of Chikkadalavata grampanchayat is 4796 hectares. There are 9 villages in the Grampanchayat. According to census report of 2001 the population was 7146 (male: 3650; female: 3496). The data is retrieve from www.censusindia.gov.in. The following 9 villages are situated in this Grampanchayat were selected for the study.

Chikkadalavata, Doddadalavata, Haleitakaloti, Hosaitakaloti, Janakaloti, Obalapura, Shanagana halli, Tondoti, Vitalapura.

The annual rainfall in this area is 428mm. In the absence of rivers, the only source of drinking water is ground water. At present drinking water to these villages is being provided through hand pumps and mini water supply system.

Sample Collection and Analysis:

Samples of ground water from bore wells were collect at the above mentioned location of Chikkadalavata grampanchayat, Madhugiri taluk, Tumkur, Karnataka. Analysis was carried for various Physico chemical water quality parameters such as Total iron content is determined by Gravimetric method. Alkalinity is determined by titrimetric method. Chloride content is determined by Argentometric method. Fluorides content is measured using SPADNS colorimetric method. Nitrate is determined by Phenol di Sulphonic acid method. Sulphate is determined by Turbidimetric method. Total Hardness is determined by EDTA Titrimetric method. pH is measured by Electrometrical method and Turbidity is determined by using Nephelometric method. The Assessment of Ground Water Quality described in "Standard methods for the examination of water and wastewater American Public Health Association [APHA, 1995].

The water samples were analyzed in water analysis laboratory of zilla panchayath, Tumkur. The physico-chemical parameters determined from laboratory analysis of ground water samples collected from the villages belonging to Chikkadalavata grampanchayat have been summarized in figures 2-10.

Results and Discussion

Total Iron:

Iron is a contaminant/impurity which is not safe for human consumption if it is present beyond permissible limit taste and appearance are affected, has adverse effect on domestic use and water supply structures, and promote iron bacteria [BIS 2009]. Iron and Manganese in water are cause of discolor and distaste [Sajad *et al,* 2009]. Figure 2 represents the variation in total iron content of the water samples. The variation ranged from a minimum of 0.48 mg/l, Chikkadalavata to a maximum of 1.08mg/l, Doddadalavata. Among the 9 samples collected, 3 samples collected from Doddadalavata, Janakaloti and Shanaganahalli respectively contain iron more than permissible limits, According to BIS specification desirable limit is 0.36mg/l and Permissible limit is 1.00mg/l.

Alkalinity:

Alkalinity of water source is more significant than its pH because it takes in to account the principal constituents that influence the water's ability to regulate the

pH of the medium. Alkalinity increases as the amount of dissolved carbonates and bicarbonates increases [Smitha *et al,* 2007].

Figure 3, represents variation in alkalinity which ranges from a minimum of 400 mg/l to a maximum of 1160mg/l and is graphically represented in fig-3. Among the 9 samples, 6 samples collected from Chikkadalavata, Haleitakaloti, Janakaloti, Obalapura, Tondoti and Vitalapura show alkalinity more than permissible limit and 2 samples collected from Doddadalavata and Haleitakaloti showed alkalinity less than permissible limits. According to BIS specification desirable and permissible limit is 600mg/l. High alkalinity in the water make boiled rice yellowish and the taste become unpleasant. Low alkalinity causes deterioration of plumbing and indicates the presence of heavy metals in water, which make undesirable to use.

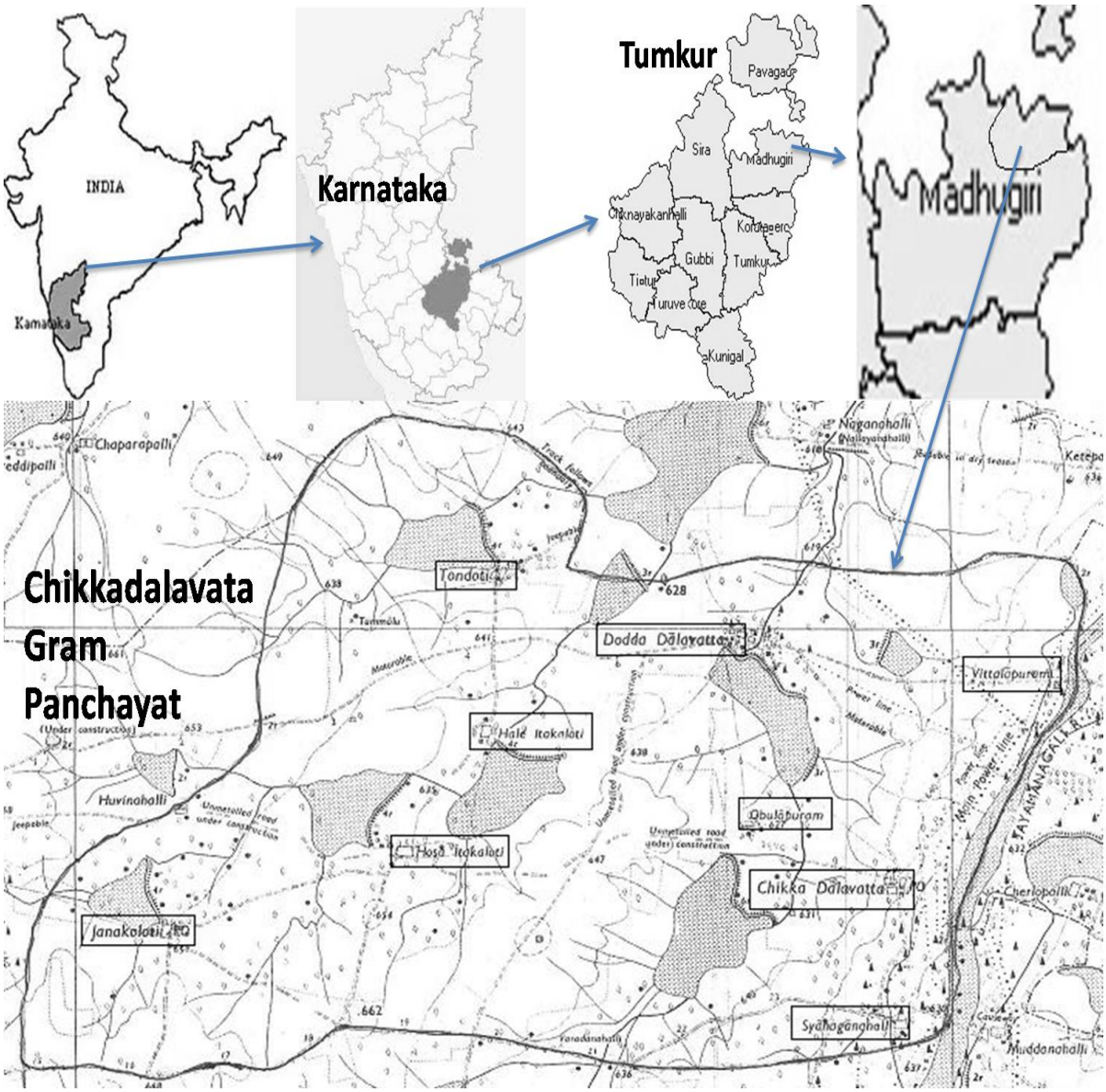

Figure- 1: Map of Chikkadalavata Grampanchayat

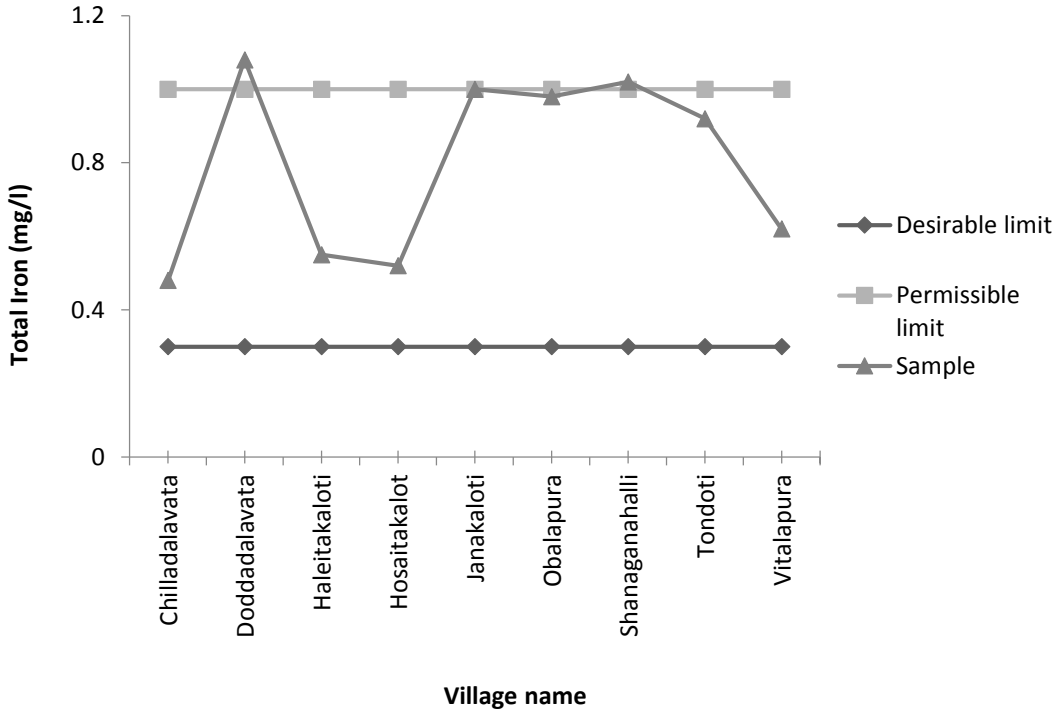

Figure- 2: Total Iron content values of various water samples Collected in Chikkadalavata Grampanchayat

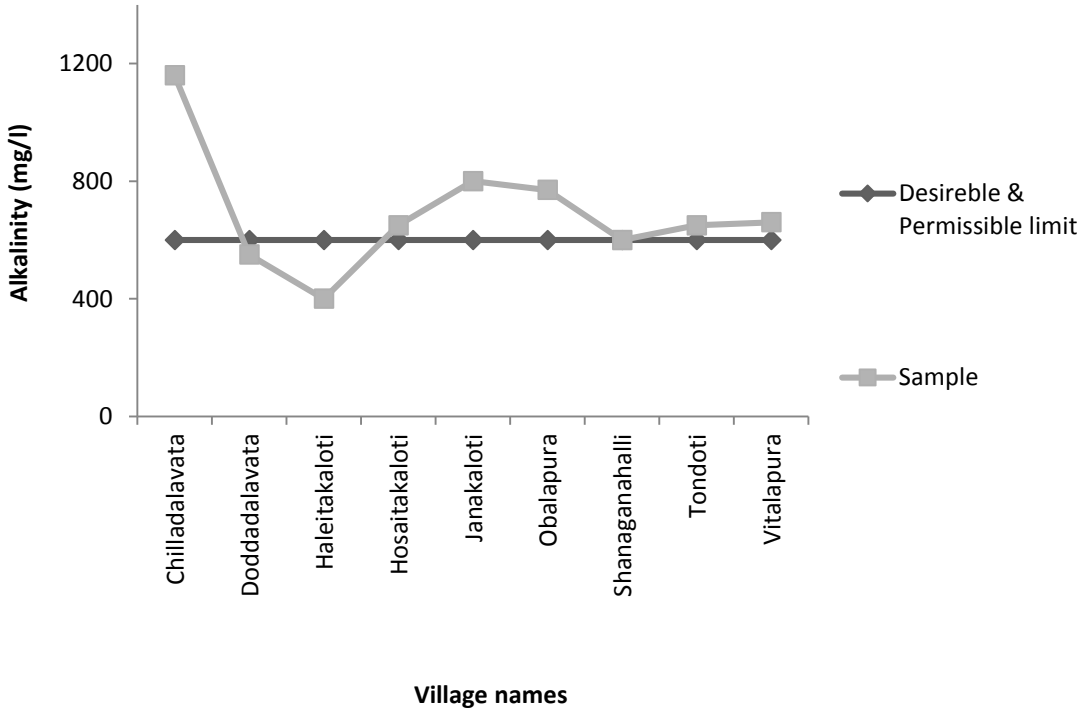

Figure- 3: Alkalinity values of various water samples Collected in Chikkadalavata Grampanchayat

Chlorides:

Chloride is often associated with sodium since sodium chloride is a common constituent of some water source [Smitha *et al*, 2007]. Figure 4, represents the variation in chloride content of the water samples. The variation ranged from a minimum of 40 mg/l, to a maximum of 140 mg/l. Consuming chlorides via drinking water usually is not harmful. People accustomed to higher chloride in water are subjected to laxative effects [Murhekar, 2011]. In the present study all 9 water samples show chloride content less than desirable limit. According to BIS specification desirable limit is 250mg/l and permissible limit is 1000mg/l. The chloride content of samples is depicted in fig. 4.

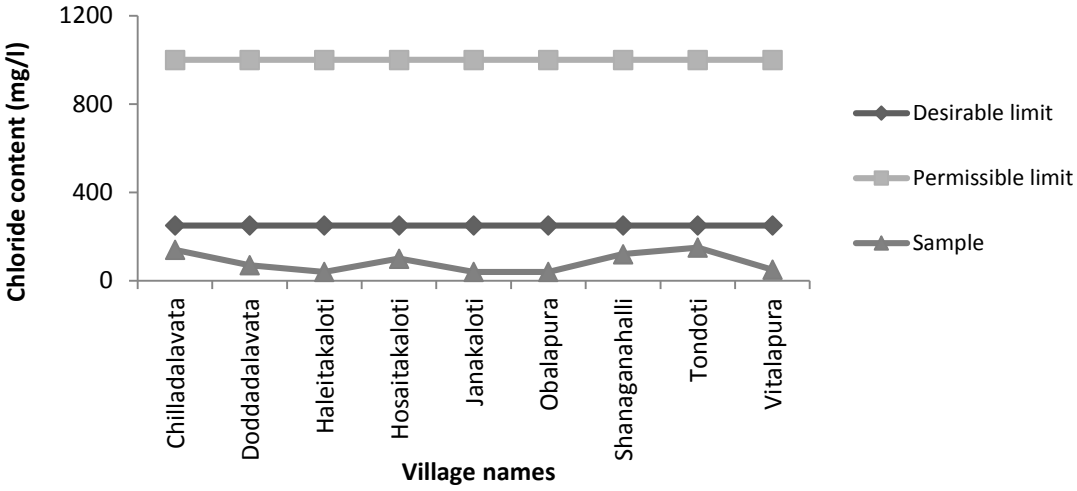

Figure- 4: Chloride values of various water samples collected in Chikkadalavata Grampanchayat

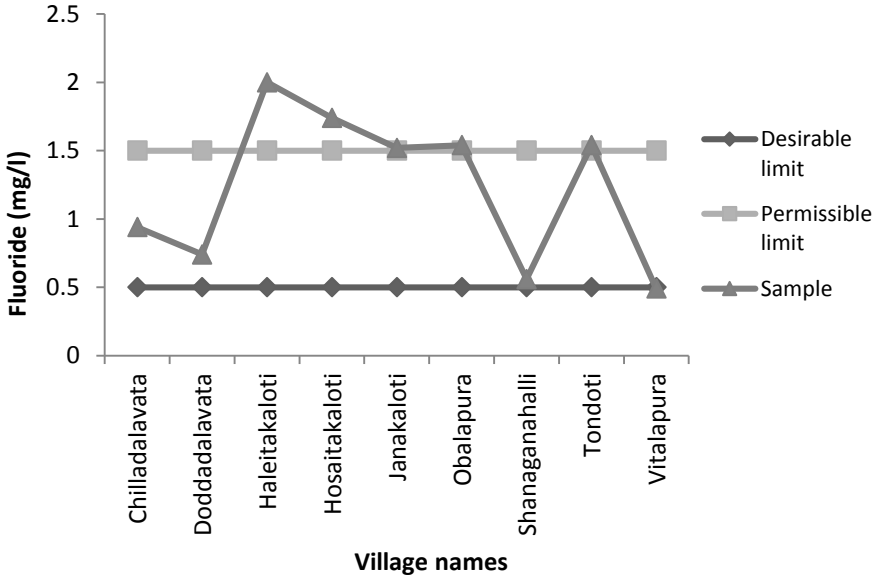

Figure -5: Fluoride values of various water samples Collected in Chikkadalavata Grampanchayat

Fluorides:

Most of the fluoride found in groundwater is naturally occurring from the breakdown of rocks and soils or weathering and deposition of atmospheric particles [Central Ground Water Board 2010]. Excess of fluorides is associated with the health risks like low-to-moderate doses of fluoride include: dental fluorosis; skeletal fluorosis, bone fracture, bone cancer, joint pain, skin rash, reduced thyroid activity, birth defects and IQ deficits [Michael et al n.d.]. Figure 5, represents the variation in fluoride content of the water samples. The variation ranged from a minimum of 0.49 mg/l, to a maximum of 2.0 mg/l. The minimum value is recorded in Vitalapura, which is less than desirable limit and maximum values were seen in 5 samples collect from Haleitakaloti, Hosaitakaloti, Janakaloti, Obalapura and Shanaganahalli which are more than permissible limit. According to BIS specification the desirable limit is 0.5mg/l and permissible limit is 1.5mg/l.

Nitrates:

Nitrate represents the final product of biochemical oxidation of ammonia [Mahananda et al, 2010]. Nitrate is considered to be of low toxicity, but nitrite and NOCs are biologically active in mammalian systems. As reduction (nitrosation) of nitrate produces nitrite and ultimately N-nitroso compounds (NOCs), it is important to consider the various exogenous sources of nitrate exposure to the human body. Methemoglobinemia (blue-baby syndrome), various cancers and birth defects were listed as possibly being associated to exposure to elevated nitrate levels in drinking water [Peter n.d.].

Figure 6, represents the variation in nitrate content of the water samples. The variation ranged from a minimum of 10 mg/l, to a maximum of 55 mg/l. Minimum values were seen in 7 samples collect from Doddadalavata, Haleitakaloti, Hosaitakaloti, Obalapura, Shanaganahalli, Tondoti and Vitalapura which are less than desirable limit and maximum values were seen in 2 samples collected from Chikkadalavata and Janakaloti in which contents are more than permissible limit. According to BIS specification the desirable and permissible limit is 45mg/l.

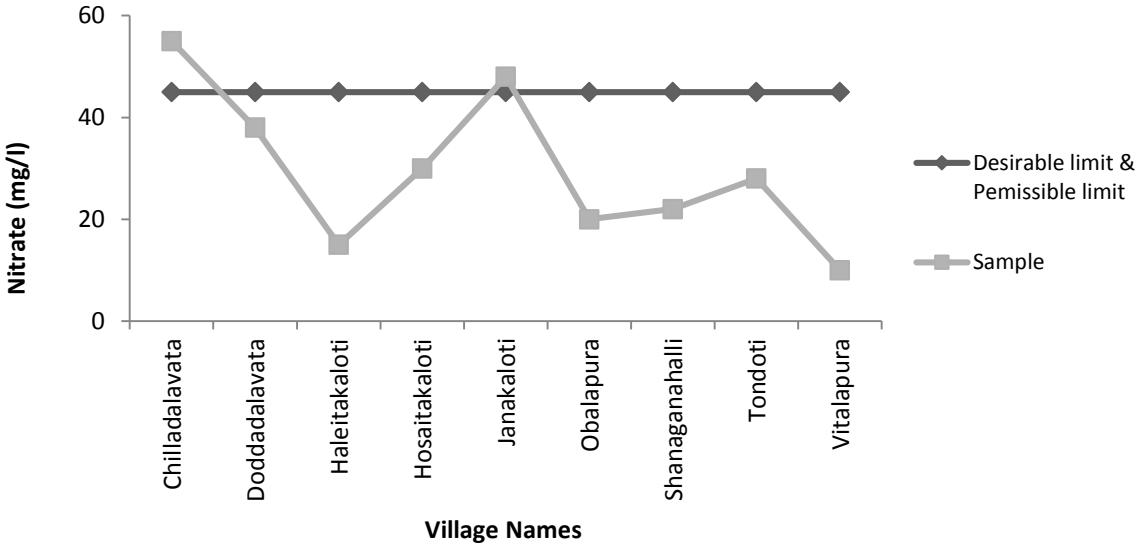

Figure 6: Nitrate values of various water samples Collected in Chikkadalavata Grampanchayat

Sulphates:

Sulphate is widely distributed in nature and may be present in natural waters. The main source of sulphur is the rocks present near the water bodies and biochemical action of anaerobic bacteria [Sharma *et al,* 2011]. The presence of sulfate in drinking-water can cause noticeable taste, and very high levels might cause a laxative effect in unaccustomed Consumers [WHO 2011b]. Figure 7 represents the variation in sulphate content of the water samples. The variation ranged from a minimum of 18 mg/l, to a maximum of 30 mg/l. However, all collected samples contain sulphate content below permissible limit which makes water suitable for drinking. According to BIS specification the desirable limit is 200mg/l and permissible limit is 400mg/l.

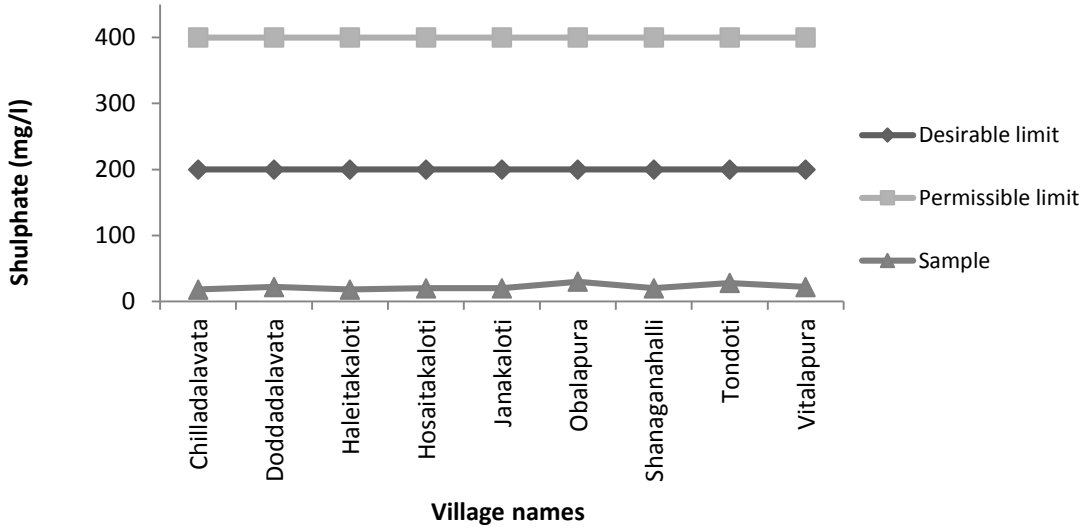

Figure 7: Sulphate values of various water samples Collected in Chikkadalavata Grampanchayat

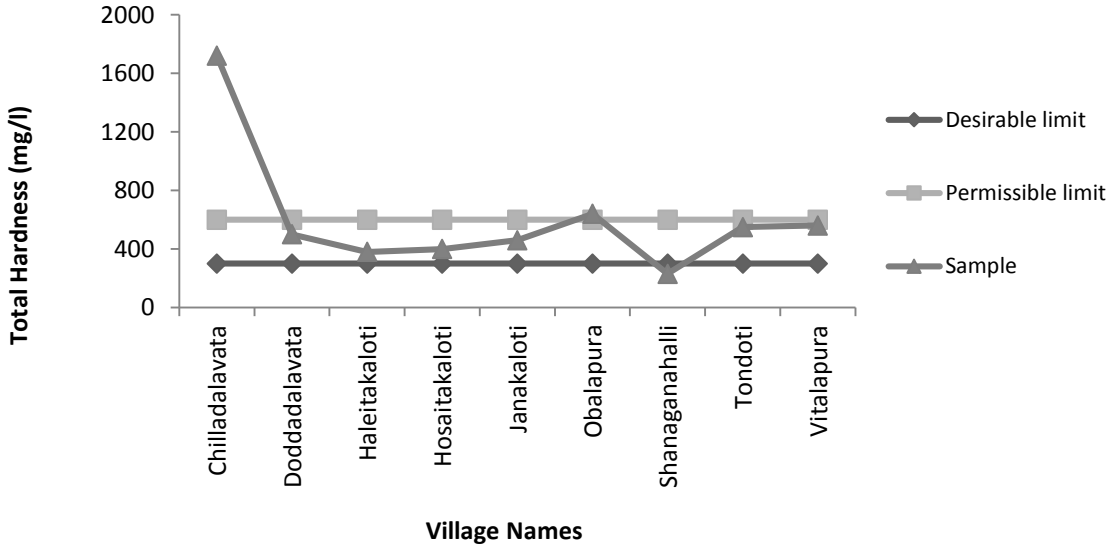

Figure- 8: Total Hardness values of various water samples Collected in Chikkadalavata Grampanchayat

Total Hardness:

Total hardness of water is a measure of the amount of minerals present in water, primarily calcium and magnesium (Gupta *et al* 2009). Inadequate intakes of calcium have been associated with increased risks of osteoporosis, nephrolithiasis (kidney stones), colorectal cancer, hypertension and stroke, coronary artery disease, insulin resistance and obesity. To a great extent, individuals are protected from excess intakes of calcium by a tightly regulated intestinal absorption and elimination mechanism through the action of 1, 25-dihydroxyvitamin D, the hormonally active form of vitamin D. Cardiac arrhythmias of ventricular and atrial origin have been reported in patients with hypomagnesaemia and in postmenopausal women in controlled diet studies. Increased intake of magnesium salts may cause a temporary adaptable change in bowel habits (diarrhea), but seldom causes hypermagnesaemia in persons with normal kidney function (WHO 2011b).

Figure 8 represents the variation in content of the water samples. The variation ranged from a minimum of 230 mg/l, to a maximum of 1720 mg/l. Two samples collected from Shanaganahalli and Vitalapura show minimum values which are less than permissible limit and two samples collected from Chikkadalavata an Oblapura show maximum values which are more than permissible limit. As per BIS specifications the desirable limit is 300mg/l and permissible limit is 600mg/l.

pH

pH is that it is a measure of the activity of the hydrogen ion (H^+) and is reported as the reciprocal of the logarithm of the hydrogen ion activity

pH of water samples ranged from a minimum of 6.89 to a maximum of 8.63. The variation is represented in figure 9. The pH content of 8 samples fall within range of desirable limit and permissible limit and sample collected from Obalapura show a value maximum than permissible limit. According to BIS specification the desirable limit is 6.5 and permissible limit is 8.5.

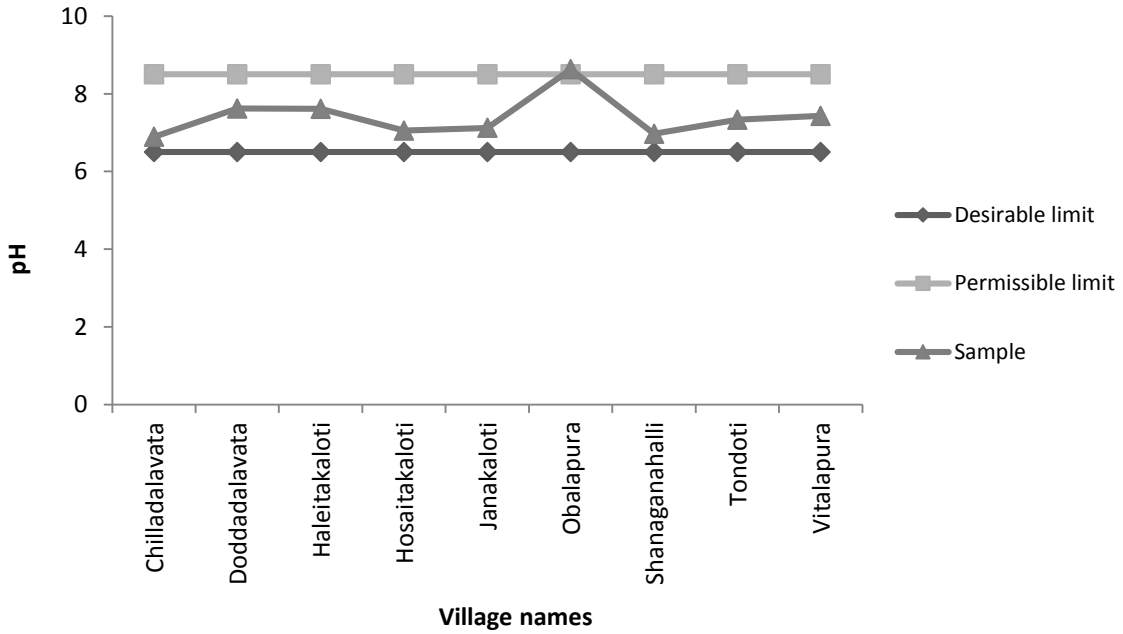

Figure 9: pH values of various water samples Collected in Chikkadalavata Grampanchayat

Turbidity:

Turbidity is a measure of light transmission and indicates the presence of suspended material. Turbidity in water is caused by suspended and colloidal matter, such as clay, silt, finely divided organic and inorganic matter, plankton and other microscopic organisms [Martin *et al*, 2008]. Turbidity becomes visible at approximately 5 NTU, and water with any visible turbidity may be rejected in favor of a clearer, possibly more contaminated source [Elizabeth and Ryan, 2006]. Figure 10 represents the variation in turbidity. The variation ranges from a minimum of 0.5NTU to a maximum of 2 NTU. All the 9 samples collected are below the desirable limit, which make sure of less or no microbial contamination. According to BIS standards desirable limit is 5NTU and permissible limit is 10NTU (Sharpe, *et al,* 1985).

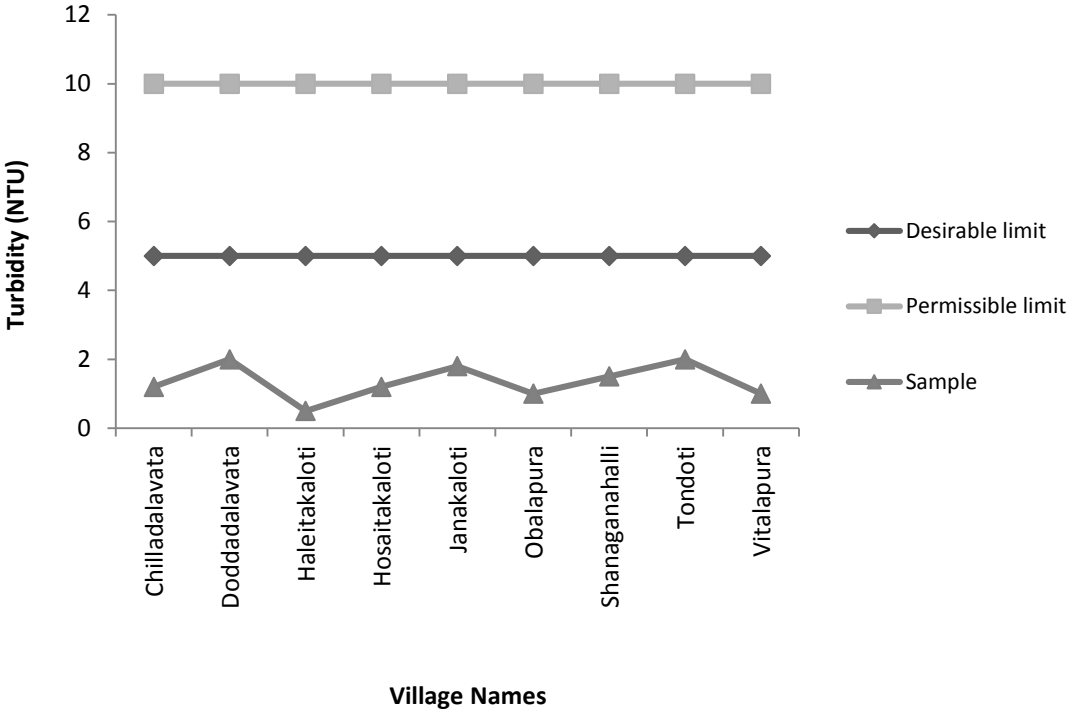

Figure- 10: Turbidity values of various water samples Collected in Chikkadalavata Grampanchayat

Conclusions

Drinking water samples were collected from nine villages of Chikkadalavata Gram panchayat. The source of drinking water is ground water from depths varying from 60m to 200m below ground level. Hand pumps and mini water supply systems exist in these villages. Water samples were collected from all the village water supply systems.

The water quality parameters were determined by testing the water samples in water testing laboratory. Some of these parameters are found relatively high in villages (Table 1) viz., Chikkadalavata contain high content of Alkalinity, Nitrate and Total Hardness (Calcium and Magnesium); Doddadalavata contain high Iron content; Haleitakaloti contain high Fluoride content; Hosaitakaloti contains high content of Alkalinity and Fluoride; Janakaloti contain high content of Iron, Alkalinity, Fluoride and Nitrate; Oblapura has high content of Alkalinity, Fluoride, Total Hardness and pH; Shanagana halli showed high values for Iron and Alkalinity; Tondoti contain high value of Alkalinity and Fluoride, and Vitalapura showed high Alkalinity content.

From the analysis of the water samples, it is found that all the villages contain some water quality parameter in excess of desirable limits. Hence, it is necessary either to treat the water to remove excess water quality parameters in water or adopt rainwater harvesting which totally eliminates use of ground water for drinking.

Table 1: Showing water quality parameters in excess of permissible limits

Sl. No.	Name of villages	Water quality parameters								
		Total iron	Alkali-nity	Chlori-des	Fluori-des	Nitrat-es	Sulp-hates	Total hard-ness	pH	Turb-idity
01	Chikkadalavata		✔			✔		✔		
02	Doddadalavata	✔								
03	Haleitakaloti				✔					
04	Hosaitakaloti		✔		✔					
05	Janakaloti	✔	✔		✔	✔				
06	Oblapura		✔		✔			✔	✔	
07	Shanagana halli	✔	✔							
08	Tondoti		✔		✔					
09	Vitalapura		✔							

Note: ✔ mark indicates presence of excess water quality parameters in tested water

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