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EVALUATION OF GROUND WATER QUALITY (HAND PUMPS) OF DOON VALLEY, UTTARKHAND, INDIA

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ABSTRACT

Ground water is the essential natural resource for drinking water. The purpose of the study was evaluating the ground water quality of hand pump water from thirty study sites of Doon valley. The analysis of physic chemical parameter such as Air and Water temperature, pH, EC, TDS, Turbidity, COD, Total Alkalinity, Total Hardness, Ca hardness, Mg hardness, Chloride, Nitrate, Phosphate etc. Except Total hardness and Nitrate, all parameter was within permissible levels of drinking water standard. The analyses tell us that before consumption of ground water it needs and some treatment for protection of human health.

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INTRODUCTION

The earth surface, have many natural resources. One of the most essential natural resource is groundwater. Its distribution and the accessibility of water is 17% in the earth surface. The annual precipitation rejuvenated the ground water availability. Some factors are responsible for restoration of ground water. These factors are different region intensity of rain fall, depth of aquifer, permeability of soil. Ground water purification depends on soil layer, ion exchange and anaerobic decomposition so that ground water is more pure in comparison to surface water.

According to WHO (1983), all over the world ground water is the vital source of drinking water for people, for this reason extreme uses in rural and semi-urban areas (UNEP; 1999).

It's equally important for agriculture, industries and various other uses. Today increased activity by human being such as industrialization, urbanization and agriculture practise deteriorated the surface water and ground water quality. Ground water is contaminated by septic tank, water logging, and pour in wastewater, fissure in rocks or man-made diggings. Contamination of ground water directly affects to human health (WHO, 1993).

MATERIAL METHOD

Study Area

District Dehradun is situated in NW corner of Uttarakhand state and extends from N Latitude 29°58' to 31°02'30" and E Longitude 77°34'45" to 78°18'30". The total area of Dehradun district is 3088 Km² with an average altitude of 640m above msl. The Doon valley is characterized by the Asan and Song River. The river Tons are the main tributary of Asan in western part of the valley discharging their water to Yamuna. Rispana, Bindal, Suswa, are in the eastern part of the Doon valley and discharge their water to the Song and then to Ganga. Doonvalley overlain by the gravel, sand and boulders with clay bands, filled up the large part of the Doon valley. The thickness of Doon gravel is variable from 52 to >500 meters in the central of the valley. Generally, the month of May and early part of June is hottest with mean temperature shooting up to 36.2°C at. The maximum temperature rises to over 42°C. When the Monsoon sets in mid-June to October, winter starts from November and continue up to February.

Water analysis

According to geographical condition, water sample were collected from different sites of Doon Valley. A total of thirty water samples were collected from hand pump of Doonvalley. Samples were collected using clean and sterilised plasticbottles and analysed all physic chemical parameter in laboratory. For physic-chemical quality, sample were analysed by appropriated

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certified and acceptable international and national standard methods (APHA, 1998) and Trivedi and Goal (1986) and the water quality assessment. The physic-chemical parameter are Air, water temperature, pH, Turbidity, Electrical Conductivity, TDS, Total Alkalinity, Total Hardness, Ca& Mg hardness, COD, Chloride, Nitrate, Phosphate etc.

RESULTS AND DISCUSSION

The total 30 samples were collected from different sites of Doon valley and analyzed the various physic-chemical parameters of ground water samples (hand pumps). The statistical value presented in Table1 and Figures 1 to 10.

Air and Water Temperature -During the present study, the Air and water temperature varies from 20.2 and 19 °C to 34 and 24.1°C respectively. All the sampling sites do not show very much difference (1-2°C). According to WHO (1993) Cool water is generally more portable than warm water. Higher value of water temperature may increase taste, odour, color and corrosion problem.

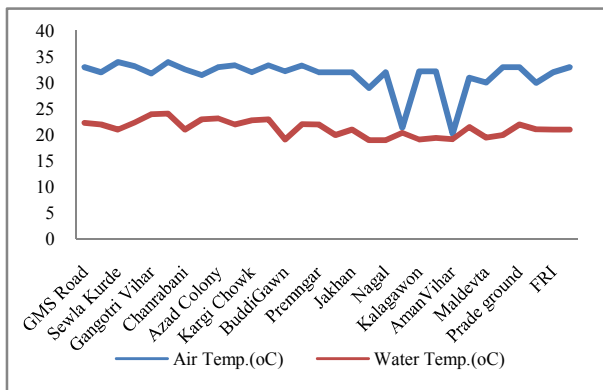


Fig 1 Air & Water temperature of groundwater at different sites of Doon Valley.

pH -pH has an indirect effect on human health. Extreme exposure of pH has been associated with eye irritation and exacerbation of skin disorder (WHO, 1993). According to BIS (1983) pH of 6.5 to 8.5 is normally acceptable. pH is all the ground water sample range from 7.41 to 8.17 with a mean of 7.6 indicating slightlyalkaline condition. The water tends to be alkaline when it possesses carbonate (Suryanarayana, 1995).

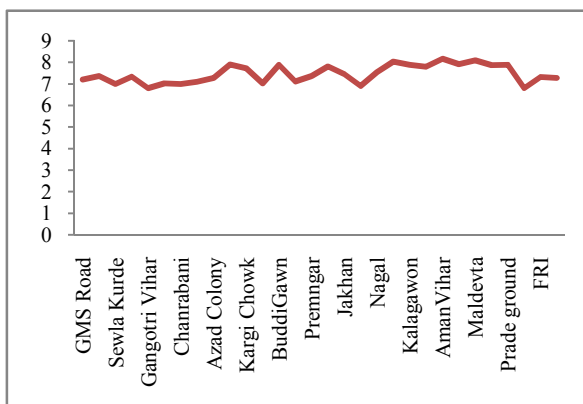


Fig 2 pH of groundwater at different sites of Doon Valley.

Electrical Conductivity (EC) -The conductivity is a numerical expression of its ability to carry on electric current, which in

ionic strength as conductivity is a measure of total ions. The ionic strength of a sample depends on ionization of solutes and other substances dissolved in it (Dandwate, 2012). During the present study time the average value of Electrical conductivity was 502 to 982 microS/cm and the mean of Electrical conductivity is 701.66 microS/cm. The range between 250 to 750 μ siemen/cm is considered as Moderate salinity water (Throne and Throne 1951).

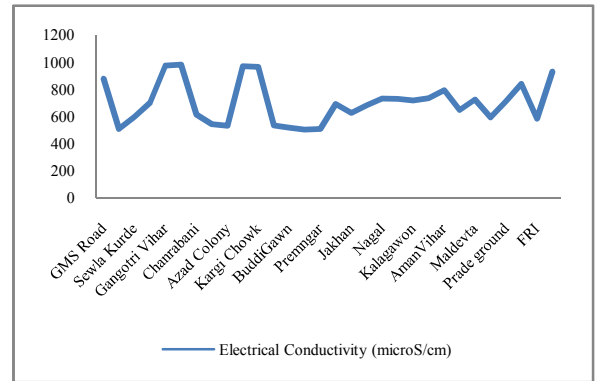


Fig 3 EC of groundwater at different sites of Doon Valley.

Total Dissolved Solids (TDS) - At the study period the TDS level in all ground water samples was observed between 324 to 628 mg/l. The mean range of water sample was 451.8 mg/l with in a permissible limit. The permissible range of TDS in water sample was 500-2000 mg/l (BIS, WHO; 1993). Water containing high solids cause constipation effects in human being (Ramakrishnaiah et al;2009).

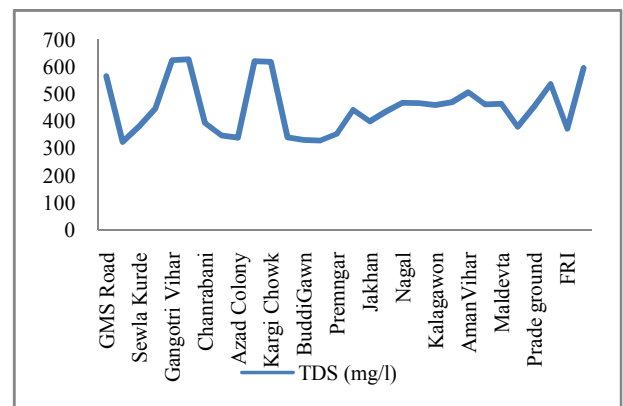


Fig 4 TDS of groundwater at different sites of Doon Valley.

Turbidity- Presence of particulate matter such as silt, Clay, organic matter etc. responsible for reduction of transparency in water. In the entire thirty water sample, turbidity range was noted 0.3 to 10.2 NTU and mean value of turbidity 3.98 NTU. According to Indian Standards, it recommends 5 NTU as desirable and 10 NTU as permissible (BIS, 1993).

Chemical Oxygen Demand (COD) - COD is a measure of the oxygen required to oxidize all compounds, both organic and inorganic, in water. COD value of the study sample varied from 0.2 to 39.84 mg/l with the mean of 5.14 mg/l exceeding the acceptable limit of BIS (1993). The higher value of COD in ground water indicates the sewage waste contamination.

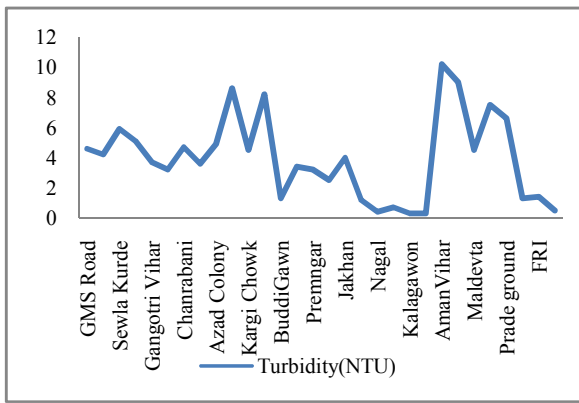


Fig 5 Turbidity of groundwater at different sites of Doon Valley.

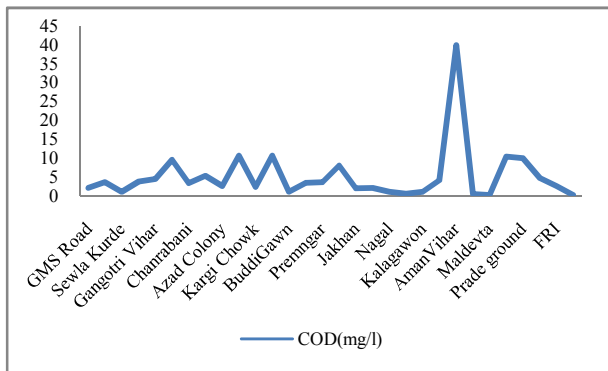


Fig 6 COD of groundwater at different sites of Doon Valley.

Total Alkalinity - The alkalinity of water is a measure of its capacity to neutralize acids. The various ionic species such as bicarbonates, carbonates and hydroxides responsible for alkalinity (Sawyer *et. al.*, 2000), which is ranked in order of their association with high pH values. During the study period, the alkalinity range varied from 148 to 402.8mg/l with the mean value 260.5 mg/l. CaCo₃ indicated slightly alkaline nature of water in the study area. According to WHO (1993) of the permissible limit of alkalinity is 200-600 mg/l.

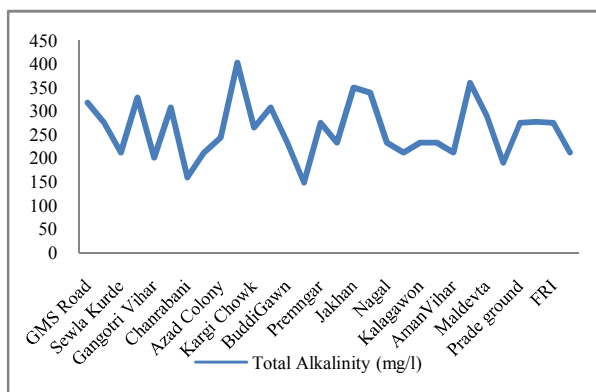


Fig 7 Total Alkalinity of groundwater at different sites of Doon Valley.

Total Hardness - In the water sample the major sources of hardness is calcium and magnesium ions from sedimentary rocks. The total hardness of all water samples varied between 200 to 556 mg/l with a mean of 345.6 mg/l, indicating the hand pump water sample quality slightly hard. A limit of 300mg/l has been recommended for potable, waters (BIS, 1983). The mean value of calcium and magnesium ions was 66.5mg/l or

50.43mg/l respectively. All calcium and magnesium concentration is within a permissible limit WHO (1993). Magnesium usually occurs at lesser concentration than calcium due to the fact that the dissolution of magnesium rich minerals is slow process.

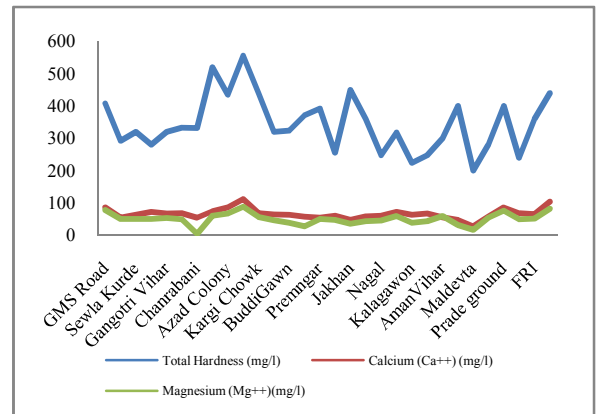


Fig 8 Total Hardness ,Ca hardness &Mg hardness of groundwater at

Chloride - Chloride is a widely distributed element in all types of rocks in one or the other form. Its affinity towards sodium is high. Therefore, its concentration is high in ground waters, where the temperature is high and rainfall is less. Soil porosity and permeability also has a key role in building up the chlorides concentration (R). The chloride content ranged between 11.36 to 68.16mg/l within mean value of 29.8 mg/l which is permissible levels.

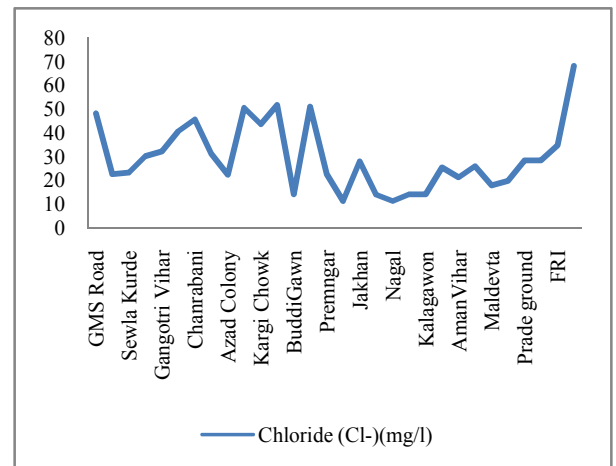


Fig 9 Chloride of groundwater at different sites of Doon Valley

Nitrate and Phosphate- Nitrates are widely present in substantial quantities in soil, in most waters, and in plants, including vegetables (WHO, 1984). It has been documented that, in some countries, water supplies containing high levels of nitrate have been responsible for causes of infantile methemoglobinemia and death (USEPA, 1977). This problem does not arise in adults. Limit of general acceptability of nitrate for drinking water is 45 mg/l (WHO, 1993). In the study time the Nitrate range was varied 0.1 to 32.0 mg/l with the mean of 3.09 mg/l that is permissible level.

Table No.-1 Statistical analysis of physico-chemical parameter of ground water quality of hand pump water Doon valley.

| S.No. | Physicochemical parameter | Maxi. | Mini. | Mean | Mode | Median | SD | Co.Var. |
|-------|-------------------------------------|-------|-------|--------|-------|--------|--------|---------|
| 1. | Air Temp.(°C) | 34 | 20.2 | 31.4 | 32 | 32.1 | 3.1 | 1.3 |
| 2. | Water Temp.(°C) | 24.1 | 19 | 21.2 | 21 | 21.03 | 1.5 | -0.04 |
| 3. | pH | 8.17 | 7.41 | 7.6 | 7.52 | 7.52 | 0.4 | -0.02 |
| 4. | E C (microS/cm) | 982 | 502 | 701.66 | 507 | 696 | 155.14 | -3224.7 |
| 5. | TDS (mg/l) | 628 | 324 | 451.8 | 329.2 | 451.5 | 97.71 | -1426.2 |
| 6. | Turbidity(NTU) | 10.2 | 0.3 | 3.98 | 3.2 | 3.85 | 2.7 | 1.70 |
| 7. | COD(mg/l) | 39.84 | 0.2 | 5.14 | 1.02 | 3.365 | 7.3 | 1.64 |
| 8. | Total Alkalinity (mg/l) | 402.8 | 148.4 | 260.5 | 212 | 254.4 | 60.3 | 59.05 |
| 9. | Total Hardness (mg/l) | 556 | 200 | 345.6 | 320 | 328 | 86.2 | -1449.8 |
| 10. | Calcium (Ca++) (mg/l) | 112.2 | 28 | 66.5 | 86.5 | 64.2 | 16.4 | -164.3 |
| 11. | Magnesium (Mg++) (mg/l) | 88.28 | 4.05 | 50.43 | 50.95 | 50.67 | 17.8 | -86.5 |
| 12. | Chloride (Cl ⁻) (mg/l) | 68.16 | 11.36 | 29.8 | 14.2 | 27 | 14.3 | -38.9 |
| 13. | Nitrate NO ₃ -N (mg/l) | 32 | 0.1 | 3.09 | 1.5 | 1.5 | 5.8 | -1.85 |
| 14. | Phosphate PO ₄ -P (mg/l) | 0.4 | 0.02 | 0.07 | 0.05 | 0.05 | 0.09 | 0.01 |

The average value of phosphate in ground water quality was found to be 0.07 mg/l with a ranging between 0.2 to 0.4 mg/l with in permissible limits. These limits are increasing due to the effect of fertilizers (Karim, 2011).

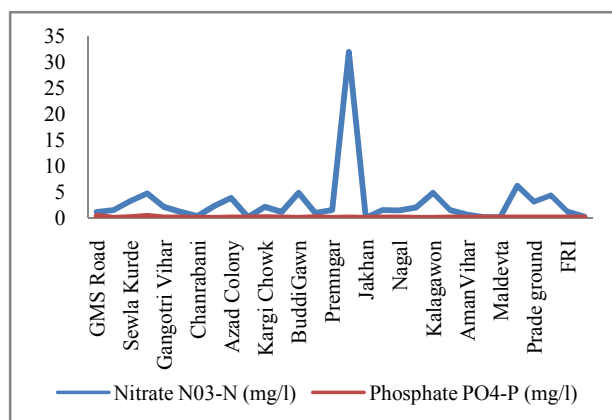


Fig 10: NO₃-N & PO₄-P of groundwater at different sites of Doon Valley.

CONCLUSION

The present study on physicochemical parameter of hand pump water quality in Doon Valley show that the concentration of pH, Electrical conductivity, TDS, COD, Total hardness, Ca hardness, Mg hardness, Total Alkalinity, Chloride, nitrate, phosphate are within permissible limit of drinking water standard WHO, BIS (1993). In the study area water quality. The values were found in respectable condition and does not show the alarming levels of pollutants but it need some degree of treatment before consumption as the concentration of Ca hardness and Nitrate for protection of adverse health effect on human being.

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