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Statistical Studies on the Quality of Drinking Water of Adjacent Villages of Dhar (M.P.)

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Abstract: ***The water quality of various drinking water samples were studied in adjacent villages of Dhar, (M.P.).Water samples were analyzed for various water quality parameters like pH, electrical conductance, total dissolved solids, total alkalinity, total hardness, chloride, sulphate, nitrate, fluoride, sodium, potassium, mercury, iron, copper, zinc, lead and cadmium. In the present study all samples of drinking water of adjacent villages for the values of iron, copper. Fluoride, Nitrate and sulphate were under the standard permissible limits as (0.3mg/l) (0.05mg/l) (1.5 mg/l) (45 mg/l) and (200 mg/l) during rainy, winter and summer seasons respectively. Pearson's correlation coefficient (r) values among various water quality parameters of all the samples were computed.***

Keywords: Drinking water, Drinking water parameters , Village areas and correlation.

1. Introduction

In adjacent villages of Dhar city maximum people depend upon handpump and well water, only few people of villages depend tube well and tape water for drinking. Contamination of ground water resources may transmit various type of disease like cholera, typhoid, dysentery and diarrhoea. Due to increasing human Population, the water quality is deteriorating everywhere. Urbanization and Industrialization have adversely affected quality of drinking water. The presence of heavy metals in drinking water is of great concern because of their toxicity and threat to human life and also to Environment. Most of the heavy metals are essential for the growth of the Living beings at lower concentration but they are Poisonous when there concentration exceeds beyond certain levels.A large number of heavy metals may be contaminating to drinking water by corrosion of metal pipes. Sewage sledge if discharged into the drinking water may be a significant source of Cu, Ag, Cd, Zn and Pb (Williams *et. al.* 1974). One of the main causes of ill heath in the under developed countries is largely the lack of safe drinking water.

In rural areas due to lack of awareness and maintenance most of the families carry out the routine activities like cloth washing, utensil washing, bathing, cattle drinking near to groundwater source, which is one of the reason leading to its contamination. Hence there is need to assess the ground water quality.

2. Material and Methods

Drinking water analyzed physically and chemically by Standard method of water and waste water (**APHA**, 1985) and practical methods for water pollution studies (**Trivedy** *et.al*., 1986). pH, electrical conductivity and total dissolved solids were measured by pH meter, conductivity meter and TDS meter respectively. The concentration of Na and K were estimated by flame photometer. Spectrophotometer was used to determine by concentration of sulphate, nitrate, fluoride, iron and mercury. The concentration of zinc, lead and cadmium were estimated by Atomic Absorption Spectrophotometer.

3. Result and Discussions

Pearson's correlation coefficient (r) values among various water quality parameters of all the drinking water samples were computed. The significance correlation coefficient values are reported in the table -1, 2 and 3. In the Adjacent villages of Dhar city the value of pH of Drinking water varied from 7.3 to 8, 7.6 to 8.8, and 7.9 to 8.7 during rainy winter and summer seasons respectively. This range is similar to those reported by Ravichandran and Jayaprakash (2011) 6.41 to 8.11 in groundwater of Ambattur industrial area of north Chennai.

The value of TDS of drinking water varied from 364mg/l to 796 mg/l, 408 mg/l to 926 mg/l, and 523 mg/l to 1032 mg/l during rainy, winter and summer seasons respectively. The value of TDS in this study were reported much higher than those reported by Thrumathol and Shivakumar (2003) they found TDS 86 mg/l to 166 mg/l in the ground water of Swaminathpuram, Dindigul, Tamilnadu. However, this range is lower to Ramkumar *et al.*, (2009) reported TDS 584.5 mg/l to 4748.5 mg/l in Groundwater of Vedaranniyam Town Tamilnadu. Total dissolved solid showed positive correlation with electrical conductivity (0.99, 0.98 and 0.96), total hardness (0.89, 0.89 and 0.83), calcium hardness (0.92, 0.93 and 0.89), magnesium hardness (0.72, 0.86 and 0.74), total alkalinity (0.76, 0.77 and 0.83) and chloride (0.55, 0.74 and 0.78) during rainy, winter and summer season respectively. It indicates that total dissolved solid in the drinking water is mainly due to the dissolved solids of calcium, magnesium, chloride and sodium.

The value of Electric Conductivity of drinking water ranged from 621 µmhos/cm to 1342 µmhos/cm, 412 µmhos/cm to 1561 µmhos/cm, and 523 µmhos/cm to 1805 µmhos/cm during rainy, winter and summer seasons respectively. This range is much lower to those reported by Ramkumar *et al.*, (2009) electric conductivity varying from 913.4 µmhos/cm to 7419.6 µmhos/cm in Ground water of Vedaranniyam Town Tamilnadu. Positive correlation obtained between electric conductivity and total hardness (0.89, 0.86 and 0.82), calcium hardness (0.92, 0.89 and 0.84), magnesium hardness (0.73, 0.84 and 0.77), total alkalinity (0.76, 0.76 and 0.82), total dissolve solids (0.99, 0.98 and 0.96) and

chloride (0.54, 0.76 and 0.78) during rainy winter and summer season respectively. It is indicated that electrical conductivity in the drinking water is mainly due to hardness and alkalinity by salt of calcium, salt of magnesium, salt of chloride and sodium is also responsible for this.

The value of Total Hardness of drinking water in ranged from 120 mg/l to 530 mg/l, 146 mg/l to 584mg/l, and 197 mg/l to 496 mg/l during rainy, winter and summer seasons respectively. Total hardness showed positive correlation with calcium hardness (0.96, 0.98 and 0.94), magnesium hardness (0.92, 0.99 and 0.98), total alkalinity (0.88, 0.90 and 0.86) during rainy winter and summer season respectively.

The value of total alkalinity of drinking water noted from 110 mg/l to 300 mg/l, 132 mg/l to 316 mg/l and 156 mg/l to 426 mg/l during rainy, winter and summer seasons respectively. The total alkalinity showed the positive correlation with calcium hardness (0.88, 0.84 and 0.74), magnesium hardness (0.78, 0.91 and 0.89), total hardness (0.88, 0.90 and 0.86) during rainy winter and summer season respectively.

The value of chloride of drinking water varied from 113.44 mg/l to 336.77 mg/l, 115 mg/l to 384 mg/l and 126 mg/l to 417 mg/l during rainy, winter and summer seasons respectively. The value of silicates of drinking water ranged from 0.1 mg/l to 1.4 mg/l, 0.3mg/l to 1.6 mg/l and 0.3 mg/l to 2.1 mg/l during rainy, winter and summer seasons respectively. The value of phosphate of drinking water varied from 0.003 mg/l to 1.46 mg/l, 0.004 mg/l to 1.72 mg/l and 0.008 mg/l to 2.13 mg/l during rainy, winter and summer seasons respectively.This range is similar to those reported by Varughese and Devi Prasad (2012) varied iron from BDL to 3.1 in groundwater of Varahanadi basin Puducherry ,Tamilnadu. Phosphate showed positive correlation with potassium (0.95, 0.90 and 0.91) during rainy, winter and summer season respectively also with silicates (0.67) and nitrate (0.85) during rainy and summer seasons respectively.

The value of sodium of drinking water varied from 18 mg/l to 60 mg/l, 18 mg/l to 91 mg/l and 29 mg/l to 109 mg/l during rainy, winter and summer seasons respectively and the value of potassium of drinking water ranged from 1 mg/l to 20 mg/l, 1 mg/l to 23 mg/l and 1 mg/l to 29 mg/l during rainy, winter and summer seasons respectively.

In the present study all samples of drinking water of adjacent villages for the values of iron, copper. Fluoride, Nitrate and sulphate were under the standard permissible limits as (0.3mg/l) (0.05mg/l) (1.5 mg/l) (45 mg/l) and (200 mg/l) during rainy, winter and summer seasons respectively.

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Table 1

	pH	TDS	EC	TH	Ca	Mg	TA	HCO_3	CL	F	NO_3	SO_4	PO_4	Na	K	Fe	Cu	Si
pH	1	-0.55	-0.56	-0.49	-0.45	-0.49	-0.58	-0.58	-0.29	-0.39	0.22	-0.4	0.38	0.59	0.52	0.44	-0.45	-0.23
Total Dissolve solids		1	0.99	0.89	0.92	0.72	0.76	0.76	0.55	0.61	0.18	-0.3	-0.45	-0.45	-0.48	-0.15	-0.18	0.04
Electrical Conductivity			1	0.89	0.92	0.73	0.76	0.76	0.54	0.60	0.18	-0.2	-0.45	-0.46	-0.49	-0.16	-0.17	0.03
Total Hardness				1	0.96	0.92	0.88	0.88	0.15	0.43	0.15	-0.1	-0.47	-0.58	-0.52	-0.24	-0.2	-0.16
Calcium Hardness					1	0.79	0.88	0.88	0.30	0.59	0.08	-0.2	-0.45	-0.46	-0.48	-0.04	-0.17	-0.06
Magnesium Hardness						1	0.78	0.78	-0.09	0.14	0.24	0.12	-0.44	-0.67	-0.51	-0.51	-0.2	-0.28
Total Alkalinity							1	1	0.13	0.32	-0.22	0.05	-0.66	-0.37	-0.69	-0.02	-0.12	-0.28
Bicarbonate								1	0.13	0.32	-0.22	0.05	-0.66	-0.37	-0.69	-0.02	-0.12	-0.28
Chloride									1	0.53	0.15	-0.5	-0.22	0.07	-0.11	0.23	-0.18	0.26
Fluoride										1	-0.03	-0.1	0.02	-0.31	-0.03	0.13	0.19	0.54
Nitrate											1	-0.5	0.23	-0.14	0.33	-0.54	-0.39	0.17
Sulphate												1	-0.08	-0.32	-0.24	-0.35	0.37	-0.11
Phosphate													1	-0.04	0.95	-0.04	0.39	0.67
Sodium														1	0.09	0.55	-0.33	-0.16
Potassium															1	0.08	0.16	0.56
Iron																1	-0.16	-0.17
Copper																	1	0.64
Silicates																		1

Correlation Coefficient (r) of Study Area in the Adjacent Villages of Dhar City in the Rainy Season

Table 2

	pH	TDS	EC	TH	Ca	Mg	TA	HCO_3	CL	F	NO_3	SO_4	PO_4	Na	K	Fe	Cu	Si
pH	1	0.26	0.16	0.38	0.42	0.36	0.1	0.1	-0.11	0.22	0.85	-0.25	0.3	0.36	0.27	0.06	0.15	-0.35
Total Dissolve solids		1	0.98	0.89	0.93	0.86	0.77	0.77	0.74	0.24	0.31	-0.04	-0.09	0.57	-0.23	-0.55	-0.17	-0.35
Electrical Conductivity			1	0.86	0.89	0.84	0.76	0.76	0.76	0.26	0.26	-0.09	-0.08	0.49	-0.18	-0.67	-0.25	-0.25
Total Hardness				1	0.98	0.99	0.90	0.90	0.41	0.24	0.3	-0.1	-0.2	0.32	-0.36	-0.51	-0.03	-0.51
Calcium Hardness					1	0.95	0.84	0.84	0.47	0.25	0.37	-0.06	-0.09	0.44	-0.28	-0.51	0.01	-0.46
Magnesium Hardness						1	0.91	0.91	0.39	0.24	0.26	-0.13	-0.26	0.25	-0.38	-0.52	-0.07	-0.52
Total Alkalinity							1	1	0.44	0.38	-0.04	0.002	-0.37	0.24	-0.53	-0.49	-0.23	-0.54
Bicarbonate								1	0.44	0.38	-0.04	0.002	-0.37	0.24	-0.53	-0.49	-0.23	-0.54
Chloride									1	0.33	0.05	0.107	-0.09	0.59	-0.07	-0.42	-0.56	-0.07
Fluoride										1	0.19	0.193	0.14	0.22	0.13	-0.39	-0.51	-0.01
Nitrate											1	-0.12	0.46	0.52	0.51	-0.16	-0.02	-0.26
Sulphate												1	-0.23	-0.06	-0.19	0.24	0.03	-0.15
Phosphate													1	0.33	0.90	-0.34	0.22	0.44
Sodium														1	0.2	-0.19	-0.35	-0.4
Potassium															1	-0.3	-0	0.46
Iron																1	0.29	-0.16
Copper																	1	0.23
Silicates																		1

Correlation Coefficient (r) of Study Area in the Adjacent Villages of Dhar City in The Winter Season

Table 3

	pH	TDS	EC	TH	Ca	Mg	TA	HCO_3	CL	F	NO_3	SO_4	PO_4	Na	K	Fe	Cu	Si
pH	1	-0.58	-0.65	-0.4	-0.31	-0.47	-0.69	-0.69	-0.7	-0.4	0.57	0.15	0.42	-0.06	0.62	-0.04	-0.21	0.18
Total Dissolve solids		1	0.96	0.83	0.89	0.74	0.83	0.83	0.78	0.09	-0.25	0.59	-0.1	0.56	-0.24	-0.44	-0.21	-0.15
Electrical Conductivity			1	0.82	0.84	0.77	0.82	0.82	0.78	0.26	-0.25	0.38	-0.05	0.44	-0.2	-0.53	-0.06	-0
Total Hardness				1	0.94	0.98	0.86	0.86	0.36	-0	-0.51	0.47	-0.4	0.2	-0.44	-0.48	0.23	0.06
Calcium Hardness					1	0.85	0.74	0.74	0.45	-0.1	-0.25	0.60	-0.22	0.47	-0.3	-0.5	0.03	-0.02
Magnesium Hardness						1	0.89	0.89	0.28	0.04	-0.64	0.35	-0.5	0.01	-0.5	-0.44	0.35	0.1
Total Alkalinity							1	1	0.56	0.08	-0.72	0.44	-0.5	0.11	-0.51	-0.26	0.08	-0.16
Bicarbonate								1	0.56	0.08	-0.72	0.44	-0.5	0.11	-0.51	-0.26	0.08	-0.16
Chloride									1	0.48	-0.01	0.25	0.09	0.67	-0.07	-0.08	-0.32	-0.42
Fluoride										1	0.1	-0.5	-0.02	0.26	0.01	0.22	0.39	-0.3
Nitrate											1	-0	0.85	0.48	0.79	-0.14	-0.42	0.08
Sulphate												1	0.05	0.45	0.11	-0.28	-0.65	-0.24
Phosphate													1	0.26	0.91	-0.48	-0.6	0.37
Sodium														1	0.17	0.039	-0.43	-0.56
Potassium															1	-0.36	-0.57	0.24
Iron																1	0.16	-0.76
Copper																	1	0.18
Silicates																		1

Correlation Coefficient (r) of Study Area in the Adjacent Villages of Dhar City in the Summer Season