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Physico-Chemical Analysis of Selected Groundwater Samples of Inkollu Mandal, Prakasam District, Andhra Pradesh, India

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ABSTRACT
Physico-chemical parameters of groundwater quality based on Physic-chemical parameters at Inkollu mandal, Prakasam district, Andhra Pradesh, India have been taken up to evaluate its suitability for Drinking purpose. Nine ground water samples were collected from different places of Inkollu mandal of Prakasam district. The quality analysis has been made through the pH, EC, TDS, Total Hardness, Sodium, Potassium, Calcium, Magnesium, Chloride, Sulphate, Nitrate, Fluoride and Iron. By observing the results, it was shown that the parameters from the water samples were compared with WHO (World Health Organization) and BIS (Bureau of Indian Standards), USPH (United state Public health) for ground water .The results revealed that some parameters were in high concentration and quality of the potable water has deteriorated to a large extent at some sampling locations.

Key words: Drinking, Groundwater, Physicochemical, Water Quality.

I. INTRODUCTION

Water is indispensable to all life on earth. The modern civilization, industrialization, urbanization and increase in population have lead to fast degradation of our ground water quality, the problems of groundwater quality is much more acute in areas which are densely populated, with localization of industries. Water for human consumption must be free from organisms and chemical substances in concentration large enough to affect health (APHA, 1995; WSC, 2007; Brian 2007), he addition of various kinds of pollutants through sewage, industrial effluents, agricultural runoff etc. into the water main stream brings about a series of changes in the physicochemical characteristics of the water, which have been the subject of several investigations (Ayodele and Abubakar, 1998, WHO/UNEP, 2011,).

II. Materials and Methods

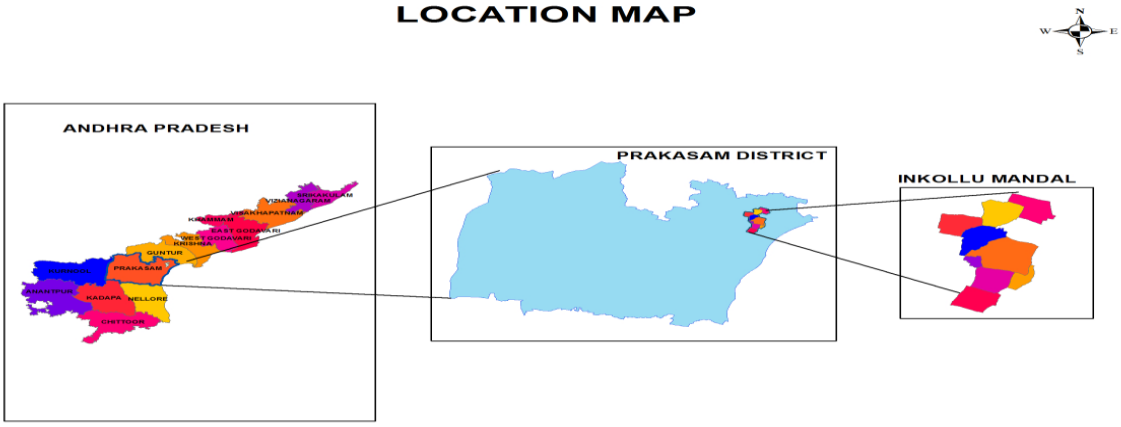
II.i. Study area

Geographical location of study area is shown in the figure 1.the location of Inkollu mandal, Prakasam District, Andhra Pradesh, India, in between 80^0.07' 50" East longitude and 15^0.55' 56" North latitude. Inkollu is under lined by the varied geological formation ranging in the age from the achean to the recent, Gondawana Supergroup, the Rock Types Budawada sandstone, Vemavaram shales, Pavuluru sandstone in the study area.

III. ii Sample collection and methods

The samples are collected from the different villages such as Gollapalem-S1, Inkollu-S2, Idupulapadu-S3, Nagandla-S4, Nakkalapalem-S5, Pavuluru-S6, Gangavaran-S7, Koniki-S8, Bimavaram-S9 are selected for collection of groundwater samples. The groundwater samples were collected carefully in new 500ml Plastic bottles. The sample bottles are washed with 10% HNO_3 and 1:1 HCl for 48 h. The Plastic bottles were labeled and immediately few drops of HNO_3 was added in order to prevent loss of metals, bacterial and fungal growth. Some samples which were turbid or containing suspended matter were filtered at the time of collection (Sudhakar et al, 2014 a. APHA, 1998),

Fig 1: Study area map



II.iii. Physicochemical Analysis.

The ground water samples were analyzed in the laboratory according to the physico-chemical per American Public Health Association (APHA, 1998) standard methods. The quality analysis has been made through the pH, EC, TDS, Total Hardness, Sodium, Potassium, Calcium, Magnesium, Chloride, Sulphate, Nitrate, Fluoride and Iron. By observing the results, it was shown that the parameters from the water samples were compared with WHO (World Health Organization) and BIS (Bureau of Indian Standards), USPH (United state Public health) for ground water.

IV. RESULTS AND DISCURSION

The various physico-chemical characteristics were analyzed for ground water from ten different sampling locations. The details of the parameter results were summarized in table 1.

Studies regarding to ground water quality analysis has been made by many authors like M.R. Rajan and I. Paneerselvam (2005), S.B. Thakare et. al. 2005, Shikha Bisht et. al. (2007)

Most of the biological and chemical reactions are influenced by the pH of water system. In the present study all the ground water samples have pH values of water samples ranges in between 7.55-8.78 (table 1 & Fig 1) against the standard of (6.5-8.5) WHO/BIS/USPH. Five samples such as S2, S3, S4, S6 and S7 are exceeding the permissible limit remaining four samples are in permissible limit.(Table 2) If pH is beyond the permissible limit, it damages the mucous membrane of cells (Koul Nishtha et al 2012)

Electrical conductivity of water is a direct function of its total dissolved salts (Pradeep, 1998) and it is the measure of the ability of water to conduct electrical current. It may depend on the concentration of ions, ionic mobility, valence of ions and temperature. The Electrical conductivity was ranging from 570 to10305 µm/cm all samples the E.C. was out of maximum permissible limit when compared with the standards. The results are indicated in Table 1 and the standard and exceeded sample numbers are showed in table 2, and the graphical representation in fig 2.

The solids can be iron, manganese, magnesium, potassium, sodium, calcium, carbonates, bicarbonates, chlorides, phosphates and other minerals. In the present groundwater samples the TDS minimum and maximum values were observed from 356 to 6542 mg/l, showed in the Table 1and fig 2. The most desirable limit of TDS is 500 mg/l except S5 and S6 samples are in permissible limit remaining all exceeded the standard value indicated in table 2. The high values of TDS causes gastrointestinal irritation to the human beings but long time use of water with high TDS can cause kidney stones and heart diseases (Jain et al 2003).

Hardness of water is an aesthetic quality of water and is caused by carbonates, bicarbonates, sulphates and chlorides of calcium and magnesium. It prevents the lather formation with soap and increases the boiling point of water. Das N.C, (2013), the maximum permissible limit of total hardness for drinking purpose is 300 mg/l (BIS). Table 1and fig 3 showed the hardness range from 202 to 662 mg/l and classified as The water having hardness up to 75 mg/l is classified as soft, 76 - 150 mg/l is moderately soft, soft, 151-300 mg/l as hard and more than 300 mg/l as very hard. Hardness more than 300 mg/l may cause heart and kidney problems (BIS 1991, Bhattacharya et al 2012), the five samples such as S1, S2, S7, S8, and S9 are exceeding the standards indicated in table 2.

Table 2 showed the permissible limit of calcium is 75 mg/l according to WHO the maximum range is 200 mg/l. The concentration of calcium in the area varied from 42.3 to 173.1 mg/l. indicated in table 1 and fig 1. Calcium plays an important role for proper bone growth (Dilip, 2001),

Chloride in ground water can be caused by industrial or domestic waste. The chloride concentration serves as an indicator of pollution by sewage. Soil porosity and permeability also has a key role in building up the chloride concentration (Jain et al (2005). The chloride content varied from 42.11-1458 mg/l.(table 1, 2 and fig 3) 50 % of the ground water samples show chloride concentration exceeded the permissible limit (250 mg/l) of WHO, that are S1,S2,S4,S8 and S9 indicates high contamination of chloride. High chloride content in water bodies, harms agricultural crops, metallic pipes and injurious to people suffering due to heart and kidney diseases (Chapolikar A. D. and Ubale 2010)

Sodium concentration is important in water and several studies have highlighted agricultural products as a predominant source of this compound the sodium level in the collected ground water samples range from 30 to 1342 (table 1 and fig 3), when compared with the standard levels of WHO and BIS more samples exceeded the range except sample no 5 and sample no 6 (table 2). Excess of Na in water is unsuitable for patients suffering from hypertension or congenital heart diseases and also from kidney problems (Rao et al, 2012)

The main reason for the increase in the potassium concentration in groundwater is due to agricultural activities. (Sudhakar and Swarna latha 2013). Potassium in the present groundwater samples was indicated in table 1 and fig 3, the range between 4.3 to 270 mg/L and the standard level of K is 20 mg/l, five samples are exceeding the WHO standard range that are S1, S2, S4, S8 and S9 sample numbers are indicated in table 2.

Sulphate (SO_4) was analyzed in groundwater samples is having value range 30-1340 mg/L indicated in table1 and fig 3. Which is further compared with the standard value range 200mg/L. Ground water samples no. S1, S2 and S8 are having high SO_4 value in the collected ground water samples indicated in table 2. Sulfates are discharged into water from fertilizers Agricultural runoff high values of the sulfate ions concentration, which can lead to serious health problems, such as kidneys incrustation (Sudhakar et al, 2014 b)

Nitrate can reach both surface water and groundwater as a consequence of agricultural activity (including excess application of inorganic nitrogenous fertilizers and manures), but groundwater concentrations generally show relatively slow changes. Some ground waters may also have nitrate contamination as a consequence of leaching from natural vegetation (Mangukiya Rupal et al., 2012), The results were obtained from table-1 and fig 1 for NO_3 (Nitrate) ranges from 16 -92 mg/L. Which were on comparison with standard values found 45 mg/l (WHO/BIS) S4 and S7 samples having higher values showed in table 2.

The main source of fluoride in ground water is fluoride bearing rock such as fluorspar, fluorite, cryolite, fluorapatite and hydroxyl apatite (Ramanaiah et al, 2006), The value of fluoride concentration in ground water samples indicated in table 1 and gif 4 and lie between 0.52-1.93 mg/l. The ground water samples have fluoride concentration within permissible limit (1.0 to 1.5 mg/l) (table 2) of WHO and are safe for drinking purpose but S1 and S8 samples are exceeded the standard level. This high fluoride content in ground water causes serious damage to the teeth and bones of human body, diseases caused called dental fluorosis and skeletal fluorosis (Dinesh, 1998).

Iron is essential element to all organisms and present in haemoglobin system. The high concentration causes a bitter astringent taste to water and a brownish color to laundered clothing and plumbing fixtures (Ngah and Nwankwoala 2013), the shortage of iron causes a disease called anaemia and continues consumption of drinking water with high concentration of iron for a long time can lead to liver disease called as haermosiderosis. The range of iron has been found in between 0.58 to 3.52 mg/l, showed in table 1 and fig 4 which are within WHO guideline (1.0 mg/l) (table 2).

Table 1: Physico-chemical analysis of ground water samples

Parameters	S1	S2	S3	S4	S5	S6	S7	S8	S9	Min	Max
pH	8.37	8.71	8.78	8.72	8.42	8.63	8.74	8.14	7.55	7.55	8.78
EC	4350	3710	980	2540	570	604	1527	10305	3376	570	10305
TDS	2664	2244	596	1572	356	368	948	6542	2036	356	6542
T.H	643	662	240	288	202	250	480	614	451	202	662
Ca	115.4	127	73.1	84.6	42.3	77	96.2	173.1	119.3	42.3	173.1
Mg	86.31	84	14	18.7	23.3	14	58.3	44.3	37.3	14	86.31
NO_3	24	22	45	83	31	16	92	45	16	16	92
Cl	613	421	103	336	47	42.11	205.9	1458	411.8	42.11	1458
SO_4	320	340	70	110	80	30	202	1340	59.8	30	1340
Na	415	250	134	302	30	35.6	137	1342	241	30	1342
K	184	270	7	80	4.3	7	4.8	81	77.1	4.3	270
F	1.61	1.15	0.79	0.83	0.55	0.52	0.68	1.93	1.28	0.52	1.93
Fe	3.15	2.63	1.52	1.67	0.62	0.58	1.03	3.52	0.66	0.58	3.52

Table 2: Standards of the drinking water parameters and no of exceeding sample

S/No	Parameters	Range	Standards	Exceeding samples
1	pH	6.5-8.5	WHO/BIS/USPH	(5) S2,S3,S4,S6,S7
2	EC	300	WHO/BIS/USPH	(9) all Samples
3	TDS	500	WHO/BIS/USPH	(7) Except S5 and S6
4	T.H	300	WHO/BIS/USPH	(5) S1,S2,S7,S8,S9
5	Ca	75-200	WHO/USPH	-----
6	Mg	30	WHO/BIS/USPH	(5) S1,S2,S7,S8,S9
7	NO_3	45	WHO/BIS	(2) S4 and S7
8	Cl	250	WHO/BIS/USPH	(5) S1,S2,S4,S8,S9
9	SO_4	200	WHO/BIS/USPH	(3) S1,S2,S8
10	Na	50-60	WHO	(7) Except S5 and S6
11	K	20	WHO	(5) S1,S2,S4,S8,S9
12	F	1-1.5	WHO/BIS	(2) S1 and S8
13	Fe	0.1	WHO/BIS	(9) all Samples

Fig 1: Graphical representation of pH, Ca, Mg, and NO_3 concentration in ground water samples

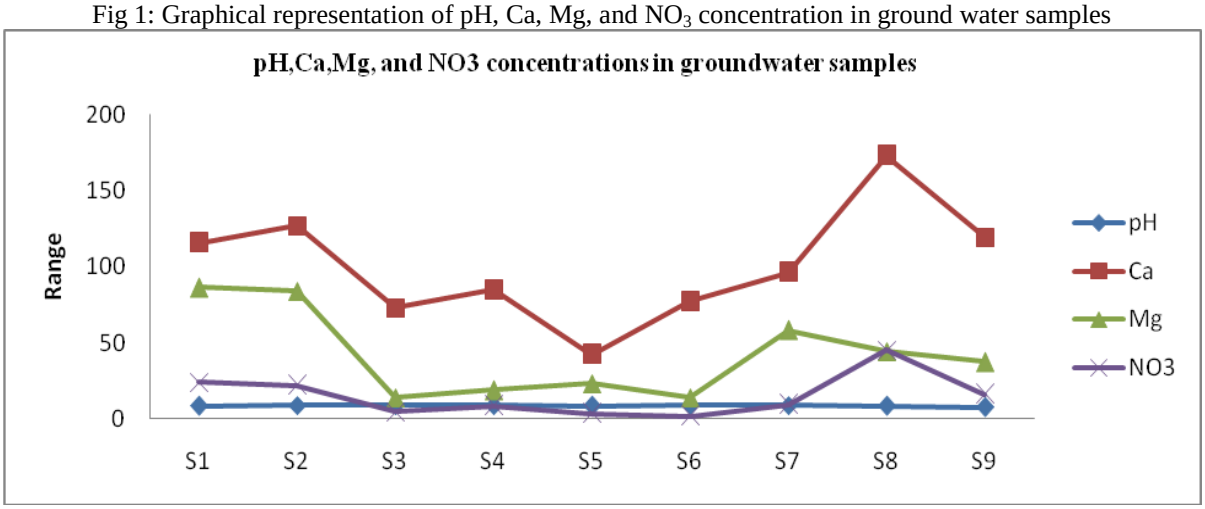


Fig 2: Graphical representation of EC and Total Dissolved solids concentrations in ground water samples

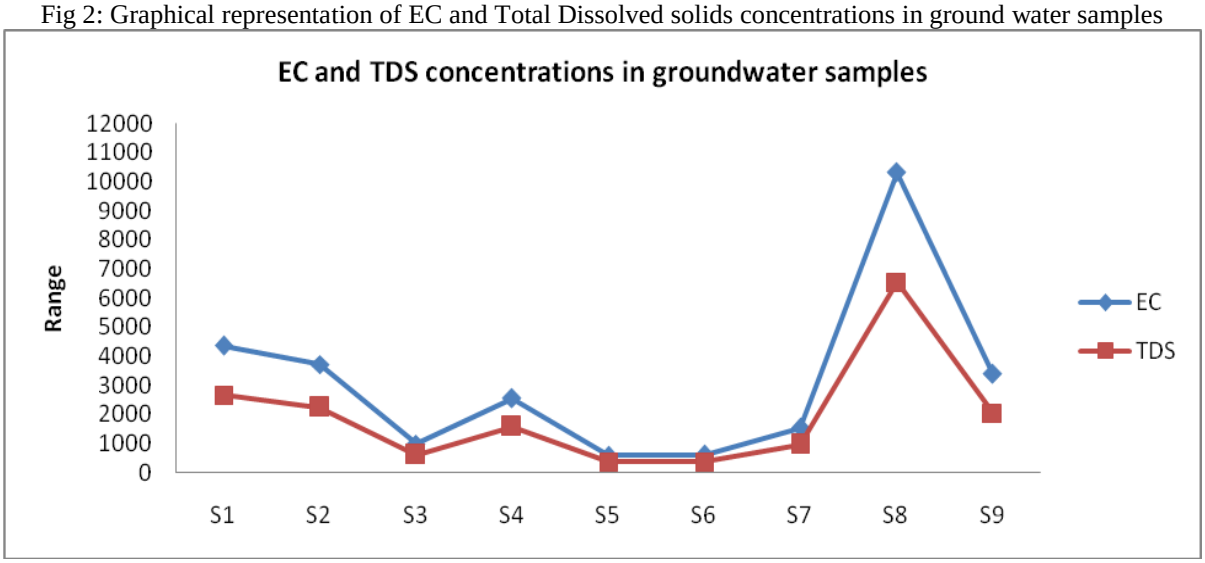


Fig 3: Graphical representation of K, Na, SO_4, Cl, and TH concentrations in ground water samples

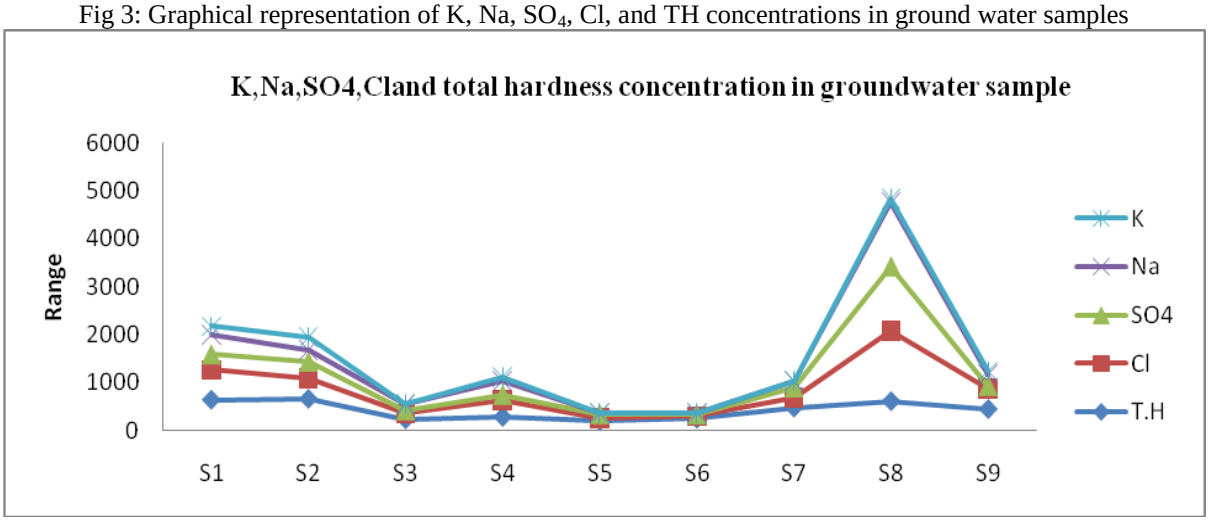
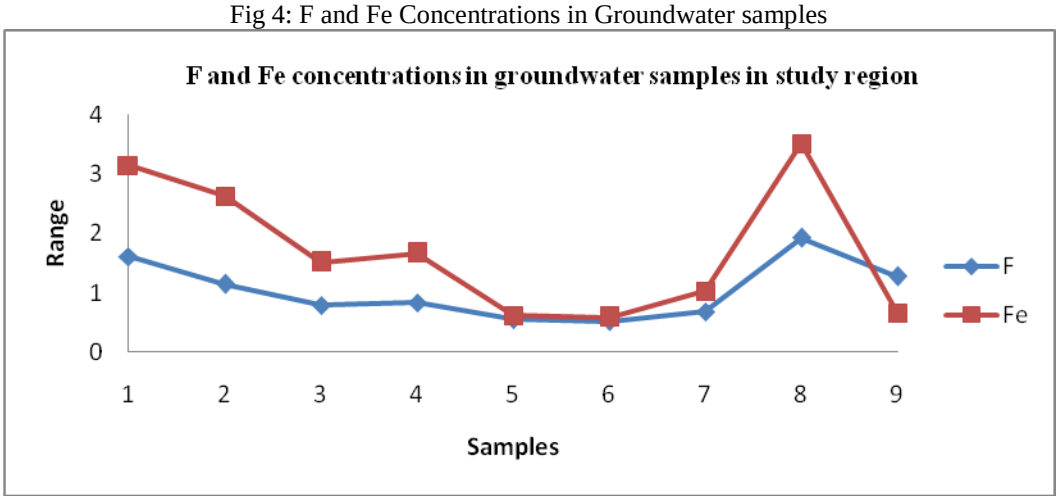


Fig 4: F and Fe Concentrations in Groundwater samples



V. CONCLUSION

After analysis of various Physico-chemical parameters, so improving access to safe drinking-water can result in tangible benefits to health. Every effort should be made to achieve drinking-water quality as safe as practicable. On the basis of above discussion, it may be concluded that the quality of ground water is not suitable for drinking purpose as directly from the sources. The ground water of Inkollu mandal villages possessed higher values of pH, EC, TDS, Na, Mg, T.H, Cl, K and Fe, and slightly higher levels in NO_3, SO_4, and F. Remaining all parameters were in the permissible limits. Hence in all sampling stations are required some degree of treatment before consumption and it also needs to be protecting from contamination.

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