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Physicochemical and Heavy Metal Characterization of Drinking Waters from Rural Water Supplies (RWS) for Quality Evaluation

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ABSTRACT

Water is a significant natural resource and its quality affects the public health frequently. Drinking water is a basic need for life and also a determinant of living standards. The presence of chemical contaminants in drinking water poses a very serious health hazards. Over 80% of people with unimproved drinking water and 70% of people without improved sanitation live in rural areas. Moreover water supply has a direct impact on the economic development of any country. Supply of drinking water for all still away and even the sanitation problem has not been reduced up to the expectations. Keeping in view the present scenario, efforts are made on characterization of drinking waters from rural water supply schemes located in Mandal head quarters in West Godavari District of Andhra Pradesh for quality evaluation. Water samples from Rural Water Supply (RWS) schemes at Mandal Head Quarters Koyyalagudem and Polavaram are collected before and after treatment and characterized for physicochemical parameters viz., pH, Electrical conductivity (EC), Total Dissolved solids (TDS), Total hardness (TH), Total Alkalinity (TA), Na, K, Calcium and Magnesium, Chloride, Sulphate, Nitrate, Fluoride, Phosphate and for heavy metal ions viz., Li, Be, Al, V, Cr, Mn, Fe, Co, Ni, Cu, Zn, As, Rb, Sr, Ag, Cd, Cs, Ba, Ti, Pb and U to evaluate the quality of drinking waters. The results indicated that the Heavy metal ion concentration are within the permissible limits while the parametric levels of pH, TDS, TH, TA, Ca^{+2}, Mg^{+2} are little on the higher side of Indian drinking water standards so that the waters become difficult to be used for drinking or domestic utility. The waters are to be treated by employing the available technologies to keep the parameters within the permissible limit and to protect the health of the public residing in the rural areas.

Keywords: Drinking water, Characterization, Parameter, Rural area, Heavy metal.

INTRODUCTION

Water is a limited natural resource and is essential for human survival. Domestic water which is closely connected to the life of the people and its quality mainly affects public health. Drinking water or Portable water should be with high quality and can be consumed without any [1, 2]. An adequate water resource for future generations is not only a regional issue but also a global concern presently fresh water wealth in India is under threat due to various natural and human activities. Arsenic, fluoride and heavy metals are

identified as minor constituents of ground water in many hydro-geological settings in our country. Higher concentration of these components including iron and nitrate is of major concern [3]. Drinking water with quality is a basic need for life and also a determinant of living standards. Absence of safe water supply can result in many diseases including diarrhea, fluorosis, cholera, hepatitis, trachoma, etc., and potentially constrain human health especially of the public under poverty line [1, 4]. Chemical contaminants viz., fluoride, arsenic and selenium pose a very serious health concern. It is estimated that about 3.5 million people in West Bengal are at a risk due to excess fluoride [1, 3- 5]. Access to safe drinking water and sanitation is a global concern, especially as a Millennium Development Goal and in recent years, it has been increasingly addressed as one of the basic human rights of nations [6]. However; in most rural areas of the developing world, safe drinking water from an improved source and sanitation services remain unacceptably lacking [7]. Despite the importance of these issues in the political agenda, water policies in many countries do not promote the creation of appropriate institutions to manage water needs and enhance supply and maintenance capabilities [8].

Providing safe drinking water in rural areas is a major challenge as it is not very easy to establish institutional facilities that will ensure that drinking water arrangements are provided, maintained, and managed in an efficient, equitable, and sustainable way [9]. Water plays a vital role in the sustenance of all life and it is a source of economic and political power and over half the world's population faces water scarcity [10]. According to the report of United Nations Department of Economics and Social Affairs (UNDESA) nearly 900 million people worldwide still do not have access to safe water [11]. Report of the WHO/ UNICEF on joint monitoring program on water supply and sanitation, some 2.6 billion, almost half the population of the developing world do not have access to adequate sanitation [12]. According to Department for International Development (DFID) over 80 per cent of people are with unimproved drinking water and 70 percent without improved sanitation live in rural areas. Water supply has a direct impact on the economic development of any country. This is because it has to support food production, manufacturing and various other water dependent societal supplies [13].

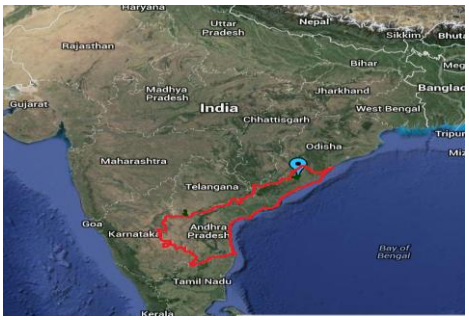
MATERIALS AND METHODS

The sampling locations are identified in the Mandal Head Quarters of Koyyalagudem and Polavaram of Jangareddigudem revenue division in West Godavari District, A.P, India. The latitude and longitude of Koyyalagudem Mandal is $16^0.92945^1$ N and $81^0.6557^1$ E and for Polavaram Mandal is $16^0.983122^1$N and $80^0.91463^1$E respectively. The samples are preserved for analysis as per the standard procedures [14].The details are presented in table 1

Table 1. Sample code and Sampling locations

Jangareddigudem Revenue Division			
Koyyalyagudem Mandal Head Quarters			
Sample Code	Type of Source	Status	Area of Sampling (Land Mark)
W-1	GW	BT	RWS storage
W-2	TW	AT	Ramalayam
W-3	TW	AT	Ashok nagar
W-4	TW	AT	Near Andra Bank
W-5	TW	AT	Polavaram road
Polavaram Mandal Head Quarters			
Sample Code	Type of Source	Status	Area of Sampling (Land Mark)
W-1	GW	BT	RWS storage
W-2	TW	AT	Bapuji colony
W-3	TW	AT	B.C colony
W-4	TW	AT	B.C colony road
W-5	TW	AT	Vinayaka temple

GW-Ground water, TW- Treated (Tap) water, BT- Before treatment, AT- After treatment



Koyyalagudem Mandal

Polavaram Mandal

Fig 1. Study area maps

Polythene containers are employed for sampling and preserved for characterization by following the standard procedures [14].The samples are characterized for physicochemical parameters viz., pH, Electrical conductivity (EC), Total Dissolved solids (TDS), Total hardness (TH), Total Alkalinity (TA), Na, K, Calcium and Magnesium, Chloride, Sulphate, Nitrate, Fluoride, and Phosphate. pH determined by pH meter (Global-DPH 505,India-Model)and Conductivity measured by the digital conductivity meter (Global-DCM-900-Model). TDS is determined from the relation TDS=Electrical conductivity (EC) X0.64. Chloride, Total hardness, Total Alkalinity and Chloride are estimated by titrimetry. Sulphate and Phosphate by spectrophotometer (Model-167, Systronics), Na and K by Flame photometer (Model-125, Systronics) and the analytical data is presented in tables 2 and 3 respectively.

Table-2: Physicochemical characteristics of RWS drinking waters of Koyyalagudem Mandal

Koyyalagudem Mandal Head Quarters															
Sample Code	Status	pH		E.C (µmhos/cm)		TDS (mg/l)		TH (mg/l)		TA (mg/l)		Na (mg/l)		K (mg/l)	
		Monsoon		Monsoon		Monsoon		Monsoon		Monsoon		Monsoon		Monsoon	
		Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
W-1	BT	7.9	8.0	437	459	280	294	200	500	400	500	6	19	2.35	21.19
W-2	AT	7.7	8.0	471	5 10	301	326	200	500	400	400	5	21	3.29	21.60
W-3	AT	7.9	7.9	757	606	484	388	200	600	500	500	8	26	0.79	8.20
W-4	AT	7.8	7.9	645	526	413	337	200	700	500	500	7	25	1.80	10.90
W-5	AT	8.2	8.0	642	568	411	363	200	700	500	500	7	24	1.76	10.72
Sample Code	Status	Ca^{+2} (mg/l)		Mg^{+2} (mg/l)		Cl^{-} (mg/l)		SO_4^{2-} (mg/l)		NO^{-}_3 (mg/l)		F^{-} (mg/l)		PO^{3-}_4 (mg/l)	
		Monsoon		Monsoon		Monsoon		Monsoon		Monsoon		Monsoon		Monsoon	
		Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
W-1	BT	80	80	BDL	73.2	106	36	21	32	11	12	0.52		BDL	BDL
W-2	AT	80	80	BDL	73.2	71	71	21	22	12	10	0.48	0.46	BDL	BDL
W-3	AT	80	80	BDL	97.6	71	36	26	28	12	10	0.46	0.42	BDL	BDL
W-4	AT	80	120	BDL	97.6	71	71	25	24	11	10	0.44	0.40	BDL	BDL
W-5	AT	80	80	BDL	122	36	36	29	27	10	8	0.46	0.42	BDL	BDL

Table-3: Physicochemical characteristics of RWS Drinking waters of Polavaram Mandal

Polavaram Mandal Head Quarters															
Sample Code	Status	pH		E.C (µmhos/cm)		TDS (mg/l)		TH (mg/l)		TA (mg/l)		Na (mg/l)		K (mg/l)	
		Monsoon		Monsoon		Monsoon		Monsoon		Monsoon		Monsoon		Monsoon	
		Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
W-1	BT	7.6	7.9	1630	1740	1043	1114	300	800	1000	1000	23	173	0.18	8.6
W-2	AT	8.1	8.1	1258	1960	805	1254	200	800	500	700	4	236	0.34	9.6
W-3	AT	8.1	7.8	1390	1780	890	1139	200	800	700	1000	21	235	0.30	9.6
W-4	AT	8.0	7.9	1990	1670	1274	1069	300	700	700	800	26	218	0.30	10
W-5	AT	8.3	8.2	688	1040	440	666	200	700	500	700	11	138	0.34	8.3
Sample Code	Status	Ca^{+2} (mg/l)		Mg^{+2} (mg/l)		Cl^{-} (mg/l)		SO_4^{2-} (mg/l)		NO^{-}_3 (mg/l)		F^{-} (mg/l)		PO^{3-}_4 (mg/l)	
		Monsoon		Monsoon		Monsoon		Monsoon		Monsoon		Monsoon		Monsoon	
		Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
W-1	BT	80	120	24.4	122	142	248	42	48	18	14	0.58	0.56	BDL	BDL
W-2	AT	40	120	24.4	122	71	213	19	28	15	12	0.48	0.42	BDL	BDL
W-3	AT	80	120	BDL	122	142	284	38	42	14	10	0.46	0.44	BDL	BDL
W-4	AT	80	80	24.4	122	71	248	60	48	10	12	0.50	0.48	BDL	BDL
W-5	AT	80	80	BDL	122	36	106	28	42	9	8	0.48	0.42	BDL	BDL

RWS samples collected during pre and post monsoon periods are characterized for heavy metal ion by employing Inductively Coupled Plasma Mass Spectrometry (ICP-MS) technique available at Bay of Bengal research institute, Andhra University, Visakhapatam, A.P, India. (Instrument is of model number: 7700 and make from Agilent Technologies). The Heavy metal ions characterized includes viz., Li, Be, Al, V, Cr, Mn, Fe, Co, Ni, Cu, Zn, As, Rb, Sr, Ag, Cd, Cs, Ba, Ti, Pb and U. The analytical data has been generated in ppb and converted to ppm for convenience and the details are presented in table 4.

Table 4. Heavy metal ion concentration in RWS drinking water

Metal ion Concentration (ppm)	Status	Sample location			
		Koyyalagudem		Polavaram	
		Monsoon		Monsoon	
		Pre	Post	Pre	Post
Li	A.T	0.0039	0.0047	0.0029	0.0044
Be	A.T	BDL	BDL	BDL	BDL
Al	A.T	0.0096	0.0145	0.0176	0.0117
V	A.T	0.0017	0.0098	0.0243	0.0390
Cr	A.T	0.0007	0.0017	0.0007	0.0034
Mn	A.T	0.0009	0.0015	0.0014	0.0068
Fe	A.T	0.0096	0.0119	0.0098	0.0121
Co	A.T	0.00003	0.00004	0.0001	0.0001
Ni	A.T	0.0010	0.0010	0.0008	0.0008
Cu	A.T	0.0026	0.0021	0.0015	0.0001
Zn	A.T	0.0092	0.0160	0.0180	0.0213
As	A.T	0.00005	0.00008	0.00045	0.0006
Rb	A.T	0.0030	0.0029	0.0019	0.0001
Sr	A.T	0.3396	0.3514	0.1218	0.6520
Ag	A.T	0.00006	0.00007	0.00007	0.00006
Cd	A.T	0.00004	0.00004	0.00003	0.00003
Cs	A.T	BDL	0.00001	BDL	BDL
Ba	A.T	0.2220	0.0176	0.0395	0.0902
Ti	A.T	BDL	0.00004	BDL	BDL
Pb	A.T	0.0010	0.0001	0.0008	0.0010
U	A.T	0.0011	0.0023	0.0010	0.0039

RESULTS AND DISCUSSION

pH: pH of RWS samples collected before treatment from Koyyalagudem Mandal Head Quarters during pre and post monsoon seasons is 7.9and 8.0 respectively and pH of waters collected after treatment during pre and post monsoon seasons ranges from 7.7-8.2 and 7.9-8.0 respectively and all the values are within the permissible limit of drinking water standards[15].
pH of RWS samples collected before treatment from Polavaram Mandal Head Quarters during pre and post monsoon seasons is 7.6and 7.9 respectively and pH of RWS samples collected after treatment during pre and post monsoon seasons ranges from 8.0-8.3 and 7.9-8.2 respectively. Water samples before and after treatment from both Koyyalagudem and Polavaram Mandal Head Quarters indicate slight alkaline nature.

Electrical Conductivity (EC): EC of RWS samples collected before treatment from Koyyalagudem Mandal Head Quarters during pre and post monsoon seasons is 437µmhos/cm and 459µmhos/cm respectively. EC values of RWS samples ranges from 471-757 µmhos cm^{-1} and 510-606 µmhos cm^{-1} in respect of samples collected after treatment.
EC of water samples before treatment collected from Polavaram Mandal Head Quarters during pre and post monsoon seasons is 1630 µmhos cm^{-1} and 1740 µmhos cm^{-1} respectively while the RWS samples collected after treatment during pre and post monsoon seasons ranges from 688-1990 µmhos cm^{-1} and 1040-1960 µmhos cm^{-1} respectively. EC of RWS samples indicate the presence of soluble salt contents.

TDS: TDS of RWS samples collected before treatment from Koyyalagudem Mandal Head Quarters during pre and post monsoon seasons is 280 mg/l and 294 mg/l respectively. TDS ranges from 301-484 mg L^{-1} and 326-388 mg L^{-1} respectively in samples collected after treatment during pre and post monsoon seasons and TDS is within the permissible limit of drinking water standards [15].
TDS of RWS samples collected before treatment from Polavaram Mandal Head Quarters during pre and post monsoon seasons is 1043 mg L^{-1} and 1114 mg L^{-1} respectively while the TDS of RWS samples collected after treatment during pre and post monsoon seasons ranges from 440-1274 mg L^{-1} and 666-1254 mg L^{-1}. Except in one sample (W-5) of pre monsoon season (440 mg L^{-1}), TDS level exceeded the permissible limit [15].

TH: TH of RWS samples collected before treatment from Koyyalagudem Mandal Head Quarters during pre and post monsoon seasons is 200 mg L^{--1} and 500 mg L^{-1} respectively. TH is 200 mg L^{-1} in each sample of pre monsoon season and TH ranges from 500-700 mg L^{-1} in samples collected after treatment during post monsoon season and TH level exceeded the permissible limit [15].
TH of RWS samples collected before treatment from Polavaram Mandal Head Quarters during pre and post monsoon seasons is 300 mg L^{-1} and 800 mg L^{-1} respectively. TH of RWS samples collected after treatment during pre and post monsoon seasons ranges from 200-300 mg L^{-1} and 700-800 mg L^{-1} respectively. During post monsoon season TH level exceeded the permissible limit [15].
Higher TH of waters cause encrustation in the water supply system and cannot be considered for Domestic purposes.

TA: TA of RWS samples of Koyyalagudem Mandal Head Quarters collected before treatment during pre and post monsoon season is 400 mg L^{-1} and 500 mg L^{-1} respectively and TA of water samples collected after treatment during pre and post monsoon seasons ranges from 400-500 mg L^{-1} and 400-500 mg L^{-1} respectively. All values exceeded the permissible limit of drinking water standards [15].
TA of Water collected before treatment from Polavaram Mandal Head Quarters during pre and post monsoon seasons is 1000 mg L^{-1} each. TA of RWS samples after treatment during pre and post monsoon seasons ranges from 500-700 mg L^{-1} and 700-1000 mg/l respectively. TA exceeded the permissible limit of drinking water standards [15].
Higher values of TA can alter the taste of the waters and hence the waters are not advisable for drinking.

Na: Na of RWS samples of Koyyalagudem Mandal Head Quarters collected before treatment during pre and post monsoon season is 6 mg L^{-1} and 19 mg L^{-1} respectively and Na of water samples collected after treatment during pre and post monsoon season ranges from 5-8 mg L^{-1} and 21-26 mg l^{-1} respectively.
Na of RWS Waters collected before treatment from Polavaram Mandal Head Quarters during pre and post monsoon seasons is 23 mg/l and 173 mg/l respectively. Na of RWS samples collected after treatment during pre and post monsoon season ranges from 4-26 mg/l and 138-236 mg/l respectively.

K: K of RWS samples before treatment collected from Koyyalagudem Mandal Head Quarters during pre and post monsoon season is 2.35 mg L^{-1} and 21.19 mg L^{-1} respectively. While K values ranges from 0.79-3.29 mg L^{-1} and 8.2 -21.6 mg L^{-1} respectively in samples collected after treatment during pre and post monsoon season.
K in RWS samples collected before treatment from Polavaram Mandal Head Quarters during pre and post monsoon seasons is 0.18 mg L^{-1} and 8.6 mg L^{-1} respectively. K in RWS samples collected after treatment during pre and post monsoon season ranges from 0.30-0.34 mg L^{-1} and 8.3-10 mg L^{-1} respectively.

Ca : Ca^{+2} in RWS samples collected from Koyyalagudem Mandal Head Quarters before treatment during pre and post monsoon season is 80 mg L^{-1} each. Ca^{+2} in RWS samples collected after treatment during pre monsoon season 80 mg L^{-1} each and 80-120 mg L^{-1} in samples collected after treatment during post monsoon season. All values exceeded the permissible limit of drinking water standards [15].
Ca^{+2} of RWS samples collected before treatment from Polavaram Mandal Head Quarters during pre and post monsoon seasons is 80 mg L^{-1} and 120 mg L^{-1} respectively. Ca^{+2} in RWS samples collected after treatment during pre and post monsoon season ranges from 40-80 mg L^{-1} and 80-120 mg L^{-1} respectively. Except in one sample (Pre Monsoon-W-2, 40 mg L^{-1}) Ca^{+2} exceeded the permissible limit.

Mg : Mg^{+2} in RWS samples collected from Koyyalagudem Mandal Head Quarters before treatment during pre and post monsoon season is Below Detectable Limit (BDL) and 73.2 mg L^{-1} respectively. Mg^{+2} of samples collected after treatment during pre monsoon season is Below Detectable Limit (BDL) each and 73.2-122 mg l^{-1} in samples collected after treatment during post monsoon season. In samples of post monsoon season Mg^{+2} concentrations exceeded the permissible limit of drinking water standards [15].
Mg^{+2} in RWS samples collected before treatment from Polavaram Mandal Head Quarters during pre and post monsoon seasons is 24.4 mg L^{-1} and 122 mg L^{-1} respectively. And Mg^{+2} of RWS samples collected after treatment during pre monsoon season ranges from BDL-24.4 mg/l and Mg^{+2} of RWS samples collected after treatment during post monsoon 122 mg L^{-1} each. During post monsoon season Mg^{+2} concentrations exceeded the permissible limit.

Cl^-: Cl^- concentration in RWS samples of Koyyalagudem Mandal Head Quarters collected before treatment during pre and post monsoon season is 106 mg L^{-1} and 36 mg L^{-1} respectively. While Cl^- concentration in RWS samples collected after treatment during pre and post monsoon season ranges from 36-71 mg l^{-1} and 36-71 mg L^{-1} respectively and all the values are within the permissible limit [15].
Cl^- concentration in RWS samples collected before treatment from Polavaram Mandal Head Quarters during pre and post monsoon seasons is 142 mg L^{-1} and 248 mg L^{-1} respectively. Cl^- concentration in RWS samples collected after treatment during pre and post monsoon season ranges from 36-142 mg L^{-1} and 106-284 mg L^{-1} respectively. Except in one sample (Post Monsoon -W-3, 284 mg L^{-1}) of post monsoon season Cl^- concentration is within the permissible limit [15].

SO_4^{-2}: $SO_4^{-2}$of RWS samples of Koyyalagudem Mandal Head Quarters collected before treatment during pre and post monsoon season is 21 mg L^{-1} and 32 mg L^{-1} respectively. SO_4^{-2} concentration in RWS samples collected after treatment during pre and post monsoon season ranges from 21-29 mg L^{-1} and 22-28 mg L^{-1} respectively and all are within the permissible limit [15].
SO_4^{-2} concentration in RWS samples collected before treatment from Polavaram Mandal Head Quarters during pre and post monsoon seasons is 42 mg L^{-1} and 48 mg L^{-1} respectively, while SO_4^{-2} concentration in

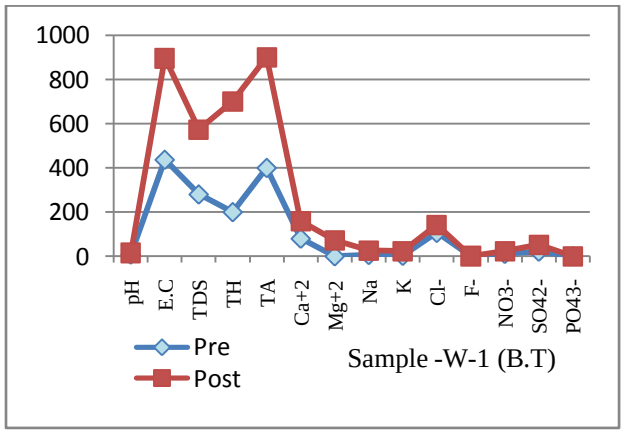
samples collected after treatment during pre and post monsoon season ranges from 19-60 mg L^{-1} and 28-48 mg L^{-1} respectively. SO_4^{-2} values of RWS samples collected before and after treatment from both Koyyalagudem and Polavaram Mandal Head Quarters are within the permissible limit of drinking water standards [15].

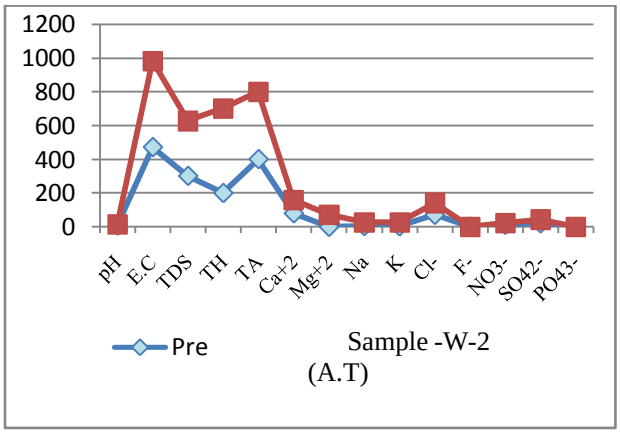
NO_3^-: $NO_3^-$of RWS samples of Koyyalagudem Mandal Head Quarters collected before treatment during pre and post monsoon season is 11 mg L^{-1} and 12 mg L^{-1} respectively. NO_3^-concentration in samples collected after treatment during pre and post monsoon season ranges from 10-12 mg L^{-1} and 8-10 mg L^{-1} respectively.
NO_3^-concentration in samples collected before treatment from Polavaram Mandal Head Quarters during pre and post monsoon seasons is 18 mg L^{-1} and 14 mg L^{-1} respectively, and NO_3^-concentration in samples collected after treatment during pre and post monsoon season ranges from 9-15 mg L^{-1} and 8-12 mg L^{-1} respectively. NO_3^-concentration in RWS samples collected before and after treatment from both Koyyalagudem and Polavaram Mandal Head Quarters are within the permissible limit of drinking water standards [15].

F^-: Fluoride in samples of Koyyalagudem Mandal Head Quarters collected before treatment during pre and post monsoon season is 0.52 mg L^{-1} and 0.50 mg L^{-1} respectively.RWS samples collected after treatment during pre and post monsoon season ranges from 0.44-0.48 mg L^{-1} and 0.40-0.46 mg L^{-1} respectively.
Fluoride concentration in RWS samples collected before treatment from Polavaram Mandal Head Quarters during pre and post monsoon seasons is 0.58 mg L^{-1} and 0.56 mg L^{-1} respectively, and F^-concentration in RWS samples collected after treatment during pre and post monsoon season ranges from 0.46-0.50 mg L^{-1} and 0.42-0.48 mg L^{-1} respectively. Fluoride concentration in RWS samples collected before and after treatment from both Koyyalagudem and Polavaram Mandal Head Quarters are within the permissible limit [15].

PO_4^{-3}: PO_4^{-3} concentration in RWS samples collected before and after treatment from both Koyyalagudem and Polavaram Mandal Head Quarters are in Below Detectable Limits (BDL) and all are within the permissible limit [15].

Heavy metals: The concentration of Heavy metal ions viz., Li, Be, Al, V, Cr, Mn, Fe, Co, Ni, Cu, Zn, As, Rb, Sr, Ag, Cd, Cs, Ba, Ti, Pb and U in RWS waters collected during pre and post monsoon season are found to be within the permissible limits of drinking water standards. The physicochemical parameters of drinking water samples before treatment (BT) and after treatment (AT) are represented graphically in figures 2 and 3 respectively.





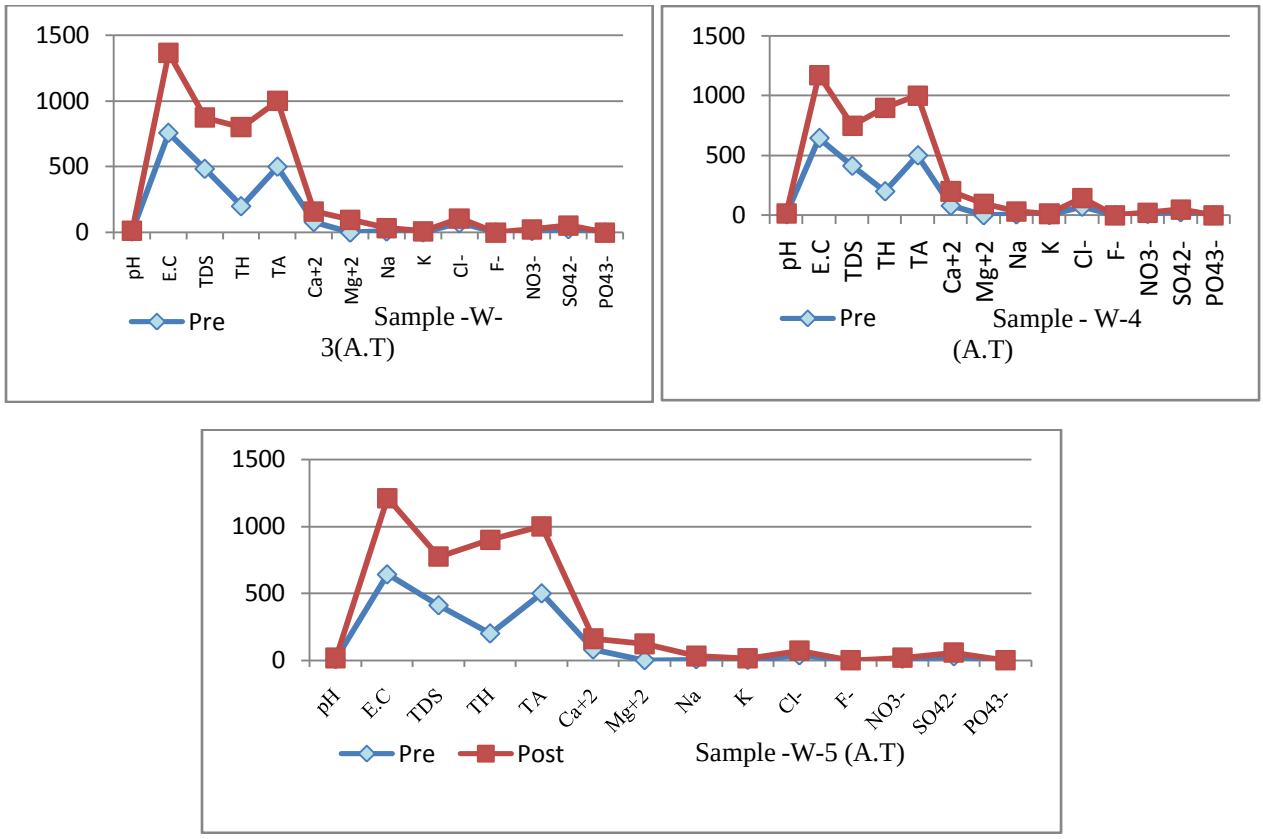
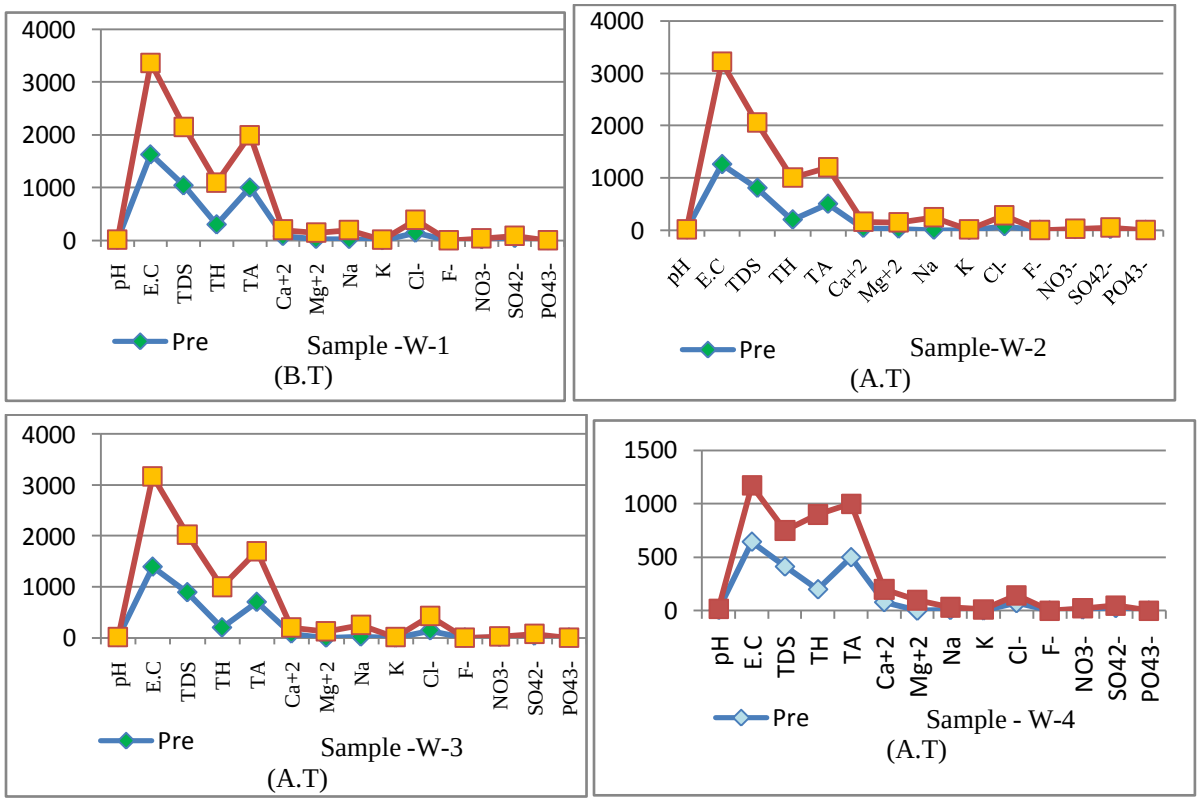


Figure 2: Characteristics of RWS drinking waters (BT& AT) of Koyyalagudem Mandal Head Quarters



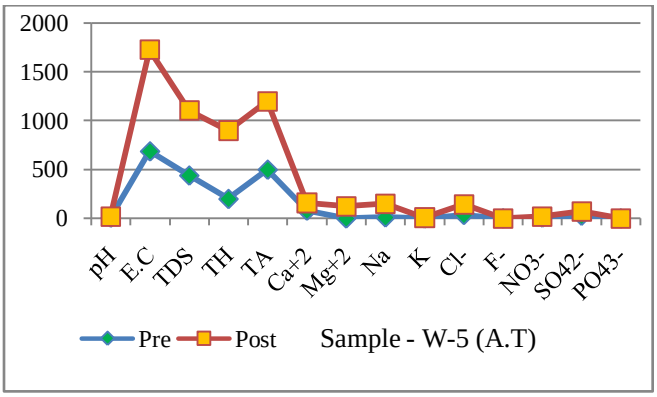


Figure-3: Characteristics of RWS drinking waters (BT & AT) of Polavaram Mandal Head Quarters

APPLICATIONS

The analytical data generated from the present research work is useful to the end users like rural water supply authorities, State ground water board authorities and sanitation authorities for considering the analytical results as data base.

CONCLUSIONS

The pH values of water samples indicate slight alkaline nature. The parametric levels of Chloride, Sulphate, Nitrate and fluoride are within the permissible limits of drinking water Standards. TDS, Total Hardness, TA, TH, Ca^{+2} and Mg^{+2} levels exceeded the permissible limits. Higher levels of TDS indicate the presence of soluble solids in water. Due to the higher TH and Ca^{+2} concentration waters can cause encrustation on water supply systems and hence the waters are doubtful for consideration for domestic utility. Higher TA can cause unpleasant taste to these waters and hence the waters may become difficult to be considering for drinking or domestic purposes and if consumed, the health of the public will be effect.

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