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Topic: Quality of Supply Water in Raipur City, Chhattisgarh (India)

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Abstract

Water is essentially required, which is fulfil the basic need of all kinds of life. Without of its the life can not be imagine. Otherhand every year 3.4 million people die as a result of water related diseases (WHO). So the paper deal on the quality of supply water at household level in Raipur Municipal area, Chhttisgarh. The supply water samples have been collected from 20 household tap from four wards (5 samples from each ward). From each location two times (pre monsoon and post monsoon) of samples have been collected for determination. The physiochemical parameters of Total Dissolved Solids (TDS), conductivity, salinity and pH of these samples were determined with the help of El make Delux Water and Soil Analysis Kit mode191 and the Do have been measured by the help of Do metre model 811. Systronics Flame Photometer has used for determination of sodium (Na) and potassium (K).

The present study reveals that the physic-chemical parameters of supply water have measured more at post-monsoon than the pre-monsoon. The TDS, salinity and conductivity has found high (0.78 ppt, 1.15 ms/cm and 0.8 ppt at pre-monsoon and 0.77 ppt, 1.16 ms/cm and 1.0 ppt at post-monsoon are respectively) in the sample number 6. The correlation matrix shows that the TDS, conductivity and salinity are positively correlated.

Key words: Supply water, physic-chemical parameters, water quality, pre- and post-monsoon.

INTRODUCTION

The Raipur Municipal Corporation (RMC) supplied the drinking water to all citizens of the city through pipe line connections pumps and trunks (in summer seasons). The river Kharun is the major source of water resource of the city, and the another source of water is ground water through tube wells. Ensuring the supply of potable water to meet the demands of the ever growing populations has now become a challenge to the water managers of most developing and underdeveloped countries (Biswas, 1993). The demand for water in India is increasing tremendously both in rural and urban areas since two decades; the water scenario in urban India is very precarious (Rao, et al., 2007). Insufficient supply of water by the municipalities for domestic and industrial sectors leads to the consumption of a large quantity of ground water (Dixit et al., 2003). According to Times of India, 2013 Fresh water crisis to hit the world by 2050.

The total population of Raipur Municipal Corporation (RMC) had 1010087 (Census, 2011). The daily average per capita supply of drinking water is 135 litters. The length of the distribution pipe lines network is 760 km (50 mm diameter, 450 km and 80-150 mm diameter – 13okm) in 2010, near about 50000 house hold are connected by the pipe lines network.

The 18866393.57gallons of water is being wasted daily in Raipur City. Out of this 2117306.60gallons of water has wasted from leakage of pipeline network (Pramanik, and Kuity, 2013). Due to leakage of distribution pipeline may increase turbidity, heterotrophic bacteria and pathogens, so promote microbiological growth in the drinking water and may cause deterioration of the water quality and possible health risk (Hem, 2002). The quality of water is of vital concern for mankind, since it is directly linked with human welfare (Nalla, et al., 2012.) According to Forooqi (2011) get a close relationship of pollution in the high vulnerable zones and indicates a clear effect of urbanisation. In urban areas rain water goes wasted because of inhabitation (Raychoudhury, 2012).

According to UNICEF water contamination posed a serious threat to children World-wide and around 1.5 million children who are under-age has died due to diarrhea and other water borne diseases a year. Globally 1.5 million annual diarrhea deaths occur among under-five year's children. Unfortunately India tops the list (The Hitavada, 2012). The Jaundice

patients Gangabai Yadav complained about supply of Yellowish water through government tap (The Hitavada, 2015).

OBJECTIVES

i) To find out the quality of supply water of house hold tap.
ii) To determine the supply water quality variance between pre and post monsoon.

STUDY AREA

The study have been carried out on four wards (namely, Ramkrishna Paramhansa Ward, Sardar ballav Bhai Patle Ward, Indiragandhi Ward, Rabindranath Tagore Ward) in Raipur Municipal Corporation (RMC), Chhattisgarh (India) which is fall under open series map numbers F44 P11 and F44 P12, it is lies between 21^{o} 12' 30" N to 21^{o} 17' 30" N latitude and 81^{o} 35' E to 81^{o} 40' East of longitude (Fig. 1).

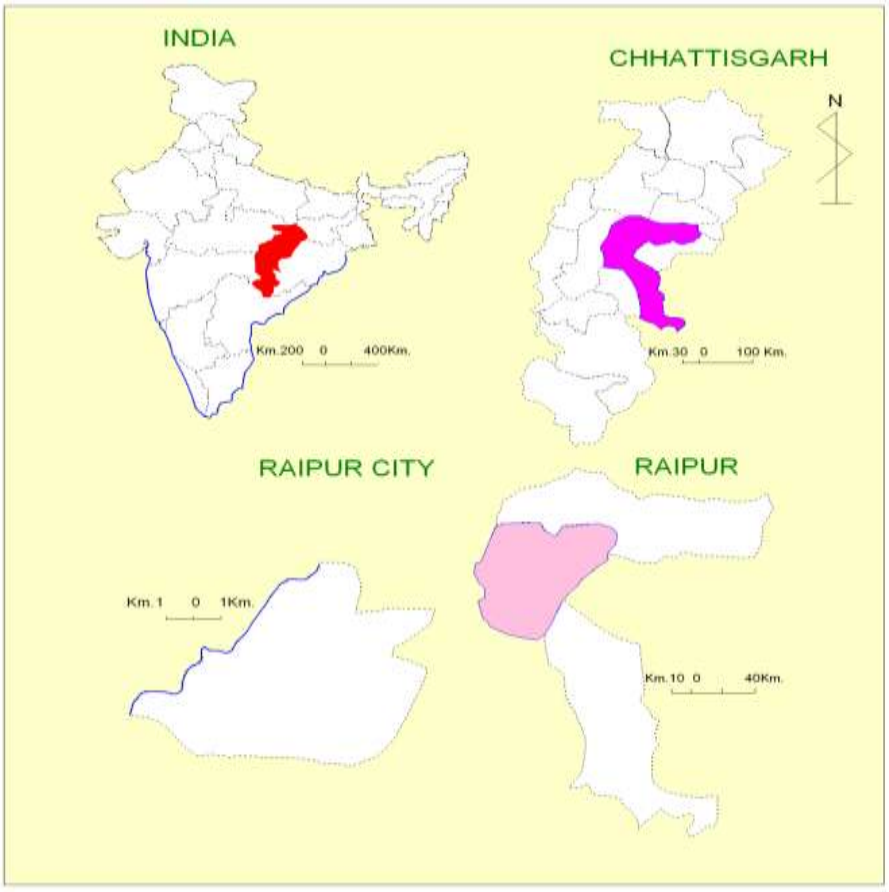

Fig. 1 Location map of the study area.

METHODS EMPLOYED

The supply water samples have been collected from 20 household tap from Ramkrishna Paramhansa Ward, Sardar ballav Bhai Patle Ward, Indiragandhi Ward, Rabindranath Tagore Ward (5 samples from each ward). From each location two times (pre monsoon and post monsoon) of samples have been collected for determination. The

physiochemical parameters of Total Dissolved Solids (TDS), conductivity, salinity and pH of these samples were determined with the help of El make Delux Water and Soil Analysis Kit mode191 and the DO have been measured by the help of DO metre model 811. Systronics Flame Photometer has used for determination of sodium (Na) and potassium (K).

RESULT AND DISCUSSION

TDS

The TDS is varies from 0.08 ppt to 0.78 ppt at pre monsoon and between 0.13 ppt to 0.77 ppt at post-monsoon as shown in Table 1 and Fig. 2. The maximum TDS of supply waqter is found in sample number 6 (slum area of Sardar Ballav Bhai Patle ward) at both seasons. The 70 % of sample at post-monsoon are found more TDS than pre-monsoon. Because all types of pollutants of urban area are washout by monsoonal rainfall and it added into the water distribution pipe line by the leakage portion. The coefficient of variation of TDS in supply water at pre-monsoon is 93.81% and 68.28% at post-monsoon.

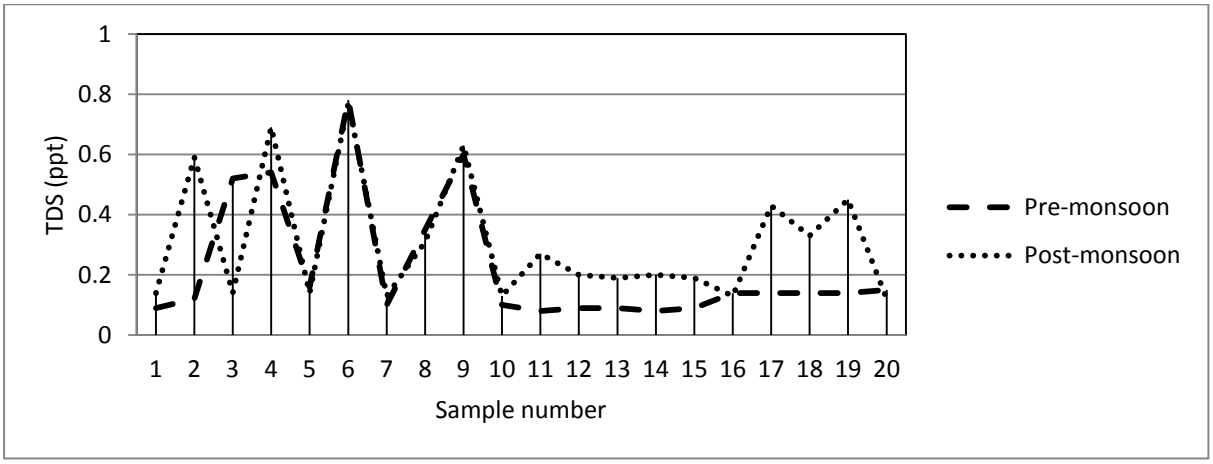

Fig.: 2 Total Dissolved Solids in supply water in Raipur City, C.G.: pre- and post-monsoon.

According to Wilcox (1955) the limit of TSD concentration in drinking water is specified as 1.5 ppt. The TDS shows highly ppositive correlation with conductivity (r=0.6883 at pre-monsoon and r=0.9991 at post-monsoon) and salinity (r=0.9197 at pre-monsoon and r=0.7479 at post-monsoon). So the TDS, conductivity and salinity are proportionally correlated.

Table: 1 Physio-chemical parameters of supply water (at household level) in Raipur City: pre- and post-monsoon scenario.

Sl. No.	TDS (ppt)		Conductivity (ms/cm)		Salinity (ppt)		pH		DO (ppm)		Na (ppm)		K (ppm)	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
1	0.09	0.14	0.15	0.20	0.0	0.3	7.75	7.59	7.28	7.5	84	104	4	6
2	0.12	0.59	0.20	0.87	0.0	0.9	7.45	7.56	7.15	7.5	62	77	16	20
3	0.52	0.14	0.80	0.20	0.5	0.3	7.37	7.85	7.19	7.1	80	82	13	7
4	0.54	0.69	0.82	1.03	0.5	1.1	7.19	7.91	7.48	6.9	68	110	7	13
5	0.16	0.14	0.25	0.20	0.0	0.3	7.73	7.88	7.40	7.1	52	75	7	6
6	0.78	0.77	1.15	1.16	0.8	1.0	7.10	7.18	7.52	7.9	78	83	11	11
7	0.10	0.13	1.13	0.20	0.0	0.0	7.29	8.10	7.45	6.1	37	42	8	8
8	0.35	0.31	1.12	0.47	0.8	0.3	7.18	7.57	7.48	7.8	26	34	5	7
9	0.60	0.63	1.01	0.94	0.7	0.8	7.30	7.39	7.44	7.8	28	70	6	5
10	0.10	0.13	1.01	0.20	0.0	0.0	7.59	7.94	7.32	6.8	28	51	5	7
11	0.08	0.27	0.15	0.38	0.0	0.7	7.51	7.35	7.12	7.1	22	64	7	24
12	0.09	0.2	0.16	0.27	0.0	0.6	7.51	7.46	7.12	7.3	29	63	9	10
13	0.09	0.19	0.16	0.26	0.0	0.7	7.53	7.47	7.08	7.3	28	52	9	8
14	0.08	0.2	0.16	0.28	0.0	0.7	7.50	7.25	7.60	7.1	26	65	8	11
15	0.09	0.19	0.16	0.25	0.0	0.7	7.32	7.64	7.10	7.7	35	47	10	9
16	0.14	0.13	0.22	0.20	0.0	0.0	8.24	8.10	6.22	6.8	49	62	15	18
17	0.14	0.43	0.22	0.64	0.0	0.4	7.59	7.72	6.88	7.2	52	67	16	20
18	0.14	0.33	0.22	0.51	0.0	0.3	7.91	7.85	6.90	7.5	53	60	18	18
19	0.14	0.45	0.22	0.67	0.0	0.5	8.20	8.02	6.26	7.2	50	77	14	23
20	0.15	0.12	0.22	0.19	0.0	0.0	8.21	8.02	6.10	7.1	52	64	11	22

Electrical Conductivity

The electrical conductivity is one of the important chemical parameter of water which is directly proportional to the salt concentration of the water (Sundaraiah, et al., 2013). The conductivity of supply water is varies from 0.15 ms/cm to 1.15 ms/cm at pre monsoon and 0.19 ms/cm to 1.16 ms/cm at post-monsoon. The 60% of supply water sample at post-monsoon has found more conductivity than pre-monsoon. In sample number 6, conductivity also found maximum (1.15 ms/cm at pre-monsoon and 1.16 ms/cm at post-monsoon) at both seasons (Fig.:3). In Sasrdar Ballav Bhai Patle ward the conductivity of pre-monsoon are found maximum (except 6 number sample) than post monsoon. Many of the household are collected the distribution water in a small water tank. In certain time the storage water may polluted and the water is inject into the distribution pipe by reverse water action.

The permissible limit of electrical conductivity in drinking water is specified as 1.5 ms/cm (WHO, 1963). The coefficient of variation conductivity in supply water at pre-monsoon is 85.55% and 69.89% at post-monsoon. The conductivity of supply water shows highly positive correlation with TDS and salinity (r=0.7543 at pre-monsoon and r=0.7210 at post-monsoon) and negative correlation with pH (r=-0.5950 at pre-monsoon and r=-0.3316 at post-monsoon).

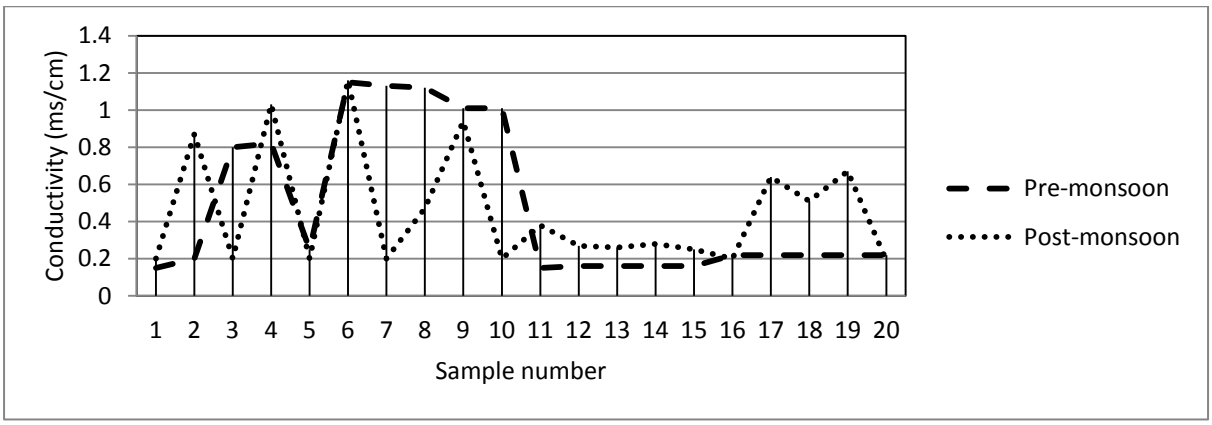

Fig.: 3 Conductivity in supply water in Raipur City, C.G.: pre- and post-monsoon.

Table: 2 Correlation matrixes of hydro-geochemical variables of supply water in the study area at pre-monsoon.

PARAMETERS	TDS	Conductivity	Salinity	pH	DO	Na	K
TDS	0						
Conductivity	0.6883	0					
Salinity	0.9197	0.7543	0				
pH	-0.5112	-0.5950	-0.6010	0			
DO	0.3476	0.5014	0.4344	-0.8656	0		
Na	0.4063	0.0395	0.1939	0.0673	-0.0714	0	
K	-0.0851	-0.3624	-0.2457	0.4095	-0.5726	0.3060	0

Salinity

According to Dinesan, et al. (2008) high TDS in the coastal area is due to salinity intrusion. The salinity of water is usually reported as electrical conductivity of the water (Das, et al., 2013). The 75% of supply water sample has found saline free water at pre-monsoon. In this time only the sample numbers 3,4,6,8 and 9 are found salinity. The maximum salinity (0.8 ppt) at pre-monsoon has found in sample numbers 6 and 8.

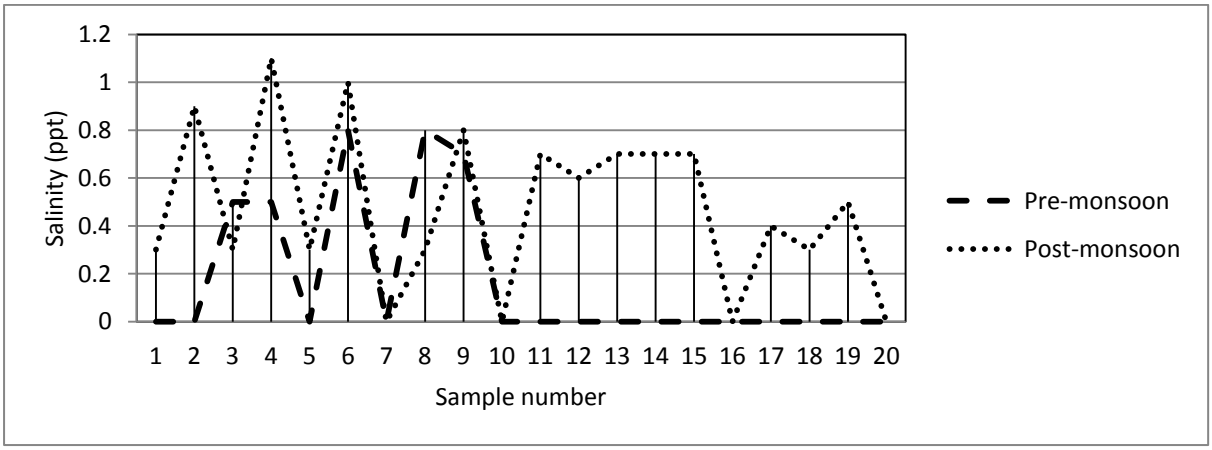

Fig.: 4 Salinity in supply water in Raipur City, C.G.: pre- and post-monsoon.

In sample number 4 (in Ramkrishna Paramhansa Ward) has found the maximum salinity (1.1 ppt) at post-monsoon (Fig.:4). The coefficient of variation in supply water at pre-monsoon is very high (182.77%) and also high (71.405%) in post-monsoon.

The salinity of supply water shows highly positive correlation with TDS and conductivity, its shows negative correlation only with pH at post-monsoon (r=-0.6747) and its shows negative correlation with pH (r= -0.6010) and potassium (r= -0.2457) at pre-monsoon as shown in Table2.

pH

As a physico-chemical parameter of supply water the pH is a very important indication of its quality and provides information in many types of geochemical equilibrium or solubility calculation (Hem, 1985). The maximum pH of supply water has found in sample number 16(Rabindranath Tagore Ward) at both season, at pre- monsoon and post- monsoon has 8.24 and 8.10 respectively on the other hand the minimum pH has found in the supply number 6 at both seasons, at pre and post- monsoon has 7.10 and 7.18 respectively but its the very closer to the perfect pH. According to ISI (1983) the permissible limit of pH concentration in drinking water is 6.5 to 8.5. The co-efficient of variation in supply water is both seasons 4.52 and 3.72 respectively (Fig.:5).

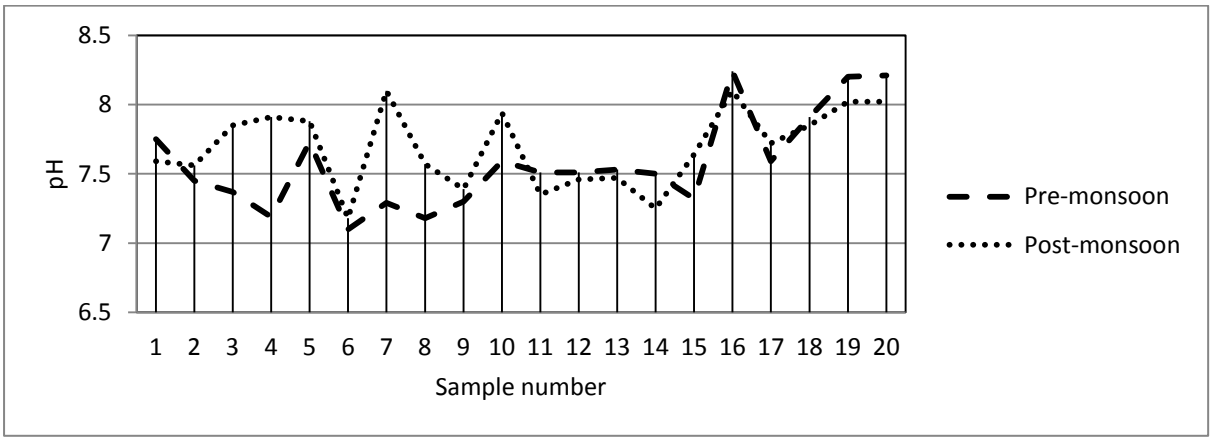

Fig.: 5 pH in supply water in Raipur City, C.G.: pre- and post-monsoon.

The ph of supply water shows negative correlation with all physico-chemical parameter except sodium and potassium at post –monsoon.

Dissolved Oxygen (DO)

The dissolved oxygen varies from 6.10 ppm to 7.60 ppm at pre-monsoon and it varies from 6.1ppm to 7.9 ppm at post monsoon (Fig.:6). There are no any logical relation of DO found between pre and post-monsoon. The coefficient of variation of DO in supply water is very low at both season 6.21% at pre-monsoon and 5.83% at post –monsoon. According to 'WHO' the DO in drinking water specified as 5mg/1 (5 ppm). The all study samples has sufficient dissolved oxygen with respect to the drinking water standards.

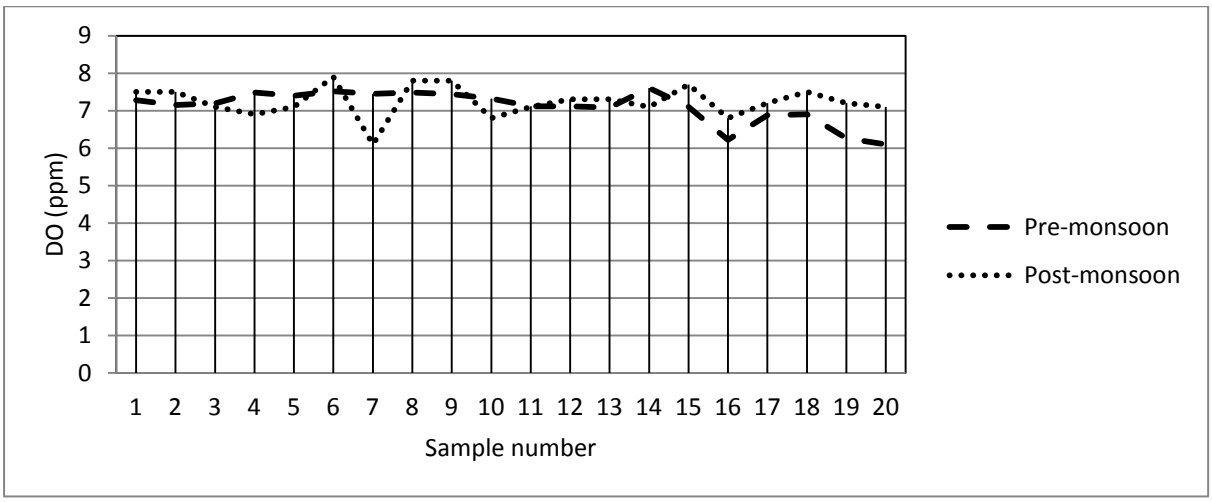

Fig.: 6 DO in supply water in Raipur City, C.G.: pre- and post-monsoon.

The DO of supply water found positive correlation with TDS , condition and salinity and negative correlation with pH, Na and K at pre-monsoon , other hand shows positive correlation with all parameter except pH and K.

Table: 3 Correlation matrixes of hydro-geochemical variables of supply water in the study area at post-monsoon.

PARAMETERS	TDS	Conductivity	Salinity	pH	DO	Na	K
TDS	0						
Conductivity	0.9991	0					
Salinity	0.7479	0.7210	0				
pH	-0.3559	-0.3316	-0.6747	0			
DO	0.4530	0.4424	0.5004	-0.6747	0		
Na	0.4307	0.4268	0.4177	-0.0464	0.0960	0	
K	0.1834	0.1876	0.0227	0.1860	-0.1041	0.0788	0

Sodium (Na)

The sodium of supply water varies from 22 ppm to 84 ppm at pre-monsoon and its varies from 34ppm to 110 ppm at post monsoon (Fig.:7). The maximum sodium has found under the sample number one in Ramkrishna Paramhangsa ward at pre-monsoon and post monsoon has fond under the sample number 4 in the same ward. All sample at post –monsoon has found the more sodium then the pre-monsoon. According to CDWQ (1996) the permissible limit of sodium for drinking water is specified as 200ppm.

The sodium of supply water shows positive correlation with all physic-chemical parameter except the DO (r= - 0.0714) at pre-monsoon and its shows also negative with the pH(r= - 0.0464) at post-monsoon as shown in Table 3.

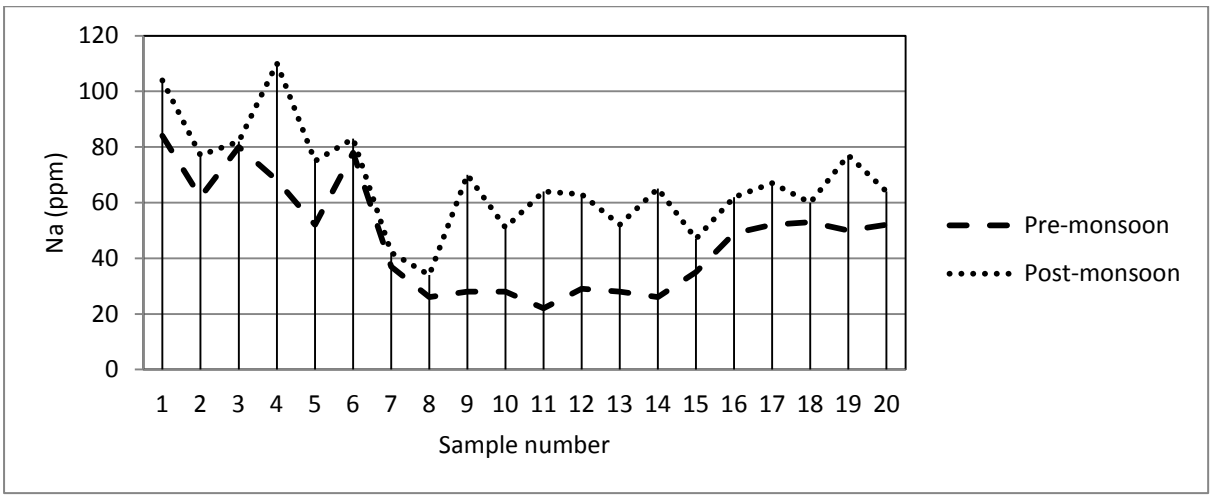

Fig.: 7 Sodium (Na) in supply water in Raipur City, C.G.: pre- and post-monsoon.

Potassium (K)

The potassium of supply water varies from 4 ppm to 18 ppm at pre-monsoon and its varies from 5 ppm to 24 ppm at post-monsoon. The 80% sample of post-monsoon has found the more potassium than the pre-monsoon. The maximum potassium (18 ppm) at pre-monsoon has found in the 18 number sample (in Rabindranath Tagor Ward) and at the post-monsoon (24 ppm) has found under 11 number sample (in Indiragandhi Ward) (Fig.:8).

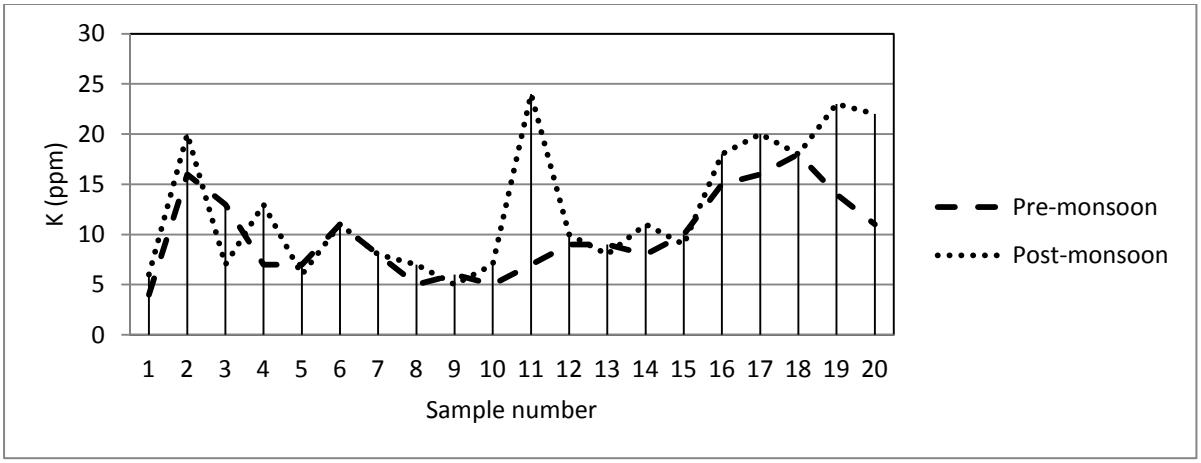

Fig.: 8 Potassium (k) in supply water in Raipur City, C.G.: pre- and post-monsoon.

The potassium of supply water in the study area shows positive correlation with pH and sodium at pre-monsoon. On the other hand its shows positive correlation with all parameters at post-monsoon except DO.

CONCLUSION

The present study reveals that the physic-chemical parameters of supply water have measured more at post-monsoon than the pre-monsoon. The water parameters of TDS, conductivity and salinity are proportionally correlated. The sample number 6 of Sardar Ballav Bhai Patle Ward is found high TDS, salinity and conductivity but pH is minimum. Due to add of urban sewage water (polluted water) into the distribution pipeline network by leakage of the

distribution pipe (Fig.: 9 and 10), the parameters of supplied water has changed from distribution centre (Rawabhata filter plant) and household tap i.e. pH of supply water in filter plant has measured 7.6 (dated on 14/10/2014 and 06/05/2015) but at household tap its varies from 7.10 to 8.24 (personal survey) at pre-monsoon (06/05/2015) and 7.18 to 8.10 at post-monsoon (14/10/2014). Also TDS of that water in filter plant has measured 0.12 ppt (120 ppm) (dated on 06/05/2015) but at household tap its varies from 0.08 ppt to 0.78 ppt (personal survey) and 0.238 ppt (238 ppm) (dated on 14/10/2014) measured in filter plant but at household tap it is varies from 0.13 ppt to 0.77 ppt (personal survey).

The present study shows that the all parameters of supply water are in the permissible limit. But we have to take a legal action regarding the leakage of distribution pipeline network, otherwise it may add various types of pollutants of the supply water and the water will be harmful for drinking.

Fig.: 9 leakage of supply pipeline

Fig.: 10 Rusty pipeline passing through the drainage

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