Analysis Of Ground Water Quality Of Pre-Monsoon Season Around Ksk Mahanadi Power Plant, Janjgir-Champa (C.G.) India

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Abstract:- This study Aims to investigate the contamination level of waste water in Janjgir-Champa District, (C.G) by considering some parameters like pH, Temperature, EC, TH, TDS, BOD, COD, F^-, Cl^-, NO_3^-, SO_4^{2-}, Turbidity, DO, HCO_3^-, CO_3^{2-}, Ca^{2+}, Mg^{2+}, PO_4^{3-}, Na^+, K^+, alkalinity, TDS, TS, TSS and Heavy metals (Pb, Cr, Fe ,Hg) concentration have been analyzed. Standard methods followed for the investigation of Physico-Chemical parameters and Heavy metals were analyzed through ICPMS method. The objective of the study investigates the pre-monsoon season variation in Physico-Chemical characteristics of water samples of three different sampling stations of Janjgir-Champa, (C.G) namely Nariyara Hand Pump (NR-HP), Banahil (BH-HP) and Tarod Hand Pump (TR-HP) respectively. The PH was found to be of range from 8.4 to 8.1; whereas the Electric Conductivity value ranged from 240 μscm^{-1} to 200$\mu s\ cm^{-1}$. In Addition, the maximum value of temperature was 36.3ºC and minimum 31.5ºC.
Furthermore, the Turbidity value ranged from 90.21 NTU to 10.52 NTU, the BOD values extend from 24.40mg/L to 20.50 mg/L. The COD value covered from 65.25 mg/L to 2.1 mg/L, and the TDS and TSS values ranged from 502.81 mg/L to 555.80 mg/L, TS value varied from 232 mg/L to 658 mg/L and the values of TSS covers the values between 85 mg/L to 72mg/L. Total alkalinity values ranged from 152.81 mg/L to 155.21mg/L, whereas the value varied from 433.56mg/L to 515.51mg/L, fluoride and chloride value ranged from 149.56 mg/L to 173.86 mg/L and 0.849 mg/L to 1.071 mg/L respectively. The values ranged of Phosphate, Sulphate and Nitrate were 0.038mg/L minimum value and 0.083 mg/L maximum value and minimum 110.6mg/L, maximum value 122.6mg/L, and the ranged of sulphate from 201.2 mg/L to 232.6 mg/L respectively. Sodium and Potassium value ranged from 23.8 mg/L to 2.1mg/L and 11.9 mg/L to 12.5mg/L respectively. Bicarbonate and carbonate value ranged from 62.1 mg/L to 70.2mg/L, 21.6 mg/L to 25.7mg/L respectively. In contrast Heavy metal (Pb, Cr, Hg, and Fe) were analyzed and compared with standard drinking water values. The result indicated that the concentration of iron value ranged between 0.8230 mg/L to 0.0159mg/L which exceeded the standards limit, although Pb and Hg value ranged between 0.005 mg/L to 0.010mg/L, 0.0020 mg/L to 0.0004 mg/L respectively and chromium is below the detection limit. The study emphasizes that the health risks associated with was the water for local and aquatic life are critical to t their survival, in the areas the quality of water is very bad at some places and it is unfit for drinking purpose.

Keywords: - Wastewater, Physico-Chemical Parameters, ICPMS, Heavy-metals, Contamination, Groundwater, Pre-monsoon.

Abbreviation: - NR-HP- Nariyara hand pump, TR-HP - Tarod hand pump, BH-HP - Banahil hand pump, ICPMS - Inductively Coupled Plasma Mass Spectrometric.

1. Introduction

One of nature's greatest gifts to humanity is clean water. Water is an important part of living organisms, without it, we cannot imagine our life. Aquatic ecosystems and hydrology depend on clean water for their wellbeing (Jackson at al., 2001). Fresh water is utilized for drinking, industrial processes, Transportation and food processing, pharmaceutical facilities, mines, coolant, paper mills and other purpose. In addition, it is employed for recreational and agricultural irrigation (Clair et al., 1978). Depending on where it comes from water, either surface water or ground water. In both urban and rural areas, ground water is the primary supply of drinking water (Gupta et al., 2009). Most of the time the effluents from different companies are not treated before being dumped into a water way due to treatment costs, incompetence and several other reasons (Valipur2015a, 2015b; Ladwani et, 2012; Shatikbala and Bhagat, 2012) as are result; it is heavily contaminated with many dangerous pollutants. Polluted water is defined as having biological or chemical contaminates (Alcamo, 2001). It has an annoying smell, flavour, colour and appearance. Heavy metals are usually present in water in trace amounts. Stress in water is caused by heavy metals from weathered soil and rocks,

mining and metallurgical release, and industrial emissions (Baori et al., aadamas1997). Many different pollutants can be found in industrial wastewater, depending on the industry's output (Gulp and Gulp,1971). Pollution from both point and non-point sources is linked to high toxicity issues and eutrophication (Sharma 1996 and Jain 2002). Numerous researchers are still working in India to better understand the physical and biological properties of both standing and flowing water resources (Pandey et al., 1993, Trivedy et al., 1986, and Kodarkar, 1992). Water Physico-Chemical properties are crucial to understand since they affect every aspect of aquatic animal's lives including their metabolism, physiology and overall Functions. Because of this, the water used for this purpose needs to be tasted frequently while keeping in mind it is unique characteristic. Rapid industrialization growth is occurring in many nations, which makes it very difficult to maintain an environment (Patil et al., 2012; Animesh and Saxena, 2011).

2. Materials And Methods

2 . 1 Material: - For analysis of various hand pump water samples parameters AR grade chemicals (Merck, India) have been used. All glassware and other sample containers were washed and rinsed with double distilled water and sterilized prior to use.

2.2 Collection of samples: - Ground water samples have been collected from three different locations of Janjgir-Champa District with the intervals of 3-4 hours between 9:00 AM to 11:00 AM in Season Pre- Monsoon. The plastic bottles were washed thoroughly with distilled water and then dried. The samples after collection were transported along with the sample date to the laboratory for the analysis. Various Physico-Chemical parameters like Temperature, pH was measured at the same time of sample collection by using thermometer and pocket digital pH meter. The other parameters such as TDS, TS, TSS, DO, COD, BOD, F^-, Cl^-, $NO_{3,}^{2-}$ PO_4^{3-}, Na^+, K^+, Ca^{2+}, Mg^{2+}, Total hardness, SO_4^{2-} Alkalinity, Turbidity, conductivity etc. were estimated in the laboratory by using standard method as prescribed by APHA (2005), (Trivedy and Goel;1984).

2.3 Study Area: - The ground water quality of Janjgir-Champa district is continuously degrading due to industrial activities. Water of the nearby fields are also being affected. Therefore, analysis of ground water of affected are a must needed for the treatment of the discussed area containing non treated water. Janjgir-Champa district is situated between 21º06' to 22º04'north latitudes and between 8203' to 8302. East longitude in Chhattisgarh state. Topographically, the district is bounded by Raigarh district in the East Janjgir-Champa district tin the north and Raipur and Raigarh district in north. Total geographical area of the district is 3852.75 sq. Kms reported by the surveyor general of India.

Fig 1: - (A) Map of C.G. (District wise) and (B) study area

Table 2.1 Methods Of Physico-Chemical Analysis

S.N.	Parameter	Unit	Method used
1	Temperature	^0C	Thermometer
2	pH	-	pH meter
3	Conductivity	μscm^{-1}	Conductivity meter
4	Turbidity	NTU	Nephelometric Method
5	Total Hardness as Calcium Carbonate	mg/L	EDTA Titration
6	DO	mg/L	Winkler Method
7	BOD	mg/L	5 days incubation at 20ºcand titration on initial final DO
8	COD	mg/L	Open Reflux Method
9	Alkalinity	mg/L	Titration
10	TS	mg/L	Gravimetrically
11	TDS	mg/L	Digital Conductivity Meter
12	TSS	mg/L	Gravimetrically
13	Fluoride	mg/L	Ion selective electrode
14	Chloride	mg/L	Silver- Nitrate Method
15	Nitrate	mg/L	Spectrophotometry
16	Sulphate	mg/L	Gravimetric Method
17	Phosphate	mg/L	spectrophotometry
18	Sodium	mg/L	Flame Photometer
19	Potassium	mg/L	Flame Photometer
20	Carbonate and bicarbonate	mg/L	EDTA titration
21	Calcium	mg/L	Flame Photometer
22	Magnesium	mg/L	Flame Photometer
23	lead	mg/L	ICPMS
24	Iron	mg/L	ICPMS
25	Chromium	mg/L	ICPMS
26	Mercury	mg/L	ICPMS

2.4 Determination of heavy metals by using ICPMS

Heavy metals are essential for all living organisms in little amount such as iron, zinc, cobalt for proper growth. However, the excessive amount of these heavy metals can also produce toxic effects and the estimation of the amount of heavy metals is important where there is a risk having human activities effect on aquatic environment. Before the analysis for heavy metals, the wastewater samples were reserved by 0.5% $HNO_3$and then water samples were filtered through whatman filter paper no.41 and then added 0.1 ml internal standard solution and temperature maintained at 20-22ºC. After that, the sample is ready to be analyzed through ICPMS instrument.

ICPMS operating conditions

Nebulizer	Glass can concentric
RF Generator	1,550w
Carrier gas	0.90L/min
Make up Gas flow rate	0.23L/min
Spray Chamber temperature	2^0C
Cones	Ni
Uptake time	20sec
Stabilization time	60sec
Helium flow rate	5ML/min
KED	2V
Sample Depth	8.0 MM
Integration time(sec)	0.1sec/point
Number of replicates	3

3. **Result and Discussion: -**

In the present study three water samples of Janjgir-Champa, District (C.G), have been analyzed. The results obtained by Physico-Chemical analysis of all parameters for one season (pre- monsoon) are given in table 3.1.

Table 3.1: - Summary of Physico-Chemical parameters of pre-monsoon season water quality parameter.

S.N.	PARAMETER	TR-HP	BH-HP	NR-HP
1.	Temp	31.5	33.7	36.3
2.	pH	8.1	8.4	7.2
3.	Conductivity	23	200	240
4.	Turbidity	20.22	90.21	10.52
5.	DO	1.7	2.1	1.8
6.	BOD	24.40	20.50	22.15
7.	COD	65.25	70.50	68.35
8.	TS	333	654	232
9.	TDS	510.53	555.80	502.81
10.	TSS	85	72	76
11.	Total alkalinity	155.21	153.85	152.81
12.	Total hardness	515.51	433.56	510.3
13.	Ca^{2+}	83.29	97.81	236.7
14.	Mg^{2+}	432.51	335.75	273.66
15.	F^-	1.071	1.061	0.849
16.	Cl^-	152.12	149.51	173.86
17.	PO_4^{2-}	0.038	0.083	0.58
18.	NO_3^-	110.6	118.6	122.6
19.	SO_4^{2-}	215.6	201.2	232.6
20.	Na^+	20.1	23.2	23.8
21.	K^+	11.9	12.3	12.5
22.	CO_3^{2-}	23.4	21.6	25.7
23.	HCO_3^-	67.6	62.1	70.2
24.	Pb	0.010	0.005	0.008
25.	Cr	0.0002	BDL	BDL
26.	Fe	0.3057	0.0159	0.8230
27.	Hg	0.0015	0.0020	0.0004

Water temperature has a significant impact on the chemical, biological and bio-chemical features of water bodies. The maximum water temperature found between 36.3ºC at NR-HP and minimum 31.5ºC at TR-HP. Acidity and alkalinity of water are indicated by PH. The limit of pH value for drinking water is 6.5 to 8.5 by ICMR. The maximum pH value of water is 8.4 at BH-HP and minimum 8.1 at TR-HP. This shows that pH value of water sample was moderately alkaline. The concentration and mobility of ions closely related to the conductivity of water.

The maximum water conductivity is 240 μscm^{-1} at NR- HP and Minimum 200 μscm^{-1} at BH -HP. The maximum permissible unit of parameter for drinking water is 300 μscm^{-1}. This water sample contaminates minimum amount of charged particles. Another measure of the amount at suspended matter in water is turbidity. It calculates how much light is dispersed or absorbed. Water's turbidity is a measurement to fits lack of clarity. When the turbidity of water is high, it become hazy but when it is low, it become clear. Turbidity is measured in Nephelometric. Turbidity units (NTU) or jacks on turbidity unit (JTU). The maximum water turbidity varied from 90.21 NTU at BH-HP, and a minimum 90.52 at NR-HP.

One of the most crucial aspects of water quality is dissolved oxygen, which has a direct impact on the survival and dispersal of flora and fauna in an ecosystem. The permissible DO unit for all the domestic purpose of drinking water is 4-6 mg/L. Dissolved oxygen ranged from 1.7 mg/L to 2.1 mg/L, in which maximum value 2.1mg/L at BH-HP and minimum value 1.7 mg/L at TR-HP. The amount of oxygen that anaerobic organisms need in water is measured by its biochemical oxygen demand. The breakdown for organic materials increases the biological oxygen requirement and creates oxygen tension in the water (ABIDA 2008). The permissible BOD limit for drinking water is 5 mg/L. The BOD ranged from 20.50 mg/L to 24.40 mg/L, in which maximum value 24.40mg/L at TR-HP and minimum value 20.50 mg/L at BH-HP the oxidation of reduced compounds in water is measured by COD. Its frequency is used to estimate the concentration for organic molecules in water directly (Kumar et al., 2011). The COD value is consistently higher than the BOD value. The COD ranges from 65.25 mg/L to 70.50 mg/L, in which maximum value is at 70.50 mg/L BH-HP and minimum value is at 65.25 mg/L TR-HP.

TDS value of water varies from 502.8 mg/L to 555.80 mg/L, in which higher value 555.80 mg/L at BH-HP and lower value 502.81 mg/L NR-HP was reported. For drinking water purposes, water with more than 500 TDS is undesirable. The permissible limit of TDS of drinking water is 500 mg/L. TS value of water very from 23 mg/L to 658 mg/L, in which higher value 658 mg/L at BH-HP and lower value 232 mg/L at NR-HP. TSS value of water varies from 72 mg/L to 85 mg/Lin which higher value 85 mg/L at TR-HP and lower value 72mg/L at BH-HP. The total alkalinity of water sample reveals the presence of OH^-, $CO_3^{2-}$and HCO_3^-. Phenolphthalein and methyl orange are employed as indicators in the acid base titration method to determine total alkalinity. The total alkalinity range varied between 152.81 mg/L to 155.21 mg/L at TR-HP and lower value 152.81 mg/L NR-HP. Total hardness is a sign of existence of Mg^{2+} and Ca^{2+} salts. In the present study the total hardness ranged varied between 433.56 mg/L to 515.51 mg/L in which higher value is 515.51 mg/L at TR-HP and lower value 433.56 mg/L at BH-HP. The Ca^{2+}value varies from 83.29 mg/L to 236.7 mg/L in which higher value 236.7 mg/L at NR-HP and lower value 83.298 mg/L at TR-HP. The Mg^{2+} value is from 273.66 mg/L to 432.51 mg/L in which higher value 432.51 mg/L at TR-HP and lower value 273.66 mg/L at NR-HP.

It is believed that a higher chloride concentration is a sign of increased pollution. Argentometric Titration method is used to determine the concentration of chloride in wastewater samples. The chloride value varied from 149.5 mg/L to 173.86 mg/L in which maximum value exceeds from 173.86 mg/L at NR-HP and minimum value is 149.51 mg/L at BH-HP, fluoride varied from 0.849 mg/L to 1.071 mg/L, in which higher value 1.071 mg/L at TR-HP and lower value is 0.849 mg/L at NR-HP, phosphate value vary from 0.038 mg/L to 0.083 mg/L, in which higher value 0.083 mg/L at BH-HP and lower value 0.038 mg/L at TR-HP, Nitrate value varies from 110.6 mg/L to 122.6 mg/L, in which higher value 122.6 mg/L at NR-HP and lower value 110.6 mg/L at TR-HP, Sulphate value is from 201.2 mg/L to 232.6 mg/L, in which higher value 232.6 mg/L NR-HP and lower value 201.2 mg/L at NR-HP and minimum value 201.2 mg/L at BH-HP. Sodium value varies from 20.1 mg/L to 23.8 mg/L, in which maximum value 23.8 mg/L at NR-HP and minimum value 20.1 mg/L TR-HP, potassium value varied from 11.9 mg/L to 12.5 mg/L in which maximum value 12.5 mg/L at NR-HP and minimum value 11.9 mg/L at TR-HP, Carbonate value vary from 21.6 mg/L to 25.7 mg/L, in which maximum value 25.7 mg/L at in NR-HP and minimum value 21.6 mg/L at BH-HP, bicarbonate value varied from 62.1 mg/L to 70.2 mg/L in which maximum value 70.2 mg/L at NR -HP and minimum value 62.1 mg/L at BH-HP.

The concentration of lead in ground water of the study area ranged from 0.05 mg/L to 0.010 mg/L. The entire three wastewater samples content chromium within the limit of BIS standard. The concentration of iron in ground water of the study area ranged from 0.0159 mg/L to 0.82 mg/L. All the samples exceeded the permissible limit of 0.3 mg/L. the higher value 0.823 mg/L at NR-HP and lower value 0.0159 mg/L at BH- HP and the value of mercury in present study ranged varied from 0.0015 mg/L to 0.000 mg/L. The higher value 0.020 mg/L at BH HP and lower value 0.0048 mg/L at NR –HP.

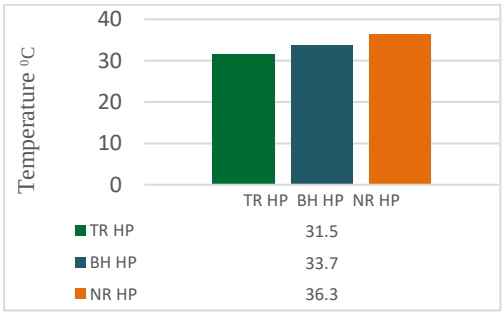


Fig 1: - Graphical representation of maintained values of Temp. in ^0C

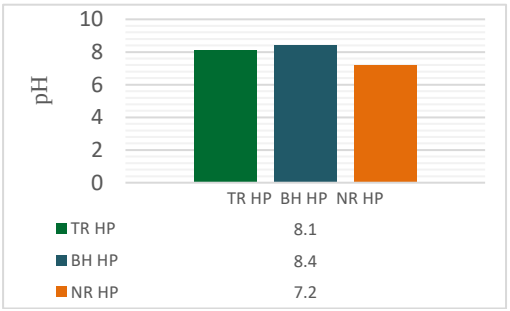


Fig 2: - Graphical representation of maintained values of pH

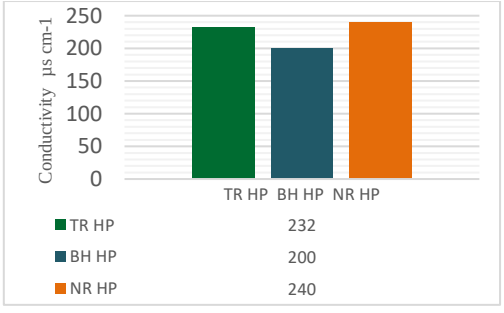


Fig 3: - Graphical representation of maintained values of EC in μscm^{-1}

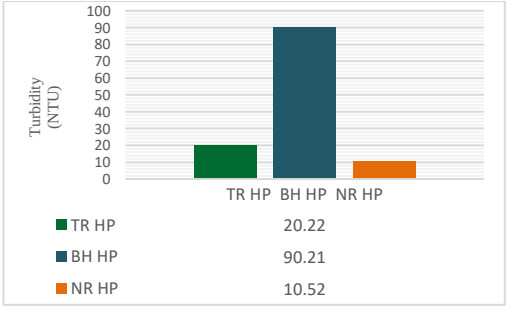


Fig 4: - Graphical representation of maintained values of Turbidity in NTU

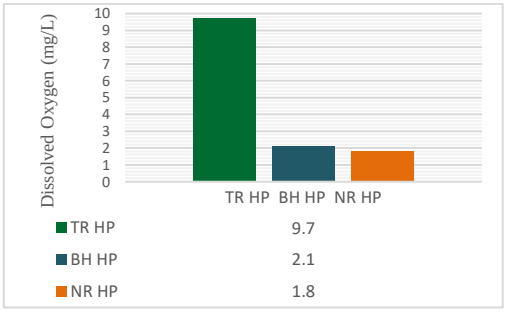


Fig 5: - Graphical representation of maintained values of BOD mg/L

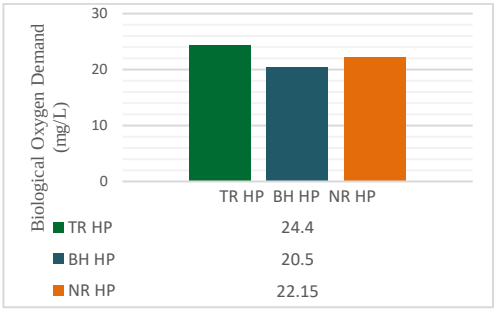


Fig 6: - Graphical representation of maintained values of DO in mg/L

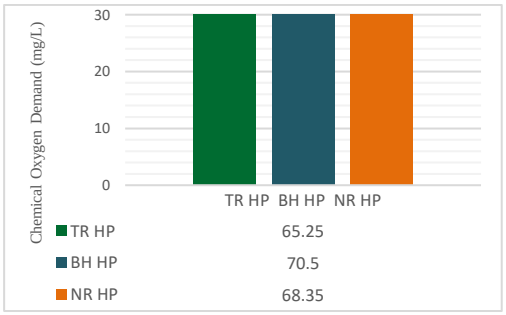


Fig 7: - Graphical representation of maintained values of COD in mg/L,

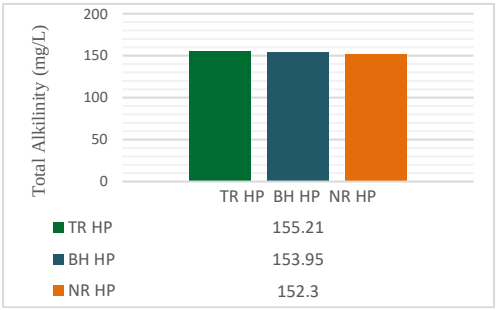


Fig 8 :- Graphical representation of maintained values of Total Alkalinity in mg/L

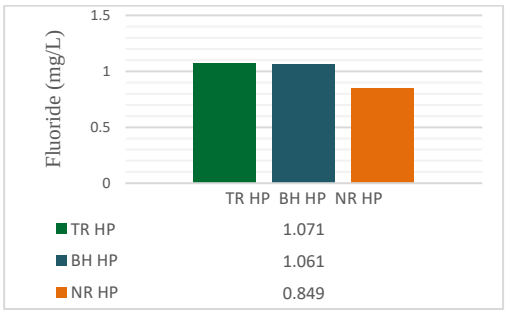


Fig 9: - Graphical representation of maintained values of F^- in mg/L,

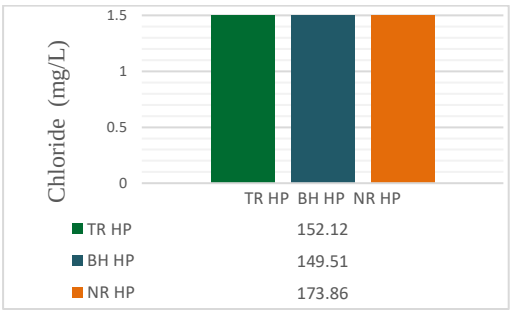


Fig 10 :- Graphical representation of maintained values of Cl^- in mg/L

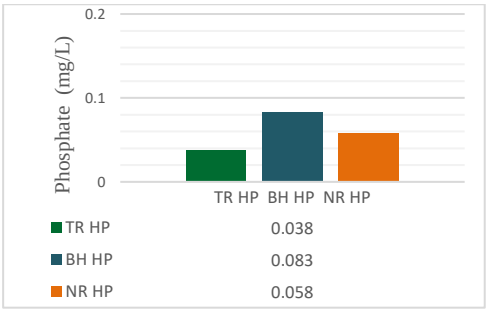


Fig 11: - Graphical representation of maintained values of Po_4^- in mg/L,

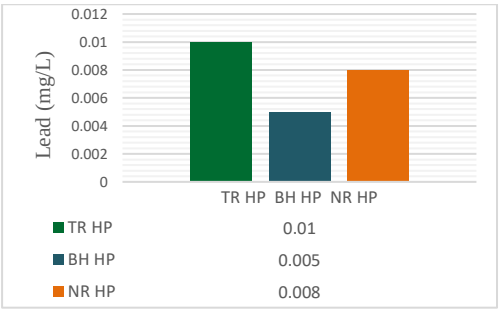
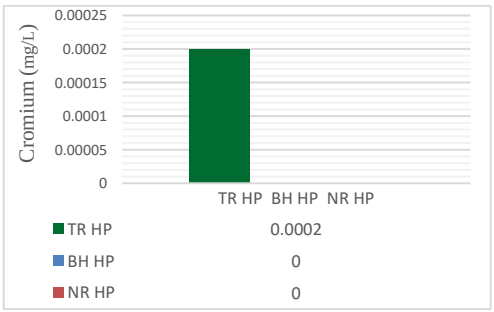


Fig 12 :- Graphical representation of maintained values of Pb in mg/L



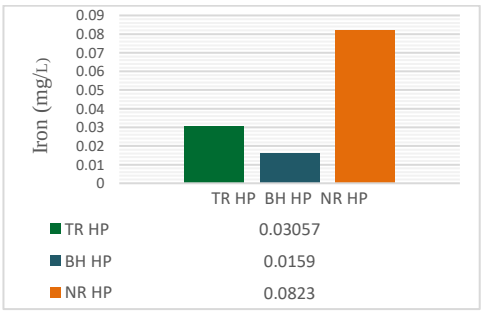


Fig 13: - Graphical representation of maintained values of Cr in mg/L,

Fig 14:- Graphical representation of maintained values of Fe in mg/L

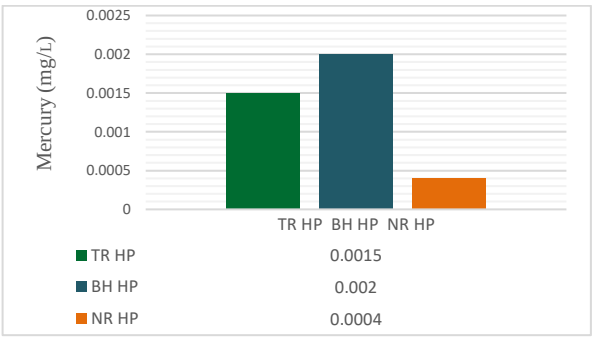
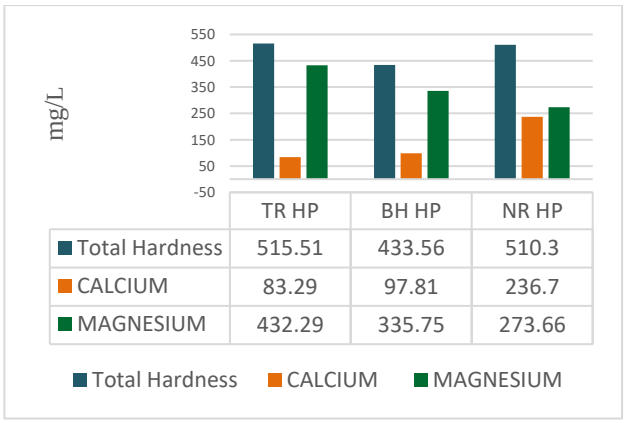


Fig 15: - Graphical representation of maintained values of Hg in mg/L



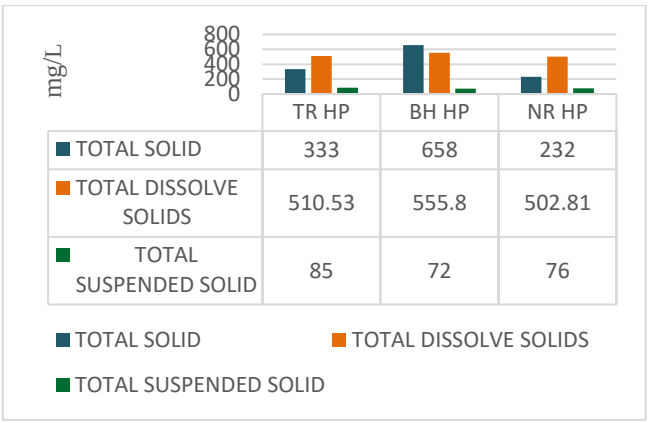
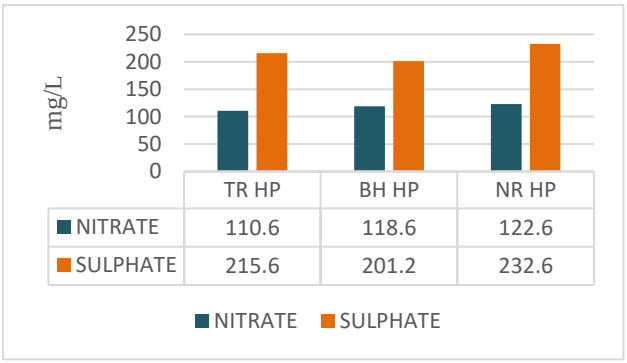


Fig 16: - Graphical representation of maintained values of TH, Ca^{2+}, Mg^{2+} in mg/L,

Fig 17:- Graphical representation of maintained values of TS, TDS, TSS in mg/L



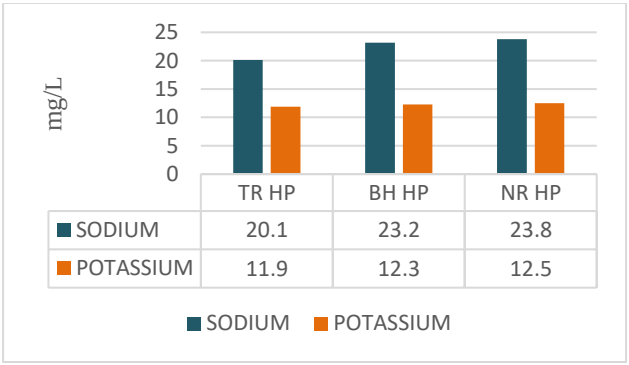


Fig 18: - Graphical representation of maintained values of No_3^-, So_4^{2-} in mg/L,

Fig 19 :- Graphical representation of maintained values of Na^+, K^+ in mg/L

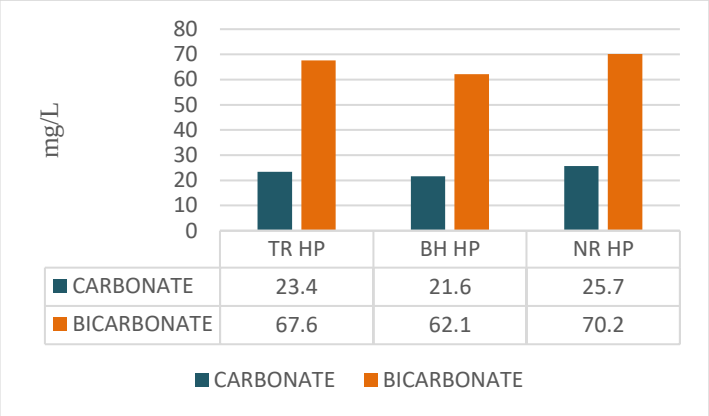


Fig 20: - Graphical representation of maintained values of CO_3^{2-}, HCO_3^- in mg/L

Conclusion: -

Analysis of different Physico-Chemical parameters of hand pump waters from different areas of Janjgir-Champa district containing water samples from different hand pump Nariyara, Banahill and Tarod area studied and concludes that as industry grows, more waste is produced that contain surface and groundwater. Based on the aforementioned studies, it can be said that the temperature of all area was quite high and, the hardness of water samples in this study area was quite high, the BOD and COD value indicate that the levels of contamination are increasing although pH, Nitrate, TDS, Turbidity, calcium, magnesium were found to be high within the range while Fluoride, Phosphate, sulphate, DO, chloride, potassium and T. alkalinity were found to be beyond the allowable limits. EC, TS, TSS values are below the acceptable range and the heavy metals (Pb, Cr, Hg) contamination was below the standard limit exception (Fe) metal. The results unequivocally show that the hand pump water from the above area is not suitable for drinking purposes as it is severely contaminated as a result of unchecked dairy effluent discharge, which causes eutrophication. The entire influence of the hand pump has led to the build-up of hazardous substances, the decline in water quality, and the shrinkage of the hand pump sediment area. There is an urgent need for ongoing pollution level monitoring in order to improve the quality of water for various purposes and time to take proper action and precautions and continuous monitoring of the pollution level. Hence, the groundwater sample requires treatment before being used.

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