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Quality Assessment of GroundWater and Surface Water Samples Collected fromTwo Different Zone of Central India

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Abstract: The problems of ground water quality in several parts of the country have become so acute in the areas that are densely populated and thickly Industrialized and have shallow ground water tube wells. The present study is aimed to evaluate the ground water, surface water quality of central India covering various physical & inorganic nonmetallic constituent i.e. Temperature, pH, Turbidity, Total dissolve solids, Hardness, Dissolved Oxygen (DO), Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Nitrate, Sulphate and Phosphate for water quality. Result Shows Slightly exceeded value of pH, turbidity, hardness; BOD, COD and phosphate were reported at some locations of study area.

Key words: Central India, Ground water, Surface Water, Physico-Chemical Parameters.

Introduction:

Ground water is an invaluable commodity available in Very limited quantities to human being and other living beings. The usefulness of ground water to a great extent depends on its chemistry [1]. The Composition of ground water is influenced mainly by geology, Climate, Hydrogeology and also human activities [2]. It has excellent natural quality, usually free from pathogens, color and turbidity and can be consumed directly without treatment[3]. The problems of ground water quality in several parts of the country have become so acute in the areas that are densely populated and thickly Industrialized and have shallow ground water tube wells. [4-5]. There are many sources that contribute contaminants to the ground water,e.g. land disposal of solid wastes, disposal on land, agricultural activities, urban runoff and polluted surface water. The quality of water is of vital concern for man since it is directly related to the human health. The most common and widespread health risk associated with drinking water is microbial contamination which has the potential to cause large outbreaks of water born diseases like dysentery, cholera, typhoid, skin infections etc. The chemical contaminations do not cause immediate, acute health problems unless they are present in massive quantities through some accident and use of drinking water sources [6]. However, for a long time of exposure they may cause serious health hazards. Rivers play an important role not only in balancing the hydrological cycle but also for augmenting water supply for drinking, municipal, industrial and agricultural use, power, generation, water way transport and other purposes. Rivers are highly complex systems influenced by several variables associated with the quality of water. Extensive literature on River water quality is available throughout the world [7-8]. In India, the water quality of the rivers has been extensively studied particularly with respect to the rivers of north India [9] and South India. These have highlighted the water quality and documented the changes brought about by rapid developmental theand urbanization. [10]Specially the riwes of rivers of drinking water supplies drawn from the river of drinking water supplies drawn from the river polluted by dyeing waste water may become unfit or otherwise unsuitable for human consumption due to odor, color, turbidity, presence of chemicals etc. The potential for hazards arises from chemicals etc. The potential for hazards arises from chemicals etc[11]. The potential for hazards arises from chemicals etc. The potential for hazards arises from chemical toxicity presence of acids, alkalis and various organic pollutants[12]. Water harness is caused primarily by the presence of actions such as calcium, and magnesium and anions such as carbonate, bicarbonate, chloride and sulphate in water. Water hardness has no known adverse effects; however some evidence indicates its role in heart disease[13]. In urban areas, the careless disposal of industrial effluents and other wastes in rivers estuaries and lakes may contribute greatly, to the poor quality of river water [14]. The central India plateau is environmentally very important to understand the rich Indian biodiversity and diffuse chemical pollution. Madhya Pradesh literally means' central province' and is located in the geographic heart of India, between latitude 21.2^0N-26.87^0N and longitude $74^0$02'-$82^0$49'E. The present study is aimed to evaluate the ground water, surface waterand air quality of central India covering various physical & inorganic nonmetallic constituent i.e. Temperature, pH, Turbidity, Total dissolve solids, Hardness, Dissolved Oxygen (DO) Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Nitrate, Sulphate and Phosphate for water quality.

Material Method:

We assume Madhya Pradesh as a central India (study area) which is divided in to two zones (a) East Zone of Central India (b) West Zones of Central India. In the present study we are intended to find out the diffuse chemical pollution in Central India on the basis of residential area an industrial area atmospheric air and surface water bodies. We have designed twenty sampling stations district for this study in east zones i,e. Rewa, Satna, Sidhi, Singrauli, Shahdol, Umaria, Katni, Panna, Chhatarpur, Jabalpur, Mandala, Dindori, Siwani, Chhindwara, Narsinghpur, Hosangabad, Betul, Damoh, Sagar, Bhopal and twenty district in west zone i,e. Gawaliar, Shivpuri, Ashok Nagar, Datiya, Muraina, Bhind, Guna, Tikamgarh, Vidisha, Raisen, Sihora, Rajgarh, Sajapur, Dewash,Ujjain, Ratlam, Indore, Khandawa, Burhanpur and Harda of Central India.Hundred twenty water samples were collected from bore wells of two different zones of central

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India samples were collected in polythene bottles and analyzed for various water quality parameters as per standard procedures [15]. The experimental values were compared with standard values recommended by world health organization (WHO) and Indian standards for drinking purposes. The statistical analysis such as mean, standard deviations (SD) of data were carried out using Microsoft office excels 2007. The location of sampling station are shown in Table – A to E and fig-1

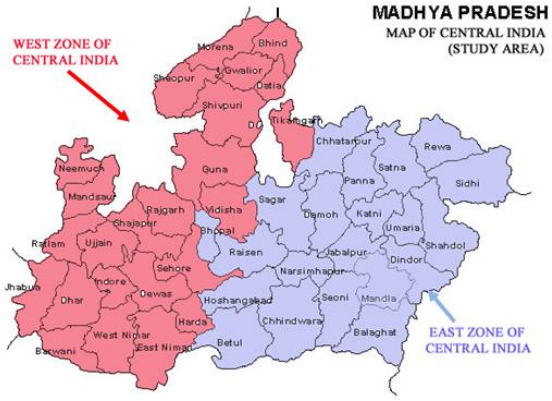

Table- A. Name of District in Central India

S. No	East Zone of Central India For Study	West Zone of Central India For Study
1	Rewa	Gawaliar
2	Satna	Shivpuri
3	Sidhi	Ashok Nagar
4	Singrauli	Datiya
5	Shahdol	Muraina
6	Umaria	Bhind
7	Katni	Guna
8	Panna	Tikamgarh
9	Chhatarpur	Vidisha
10	Jabalpur	Raisen
11	Mandala	Sihor
12	Dindori	Rajgarh
13	Siwani	Shajapur
14	Chhindwara	Dewash
15	Narsinghpur	Ujjain
16	Hosangabad	Ratlam
17	Betul	Indore
18	Damoh	Khandawa
19	Sagar	Burhanpur
20	Bhopal	Harda

Table- B Location of Sampling Station with Code for Ground and Surface Water in East Zone Central India (of year 2013 to 2014)

	Residential Area	Industrial Area	Surface Water Area
1	R_1= Rewa Near Bus Stand,	I_1= Near J.P. Cement Plant Rewa,	S_1=Bihar River Rewa City Near Cholipur,
2	R_2= Satna Near District Hospital,	I_2= Near Birla Cement Plant Satna,	S_2= Bichhiya River Rewa City near Bichhiya,
3	R_3= Sidhi Near Sanjay Gandhi P.G. College,	I_3= Near Madariya Industrial area Sidhi,	S_3= Tamas River Satna City near Madhogarh,
4	R_4= Singrauli Near Railway station,	I_4= Near N.T.P.C. Singurauli,	S_4= Gopad River Near Sidhi City,
5	R_5= Shahdol Near New Bus Stand,	I_5= Near Ramnagar Coal Mince area Shahdol,	S_5= Sone River Near Singarauli,
6	R_6= Umaria Near Govt. R.V.P.S. College,	I_6= Near beersinghpur Coal Mince area Umaria,	S_6= Ban Ganga Shahdol City,
7	R_7= Katni Near Swetamber Temple,	I_7= Near Ardinance Factory Katni,	S_7= River Mudwara Near Katni City,
8	R_8= Panna Near Bus Stand,	I_8= Near Majhgama Mince area Panna,	S_8= Ken River Near Panna City,
9	R_9= Chhatarpur Near Higher Secondary,	I_9= Near Mince area Chhatarpur,	S_9= Bari Pond Near Chhayarpur City,
10	R_{10}= Jabalpur Near S.B.I. Chhorha,	I_{10}= Near Khamaria Industrial area Jabalpur,	S_{10}= Narmada Rivers Jabalpur City Near Bhedaghat,
11	R_{11}= Near R.D. P.G College Mandala,	I_{11}= Maneri Industrial area Mandala,	S_{11}= Narmada Rivers Mandala City Near Polytechnic College,
12	R_{12}= Dindori Near Main Post Office,	I_{12}= Mining area Dindori,	S_{12}= Kochouphung Lake Near Dindori City,
13	R_{13}= Near Govt P.G. College Siwani,	I_{13} Near Kelori Tehsil Mince area Siwani,	S_{13}= Talab Siwani City Near Bus Stand,
14	R_{14}= Chhindwara Near State Bank of India,	I_{14}= Near Amabana Coal Mince area Chhindwada,	S_{14}= Bohani Talab Near Harsinghpur City,
15	R_{15}= Narsinghpur Near Railway Station,	I_{15}= Near Oil Mills Gadarwara Narsinghpur,	S_{15}= Narmada River Hosangabad City Near Govt. Girls P.G. College,
16	R_{16}= Near District Hospital Hosangabad,	I_{16}= Near Itarsi Industrial area hosangabad,	S_{16}= Tapti River Betul City Near Multai Bus Stand,
17	R_{17}= Betul Near Excellence School,	I_{17}= Near Oil Plant Betul,	S_{17}= Gandhi Sagar Risaviour Near Sagar City,
18	R_{18}= Damoh Near Bus Stand,	I_{18}= Near Gandhi Ashram Industrial area Damoh,	S_{18}= Bhopal Talab Near Hamidiya Hospital,
19	R_{19}= Sagar Near Railway Station,	I_{19}= Near Belai Industrial area Sagar,	S_{19}= Mandakin River Chitrakoot Near Ramghat,
20	R_{20}= Bhopal Near Hamidia Hospital.	I_{20}= Near Manddeep Industrial area Bhopal.	S_{20}= Narmada River Near Amarkantak City.
21	R_{21}= Near Gajaraja Medical College Gawaliar	S_{21}= Gawalior,Near Madhav Sagar Lake	I_{21}= Near Taxtile Industry Gawalior

22	$R_{22=}$ Near Tatyatope Park Shivpuri	$S_{22=}$ Sindha River Shivpuri	$I_{22=}$ Shivpuri Near Kattha Factory
23	$R_{23=}$ Ashok Nagar Near Busstand	$S_{23=}$ Tulsi Sarovar Ashok Nagar District	$I_{23=}$ Near New Industrial Area Rawasar Tehsil,Ashok Nagar
24	$R_{24=}$ Datia Near Pitamabra Temple	$S_{24=}$ Sindha River Near Datia City	I_{24} = Datia Near Metal Industries Industrial Area ,Datia
25	$R_{25=}$ Muraina Near Railway Station	$S_{25=}$ Sita Sagar Lake Near Muraina City	I_{25} = Muraina, Near Banmaor Cement Plant
26	$R_{26=}$ Bhind ,Near Head Post Office	$S_{26=}$ Balsamand Lake Bhind	$I_{26=}$ Bhind Near Cotton Textile Industry
27	$R_{27=}$ Near Delhi Public School Guna	$S_{27=}$ Ganga Sagar Lake Near Guna City	$I_{27=}$ Near National Fartilizer Limited ,Guna.
28	$R_{28=}$ Civil Line Tikamgarh	$S_{28=}$ Betwa River Near Tikamgarh	$I_{28=}$ Tikamgarh, Near Plastics , Rubber Spectro Based Industry
29	$R_{29=}$ Near S.A. Institute of TechnologyVidisha	$S_{29=}$ Betwa River Near City Vidisha	$I_{29=}$ Near Kurwai Industrial area Vidisha
30	$R_{30=}$ Raisen,Near Higher Secondary School	$S_{30=}$ Dhasan River ,Near Raisen City	$I_{30=}$ Near Obedulaganj Industrial area Raisen
31	$R_{31=}$ Sihore, Near Railway Colony	$S_{31=}$ Bhojtal from Bhopal Division Shiore District	$I_{31=}$ Near Budani Industrial Area Sihore District.
32	$R_{32=}$ Near Anjalilal Temple ,Rajgarh Biora	$S_{32=}$ Parvati River Near N.S.C.B. Govt, P.G, College Biora	$I_{32=}$ Near Jut Mils Rajgarh.
33	R33=Near Ghati Shajapur Housing Board Colony.	$S_{33=}$Parvati River, Near Shajapur city	I_{33}= NearCauesting Foundry and Rerolling mills.
34	R_{34}=Near Tilak Nagar Dewas	S_{14}= Kali Sindha river, Near Dewas City.	I_{34}=Near renboxi Pharmaceutical industry Dewas
35	R_{35}=Near Dussehra Maidan, Ujjain	S_{35}= Chhipra river near Mahakaleswer	I_{35}= Near Synthetic yarn industry Ujjain
36	R_{36}= Near Sai Baba Mandir Ratlam	S_{36}=Chambal River Near Ratlam City	I_{36}=Drag and Pharmaceutical industry, Ratlam.
37	R_{37}=Near Maheswari Higher Secondary School, Indore.	S_{37}= NearJanapav River Chambal	I_{37}=Near Plastics industry, Indore.
38	R_{38}=Near Malviya Colony,lal chowki Khandwa.	S_{38}=Narmada river Near Omkareswar, Khandwa	I_{38}=Near cotton mills Khandwa.
39	R_{39}=Near Bus Stand Burhanpur District	S_{39}= Tapti River NearBurhanpur City	I_{39}=Near Papers mills NepaNagar, Burhanpur.
40	R_{40}=Near Harda Polytechhnique College.	S_{40}=Pond Near Khirkiya, Harda.	I_{40}=Eknath Solvent Extraction Gram Pidgoan, Harda.

Result and Discussion:

Temperature: Temperature is basically important for the Chemical and biological reactions of organisms in water. The increase in temperature decrease the portable of water because of elevated temperature carbon dioxide and other volatile gases which import taste are expelled (Karunakaran *etal.* 2009)[16]. The temperature of all the water samples of different areas of both in Zone of Central India were found raged between 10 ^{0}C to 40 ^{0}C. The highest temperature was recorded in summer season in the industrial area of west Zone Central India, while lowest was recorded in winter in Amarkantak region of East Zone Central India. (Arya etal. 2011)[17]Studiedassessment of underground water quality: A Case study of Jhansi city, utter Pradesh, India, reported temperature values varied between 12.0 ^{0}C to 32.0^{0}C .

PH: The pH of all the ground and surface water samples collected from different areas of Central India were observed range from 6.0 to 9.5. All the samples were below the permissible limit except samples I_2, I_7, R_{29}, S_{22}, S_{28}, and S_{33} (Shrivastava *etal.* 2014)[18] studied ground water quality assessment of Birsinghpur Area, Satna District, Madhya Pradesh and PH Concentration was found ranged from 6.8 to 7.8.

Turbidity: The turbidity of all the water samples is found ranged between 0.01 to 12.8 NTU. The Maximum value of Turbidity (12.8 NTU) was observed at sampling stations of I_{25} during the monsoon season. The values from all the sampling station within the WHO recommended values (5NTU) except the sampling station R_8, I_{10}, S_1, I_{25}, I_{26}, I_{30}, S_{25}, S_{29}, and S_{32}. (Mariappan *etal.* 2002)[19]High turbidity shows presence of large amount of suspended solid.

Total Hardness:

. In the present study the TH of water was observed to be 122 to 960 mg/l. The highest value was found 960 mg/l at sampling stations R_{29}, during monsoon seasons of study area. (Sunit*etal.* 2005))[20] Studied hydrogeo-chemistry of ground water, gooty Area, Anantapur District, Andhrapradesh and total hardness values were found ranged between 360 to 4040 mg/l.

TDS: The term total dissolved solid refer mainly to the inorganic substances that are dissolved in water. The effects of TDS on drinking water quality on the levels of the individual

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components, excusive hardness, mineral deposition and corrosion are common properties of highly mineralized water. In the present study TDS was observed ranged between 23.0 to 542.0 mg/l. Maximum concentration is found in ground and surface water sample collected from Central India which is 542.0 mg/l at sampling station I_8 (Near majhgama mince area panna) during monsoon season. Only four samples (R_7 I_{18}, S_{19}, and I_{37}) are exceeded the permissible limit of WHO. (Zinjad et*al.* 2013)[21]Carried out Physico-chemical parameters of drinking water in parvara areas around parvara River and TDS value was found ranged between 481 to 655.0 mg/l.

Dissolved Oxygen: The amount of dissolved oxygen recorded in the surface and ground water of different sampling stations of Central India ranged between 0.6 to 8.0 mg/l. The highest DO (8.0 mg/l) was found at sampling station S_2 during summer seasons in surface water area of Central India. The lower values of DO Indicate that these water will not be utilized for drinking purposes. (Singh *etal.* 2012)[22]Studied Assessment of physico-Chemical status of ground water samples of Dhalpur District, Rajasthan and reported the DO values varied from 3.2 to 6.8 mg/l.

Bio-Chemical oxygen Demand: kumar *etal.* 1996)[23] Biochemical oxygen Demand depends on aquatic life variation in BOD indicates dynamism in aquatic life present in the pond. BOD refers the oxygen used by the microorganism in the aerobic oxidation of organic matter. Therefore with the increase in the amount of organic matter in the water the BOD increases. Biochemical oxygen Demand varied from 1.0 to 23.2 mg/l Maximum BOD was found (23.2 mg/l) at sampling station R_{27}, during India. values of BOD at sampling stations R_2, R_4, I_1, I_2, I_3, I_6, I_{10}, I_{11}, I_{16}, I_{20}, S_1, S_2, S_3, S_{11}, S_{17}, S_{19}, R_{21}, R_{22}, R_{23}, R_{24}, R_{25}, R_{27}, R_{30}, R_{35}, R_{37}, I_{22}, I_{23}, I_{24}, I_{26}, I_{27}, I_{28}, I_{29}, I_{30}, I_{31}, I_{33}, I_{34}, I_{37}, S_{21}, S_{24}, S_{25}, S_{26}, S_{27}, S_{28}, S_{29}, S_{31}, S_{32}, S_{33}, S_{34}, S_{35}, S_{36}, S_{38} and S_{40} are higher than the permissible limits prescribed by WHO, during all the seasons of the study area.

Chemical oxygen Demand: In the present study, the values of COD varied from 1.3 to 118.0 mg/l. Maximum COD was found (118.0 mg/L) at sampling station S_{30},during monsoon seasons in surface water area of west during Zone Central India. Fifty four samples of COD was found higher than the permissible limit set by WHO as 10.0 mg/l, during all the seasons (Monsoon, winter and summer). High values of COD indicate water pollution, which is linked to sewage effluents discharged from city, Industry and agricultural practice. (Watkar et*al.* 2014)[24] Studied the impact of Ideal Immersion on water quality of kolar River in saoner, District Nagpur India and reported the Chemical oxygen Demand found to be 54.12 to 59.14 mg/l

Nitrate: In the present Study the nitrate content of water was found to be 0.001 to 17.3 mg/l. The highest value of 17.3 mg/l was recorded at location while the Minimum value 0.001 mg/l was recorded at location S_{16}, which is within permissible limit Prescribed by WHO for Drinking water. (Singh *etal.* 2014)[25] studied water quality assessment of kanke reservoir water of Raneli Town ship areas and nitrate concentration was found below the 0.5 mg/l. **Sulphate**: It the concentration exceeds above 500 mg/l it has laxative effect and gastrointestinal irritation occurs. This effect leads to dehydration in infants. In the Present study, over all the concentration range of sulphate varied between 0.003 to 200 mg/l. Maximum concentration of 200 mg/l was observed in monsoon season and minimum concentration 0.003 mg/l during the summer season. The Maximum Concentration of sulphate (200 mg/l) was detected at sampling station of R_6. (Tripathi *et al.* 2014)[26]Studied assessment of ground water quality in Umaria District, Vindhya Pradesh India, reported the sulphate content ranged between 5.0 to 398 mg/l

Phosphate: In the Present study the phosphate Concentration ranged from 0.001 to 3.0 mg/l. The Maximum concentration of phosphate 3.0 mg/l. was observed at the location R_{10}, while Minimum concentration of phosphate was detected to be 0.001 mg/l at R_{12} sampling station. (Prasanna *etal.* 2010)[27] studied physico-Chemical Properties of water Collated from Dharma estuary and analyzed the phosphate content and values were found ranged between 0.04 to 1.15 mg/l. All the results are Showan in **fig-2 to12**

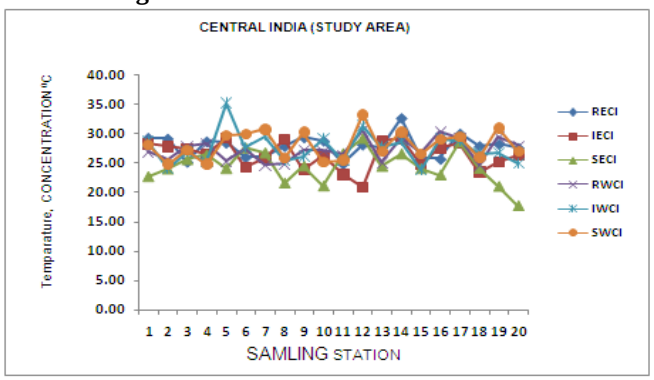

Figure 2:Comparative Temperature profiles of two different Zone of Central India.

* RECI = Residential Area of East Zone Central India ** RWCI = Residential area of West Zone Central India

* IECI = Industrial area of East Zone Central India ** IWCI = Industrial area of West Zone Central India

* SECI = Surface water area of East Zone Central India ** SWCI = Surface water area of Waste Zone Central India

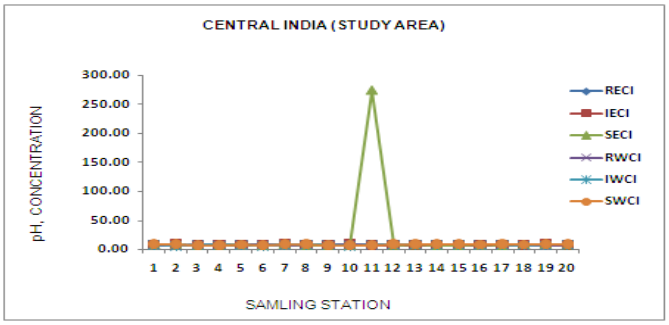

Figure 3:Comparative pH profiles of two different Zone of Central India.

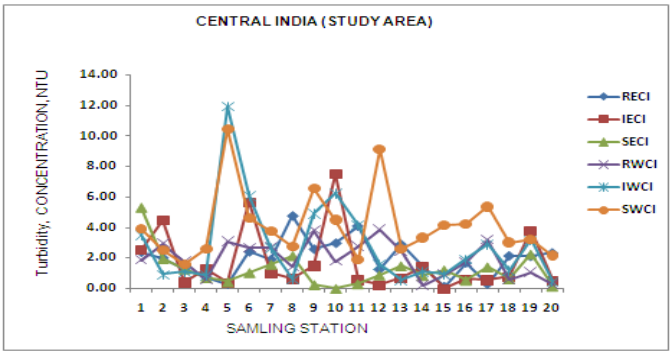

Figure 4:Comparative Turbidity profiles of two different Zone of Central India.

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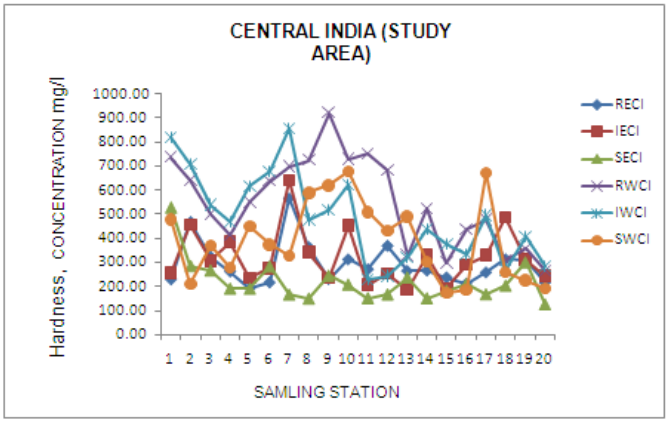

Figure 5:Comparative Hardness profiles of two different Zone of Central India.

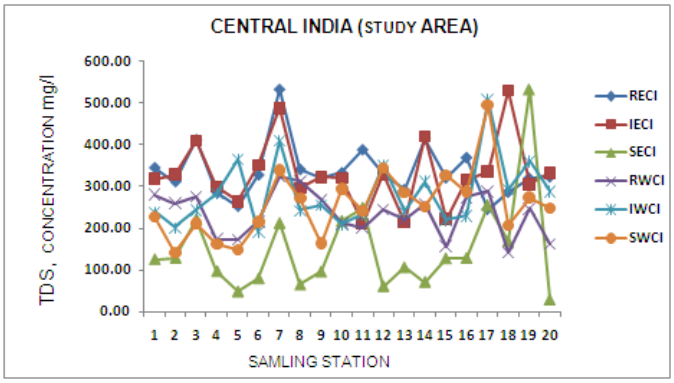

Figure 6:Comparative TDS profiles of two different Zone of Central India.

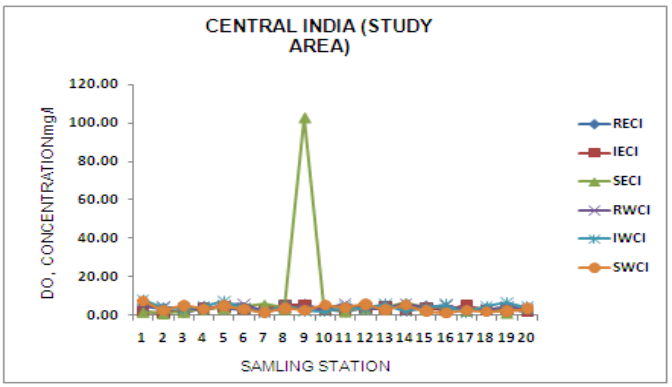

Figure 7:Comparative DO profiles of two different Zone of Central India.

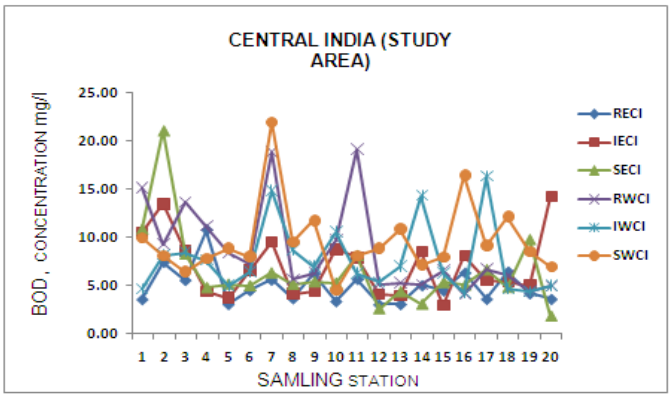

Figure 8:Comparative BOD profiles of two different Zone of Central India.

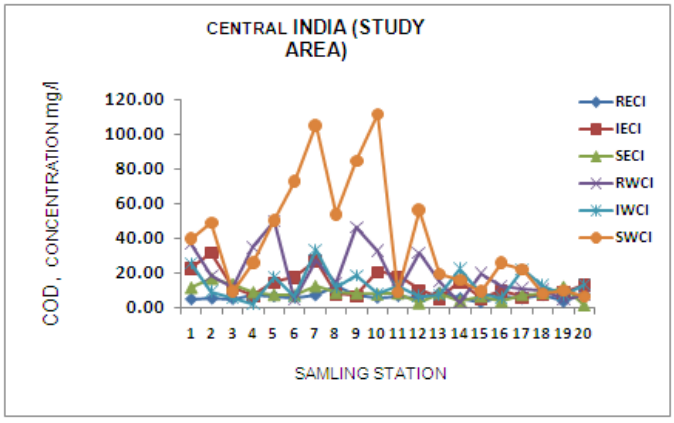

Figure 9:Comparative COD profiles of two different Zone of Central India.

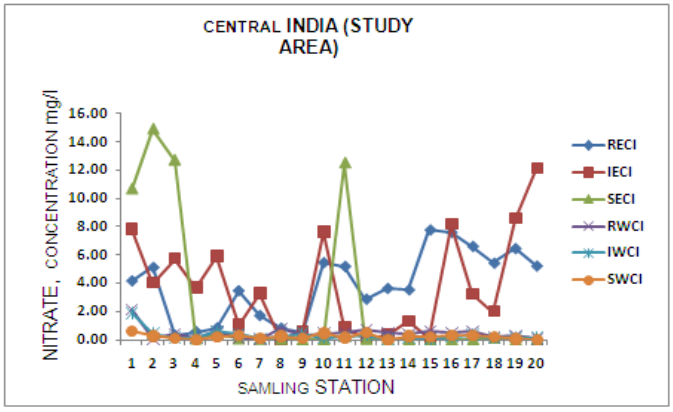

Figure 10: Comparative Nitrate profiles of two different Zone of Central India.

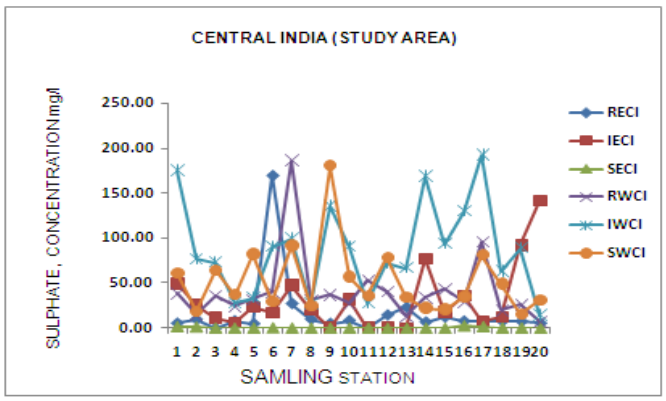

Figure 11: Comparative Shulphate profiles of two different Zone of Central India.

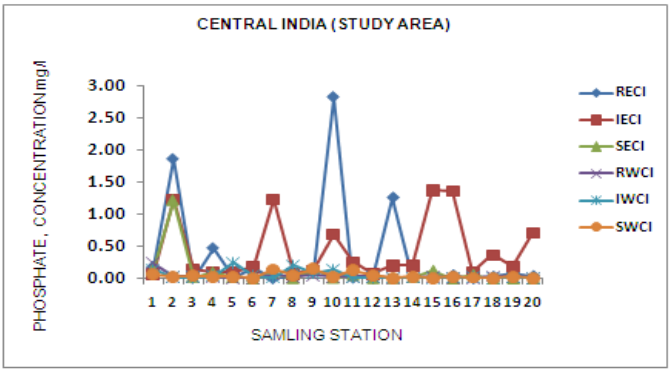

Figure 12: Comparative Phosphate profiles of two different Zone of Central India.

Conclusion:

The comparative results showed the temperature (10^0C to 40^0C), pH (6.0to 9.5), turbidity (0.01to 12.8 NTU), total hardness (122 to 960 mg/l), TDS (23.0 to 542.0 mg/l), DO (0.6 to 8.0 mg/l) BOD (1.0 to23.2 mg/l), COD (1.3 to118.0 mg/l), nitrate (0.01 to 17.3), sulphate (0.003 to 200 mg/l) and Phosphate (0.001 to 3.0 mg/l).The temperature of all the water samples of study area were found between10^0C to 40^0C , the highest temperature was recorded in summer season in the industrial area of west zone central India.TDS, nitrate and sulphate of all the samples of study area were found below the recommended level. Slightly exceeded value of pH, turbidity, hardness, BOD, COD and phosphate were reported at some locations of study area. The ground water is believed to be comparatively much clean and free from pollution then surface water, but prolonged discharge of Industrial effluents, domestics' sewage and solid waste dump causes the ground water to become polluted and created health problems.

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Reference:

i. *Amrita Singh and Sunil K. Choudhary, Chemical Analysis of ground water Nathnagar Block under Bhagalpur district, Bihar (India), J. Environ. Science & Engg. Vol.53, 2011,pp469-474.*

ii. *Telebi, A. Chandrashekhara, M.J.G. Fazlli, M.S. Khosra, F.V. and A.G Bhole, Hydrogeo Chemistry and Quality of Ground Water in yenne Hole watershed Journal IAEM,vol.21, 1994, pp 8-16.*

iii. *C.K Jain, C.P. Kumarand M.K. Sharma, Ground Water quality of Ghataprabha Command Area , Karnataka, Indian J. Environ,& Ecoplan,vol. 7, No.2, 2003,pp251-262.*

iv. *Joydev Dutta, Mridul Chetia and A.K. Mishra, Drinking Water Quality in Six Small Tea Gardene of Sonitpur District of Assam , India, With Special Reference to Heavy Metals, J. Environ. Science & Engg. Vol.53 No.4, 2011, pp443-450.*

v. *R.K. Tiveddy, Ecology and Pollution of Indian Rivers (Ashish Publishing House, New Delhi) 1998.*

vi. *B. Bhuyan and Sharma HP, Public health impact of Pesticide use in the Tea- Gardens of Lakhimpur District, Assam, Ecplpgy, Environment and Conservation, vol.10,No3, 2004, pp333-338.*

vii. *V. Subramnian and D. K. Datta, Nature of Solute Loads in the Rivers of the Bengal Drainage Basin, Bangladesh, Journal of Hydrology, vol.198, 1997, pp196 -208.*

viii. *A. J. Robson and C. Neal, A Summary of Regional Water Quality for Eastern UK Rivers, Science of the Total Environment, vol.194 No.195, 1997,pp15 – 39.*

ix. *L. James, Distribution of Trace Heavy Metals in Two Distributaries of Rivers Cauevery, Int. Journal Environmental Protection, vol.10, No.5, 1990, pp350 – 352.*

x. *V. K. Srivastava, Population Dynamics' of Benthic Micro invertebrates in Relation to Water Quality and Silt load of Siang River of Arunchal Pradesh, Journal. Appl. Biosc., vol.32, No.1,2006 ,pp 44 – 53.*

xi. *A. Sharma, S. K. Singh and L. Kori (2009a). Molecular Edemiological Characteristics of Shigella Spp. Isolated from River Narmada During 2005 – 2006, J. Environ. Health, vol.71, No. 6, 2009,pp61 – 66.*

xii. *A.C. Chindah, A. S. Braide and O.C. Sibeuda, Distribution of Hydrocarbons and Heavy Metals in and a Crustacean (Shrimps-Notialis) from the Boney /new Calabar River Estuary, Niger Delta Ajeam- Rageea., 2004 ,pp1-14 .*

xiii. *P. K. Dutta. An Overview of Textile Pollution and its Remedy. Indian Journal Environmental protection, vol.14, No.6, 1994, pp 443 – 446.*

xiv. *H. A. Schroeder, Relations between Hardness of Water and Death Rates from Centain Chronic and Degenerative Diseases in the United States, Journal Chronic Disease, vol.12, 1960,pp 586 – 591.*

xv. *Standard Method for the Examination of Water and Waste Water (20th Edition) APHA, America Water Works Association (AWWA) and Water Work Environment Federations. Washington.1999, pp1325.*

xvi. *K. Karunakaran, P. Thamilarasu and R. Sharmila, Statistical Study on physico-chemicalCharacteristics of Ground Water in and Around Namakkal, Tumilnadu, India, Journal of Chemistry, vol.6,No.3, 2009, pp909- 914.*

xvii. *Sandeep Arya, Vinit Kumar, Minakshi and Anshu Dhaka, Assessment of Underground Water Quality: International Multidisciplinary Research Journal, vol.1, No.7, 2011, pp11-14.*

xviii. *K.B.L Shrivastav, S.P Mishra and Neerja Manlick, Ground Water Quality Assessment of Birsinghpur Area, Satna District, Madhya Pradesh, India,Poll Res., vol. 1 No.1, 2014 ,pp125-132.*

xix. *P.Mariappan and T. Vasudivan, Correlation of some physico-chemical Parameters of Drinking Water Ponds in Eastern Parts of Sivagangai District, Tamil Nadu. Poll. Res. Vol. 21,No.4, 2002 ,pp 403 – 407.*

xx. *V. Sunitha, V. Sudarshan, and B Rajeswara Reddy, Hydro geochemistry of Ground Water, Gooty Area, Anantpur District, Andhra Pradesh, India. Poll .Res, vol.24, No.1, 2005, pp217 – 224*

xxi. *D. G. Zindal, Study of physico – Chemical Parameters of Drinking Area Around Parvavara River Journal of Applicable Chemistry, vol.2,No.3, 2005, pp545-548.*

xxii. *M. K. Singh Dhaneshwar Jha and Jyoti Jadoun Assessment of Physico-chemical Status of Ground Water Samples of Dhalpur District, Rajasthan, India, International journal of Chemistry, vol.4,No.4, 201 ,pp96-104.*

xxiii. *A. Kumar, Comparative Study on diel Variation of Abiotic Factor in Lentic and Lotic Fresh Water Ecosystems of Santal Paragana (Bihar), Journal Environ Pollu., vol.3, 1996 ,pp83-89.*

xxiv. *A. M. Watkar and M. P. Barbate, Impact of Idol Immersion on Water Quality of Kolar River in Saoner, District Nagpur, India, International Research Journal of Environment Science, vol.3, No.3, 2014,pp39- 42.*

xxv. *P. Singh, A.K. Tiwari and P. K. Singh, Studied Water Quality Assessment of Kankee Reservoir Water of Roneli Town Ship Area, IJEP, vol.34,No. 9, 2014,pp735- 741.*

xxvi. *Indra Prasad Tripathi, Arvind Prasad Dwivedi and M. Suresh Kumar , Assessment of Ground Water Quality in Umaria District, Vindhya Pradesh, India, Journal of Applicable Chemistry, vol. 3, No.2, 2014,pp798- 811.*

xxvii. *Muddeli Bipara Prasanna, Physico-chemical Properties of Water Collected from Dharma Estuary and Analyzed the Phosphate, IJEP, 2010.*