

Water Quality of Surface Water Resources in Nagpur District of Maharashtra

G.K.Khadse, P.M.Patni, Kirti Lanjewar and P.S. Kelkar

National Environmental Engineering Research Institute, Nehru Marg, Nagpur-440020

e-mail : gk_khadse@neeri.res.in

ABSTRACT

Water samples from reservoirs and rivers were collected during post monsoon and summer seasons. Various physico-chemical parameters, trace elements and bacteriological parameters were analyzed to assess the possibility of point and non-point pollution loads in the water resources. pH, turbidity, conductivity, total alkalinity and total hardness were found in the range of 6.2 to 8.3, 0.3 to 39 NTU, 67 to 680 μScm^{-1} , 32 to 284mg/L and 62 to 308 mg/L respectively. Ca, Mg, Na and K were found in the range of 8 to 61 mg/L, 2 to 41 mg/L, 3 to 79 mg/L and 1 to 28 mg/L respectively. The respective ranges of Cl, SO₄, NO₃ and PO₄ were observed between 2 to 94 mg/L, 1 to 31 mg/L, 1 to 20 mg/L and 0.1 to 1.7 mg/L. DO and COD in the water ranged between 5.1 to 8.3 mg/L and 8 to 54 mg/L respectively. The study showed alkaline nature of water with sodium and calcium as dominating cations and chlorides as major anion. Trace metal concentration in all the samples are within the desirable limit. Most of the reservoirs and rivers are bacteriologically contaminated. The temporal and spatial variability in water quality may be assigned to catchment characteristics, agricultural and urban activities in the catchment and human and animal activities nearby water sources.

INTRODUCTION

Water is the most important natural resource in the world since without it life cannot exist and most industries could not operate. The presence of a safe and reliable source of water is thus an essential prerequisite for the establishment of a stable community. Water quality studies are regarded as one of the thrust areas in the water resource sector, as envisaged in the National Water Policies (2000 & 2002) that "both surface water and ground water should be regularly monitored and phased program should be undertaken for improvements in water quality". Water quality is defined by certain physical, chemical and biological characteristics. The water quality must be evaluated to see how it fits the intended use.

STUDY AREA

Study area comprised of the entire Nagpur district in the eastern part of Maharashtra. The district lies between 20°35' and 21°45' North latitudes and 78°15' and 79°40' East longitudes. Nagpur district has a total geographical area of 9,931 km² and constitutes 8.2% of the total area of Maharashtra state. Geographically, Nagpur district can be divided

into three parts viz. Northern hilly region, Western hilly area, Kanhan and Venna river valleys. The area of Nagpur district is occupied by varied assemblages of rock formations ranging in antiquity from proterozoic to recent with an altitude range of 275 to 305 m. Nagpur district experiences typical tropical monsoon climate with hot summer followed by the rainy season. The summer starts by the middle of March and attained its peak during the later part of May and early part of June with mean daily maximum temperature at 42.8°C. The rainy season due to the effect of south-west monsoon sets in by middle of June and continues till September with an average rainfall of 1,063 mm. The winter season commences towards end of November. December is the coldest month with mean daily maximum temperature at 28.70C and mean daily minimum temperature at 12.1°C.

MATERIALS AND METHODS

The surface water resources Viz. Rivers and reservoirs were selected from all over the Nagpur district with due consideration of the criteria like catchment characteristics, distribution and representation of the area, socio-economic and environmental sanitation conditions and designated usages of water bodies. Total 35 samples were collected from reservoirs and rivers during October, 2004 and May, 2006 for physico-chemical and bacteriological parameters, and heavy metals. The samples were preserved as per requirement of all the parameters following standard methods. The water samples were analyzed for various physico-chemical, bacteriological and heavy metal parameters as per the methods prescribed in the Standard Methods for the Examination of Water and Wastewater, APHA, AWWA and WEF, 20th Edition, 1998. The parameters like Temperature, DO, pH, Conductivity and Alkalinity were carried out at the site. Samples for the analysis of other parameters were properly preserved and brought to the headquarter for analysis. The samples for bacteriological analysis were preserved in icebox and transported to headquarter for analysis within 24 hours. Membrane filtration technique was used for bacteriological analysis for estimation of Total coliforms and Faecal coliforms.

RESULTS AND DISCUSSION

Water Quality Assessment

The characteristics of water from various resources are summarized as below.

Physico-chemical characteristics: Water quality data (Table 2&3) of reservoirs showed that pH ranged from 6.2 to 8.3 and 6.8 to 8.4 respectively during post monsoon and summer seasons. Conductivity ranged from 58 to 586 mS/cm and 67 to 520 mS/cm during post monsoon and summer seasons respectively, which may be attributed to the concentration of salts in reservoirs during summer. Total alkalinity during summer season (84 to 248 mg/L) was higher than post monsoon season (56 to 184 mg/L). Total hardness also shows the same trend as that of alkalinity. Sodium and calcium are the dominant cations followed by magnesium and potassium. Chloride is the dominant anions followed

Table 1 : Details of Water Sampling Locations (Nagpur District)

S.No.	Name of Source	Location	Longitude	Latitude	Altitude
Surface water resources (Reservoirs)					
1.	Mordham	~1.5 km from Linga , Kalmeshwar Tah.	21 ^o 13'00" N	78 ^o 48'35" E	280m
2.	Kotwalbardi	Near Nimji , Kalmeshwar Tah.	--	--	--
3.	Jam	Near Ridhora, Katol – Kondhali road, Katol Tah.	21 ^o 08'47" N	78 ^o 52'40" E	264 m
4.	Zilpa	Near Zilpa , Katol – Saoner road, Saoner Tah.	21 ^o 15'53" N	78 ^o 35'28" E	411 m
5.	Kar	Border of Nagpur –Wardha Districts, Katol Tah.	21 ^o 20'41" N	78 ^o 28'44" E	399 m
6.	Khumari	Khumari village near Mohpa, Kalmeshwar Tah.	21 ^o 18'58" N	78 ^o 51'07" E	256 m
7.	Chandrabha ga	Near Jangad, Kalmeshwar Tah.	21 ^o 16'07" N	78 ^o 46'20" E	378 m
8.	Kesarnala	Near Telgaon, Katol - Saoner road, Saoner Tah.	21 ^o 22'00" N	78 ^o 50'01" E	377 m
9.	Kolar	Near Telangkheldi, Saoner Tah.	21 ^o 24'47" N	78 ^o 47'36" E	378 m
10.	Raibasa	Near Raibasa, ~ 5 km from Kelwad, Saoner Tah.	21 ^o 24'47" N	78 ^o 47'36" E	370 m
11.	Khecranala	On Khapa – Nagalwadi road , Ramtek Tah.	21 ^o 32'10" N	78 ^o 56'55" E	336 m
12.	Kanhadevi	Near Kanhadevi, Parseoni Tah.	21 ^o 22'21" N	79 ^o 08'41" E	316 m
13.	Dongartal	~5 km west of Deolapar, Ramtek Tah.	21 ^o 36'23" N	79 ^o 20'28" E	402 m
14.	Khidki	On Deolapar – Belda road, Ramtek Tah.	21 ^o 34'39" N	79 ^o 23'06" E	376 m
15.	Khindsi	On Ramtek -Tumsar road, Ramtek Tah.	21 ^o 32'10" N	79 ^o 22'41" E	308 m
16.	Salaimendha	Near Salaimendha, Hingna Tah.	--	--	--
17.	Kanholibara	Near Kanholibara, Hingna Tah.	20 ^o 50'36" N	78 ^o 50'46" E	328 m
18.	Wakeshwar	Near Wakeshwar, Nagpur Tah.	21 ^o 00'38" N	79 ^o 21'14" E	248 m
19.	Wadgaon	Lower Venna Project, Wadgaon, Hingna Tah.	20 ^o 43'21" N	79 ^o 07'04" E	265m
20.	Nand	Near Shedeshwar village, Umrer Tah.	--	--	--
21.	Sayaki	Near Dhava, Umrer-Champa- Makardhokda road, Umrer Tah.	21 ^o 00'07" N	79 ^o 12'55" E	297 m
22.	Makardhok a	Near Makardhokda, Umrer Tah.	20 ^o 55'13" N	79 ^o 10'42" E	297 m
23.	Pandhrabodi	Near Umrer, Umrer Tah.	20 ^o 52'17" N	79 ^o 12'43" E	282 m
24.	Chinchala	Near Chinchala, Umrer Tah.	20 ^o 45'32" N	79 ^o 20'37" E	295 m
25.	Thana	In between Thana and Shirpur, Umrer Tah.	20 ^o 50'35" N	79 ^o 23'58" E	290 m
26.	Undri	On Panchgaon - Kuhi road, Umrer Tah.	21 ^o 00'05" N	79 ^o 12'56" E	296 m
27.	Ukarwadi	Near Champa, Nagpur-Umrer road, Umrer Tah.	21 ^o 01'08" N	79 ^o 09'59" E	288 m
28.	Karandla	On Umrer-Tarna road, Bhiwapur Tah.	20 ^o 45'38" N	79 ^o 20'43" E	300 m
29.	Satighat	Near Tarna, Umrer-Mandhal road, Kuhi Tah.	20 ^o 48'46" N	79 ^o 22'09" E	284 m
30.	Umrer Lake	In Umrer town, Umrer Tah.	21 ^o 51'18" N	79 ^o 19'22" E	289 m
31.	Ambazari lake	In Nagpur city, Nagpur Tah.	--	--	--
Surface water resources (Rivers)					
32.	Kanhan	Near Khapa on Parseoni road, Saoner Tah.	21 ^o 32'10" N	78 ^o 50'55" E	332 m
33.	Venna	Near Butibori on Wardha road, Nagpur Tah.	20 ^o 58'09" N	79 ^o 02'48" E	275 m
34.	Wainganga	Near Ambhora on Bhandara road, Kuhi Tah.	20 ^o 53'36" N	79 ^o 24'48" E	273 m
35.	Kanhan	From bridge near Mauda, Mauda Tah.	21 ^o 13'22" N	79 ^o 13'54" E	311 m

Table 2 : Physico-chemical and Bacteriological Quality (October, 2004)

Sl. No.	Temp. (°C)	pH	Turb. (NTU)	Cond (µs/cm)	TDS	T.Alk	T.Hard	Ca	Mg	Na	K	Cl	SO ₄	NO ₃	PO ₄	F	DO	COD	TC	FC
mg/L																				
Surface water resources (reservoirs)																				
1	34	8.2	15.2	326	196	236	164	38	17	39	8	28	4	4	0.9	0.4	6.5	25	62	18
2	35	7.8	1.0	277	166	196	120	11	22	50	6	38	11	4	0.1	0.2	6.9	37	200	30
3	33	7.7	1.3	320	192	210	140	21	21	35	7	34	4	1	0.1	0.1	7.4	30	3000	950
4	33	7.6	15.4	288	173	224	128	16	21	38	7	34	9	4	0.1	0.2	7.1	25	200	36
5	32	7.6	2.0	299	179	132	144	18	24	33	20	36	3	6	0.2	0.2	6.1	10	65	15
6	32	8.1	6.1	332	199	150	140	24	19	35	8	46	3	4	0.2	0.6	6.5	32	800	160
7	35	8.4	2.4	303	182	196	136	30	15	35	4	44	4	5	4.0	0.2	6.8	23	90	20
8	35	8.0	2.4	223	134	146	96	19	12	22	6	24	2	3	0.4	0.5	6.3	17	1600	340
9	34	8.1	0.8	278	167	216	124	29	13	40	9	28	2	2	0.2	0.5	6.0	12	260	10
10	34	8.0	21.7	334	200	204	140	26	18	30	7	32	6	4	0.6	0.1	6.8	20	1400	110
11	35	7.9	0.9	269	161	180	148	38	13	25	7	28	2	3	0.8	0.1	7.1	42	120	28
12	33	8.1	0.6	362	217	248	96	40	15	44	28	32	16	12	0.1	0.1	7.2	26	280	95
13	34	7.7	5.1	81	49	84	76	11	12	7	5	26	3	3	0.2	0.2	7.4	29	220	10
14	35	8.0	10.7	205	123	136	68	8	12	41	4	38	3	4	0.1	0.3	6.8	27	2100	400
15	35	7.6	0.9	172	103	108	80	27	3	27	6	28	3	2	0.2	0.3	7.4	35	400	30
16	33	7.7	1.6	300	180	168	136	23	16	32	6	30	7	4	0.1	0.2	7.2	22	360	32
17	34	7.7	2.0	306	184	248	144	24	18	28	5	83	4	4	0.2	0.1	7.0	17	200	40
18	34	7.7	1.2	391	235	152	116	19	17	74	5	84	14	1	0.3	0.1	7.1	15	70	22
19	33	7.9	0.8	373	224	138	120	34	9	42	14	52	10	6	0.1	0.4	6.5	28	42	14
20	34	7.7	17.0	208	125	180	80	18	9	56	12	30	4	4	0.3	0.5	6.9	17	100	24
21	35	7.8	39.0	321	193	152	144	37	13	15	8	26	4	6	0.8	0.5	6.8	15	180	40
22	33	7.9	17.0	295	177	154	144	37	13	19	10	32	3	6	1.2	0.6	7.1	29	TNC	500
23	34	7.8	1.9	207	124	132	96	29	6	41	9	48	2	4	0.1	1.1	7.5	44	160	30
24	34	7.6	2.0	164	99	100	88	16	12	20	1	52	4	8	0.6	0.1	6.8	39	1640	170
25	33	7.1	4.0	296	178	134	96	21	11	30	11	36	7	9	0.6	0.2	8.8	30	20	4
26	34	7.7	1.6	165	99	140	72	24	3	35	8	24	5	11	0.3	0.2	7.3	33	200	35
27	33	7.6	1.7	227	136	164	100	26	9	23	4	32	4	5	0.1	0.7	7.2	12	240	20
28	34	6.8	24.9	184	110	94	52	14	4	42	3	40	5	16	0.6	0.4	7.5	18	120	20
29	34	7.0	2.8	67	40	88	64	8	11	7	5	32	1	8	0.3	0.3	7.2	27	400	80
30	35	7.6	3.0	520	312	168	144	34	15	58	12	94	2	15	0.1	0.1	7.5	31	2500	280
Surface water resources (Rivers)																				
31	35	7.3	2.7	400	240	112	192	38	40	64	11	4	1	1	0.4	0.2	6.4	22	4600	420
32	33	8.0	2.4	411	247	284	192	46	18	79	6	38	11	5	0.5	0.4	6.9	12	310	100
33	34	7.7	0.9	623	554	220	308	22	41	36	16	60	20	5	0.6	0.2	6.0	17	240	85
34	33	7.4	2.2	443	266	260	152	34	17	75	12	56	10	20	1.7	0.2	8.2	15	420	96
35	35	7.9	1.9	534	320	272	168	34	20	73	8	50	31	2	1.7	0.3	6.5	20	120	32

Table 3: Physico-chemical and Bacteriological Quality (April-2006)

Sl. No.	Temp (°C)	pH	Turb. (NTU)	Cond (µs/cm)	mg/L														COD	TC	FC
					TDS	T. Alk	T. Hard	Ca	Mg	Na	K	Cl	SO ₄	NO ₃	PO ₄	F	DO				
Surface water resources (reservoirs)																					
1	34	8.2	15.2	326	196	164	38	17	39	8	28	4	4	0.9	0.4	6.5	25	62	18		
2	35	7.8	1.0	277	166	120	11	22	50	6	38	11	4	0.1	0.2	6.9	37	200	30		
3	33	7.7	1.3	320	192	140	21	21	35	7	34	4	1	0.1	0.1	7.4	30	3000	950		
4	33	7.6	15.4	288	173	128	16	21	38	7	34	9	4	0.1	0.2	7.1	25	200	36		
5	32	7.6	2.0	299	179	144	18	24	33	20	36	3	6	0.2	0.2	6.1	10	65	15		
6	32	8.1	6.1	332	199	140	24	19	35	8	46	3	4	0.2	0.6	6.5	32	800	160		
7	35	8.4	2.4	303	182	136	30	15	35	4	44	4	5	4.0	0.2	6.8	23	90	20		
8	35	8.0	2.4	223	134	146	19	12	22	6	24	2	3	0.4	0.5	6.3	17	1600	340		
9	34	8.1	0.8	278	167	124	29	13	40	9	28	2	2	0.2	0.5	6.0	12	260	10		
10	34	8.0	21.7	334	200	204	26	18	30	7	32	6	4	0.6	0.1	6.8	20	1400	110		
11	35	7.9	0.9	269	161	148	38	13	25	7	28	2	3	0.8	0.1	7.1	42	120	28		
12	33	8.1	0.6	362	217	248	40	15	44	28	32	16	12	0.1	0.1	7.2	26	280	95		
13	34	7.7	5.1	81	49	84	76	11	12	7	5	26	3	0.2	0.2	7.4	29	220	10		
14	35	8.0	10.7	205	123	136	8	12	41	4	38	3	4	0.1	0.3	6.8	27	2100	400		
15	35	7.6	0.9	172	103	108	27	3	27	6	28	3	2	0.2	0.3	7.4	35	400	30		
16	33	7.7	1.6	300	180	136	23	16	32	6	30	7	4	0.1	0.2	7.2	22	360	32		
17	34	7.7	2.0	306	184	144	24	18	28	5	83	4	4	0.2	0.1	7.0	17	200	40		
18	34	7.7	1.2	391	235	152	19	17	74	5	84	14	1	0.3	0.1	7.1	15	70	22		
19	33	7.9	0.8	373	224	138	34	9	42	14	52	10	6	0.1	0.4	6.5	28	42	14		
20	34	7.7	17.0	208	125	180	18	9	56	12	30	4	4	0.3	0.5	6.9	17	100	24		
21	35	7.8	39.0	321	193	152	37	13	15	8	26	4	6	0.8	0.5	6.8	15	180	40		
22	33	7.9	17.0	295	177	154	37	13	19	10	32	3	6	1.2	0.6	7.1	29	TNC	500		
23	34	7.8	1.9	207	124	132	29	6	41	9	48	2	4	0.1	1.1	7.5	44	160	30		
24	34	7.6	2.0	164	99	100	16	12	20	1	52	4	8	0.6	0.1	6.8	39	1640	170		
25	33	7.1	4.0	296	178	134	21	11	30	11	36	7	9	0.6	0.2	8.8	30	4	4		
26	34	7.7	1.6	165	99	140	24	3	35	8	24	5	1	0.3	0.2	7.3	33	200	25		
27	33	7.6	1.7	227	136	164	26	9	23	4	32	4	5	0.1	0.7	7.2	12	240	30		
28	34	6.8	24.9	184	110	94	14	4	42	3	40	5	16	0.6	0.4	7.5	18	120	20		
29	34	7.0	2.8	67	40	88	8	11	7	5	32	1	8	0.3	0.3	7.2	27	400	80		
30	35	7.6	3.0	520	312	168	34	15	58	12	94	2	15	0.1	0.1	7.5	31	2500	280		
Surface water resources (Rivers)																					
31	35	7.3	2.7	400	240	192	38	40	64	11	4	1	1	0.4	0.2	6.4	22	4600	420		
32	33	8.0	2.4	411	247	284	46	18	79	6	38	11	5	0.5	0.4	6.9	12	310	100		
33	34	7.7	0.9	623	554	308	22	41	36	16	60	20	5	0.6	0.2	6.0	17	240	85		
34	33	7.4	2.2	443	266	152	34	17	75	12	56	10	20	1.7	0.2	8.2	15	420	96		
35	35	7.9	1.9	534	320	272	168	34	20	73	8	50	31	2	1.7	0.3	6.5	20	120	32	

by sulfate, nitrate and phosphate and were found within acceptable range in the reservoir water. Fluoride contents were also observed within acceptable range (0.1 to 1.2 mg/L). DO in reservoirs ranged from 5.1 to 10 mg/L and 6.1 to 8.8 mg/L during post monsoon and summer seasons respectively whereas COD ranged from 8 to 54 mg/L and 10 to 44 mg/L during post monsoon and summer seasons respectively.

Water quality data (Table 2&3) of river showed that pH ranged from 7.7 to 8.3 and 7.4 to 8.0 respectively during post monsoon and summer seasons. Conductivity ranged from 349 to 680 mS/cm and 411 to 623 mS/cm during post monsoon and summer seasons respectively. This may be attributed to the concentration of salts in river during summer due to minimum flow of the river. Total alkalinity during summer season (220 to 284 mg/L) was higher than post monsoon season (160 to 200 mg/L). Total hardness also shows the same trend as that of alkalinity. Sodium and calcium are the dominant cations followed by magnesium and potassium. Chloride is the dominant anions followed by sulfate, nitrate and phosphate and were found within acceptable range in the river water. Fluoride contents were also observed within acceptable range (0.4 to 0.6 mg/L). DO in river water ranged from 6.3 to 9.2 mg/L and 6.0 to 8.2 mg/L during post monsoon and summer seasons respectively whereas COD ranged from 5 to 13 mg/L and 12 to 20 mg/L during post monsoon and summer seasons respectively.

All the other parameters are found within the permissible BIS limit (Table 4). Similarly water samples of Wainganga river taken at Ambhora and Kanhan river taken near Mauda showed that values of pH, conductivity, total dissolved solids, total hardness, total alkalinity and heavy metals are within the normal range. It has been observed that Venna river sample taken near Bultibori showed the higher values of physico-chemical parameters, which may be attributed to the Butibori MIDC area in catchment of Venna river showing the possibility of industrial effluent from Butibori MIDC area is mixing at the upstream causing change in the river water quality. However all the parameters are within the CPHEEO guideline value.

Heavy metals: Heavy metals concentration in reservoir water samples in Nagpur region showed that Cadmium, Chromium and Copper are not present in any of the sample. Arsenic, zinc, lead, manganese and iron are found in some of the samples. Concentration of arsenic, zinc, lead, manganese and iron were ranged between ND and 0.04 mg/L, ND and 0.23 mg/L; ND and 0.04 mg/L; 0.01 and 0.27 mg/L; ND and 0.66 mg/L respectively which is below the permissible limit as per BIS-10500-1991. Only one sample (N-61) showed the iron concentration 1.15 mg/L, which is above permissible limit and may be attributed to leaching of iron from soil strata and occurrence in water by dissolution as evident from the red soils in nearby areas.

Table 4: Heavy Metal Contents of Water Resources (October, 2004)

Sl. No.	Sample Code	As	Zn	Pb	Cd	Mn	Fe	Cr	Cu
Surface water resources (Reservoirs)									
1	N-1	0.02	ND	0.03	ND	0.02	ND	ND	ND
2	N-3	0.03	ND	0.03	ND	0.06	ND	ND	ND
3	N-7	ND	ND	0.01	ND	0.17	ND	ND	ND
4	N-9	0.03	ND	0.04	ND	0.04	0.08	ND	ND
5	N-12	ND	ND	ND	ND	0.12	ND	ND	ND
6	N-20	ND	ND	ND	ND	0.05	ND	ND	ND
7	N-22	0.02	ND	0.01	ND	0.07	ND	ND	ND
8	N-23	0.04	0.07	0.02	ND	0.20	0.20	0.07	ND
9	N-24	0.02	ND	ND	ND	0.07	0.15	ND	ND
10	N-26	0.02	ND	0.03	ND	0.10	0.42	ND	ND
11	N-29	0.02	ND	0.04	ND	0.07	ND	ND	ND
12	N-30	ND	0.23	0.01	ND	0.07	0.02	ND	ND
13	N-34	0.01	ND	0.04	ND	0.01	ND	ND	ND
14	N-35	ND	ND	ND	ND	0.01	ND	ND	ND
15	N-37	ND	0.01	0.01	ND	0.02	0.01	ND	ND
16	N-39	0.03	0.03	0.04	ND	0.16	0.23	ND	ND
17	N-41	0.03	ND	0.03	ND	0.14	0.17	ND	ND
18	N-43	0.02	ND	0.03	ND	0.04	0.19	ND	ND
19	N-47	0.04	ND	0.02	ND	0.01	ND	ND	ND
20	N-49	0.02	ND	0.03	ND	0.11	ND	ND	ND
21	N-50	0.02	ND	0.03	ND	0.11	ND	ND	ND
22	N-51	0.01	ND	0.04	ND	0.02	ND	ND	ND
23	N-53	ND	ND	0.01	ND	0.08	ND	ND	ND
24	N-54	0.01	ND	0.03	ND	0.03	0.17	ND	ND
25	N-56	0.01	ND	0.02	ND	0.06	0.12	ND	ND
26	N-58	0.02	ND	0.03	ND	0.10	0.13	ND	ND
27	N-59	0.02	ND	0.02	ND	0.08	0.12	ND	ND
28	N-60	ND	ND	0.02	ND	0.05	0.66	ND	ND
29	N-61	ND	ND	0.01	ND	0.27	1.15	ND	ND
30	N-62	0.01	ND	0.02	ND	0.25	ND	ND	ND
31	N-69	ND	ND	0.04	ND	0.20	ND	ND	ND

Table 5: Heavy Metal Contents of Water Resources (April, 2006)

Sl. No.	Sample Code	As	Zn	Pb	Cd	Mn	Fe	Cr	Cu
Surface water resources (Reservoirs)									
1	N-1	0.02	0.01	0.02	ND	0.02	0.04	ND	ND
2	N-3	0.02	0.02	0.01	ND	0.06	0.02	ND	ND
3	N-7	0.02	0.01	ND	ND	0.17	0.01	ND	ND
4	N-9	0.01	0.01	0.02	ND	0.04	0.08	ND	ND
5	N-12	0.01	0.01	0.02	ND	0.12	0.02	ND	ND
6	N-20	ND	ND	ND	ND	0.05	0.03	ND	ND
7	N-22	0.02	0.02	0.01	ND	0.07	0.01	ND	ND
8	N-23	0.01	0.07	0.02	ND	0.20	0.20	ND	ND
9	N-24	0.02	ND	0.02	ND	0.07	0.15	ND	ND
10	N-26	0.02	0.01	0.03	ND	0.10	0.42	ND	ND
11	N-29	0.02	ND	0.02	ND	0.07	0.04	ND	ND
12	N-30	ND	0.13	0.01	ND	0.07	0.02	ND	ND
13	N-34	0.01	0.02	0.02	ND	0.01	0.03	ND	ND
14	N-35	ND	ND	0.02	ND	0.01	0.03	ND	ND
15	N-37	ND	0.01	0.01	ND	0.02	0.01	ND	ND
16	N-39	0.01	0.03	0.01	ND	0.16	0.23	ND	ND
17	N-41	0.02	ND	0.03	ND	0.14	0.17	ND	ND
18	N-43	0.02	0.01	0.03	ND	0.04	0.19	ND	ND
19	N-47	0.02	0.02	0.02	ND	0.01	0.03	ND	ND
20	N-49	0.02	ND	0.03	ND	0.11	0.02	ND	ND
21	N-50	0.02	0.01	0.03	ND	0.11	0.03	ND	ND
22	N-51	0.01	ND	0.03	ND	0.02	0.04	ND	ND
23	N-53	ND	ND	0.01	ND	0.08	0.03	ND	ND
24	N-54	0.01	0.01	0.03	ND	0.03	0.17	ND	ND
25	N-56	0.01	0.02	0.02	ND	0.06	0.12	ND	ND
26	N-58	0.02	ND	0.03	ND	0.10	0.13	ND	ND
27	N-59	0.02	0.02	0.02	ND	0.08	0.12	ND	ND
28	N-60	ND	ND	0.02	ND	0.05	0.66	ND	ND
29	N-61	ND	0.02	0.01	ND	0.27	1.15	ND	ND
30	N-62	0.01	0.02	0.02	ND	0.25	0.03	ND	ND
31	N-69	ND	ND	0.03	ND	0.20	0.02	ND	ND
Surface water resources (Rivers)									
32	N-28	ND	ND	0.05	ND	0.03	ND	ND	ND
33	N-44	ND	ND	0.03	ND	0.04	ND	ND	ND
34	N-65	ND	ND	0.04	ND	0.02	ND	ND	ND
35	N-67	ND	ND	0.04	ND	0.02	ND	ND	ND

Heavy metals concentration in river water samples of Kanhan, Wainganga and Venna in Nagpur region showed that Arsenic, Zinc, Cadmium, Iron, Chromium and Copper are not present in any of the samples. Lead and Manganese found in the range of 0.03 to 0.05 mg/L and 0.01 to 0.04 mg/L respectively (Table 4 & 5). The concentrations are within the permissible limit as per IS-10500-1991.

Bacteriological quality: All the reservoir water samples were found contaminated with total coliforms and faecal coliforms. The total coliforms ranged from 20 to 7240 CFU/100 ml and 20 to TNC CFU/100 whereas faecal coliforms ranged from 10 to 1770 CFU/100 ml and 4 to 500 CFU/100 ml during post monsoon and summer seasons respectively (Table 2&3).

All the river water samples were found contaminated with total coliforms and faecal coliforms. The total coliforms ranged from 80 to 1540 CFU/100 ml and 120 to 420 CFU/100 ml whereas faecal coliforms ranged from 20 to 650 CFU/100 ml and 32 and 100 CFU/100 ml during post monsoon and summer seasons respectively (Table 2&3). The occurrence of coliforms in the river water is attributed to flow of organic matter from catchment area and entry of sewage from villages and towns along the bank of the rivers.

CONCLUSION

The results showed that majority of surface water resources (i.e. rivers and reservoirs) fall within permissible limits of drinking water standards except coliform counts. The water resources are suitable for irrigation with few exceptions. Spatial variation in surface water quality depends upon geological strata, pollution load by point and non-point sources and local ongoing practices in catchment area. The problem is aggravated in critical season, as pollution and chemical ingredients get concentrated in small amount of water resources. This calls for proper catchment area treatment strategies for conservation and protection of surface water resources. Use of these resources for drinking purpose require proper water treatment with disinfection, whereas for irrigation it requires adoption of proper irrigation methods and scheduling of irrigation in order to achieve efficiency in irrigation. The importance of water as a natural resource, which requires careful management and conservation, must be universally recognized. Although nature often has great ability to recover from environmental damage, the growing demands on water resources necessitates the professional application of fundamental knowledge of water cycle to ensure the maintenance of quality and quantity of water

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