

Indexing Of Water Quality in Semi Urban Area of Moradabad District in Northern India.

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Abstract: A study for the quality of ground water was carried out in semi urban area of Moradabad district (Uttar Pradesh) of North India. The water samples were collected from bore wells, tube wells and hand pumps in research area. Various physico-chemical parameters were analysed. The pH value was in proximity to benchmarked NPI index value i.e 1.0, while the NPI value for total alkalinity was found to be above one. The NPI values for calcium, magnesium, phosphate, chlorides, total dissolved solids, total hardness and nitrate were far below the critical NPI value of 1.00

Keywords: Ground water, Moradabad, semi urban area, water quality.

I. Introduction

Water is essential ingredient for the survival of life on our globe. All the metabolic reactions of living beings depend mainly on its presence. The activities of mankind have spoiled various water sources including ground water. The masses of the said area are dependent on ground water and the use of this contaminated water can endanger both health and their existence.

Moradabad, an industrial city in Uttar Pradesh region of North India, is situated between 28°- 21' to 28° - 16' latitude North and 78° 4' to 79° longitudes East. The rapid urbanization and industrialization has led to deterioration of ground water quality to a large extent Thus ground water pollution is serious problem ,therefore, a concerted attempt is required in India and abroad to deal with it. Physico chemical analysis pertaining to the ground water pollution was monitored to assess the water quality. In the present study the chosen parameters were pH, total dissolved solid (TDS), turbidity, total alkalinity (TA),total hardness (TH),Nitrate(NO₃⁻),phosphate (PO₄⁻),chlorides (Cl⁻), sulphate (SO₄⁻), magnesium (Mg), and calcium (Ca). Water quality index (WQI) was calculated which reflects the collective criteria of the drinking water quality of the semi urban area of the city.

II. Methodology

The samples were collected in triplicates from the sites marked 1 to 10 of experimental zone in three different seasons i.e. summer, monsoon and winters of the year 2013-2014. They were preserved, marked and analysed according to standard methods (APHA, 1992). The pH was measured using pH meter (SYSTRONICS 335) while total dissolved solids and turbidity were measured by conductivity meter and turbidity meter (ELICO CL-52) respectively Chloride was measured argentometrically whereas sulphate, nitrate and phosphates were determined spectrophotometrically, while total hardness, total alkalinity, calcium and magnesium were measured titrimetrically. The water quality was assessed using Nemerow's pollution index (NPI), mathematically expressed as

$$NPI = C_i / L_i$$

Where C_i and L_i are observed concentration and permissible limit of ith parameter respectively
The NPI value exceeding 1.00 indicates the presence of pollutant parameter in water sample.

III. Results And Discussion

The analytical results obtained were compiled in table 1. All the parameters were measured in mg/L except pH and turbidity (NTU). The variation of physiochemical parameters in different seasons and sites are shown in graphs 1 to 11

The pH ranged from 7.68 to 8.02, suggesting alkaline nature of water .The values was higher in rainy season than summers and winters in all sites. The highest value was at site 10 and lowest at site 9. TDS denotes mainly the various kinds of minerals present in water, its higher content elevates the density of water, It influences osmo-regulation of fresh water organisms and reduces utility of water for drinking, irrigational and industrial processes. The value of TDS is maximum at site 5(319 mg/L) and minimum at site 2 (268 mg/L), but the values of TDS were found well within the limit of BIS standards. Turbidity refers to the relative clarity of water its maximum value was at site 7 (1.23 NTU) and minimum value at site 3 (0.36 NTU).The NPI value of

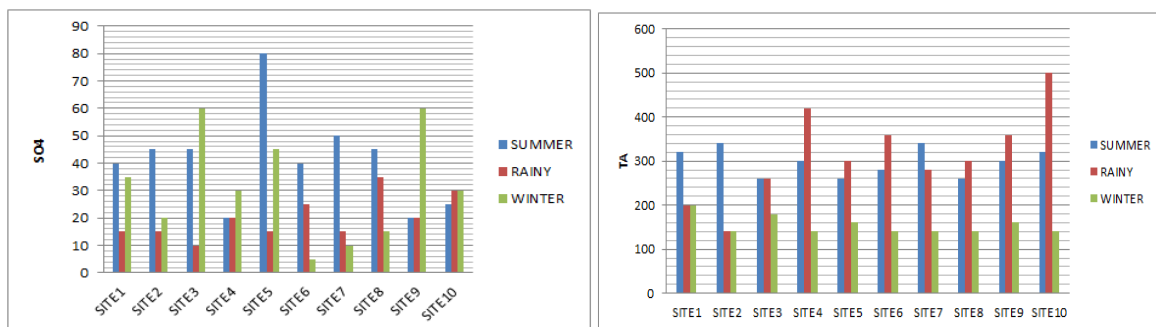
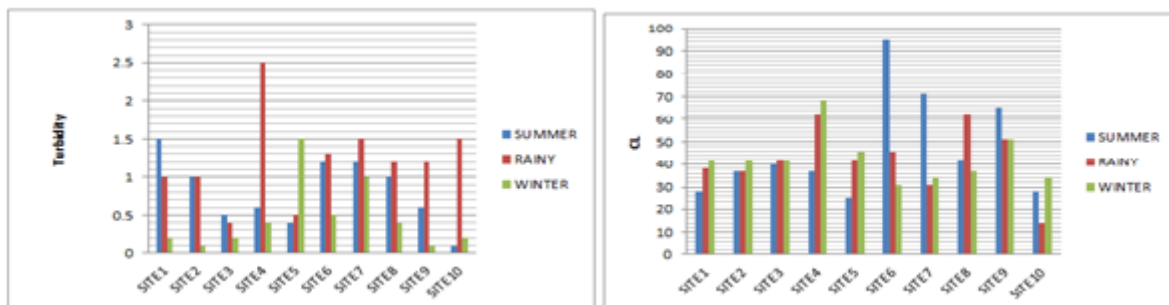
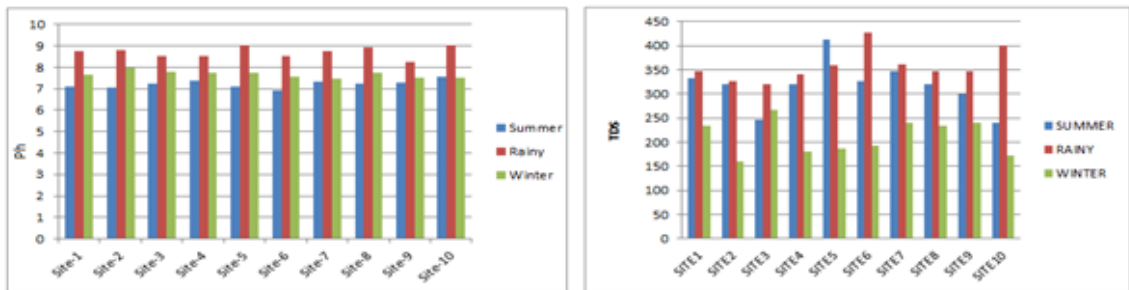
pH was just below standard index bench mark 1.00, while TDS and Turbidity NPI value are well within the preset standard.

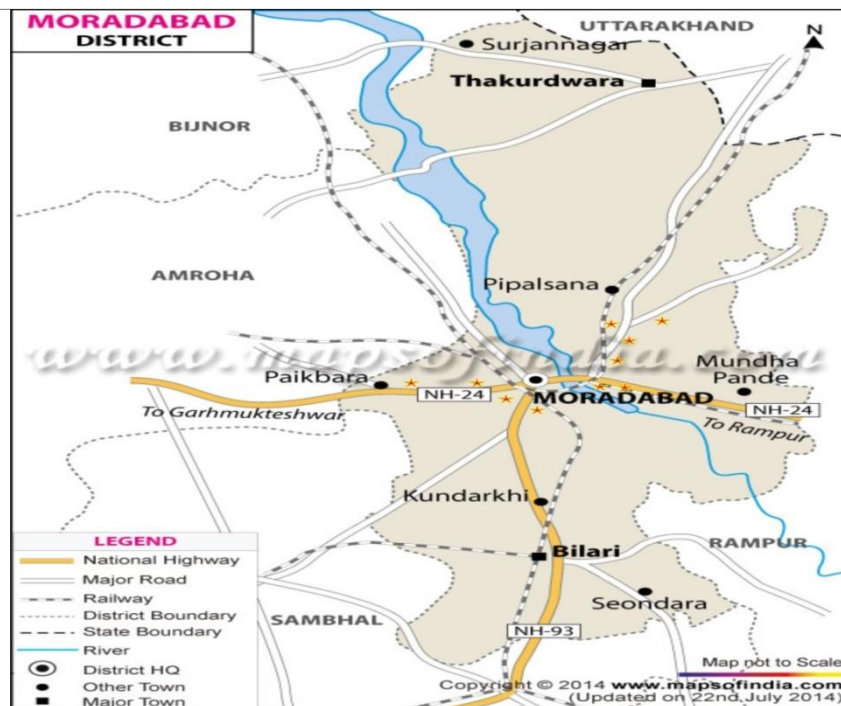
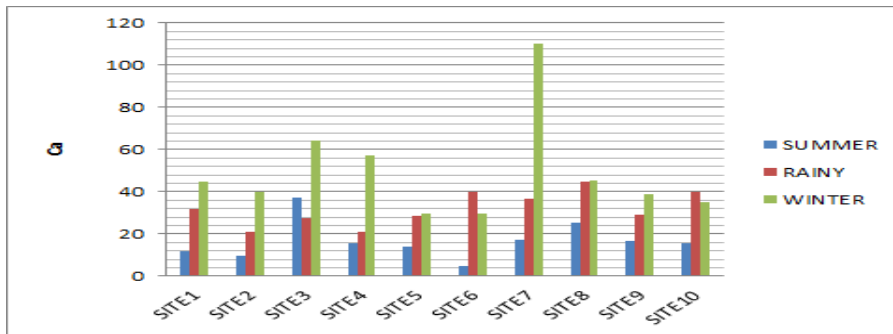
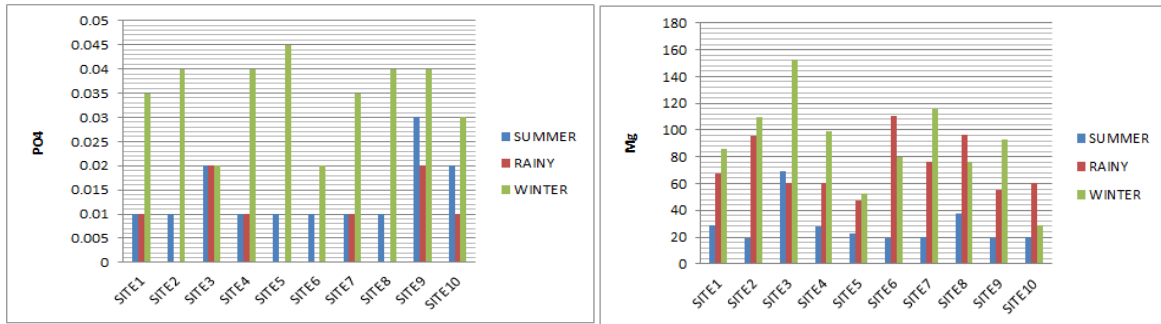
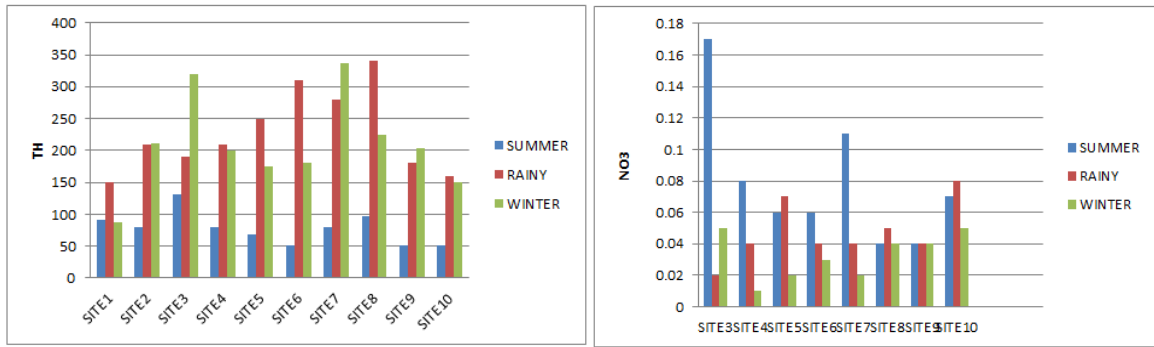
Though its Chloride is not a potential hazard to human health, yet its presence in ground water indicates its origin from natural and anthropogenic sources. It is found to be maximum at site 6 (57.20) and minimum at site 1 (10.87). Even Sulphate, which imparts hardness to the water, was maximum at site 3 (38.33) and minimum at site 8 (20.12). The values of nitrate ranged from lowest at site 2 (0.036) and to highest at site 10 (.066). Phosphate being essential for life, ranged from 0.01 to 0.03 mg/L, the lowest value was found at site 6 and highest at site 9. The NPI value calculated for chloride, sulphate, nitrate and phosphate were again found to be well within the critical and alarming presumed index indicator 1.00

Total alkalinity is a measure of an aggregate property of water. The maximum value was at site 10 (320 mg/L) and lowest at site 1 (206 mg/L). The NPI of alkalinity was found to be greater than 1.00 for all the samples. It is found that high alkalinity imparts bitter taste to water making it unpalatable. Hardness of water is mainly due to calcium and magnesium present in it. The maximum and minimum value of total hardness was observed at site 7 (232mg/L) and site 10 (120) respectively. The calcium content varied from 36.44 (site 10) to 93.92 mg/L (site 3) and the magnesium concentration ranged from 23.48 mg/L (site 2) to 54.76 mg/L (site 7). In low concentration these are non toxic but in high concentration impart hardness to water.

IV. Conclusion

The data collected led to the conclusion that concentration of indicative parameters in ground water are site specific and are highly variable. A water quality index give effects of various parameters. To sum up the findings the sub surface water of the experimental zone of Moradabad is moderately fit for drinking purposes. However, parameters varied even from sample to sample. The NPI index of most of the parameters in ground water quality did not exceed limits of 1.00 with a few exceptions. The seasons also influenced the ground water quality of the region. It seems that on precautionary basis, the measures could be taken at this stage before the pollution status deepens in the outskirts of the Moradabad city in coming times and passes the stage of irreparable rectification.





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Table 1: Physico-Chemical parameters and NPI of ten sites in less densely populated area of Moradabad city.

Parameter	NayaGoan Site – 1						Budampur Site – 2						Chodherpur Site – 3					
	Summer	Rainy	Winter	Average	NPI	SD ±	Summer	Rainy	Winter	Average	NPI	SD ±	Summer	Rainy	Winter	Average	NPI	SD ±
pH	7.09	8.74	7.67	7.83	.92	.837	7.07	8.81	7.96	7.95	.93	0.8700	7.22	8.50	7.83	7.85	.923	0.64
TDS	333.3	346.6	233.3	304.4	.304	61.83	320	326.6	160	268	.268	94.34	246.6	320	266.6	277.73	.277	37.94
Turbidity	1.5	1.0	.2	.9	.18	0.655	1.0	1.0	0.1	0.7	.14	0.5196	.5	.4	.2	.36	.073	0.0153
Cl ⁻	28.40	38.40	42.6	10.87	.043	7.29	36.92	36.90	42.6	38.81	.155	3.285	36.92	42.60	42.6	40.71	.163	3.279
SO ₄ ²⁻	40	15	35	30	.075	13.23	45	15	20	26.66	.066	16.073	45	10	60	38.33	.096	25.66
TA	320	200	200	240	2.0	69.28	340	140	140	206.66	1.72	115.47	260	260	180	233.33	1.94	46.19
TH	92	150	188	143.33	.087	48.35	80	210	212	167.33	.335	75.64	132	190	320	214	.428	96.27
NO ₃ ⁻	.06	.06	.04	.053	.00035	.01155	.07	.02	.02	.0366	.00024	.0289	.17	.02	.05	.08	.00053	0.079
PO ₄ ³⁻	.01	.01	.035	.0183	.183	.0144	.01	.00	.04	.0166	.166	0.0100	.02	.02	.02	.02	.20	0.000
Mg	29.23	67.5	86.03	60.92	.406	28.97	19.23	95.91	109.20	74.78	.498	48.564	69.23	60.12	152.40	93.92	.626	42.76
Ca	11.71	32.06	45.05	29.61	.148	16.80	9.71	20.84	39.90	23.48	.117	15.27	37.04	27.25	64.30	42.86	.214	19.19

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Parameter	Agwanpur Site – 4						Agwanpur III Site - 5						Nanpur Site – 6					
	Summer	Rainy	Winter	Average	NPI	SD ±	Summer	Rainy	Winter	Average	NPI	SD ±	Summer	Rainy	Winter	Average	NPI	SD ±
pH	7.37	8.52	7.75	7.88	.93	0.586	7.09	9.01	7.72	7.94	.934	0.9787	6.92	8.52	7.54	7.66	.901	0.8067
TDS	320	340	180	280	.280	87.178	413.3	360	186.6	319	.319	118.53	326.6	426.6	193.3	315.5	.315	117.04
Turbidity	.6	2.5	.4	.5	.1	1.16	.4	.5	1.1	.666	.133	0.379	1.2	1.3	.5	1	.20	.0436
Cl ⁻	36.92	62.40	68.2	55.84	.223	16.64	25.56	42.60	45.4	37.85	.151	10.53	95.01	45.40	31.20	57.20	.23	33.57
SO ₄ ²⁻	20	20	30	23.33	.058	5.77	80	15	45	46.66	.116	32.53	40	25	5	23.33	.053	17.56
TA	300	420	140	286.66	2.388	140.475	260	300	160	240	2.0	72.11	280	360	140	260	2.166	111.36
TH	80	210	200	163.33	.327	72.34	68	250	175	164.33	.329	91.47	52	310	180	180.66	.361	129.01
NO ₃ ⁻	.08	.04	.01	.043	.00029	0.35	.06	.07	.02	.05	.00033	.02646	.06	.04	.03	.043	.00028	.01528
PO ₄ ³⁻	.01	.01	.04	.02	.20	0.07	.01	.00	.045	.0183	.183	.024	.01	.00	.02	.01	.10	.0111
Mg	27.63	60.4	99.23	62.42	.416	35.84	22.82	47.56	52.64	41.01	.273	15.95	19.23	110.28	80.08	69.86	.466	46.34
Ca	15.42	20.84	57	30.95	.155	22.60	14	28.56	29.40	24.08	.120	8.66	5.00	40.08	29.7	24.93	.125	18.02

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Parameter	LALPUR Site – 7						KashipurTiraha Site - 8						Kashipur road Site – 9					
	Summer	Rainy	Winter	Average	NPI	SD ±	Summer	Rainy	Winter	Average	NPI	SD ±	Summer	Rainy	Winter	Average	NPI	SD ±
pH	7.32	8.74	7.47	7.84	.923	0.8067	7.25	8.95	7.72	7.97	.94	0.878	7.30	8.25	7.50	7.68	.904	0.50083
TDS	346.6	362	240	316.2	.316	117.045	320	346.6	233.3	299.96	.299	59.24	300	346.6	240	295.53	.295	53.44
Turbidity	1.2	1.5	1.0	1.23	.274	.436	1.0	1.2	.4	.866	.173	0.416	.6	1.2	.1	.63	.126	0.5508
Cl ⁻	71.00	31.20	34.10	45.43	.182	33.57	42.60	62.40	36.9	47.3	.189	13.384	65.44	51.12	51.10	55.89	.224	7.292
SO ₄ ²⁻	50	15	10	25	.0625	17.56	45	35	15	20.12	.050	15.275	20	20	60	33.33	.083	23.09
TA	340	280	140	253.33	2.11	111.36	260	300	140	233.33	1.94	83.26	300	360	160	273.33	2.28	102.63
TH	80	280	336	232	.464	129.01	96	340	224	220	.44	122.05	52	180	204	145.33	.291	81.72
NO ₃ ⁻	.11	.04	.02	.056	.00038	0.0153	.04	.05	.04	.043	.00029	0.00577	.04	.04	.04	.04	.000	0.00027
PO ₄ ³⁻	.01	.01	.035	.0183	.183	.0100	.01	.00	.04	.0166	.166	0.02082	.03	.02	.04	.03	.30	0.0100
Mg	20.03	76.28	116.03	70.78	.472	46.38	37.25	96.12	96.03	76.47	.509	33.96	19.23	55.48	92.82	55.84	.372	36.79
Ca	17.45	36.87	109.95	54.76	.274	8.02	25.10	44.88	45.08	38.35	.192	11.49	16.80	28.85	38.95	28.2	.141	11.089

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parameter	Kashipur IV SITE - 10						WHO /CPHEEO Standard(mg/L)
	Summer	Rainy	Winter	Average	NPI	SD ±	
pH	7.54	9.04	7.49	8.02	.944	0.88	8.5-6.5
TDS	240	400	173.3	271.1	.271	116.50	1000
Turbidity	.1	1.5	.2	.60	.12	0.781	5 NTU
Cl ⁻	28.40	14.20	34.10	25.56	.102	10.248	250
SO ₄ ²⁻	25	30	30	28.33	.0708	2.886	400
TA	320	500	140	320	2.666	180	120
TH	52	160	150	120	.241	59.676	500
NO ₃ ⁻	.07	.08	.05	.066	.00044	0.0153	50
PO ₄ ³⁻	.02	.01	.03	.02	.20	0.0100	0.1
Mg	20.4	60.12	28.85	36.44	.243	20.924	150
Ca	15.85	40.08	35.08	30.34	.152	12.84	200

TABLE 2: Various samples point location to serial number in less densely populated area of Moradabad city.

S.No.	Location	Source	Depth (In Feet)
1	NayaGoan Site – 1	Hand Pump	40
2	Budanpur Site – 2	Hand Pump (Indian mark II)	120
3	Chodherpur Site – 3	Hand Pump (Indian mark II)	120
4	Agwanpur Site – 4	Hand Pump	45
5	Agwanpur IIISite - 5	Hand Pump	40
6	Nanpur Site – 6	Hand Pump	35
7	Lalpur Site – 7	Hand Pump	40
8	KashipurTiraha Site - 8	Hand Pump	40
9	Kashipur road Site –9	Hand Pump	40
10	Kashipur IV SITE - 10	Hand Pump (Indian mark II)	120

All values in mg/L except pH and turbidity (in NTU)

S = Summer R= Rainy W= winter

WHO = World Health Organization

CPHEEO = Central Public Health and Environmental Engineering Organization

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