



## **GROUND WATER QUALITY AND EFFECT OF MONSOON AT SULTANPUR, UTTAR PRADESH (INDIA)**

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### **ABSTRACT**

Ten different ground water samples in pre-monsoon and after onset of monsoon were collected during the year 2009 from different India Mark II hand pumps of extensively used different public places at Sultanpur district of Uttar Pradesh. Samples were collected and analysed quantitatively for both the periods following standard method and procedures of sampling and estimation. Ground water quality with reference to estimated physico-chemical parameters was found to be poor at almost all the sites of study. The water is alkaline, hard or very hard and full of chemical contaminants. The contaminants are above the recommended drinking water standard. Ground water shows some improvement after onset of monsoon; however, water quality is still very poor. People dependent on this water are prone to health hazards of polluted drinking water and water quality management is the need of hour.

**Key words:** Ground water, Sultanpur, Water quality parameter, Contaminants, Monsoon.

### **INTRODUCTION**

Groundwater extraction for various purposes has made a major contribution to the improvement of social and economic life of the people. However, the development and unsystematic, unplanned and uncontrolled use of water resources resulted into imprudent exploitation of resources and have many undesirable and irreversible environmental consequences. Water is the elixir of life system and without it, life can not exist. The presence of safe and reliable drinking water is an essential pre-requisite for a stable community<sup>1</sup>.

Sultanpur is a 'C' class city of Eastern Uttar Pradesh and lies in latitude 26°15' N and longitude 82° 05' E on the right bank of Gomti river. District Faizabad is in the North,

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Pratapgarh is in the South and Lucknow is in the North-west of Sultanpur district. Industrialization, population growth and some other different human activities are playing their roles in multiplying the level of underground water contamination.

## EXPERIMENTAL

Ten different underground drinking water sites were selected for quantitative estimation of a number of physico-chemical water quality parameters<sup>2</sup>. Extensively used India Mark II hand pump water sites at 10 different public places were selected. All the samples were collected, preserved and estimated quantitatively following standard methods and procedures in pre-monsoon and after onset of monsoon period during 2009. All the chemicals of AR grade were used<sup>3</sup>. The estimated physico-chemical parameters are- pH, conductivity, turbidity, alkalinity, hardness, total dissolved solids, dissolved oxygen, chemical oxygen demand, biochemical oxygen demand, fluoride, sulphate, calcium, magnesium, iron and zinc. For pH, Systronics micro pH system 361, for conductivity Systronics conductivity meter 306 and for turbidity Nepheloturbidity meter type 131 were used.

A brief description of sampling sites is presented in Table 1.

**Table 1: A brief description of sampling sites**

Site No. and name	Location of site	Type of source	Depth of boaring (in ft.)	Apparent water quality	Use of water
I. Madhusudan Inter College	1.5 km West to Sultanpur	IM2 hand pump, Complementary source	110 (Approx.)	Turns turbid on standing	Drinking
II. Police lines	0.5 km North to site No. I	IM2 hand pump, only source	110 (Approx.)	Turns yellow on standing	Drinking
III. Forest Office	1.5 km North to collectorate	IM2 hand pump, only source	100 (Approx.)	Colourless, odourless	Drinking
IV. P.W.D. Office	1.5 km North to Sultanpur Collectorate	IM2 hand pump, only source	100 (Approx.)	Colourless, odourless	Drinking
V. Primary School, Khairabad	1.0 km South to collectorate	IM2 hand pump, only source	90 (Approx.)	Turns yellow on standing	Drinking

Cont...

Site No. and name	Location of site	Type of source	Depth of boaring (in ft.)	Apparent water quality	Use of water
VI. Mohd. Haneef Inter College	1.0 km South to site No. III	IM2 hand pump, only source	100 (Approx.)	Colourless, odourless	Drinking
VII. Primary School, Dihwa	1.0 km South to site no. IV	IM2 hand pump, only source	100 (Approx.)	Colourless, odourless	Drinking
VIII. Govt. Inter College	Adjacent to Bus station	IM2 hand pump, Complementary source	100 (Approx.)	Colourless, odourless	Drinking
IX. I.T.I. Campus	2.5 km to Bus station	IM2 hand pump, only source	100 (Approx.)	Colourless, odourless	Drinking
X. Irrigation Deptt. Campus	2.5 km East to Bus station	IM2 hand pump, only source	100 (Approx.)	Colourless, odourless	Drinking

## RESULTS AND DISCUSSION

Site-wise estimated amount of different physico-chemical parameters in pre-monsoon and after onset of monsoon period with their W.H.O. standards are presented in Table 2<sup>4</sup>. Site-wise seasonal variation of important water quality parameters is also presented in Fig. 1 to Fig. 5. Critical analysis of data is presented in Table 2 and different graphs and its comparison with W.H.O. drinking water standards reveals following facts regarding water quality of study area and effect of monsoon on water quality<sup>6,7</sup>.

The underground water of study area is highly alkaline with high pH values and alkalinity as well. The observed range of pH and alkalinity in pre-monsoon period is 8.1-8.59 and 244-512 ppm. After onset of monsoon, the range of pH is 7.1-7.68 and the range of alkalinity value is 248-558. The underground water is very hard. The concentration of magnesium is higher than that of calcium. Hence, the hardness of water is mainly due to salts of magnesium. The water of study area is deficient of essential micro-nutrient- calcium and zinc. In pre-monsoon period, the water is also deficient in fluoride, which is essential for teeth and bones. After onset of monsoon, the water is enriched with fluoride and its concentration at few sites is alarming because the low and high; both concentrations of fluoride are injurious. The underground water is also polluted with reference to iron concentration at all the sites for both the periods and the water is also full of chemical contaminants<sup>5</sup>.

**Table 2(a): Site-wise values of water quality parameters for pre-monsoon period and after the onset of monsoon with their W.H.O. standards**

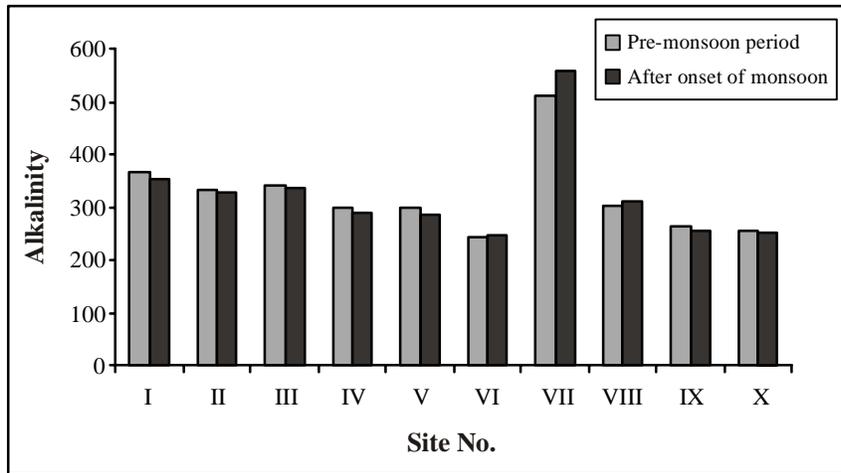
Parameter	Site No. I		Site No. II		Site No. III		Site No. IV		Site No. V		W.H.O. Standard
	*	**	*	**	*	**	*	**	*	**	
pH value	8.24	7.57	8.12	7.12	8.32	7.12	8.24	7.50	8.57	7.68	<b>7.0-8.5 (8.0)</b>
Conductivity ( $\mu$ Siemen/cm)	0.76	0.56	1.11	0.84	0.73	0.56	0.74	0.57	0.69	0.49	<b>0.300</b>
Turbidity (NTU)	14.00	16.00	15.00	16.00	11.00	13.00	12.00	13.00	14.00	16.00	<b>5.00</b>
Alkalinity (ppm)	368.00	354.00	332.00	328.00	340.00	335.00	296.00	288.00	296.00	286.00	<b>100.0</b>
Hardness ( ppm)	384.00	292.00	276.00	270.00	252.00	238.00	260.00	242.00	300.00	276.00	<b>100.00</b>
Total dissolved solids (ppm)	506.00	386.00	709.00	612.00	483.00	398.00	489.00	372.00	457.00	352.00	<b>500.00</b>
Dissolved oxygen (ppm)	1.30	1.50	1.40	1.60	1.30	1.60	1.00	1.30	1.20	1.30	<b>5.00</b>
Chemical oxygen demand (ppm)	6.80	7.20	6.82	7.15	6.90	7.50	6.72	7.12	6.75	7.10	<b>10.00</b>
Biochemical oxygen demand (ppm)	5.50	7.50	6.50	8.00	6.50	8.00	7.00	8.50	7.50	8.00	<b>6.00</b>
Fluoride (ppm)	0.17	1.68	0.30	1.72	0.36	1.85	0.38	1.39	0.17	1.70	<b>1.00</b>
Sulphate (ppm)	9.68	8.50	28.97	19.80	6.56	5.50	9.30	7.58	20.57	15.20	<b>500.00</b>
Calcium (ppm)	6.40	5.30	9.60	7.20	6.40	5.20	6.40	6.00	6.40	5.80	<b>100.0</b>
Magnesium (ppm)	88.32	81.12	60.48	56.28	56.64	48.52	58.56	54.20	68.60	65.20	<b>30</b>
Iron (ppm)	1.40	1.28	1.38	1.28	2.00	1.05	2.00	1.85	0.60	0.58	<b>0.5</b>
Zinc (ppm)	1.80	2.00	0.80	1.00	0.60	0.60	0.60	0.60	1.00	1.20	<b>5</b>

**Table 2(b): Site-wise values of water quality parameters for pre-monsoon period and after the onset of monsoon with their W.H.O. standards**

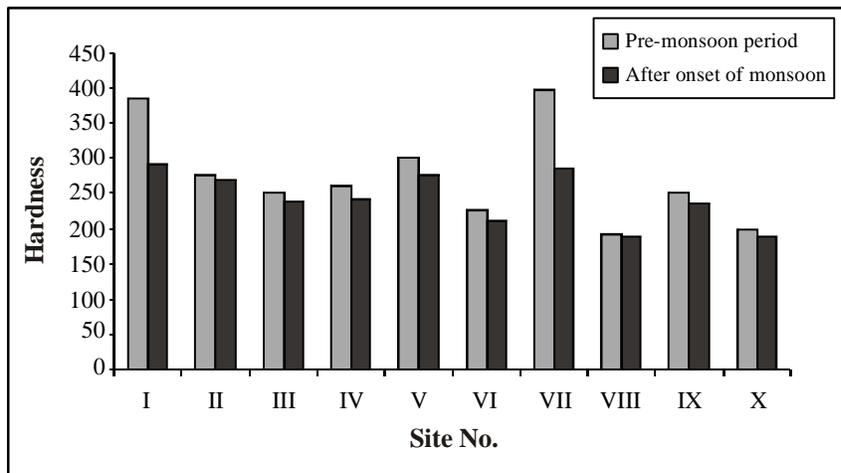
Parameter	Site No. VI		Site No. VII		Site No. VIII		Site No. IX		Site No. X		W.H.O. Standard
	*	**	*	**	*	**	*	**	*	**	
pH value	8.30	7.20	8.25	7.20	8.55	7.35	8.47	7.20	8.59	7.50	<b>7.0-8.5 (8.0)</b>
Conductivity ( $\mu$ Siemen/cm)	0.96	0.80	1.58	1.20	0.69	0.51	0.52	0.45	0.49	0.40	<b>0.300</b>
Turbidity (NTU)	10.00	12.00	11.00	13.00	10.00	11.00	10.00	12.00	11.00	13.00	<b>5.00</b>
Alkalinity (ppm)	244.00	248.00	512.00	558.00	304.00	312.00	264.00	256.00	254.00	250.00	<b>100.0</b>
Hardness (ppm)	228.00	212.00	396.00	286.00	192.00	188.00	252.00	236.00	200.00	190.00	<b>100.00</b>
Total dissolved solids (ppm)	632.00	515.00	690.00	530.00	455.00	342.00	343.00	335.00	324.00	255.00	<b>500.00</b>
Dissolved oxygen (ppm)	1.50	1.90	1.60	1.80	1.20	1.50	1.20	2.00	1.10	1.60	<b>5.00</b>
Chemical oxygen demand (ppm)	6.80	7.62	6.90	7.40	6.95	7.21	7.10	7.50	6.80	7.10	<b>10.00</b>
Biochemical oxygen demand (ppm)	7.00	8.00	7.00	8.50	7.50	7.50	7.00	8.50	7.50	8.00	<b>6.00</b>
Fluoride (ppm)	0.31	1.78	0.68	2.18	0.02	0.58	0.47	1.92	0.08	1.02	<b>1.00</b>
Sulphate (ppm)	12.91	8.31	28.69	19.30	12.16	16.18	6.70	5.50	10.12	8.50	<b>500.00</b>
Calcium (ppm)	8.00	7.40	4.80	4.20	6.40	6.10	4.80	4.60	9.60	9.20	<b>100.0</b>
Magnesium (ppm)	49.92	42.82	44.16	40.26	44.24	40.14	57.60	50.60	42.74	40.20	<b>30</b>
Iron (ppm)	1.28	1.26	1.00	1.00	1.28	1.26	1.80	1.85	1.00	0.60	<b>0.5</b>
Zinc (ppm)	1.20	1.40	0.80	1.00	1.90	2.00	1.00	1.40	1.20	1.80	<b>5</b>

\* Pre-monsoon period; \*\* After onset of monsoon

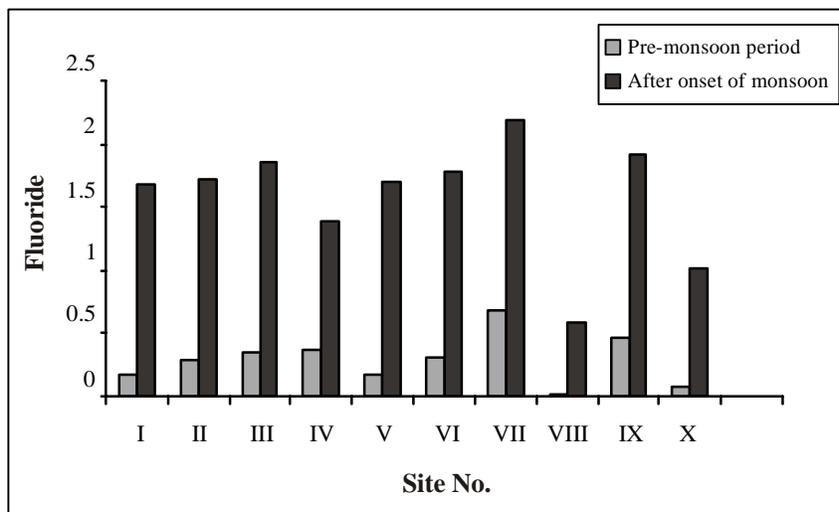
Comparison of estimated values of different water quality parameters for pre-monsoon and after onset of monsoon in Fig. 1 to Fig. 5 clearly indicates that the underground water quality shows some improvement after the onset of monsoon. The alkalinity and hardness of water is decreased. Other chemical contaminants show marginal decrease in their concentrations. No significant inference regarding the water quality with reference to its fluoride concentration can be drawn as its concentration has reached to the other end of its hazards with higher concentrations. This way the water quality shows improvement after onset of monsoon but it is of no use as the underground water is still highly polluted.



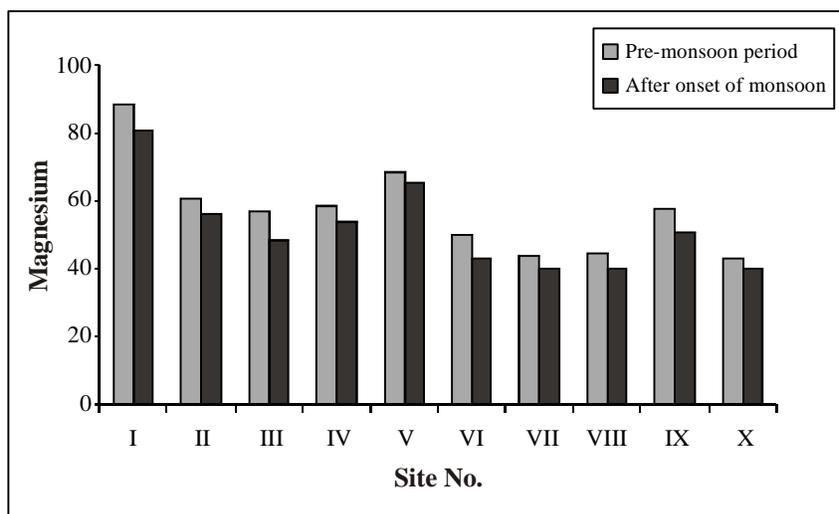
**Fig. 1: Site-wise seasonal variation of alkalinity**



**Fig. 2: Site-wise seasonal variation of hardness**

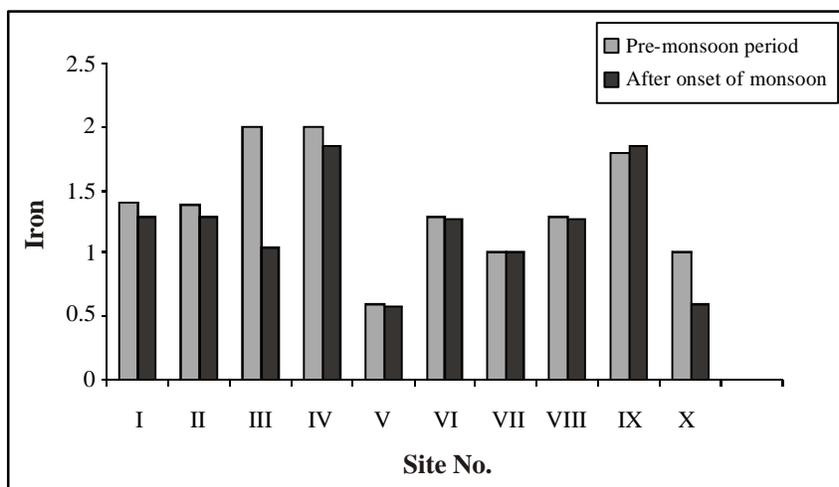


**Fig. 3: Site-wise seasonal variation of fluoride**



**Fig. 4: Site-wise seasonal variation of magnesium**

People; especially children, pregnant women and elderly persons exposed to the polluted water of study area are prone to health hazard of polluted drinking water. Some steps must be taken urgently to check the underground water quality at Sultanpur district of Uttar Pradesh. The present study may assist the local authorities in making future underground water quality management policies.



**Fig. 5: Site-wise seasonal variation of iron**

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