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Ground water quality in Chaka block, Prayagraj Allahabad, U.P. India

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Abstract
Groundwater quality obtained from different villages of Chaka block of karchana Tehsil, Prayagraj, U.P. The water samples was analyzed for their Physio-chemical characteristics pH, Electric Conductivity, Total Dissolved Solids, Alkalinity, Chloride, Total Hardness, Calcium Hardness, Magnesium Hardness for five villages *viz* Bagbana, Chowkata, Murarpur, Hariharpur and Champatpur. Experimental results shows the water on comparing the results against drinking water quality standards laid by World Health Organization (WHO), It is found that some villages water samples exceeded the permissible limit.

Keywords: Groundwater, drinking water, water quality, pollution

Introduction
Water is mostly used for industrial and municipal purposes. In order to ensure the right quality and quantity of water for these purposes it is extremely important to monitor water supply throughout taking all the aspects into consideration (Singh *et al.*, 2008; Singh and Nath, 2019; Sebastian *et al*., 2018) [12, 11, 10]. Ground water forms the major source of water supply for drinking purposes in most parts of India. It accounts for about 88% safe drinking water in rural areas, where the population is widely dispersed and the infrastructure needed for treatment and transportation of surface water does not exist. Groundwater also plays an important role in agriculture, for both watering of crops and for irrigation of dry season crops. It is estimated that about 45% of irrigation water requirement is met from ground water sources. Groundwater serves as the primary source of drinking water for more than 95% of the population Allahabad, India. In 1967, Allahabad had around thousands of tube wells, In the state, the extraction of groundwater has increased by 200 times during the last three decades. The underground waters contain elevated arsenic concentration, which are usually above the WHO (1996) permissible safe limits of 10 ppb (Hundal *et al.*, 2007) [5]. Rapid urbanization, especially in developing countries such as India, has affected the availability and quality of groundwater due to its exploitation. Once the groundwater is contaminated, its quality cannot be restored by stopping the pollutants from the sources (Ramakrishnaiah *et al.*, 2009) [9]. The quality of waters, traceable components and features can be affected by many different factors: bacteria, algae, temperature, turbidity, suspended and dissolved solids, salinity, pH, dissolved oxygen, phosphorus and other nutrients such as nitrogen and also organic and inorganic compounds (Chiles JP and Delfiner P 1999) [1]. The estimation of quality and the use of groundwater for different purposes are becoming more significant. Thus, probes related to an understanding of the hydro-chemical aspects of the groundwater, geochemical processes and its development under natural water flowing manners, not only aids in the practical utilization and protection of this expensive resource but also aid in visualizing the changes in the groundwater environment (Gidey A., 2009). The quality of ground water depends on various chemical constituents and their concentration, which are mostly derived from the geological data of the particular region. In many parts of the country available water is rendered non-potable because of the presence of heavy metal in excess. The situation gets worsened during the summer season due to water scarcity and rain water discharge. Contamination of water resources available for household and drinking purposes with heavy elements, metal ions and harmful microorganisms is one of the serious major health problems (Garg *et al*., 1991). According to WHO, about 80% of all the diseases in human beings are caused by stopping the pollutants from the sources. It is therefore vital to regularly monitor the quality of groundwater.

Materials and Method

Sampling area

The area for the present investigation is Chaka block Prayagraj. The city of Prayagraj lies on 25.45°N latitude and 81.85°E longitude at an altitude of 98.0m in the state of Uttar Pradesh. The city is spread 0ver an area of about 3,424 sq.km and as temperature varies from maximum 45.6°C to minimum 1.1°C. All the experimental analysis was done in laboratory of Department of Environmental Sciences& NRM, College of forestry, Sam Higgin Bottom University of Agriculture Technology and Science, Prayagraj.

Sampling Location

Sampling locations was selected for collection of water samples in Chaka block of Karchana Tehsil at Prayagraj district. The source of sample collection was hand pump only (government and private hand pumps). Samples were collected from different villages of Chaka block, Karchana Tehsil at Prayagraj district.

Sampling Period

The water sampling was performed in the month of January, February and March of 2020 (before lockdown) and October, November of 2020 (after lockdown) due to COVID-19 following the standard sampling procedure mentioned in APHA/AWWA (1998). The samples were drawn in clean bottles without any air bubbles. Prior to collection, the sample bottles were rinsed thorouly with the sample water and tightly sealed after collection and labeled in the field. The hand pumps were continuously pumped prior to the sampling, to ensure that ground water to be sampled was representative of ground water and to avoid contamination from the surface. The depth of hand pumps ranged from 90-150 feet in all these stations. The samples were collected as per the standard methods of water examination, APHA (1998).

Sampling Collection

Sample was collected at 20 days interval and transported to environmental science laboratory for further analysis. Sample was analyzed as per standard method for examination of water and waste water (APHA/AWWA). Samples were randomly collected from different sampling location. The water samples were collected in such a way that they cover the entire area without any clustering. Water quality parameters was monitored pH, EC, Total dissolved solids using digital meters, whereas, titration method will be adopted to test chlorides, alkalinity, Total hardness and calcium hardness and magnesium hardness.

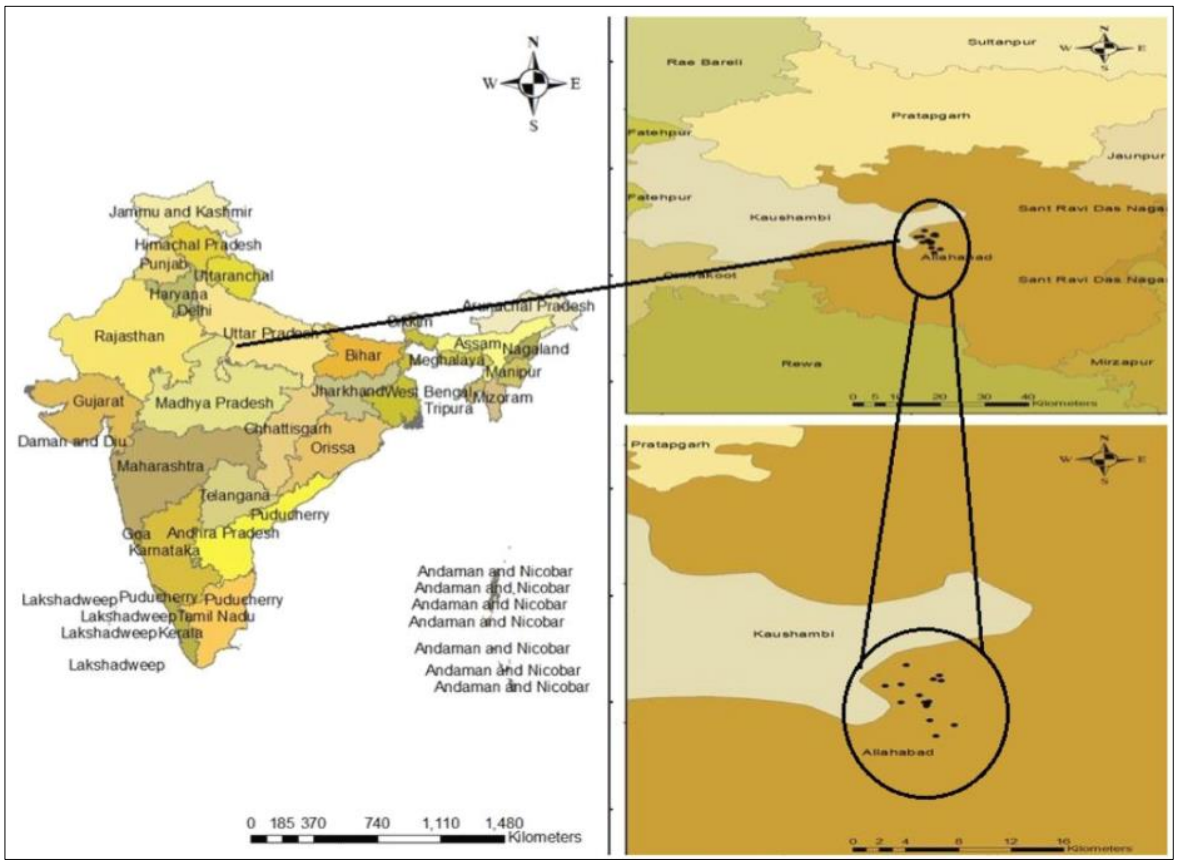

Fig 1: Map of study area

Table 1: Water quality parameters along with methods

S. No.	Parameters	Methods/Instrument
1	pH	Digital pH meter
2	EC	Digital conductivity meter
3	TDS	Digital TDS meter
4	Total hardness (mg/l)	EDTA titrimetric method
5	Calcium hardness (mg/l)	EDTA titrimetric method
6	Magnesium hardness (mg/l)	By difference
7	Alkalinity (mg/l)	Titration method
8	Chloride (mg/l)	Argentometric method

Table 2: Indian Standards for drinking water (BIS) (IS: 10900:1991)

S. No	Parameters	Acceptable limit	Permissible limit
1	PH	6.5-8.5	No relaxation
2	EC	500mmhos/cm	2000mmhos/cm
3	TDS	500mg/l	2000mg/l
4	Total hardness (mg/l)	300mg/l	600mg/l
5	Calcium hardness (mg/l)	75mg/l	200mg/l
6	Magnesium hardness (mg/l)	30mg/l	150mg/l
7	Alkalinity (mg/l)	200mg/l	600mg/l
8	Chloride (mg/l)	250mg/l	1000mg/l

Result and Discussions

The present research was focused on "Application of GIS for ground water quality management in rural areas of Prayagraj (Allahabad) U.P. India" to study the quality parameter of ground water in Chaka block of Karchana tehsil. Water samples were collected from different sites during the intervals from different hand pumps and were analyzed for the different parameters like pH, Electric Conductivity, Total Dissolved Solids, Alkalinity, Chloride, Total Hardness, Calcium Hardness, and Magnesium Hardness. The results are summarized below:

pH

pH values varies between (6.5 to 7.5) and minimum 6.5was observed in Bagbana village and maximum 7.5 observed in Murarpur village. The average pH values fall under the permissible limit (6.5 to 8.5) set by BIS. Similar finding was observed by other author Nath *et al*., (2015) [7], Nafees *et al*., (2015) [6].

Electric Conductivity

Electric conductivity in sampling sites ranges from (0.43 to 1.09 mmhos/cm). The minimum EC was observed 0.43 mmhos/cm at Chowkata village and maximum 1.09 mmhos/cm at Murarpur village. Electrical conductivity falls under the permissible range 100 to 2000 mmhos prescribed by BIS standards. The major reason of high electrical conductivity in water samples due to dissolved inorganic substances in ionized form.

Total Dissolved Solids

Total dissolved solids concentration varies between a minimum of 129.4 mg/l at Murarpur and maximum 280.3 mg/l in Champatpur village, all the values were under the permissible limit prescribed by BIS standards and total dissolved solids reflects the salinity behavior of ground water samples. The higher total dissolved solids in water samples due to low water level with in aquifer, sediment effect and discharges of waste water from houses and accumulated in ponds and pits.

Alkalinity

Maximum concentration of alkalinity is 102 mg/l in Hariharpur village and minimum concentration observed 42 mg/l in Chowkata village. Alkalinity of water samples within the acceptable limit (200 mg/) according to BIS. The higher concentration of alkalinity due to the presence of bicarbonate, carbonate and hydroxide compound of calcium, sodium and potassium. Similar study was conducted by other author and result of alkalinity in groundwater is well supported by (Nafees *et al.*, 2015) [6].

Chloride

The chloride concentration lies between the minimum 22.98 mg/l at Murarpur village and maximum 123.96 mg/l in Hariharpur village which is under the permissible limit. The chloride was affected due to the agriculture activities, industries and chloride rich rocks and high concentration of chloride is due to the invasion of domestic wastes and disposals by human activities (Jha and Verma, 2000).

Total Hardness

The total hardness is the measure of the capacity of water to precipitate soap. Hardness of the water is due to presence of Ca and Mg salts. Usually the hardness is not harmful to health but is has been suspected to play some role in heart diseases (Ashfaq and Faizan, 2014). Total hardness observed minimum of 230 mg/l Hariharpur village and maximum 366 mg/l in Champatpur village. The major reason of hardness in the Groundwater samples due to dissolved minerals, seepage and runoff. (Nath *et al.*, 2015) [7]. The standard limits of total hardness are 300 to 600 mg/l as per BIS.

Calcium Hardness

Calcium as $CaCo_3$ is directly related to hardness and is the chief cation in the water. The calcium value varies between minimum of 90 mg/l at Murarpur village and maximum 232 mg/l in Champatpur village, calcium concentration ranged between 75 to 200 mg/l. the result of calcium hardness in water except Champatpur all the villages were within the permissible limit of BIS standards and it is not harmful for drinking purpose for villages.

Magnesium Hardness

Minimum of 112mg/l in Hariharpur village and maximum of 226mg/l in Chowkata village which was higher than the permissible limit (30 to 100 mg/l) which was prescribed by the BIS standard. The high values of magnesium hardness can be attributed to the large amounts of magnesium salts in ground water is directly related to hardness and which is not fit for drinking purpose for all the villagers. Similar study was conducted by other author and result of magnesium hardness in groundwater is well supported by (Nafees and Nath, 2015) [7].

Table 3: Variation of different parameters in different villages (Sampling site)

Villages	Ph			EC			TDS (mg/l)			Alkalinity (mg/l)		
	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg
Bagbana	6.5	7.0	6.78	0.61	0.83	0.71	160.5	181.4	171.92	52	98	69.2
Chowkata	6.8	7.4	7.12	0.43	0.79	0.61	155.8	172.3	163.74	42	70	52.4
Murarpur	6.8	7.5	7.04	0.78	1.09	0.89	129.4	145.3	138.20	56	64	60.4

Hariharpur	6.6	7.4	7.00	0.53	0.89	0.70	252.1	271.7	261.34	54	102	71.6
Champatpur	7.0	7.3	7.16	0.64	1.04	0.87	270.9	280.3	271.74	70	76	73.6

Table 4: Variation of different parameters in different villages (Sampling site)

Villages	Chloride (mg/l)			Total Hardness (mg/l $CaCO_3$)			Calcium Hardness (mg/l)			Magnesium Hardness (mg/l)		
	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg
Bagbana	39.98	44.98	42.38	260	340	294.40	140	182	157.60	120	168	137.60
Chowkata	30.99	36.97	33.78	296	352	324.00	116	148	128.40	162	226	195.60
Murarpur	22.98	26.99	24.78	270	292	281.20	90	148	118.60	122	194	162.60
Hariharpur	100.96	123.96	115.76	230	310	260.40	108	158	128.80	112	158	131.60
Champatpur	58.98	73.97	68.17	340	366	352.00	180	232	202.80	116	172	149.20

Conclusion

The present research "Ground water quality in Chaka block Prayagraj (Allahabad), U.P, India" was the concern expressed for deterioration in the ground water quality (hand pumps).

It is noticed that analyzed parameters of groundwater from five different sites in Chaka block showed that the pH, EC, TDS, Alkalinity, Chloride, Total Hardness values were within the permissible limit. But Calcium Hardness and Magnesium Hardness values are not within the permissible limit. Having some high values, it is more than the permissible limit.

The study reveals that groundwater is the only source for people in the study area, and the results of chemical analysis of ground indicate considerable variation. Most of the water samples do comply with BIS standards for drinking purpose. Regular chemical analysis is must be done to insure that the quality of the water in this area is not contaminated.

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