

Groundwater Quality of Shallow Aquifer in Uttar Pradesh

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Abstract: The chemical composition of groundwater affects its suitability for different uses. Groundwater is vulnerable to contamination from a range of activities such as industrial & agricultural enterprises and changes in land use. Poor management of groundwater can cause many significant water quality problems such as rendering water unfit for human or animal consumption. Major threats to ground water quality include - salinity, acidity, nutrients, contaminants such as heavy metals, industrial chemicals & pesticides. Keeping in view the various threats to groundwater quality, efforts have been made to study the ground water quality of Uttar Pradesh.

Uttar Pradesh is the most populous and fourth largest state of India. It lies in the north-central part of the country in between 27°40' N latitude to 80°00' E longitude. The northern part of the state is drained by the rivers originating from Himalyas i.e. Ganges and its main tributaries-Yamuna, Gomati, Ghaghra & Gandak rivers. The Chambal, Betwa & Ken rivers originating from the Vindhya range drain the southwestern part of the state before joining the Yamuna whereas the Son originating in the Vindhya range drains the southeastern part of the state and joins the Ganges beyond the state borders (in Bihar).

Systematic study of chemical analysis data of 653 groundwater samples collected from GWMS (Ground Water Monitoring Stations) in Uttar Pradesh reveals that the groundwater of the study area is slightly alkaline (pH ranges from 7.35 to 8.70). 94.4% of the water samples have EC values upto 2250 μ Siemens/cm at 25°C whereas only 5.6 % water samples exhibit high EC values with a maximum of 18520 μ Siemens/cm at 25°C at Narkhi block (distt. Ferozabad). Salinity problem is observed in parts of 23% districts under study. The concentration of total hardness has been found to vary widely. It ranges between 90 to 1997 mg/l with 97% of water samples falling within the permissible limit of 600 mg/l (BIS- 2012) with the highest value 1997 mg/l recorded at Narkhi block (dist. Ferozabad). Geochemical classification of groundwater as per modified Piper diagram (Chadha, 1998) shows that 78.5% water samples exhibit Ca-Mg-HCO₃ type of water, 11.9% NaHCO₃ type, 5.8% NaCl type and 3.8% Ca-Mg-Cl₂ type of water. Fluoride concentration in 94.2 % samples is found within the permissible limit of 1.5 mg/l (BIS 2012) with a maximum of 6.0 mg/l from Bichpuri block (distt. Agra). Fluoride problem is observed in parts of 32% districts under study. The nitrate concentration in 89.1% water samples is found to be within the permissible limit of 45 mg/l (BIS 2012) with a maximum of 1370 mg/l from Narkhi block (dist. Ferozabad). High nitrate is observed in parts of 57% districts under study. Such high nitrate concentration observed in various districts is due to anthropogenic activities. By and large, the chemical quality of ground water of phreatic zone in Uttar Pradesh is found to be suitable for potable purposes as per available chemical parameter data (as per BIS

2012). Presence of some constituents beyond the permissible limit at some locations renders the water unfit for public water supply.

Keywords: Chemical parameters, Fluoride, Geochemical classification, Groundwater quality, Nitrate, Salinity.

1. Introduction

The availability of fresh water for human consumption, irrigation, agricultural development and other activities is associated with the growing needs of modern living conditions but is decreasing day by day due to increase in population, urbanisation, industrialisation and erratic behavior of rains. To meet the requirement of fresh water, the dependency on ground water is increasing in comparison to surface water.

The chemical composition of groundwater affects its suitability for different uses. Groundwater is vulnerable to contamination from a range of activities such as industrial & agricultural enterprises and changes in land use. Poor management of groundwater can cause many significant water quality problems such as rendering water unfit for human or animal consumption. Major threats to ground water quality include - salinity, acidity, nutrients, contaminants such as heavy metals, industrial chemicals & pesticides. Polluted ground water may cause environmental damage where it discharges into waterways and wetlands and adversely impacts on groundwater dependent ecosystem. Poor groundwater quality also poses significant risk to human health. Keeping in view the various threats to groundwater quality efforts have been made to study the ground water quality of Uttar Pradesh.

2. Geomorphology of the Area

Uttar Pradesh lies in the north-central part of the country in between 27°40' N latitude to 80°00' E longitude. It is the most populous and the fourth largest state of India. The state is bordered by the state of Uttarakhand & the country of Nepal in the north, the state of Bihar to the east, the states of Jharkhand & Chhattisgarh to the south-east, the state of Madhya Pradesh to the south and the states of Rajasthan, Haryana & the national capital territory of Delhi in the west. The northern part of the state is drained by the rivers originating from Himalyas i.e. Ganges and its main tributaries-Yamuna, Gomati, Ghaghra & Gandak rivers. The Chambal, Betwa & Ken rivers originating

from the Vindhya range drain the southwestern part of the state before joining the Yamuna whereas the Son originating in the Vindhya range drains the southeastern part of the state and joins the Ganges beyond the state borders (in Bihar).

3. Materials and Method

Six hundred and fifty-three groundwater samples from sixty districts were collected from GWMS (Ground Water Monitoring Stations) in Uttar Pradesh. The chemical analysis of water samples were carried out at the Regional Chemical Laboratory, CGWB, NR, Lucknow, by using the standard methods (APHA, 2012).

4. Results and Discussion

Systematic study of chemical analysis data of 653 ground water samples collected from GWMS (Ground Water Monitoring Stations) in Uttar Pradesh reveals that the ground water of the study area is slightly alkaline (pH ranges from 7.35 to 8.70).

94.4% of the water samples have EC values up to 2250 μSiemens/cm at 25°C whereas only 5.6 % water samples exhibit high EC values with a maximum of 18520 μSiemens/cm at 25°C at Narkhi block (distt. Ferozabad). Salinity problem is observed in parts of 23% districts under study i.e. in Agra, Aligarh, Budaun, Deoria, Farrukhabad, Fatehpur, Ferozabad, Hamirpur, Hathras, Jhansi, Kannauj, Kanpur Dehat, Mathura and Unnao (Fig. 1).

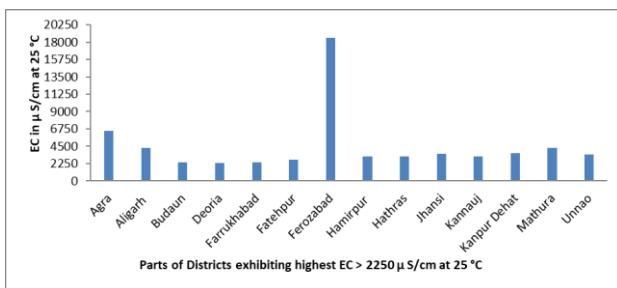


Fig. 1.

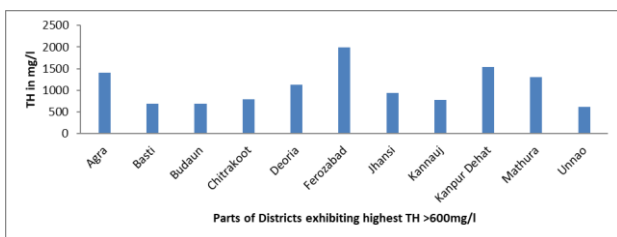


Fig. 2.

The concentration of total hardness has been found to vary widely. It ranges between 90 to 1997 mg/l with 97% of water samples falling within the permissible limit of 600 mg/l (BIS-2012) with the highest value 1997 mg/l recorded at Narkhi block (dist. Ferozabad). High concentration of total hardness is observed in parts of 18% districts under study i.e. in Agra,

Basti, Budaun, Chitrakoot, Deoria, Ferozabad, Jhansi, Kannauj, Kanpur Dehat, Mathura and Unnao (Fig. 2).

Fluoride concentration in 94.2 % samples is found within the permissible limit of 1.5 mg/l (BIS 2012) with a maximum of 6.0 mg/l from Bichpuri block (distt. Agra). Fluoride problem is observed in parts of 32% districts under study i.e. Agra, Allahabad, Auraiya, Etawah, Farrukhabad, Fatehpur, Ferozabad, Ghaziabad, Hathras, G.B.Nagar, Mahoba, Mainpuri, Mathura, Muzaffarnagar, Pratapgarh and Unnao (Fig. 3). High Fluoride water is unsuitable for potable purposes as it causes dental fluorosis.

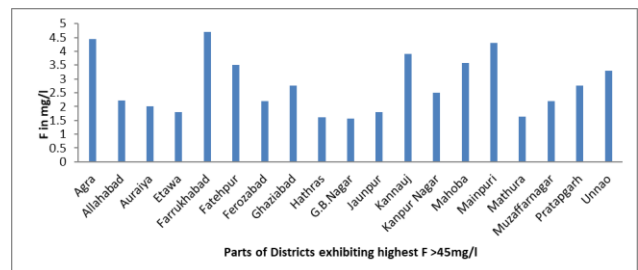


Fig. 3.

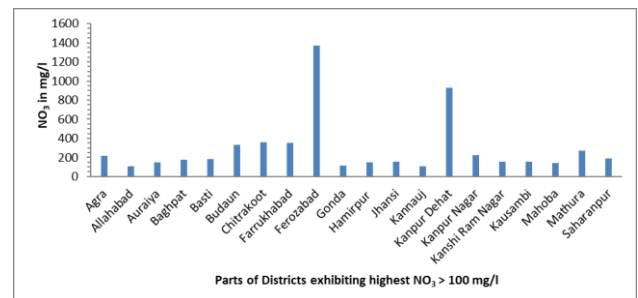


Fig. 4.

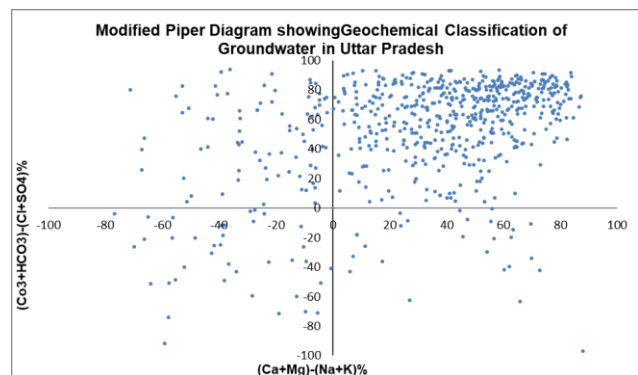


Fig. 5.

The nitrate concentration in 89.1% water samples is found to be within the permissible limit of 45 mg/l (BIS 2012) with a maximum of 1370 mg/l from Narkhi block (distt. Ferozabad). High nitrate is observed in parts of 57% districts under study i.e. Agra, Aligarh, Allahabad, Auraiya, Baghpat, Ballia, Balrampur, Banda, Basti, Budaun, Bulandshahar, Chitrakoot, Etah, Farrukhabad, Fatehpur, Ferozabad, Ghaziabad, Gonda, Hamirpur, Hathras, Jalaun, Jhansi, Kannauj, Kanpur Dehat, K.

R. Nagar, Kausambi, Lalitpur, Mahoba, Mathura, Meerut, Muzaffarnagar, Pratapgarh, Saharanpur and Sitapur (Fig.4). Such high nitrate concentration observed in various districts is due to anthropogenic activities.

The geochemical classification of ground water as per modified Piper diagram, Fig. 5 (Chadha, 1998) reveals that 78.5% water samples exhibit Ca-Mg-HCO₃ type of water, 11.9% NaHCO₃ type, 5.8% NaCl type and 3.8% Ca-Mg-Cl₂ type of water.

5. Conclusion

By and large, the chemical quality of ground water of phreatic zone in Uttar Pradesh is found to be suitable for potable purposes as per available chemical parameter data (as per BIS

2012). Presence of some constituents beyond the permissible limit at some locations renders the water unfit for public water supply.

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