



A Study of Groundwater Quality in Urban and Peri-urban Areas of Gorakhpur City in India

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Abstract

This study was carried out in Gorakhpur city and peri-urban area of Khorabar block to assess the some groundwater quality parameters of selected India Mark-II and shallow depth hand pumps. A total number of 16 samples were tested for pH, acidity, alkalinity, chloride, total hardness and fluoride and the results are compared for Gorakhpur city and Khorabar block. It is revealed that total dissolved solids and hardness exceeded in 25 percent of the samples taken from shallow depth hand pumps in Gorakhpur city whereas, in Khorabar block 25 percent of the samples were affected by pH. It is, therefore, suggested to take up detailed water quality surveys and community awareness programs on water quality in urban and peri-urban areas of Gorakhpur city.

Keywords: Physico-chemical parameter, India mark-II hand pump, shallow depth hand pump, groundwater quality.

Introduction

Groundwater is an important water resource in both the urban and rural areas of India, but in many cities, piped water supply is also available. Rural dwellers rely basically on hand-pumps for potable water, as the streams usually dry up in dry season. These resources are under threat from pollution either from human life style manifested by the low level of hygiene practiced in the developing nations¹. Environmental health involves all the factors, circumstances and conditions in the environment or surroundings of humans that can influence health and well-being. Pollution of water is due to increased human population, industrialization, use of fertilizers in agriculture and man made activity². The water parameters such as temperature, turbidity, nutrients, hardness, alkalinity, dissolved oxygen etc. are some of the important factors that need to be considered during water quality assessment studies. The physical and chemical methods are concerned with a variety of procedure, each applicable to a particular situation. In many instances a combination of chemical analysis is needed to obtain a reasonably accurate picture of the quality of water³.

Urban and Peri-urban Conflicts: Sustained global population growth has placed an enormous pressure on planet earth's finite resource of fresh water. In many countries, that are an increasing competition for water use among agriculture, industry and domestic needs, threatens economic development, food security, livelihoods, poverty reduction and the integrity of ecosystems. Rising demand for groundwater is a particular concern as, in many areas; groundwater production exceeds the level of sustainability⁴. By far, the biggest rivals in the global water supply contest are: i. The rapidly expanding towns and cities which support over half the world's population and require water for industry, potable water supply and sanitation⁵. ii. The agricultural sector which already consumes some 70% of

available resources, much of it to fuel Asia's green agricultural revolution^{6,7,8}. Discordance over water is no stranger to the urban environment and the addition of a rural dimension adds an unwelcome level of complexity to the task at hand. Based on studies in India⁹ conflicts typically arise due to: i. Quantity, with conflicts arising between sectors or users (e.g. agriculture vs. domestic; municipality vs. industries or private users; urban vs. peri-urban or rural). ii. Quality, with conflicts arising from the threat of water that is unsafe to drink.

In this study, the water quality parameters of some physico-chemical water quality parameters from shallow depth hand pumps and India Mark-II were studied in urban and peri-urban areas of Gorakhpur city.

Study Area: The study area includes Gorakhpur city with Khorabar block in the peri-urban area. Gorakhpur city is located 265 km last of the state capital Lucknow on national highway-28. It is situated near at the confluence of river Rohin and Rapti. The city is known for Gorakhnath temple and Gita Press and is the principal town of lastern Uttar Pradesh having a population nearly 6, 71,048 lakhs.

Material and Methods

A total number of 16 samples of groundwater were taken from Gorakhpur city and Khorabar block located in peri-urban area. Prior to sampling, all the sampling containers were washed and rinsed thoroughly with the groundwater to be taken for analysis. Samples were collected in pre-cleaned plastic polyethylene bottles of 1 litre capacity and were tested for fluoride, pH, alkalinity, total hardness, acidity, chloride, total dissolved solids (TDS) respectively in Environmental and P. H. E Laboratory of Madan Mohan Malaviya Engineering College, Gorakhpur. Parameters were determined using standard procedures.

Data Collection¹⁰: In the study, 16 groundwater samples were collected from India Mark-II and shallow depth hand pumps of Gorakhpur city and Khorabar block located in peri-urban area during July, 2013. Of the 16 samples, 8 samples were collected from the shallow depth hand pump and the other 8 samples were collected from India Mark-II. During sample collection, handling, and preservation, standard were followed. The results of groundwater quality assessment are shown in table 1 and table 2.

Results and Discussion

The maximum and minimum observed data of groundwater quality in Gorakhpur city and Khorabar block (peri-urban area) are shown in table 3. It is revealed from table 1 and 2 that fluoride concentration is nil in all the samples in shallow depth

and India mark-II hand pumps. At the same time, it is recognized that total dissolved solids and hardness are found to exceed the permissible limit but not cause the rejection in Gorakhpur city in 25 % of the samples taken from shallow depth hand pumps.

However, all the samples taken from India Mark-II hand pumps are found to be within the permissible limit. However, in Khorabar block, which is located in peri-urban area, 25% of water samples taken from shallow depth hand pumps were found beyond permissible limit in terms of pH. Thus it is noticed that, for the set of studied parameters, the water quality in urban and peri-urban areas of Gorakhpur city is affected in case of shallow depth hand pumps only.

Table-1
Results of Groundwater Quality Assessment of Water in Gorakhpur city

| Sl. No | Village | Hand Pump Type | Temp (°C) | TDS (mg/L) | pH | Acidity (mg/L) | Alkalinity (mg/L) | Cl ⁻ (mg/L) | Hardness (mg/L) | F ⁻ (mg/L) | Remarks |
|--------|-------------------|----------------|-----------|------------|------|----------------|-------------------|------------------------|-----------------|-----------------------|---------|
| 1 | Rustampur | India Mark-II | 28.5 | 450 | 7.71 | 14 | 65 | 36 | 250 | NIL | WNL |
| 2 | Hariom Nagar | Shallow | 33 | 375 | 7.7 | 31 | 45 | 4 | 202 | NIL | WNL |
| 3 | Gorakhnath Temple | India Mark-II | 30.5 | 340 | 8 | 12 | 55 | 36 | 210 | NIL | WNL |
| 4 | Golghar | Shallow | 32 | 340 | 8.5 | 13 | 35 | 16 | 85 | NIL | WNL |
| 5 | Dharmshala | India Mark-II | 29 | 250 | 7.2 | 35 | 75 | 76 | 275 | NIL | WNL |
| 6 | Betihata | Shallow | 30 | 960 | 7.7 | 35 | 85 | 76 | 370 | NIL | NWNL |
| 7 | Taramandal | India Mark-II | 30.4 | 322 | 8.3 | 13 | 55 | 48 | 130 | NIL | WNL |
| 8 | Railway Station | Shallow | 30 | 670 | 6.8 | 28 | 41 | 112 | 330 | NIL | NWNL |

Table-2
Results of Groundwater Quality Assessment of Water in Khorabar block (Peri-urban Area)

| Sl. No | Village | Hand Pump Type | Temp (°C) | TDS (mg/L) | pH | Acidity (mg/L) | Alkalinity (mg/L) | Cl ⁻ (mg/L) | Hardness (mg/L) | F ⁻ (mg/L) | Remarks |
|--------|--------------|----------------|-----------|------------|------|----------------|-------------------|------------------------|-----------------|-----------------------|---------|
| 1 | Ramnagar | India Mark-II | 31 | 278 | 6.9 | 21 | 50 | 12 | 196 | NIL | WNL |
| 2 | Kadjahan | Shallow | 30 | 102 | 6.8 | 7 | 14 | 16 | 73 | NIL | WNL |
| 3 | Motiram | India Mark-II | 29 | 266 | 7.8 | 9 | 37 | 28 | 150 | NIL | WNL |
| 4 | Motiram Adda | Shallow | 28 | 226 | 6.43 | 18 | 30 | 4 | 162 | NIL | NWNL |
| 5 | Bansapti | India Mark-II | 28.5 | 179 | 7.65 | 16 | 38 | 4 | 123 | NIL | WNL |
| 6 | Laxmipur | Shallow | 26.8 | 198 | 6.11 | 26 | 15 | 28 | 110 | NIL | NWNL |
| 7 | Dhobauli | India Mark-II | 28 | 270 | 7.45 | 6 | 38 | 24 | 173 | NIL | WNL |
| 8 | Gahira Gaon | Shallow | 28.5 | 131 | 8.41 | 9 | 22 | 4 | 105 | NIL | WNL |

Table-3
Maximum and Minimum Values of Different Water Quality Parameters of Gorakhpur City and Khorabar block

| S. No. | Parameters | Gorakhpur City | | Khorabar | | Permissible Values as per IS: 10500-1991 |
|--------|-------------------|----------------|---------|----------|---------|--|
| | | Maximum | Minimum | Maximum | Minimum | |
| 1 | TDS (mg/L) | 960 | 250 | 278 | 102 | 500 |
| 2 | pH | 8.5 | 6.5 | 8.41 | 6.11 | 6.5-8.5 |
| 3 | Alkalinity (mg/L) | 85 | 35 | 50 | 14 | 200 |
| 4 | Chloride (mg/L) | 112 | 4 | 28 | 4 | 250 |
| 5 | Hardness (mg/L) | 370 | 85 | 196 | 73 | 300 |

Conclusion

Groundwater is extensively used for water supply in urban and peri-urban areas of Gorakhpur city. The present study is based on the results of the water quality assessment for selected parameters and exhibits that some shallow depth hand pumps are affected by high extent of total dissolved solids and hardness in Gorakhpur city whereas some shallow depth hand pumps are affected by pH in Khorabar block (peri-urban area). This necessitates a detailed water quality survey in Gorakhpur city and peri-urban areas. Also, there is a need to educate and convince people to avoid using shallow depth hand pumps on one hand and providing the access to safe drinking water through India Mark-II hand pump or piped water supply in near future on the other hand. Such community awareness programmes need to be taken up in peri-urban areas as well.

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