Study of Some Physico-Chemical Parameters of Groundwater in Gorakhpur District

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Abstract

In this study, water quality assessment was carried out in 8 blocks of Gorakhpur District. The aim of the study was to assess the physico-chemical parameters of drinking water quality from groundwater sources (India Mark-II and shallow depth hand-pumps). It is found that the increase in the level of some of the physico-chemical parameters of ground water has emerged as an important issue in rural areas. It is revealed that TDS, hardness and pH are the parameters requiring attention in most of the shallow depth hand pumps except in Campierganj and Chargawan blocks, whereas pH and chloride also need attention in some cases. The water quality scenario exhibits that Chargawan block has the highest overall compliance status (87.5%) whereas Kauriram shows a poor overall compliance status (50%). Even though the fluoride concentration is found to be within the permissible limit of 1 mg/l in two villages of Campierganj block yet it indicates a need for examination of more number of water samples from this block with a view to ensure the safety of public health against adverse effects of fluoride

Key words: *Physico-chemical water quality, parameters, India Mark-II and shallow depth hand pumps, compliance status*

1. Introduction

Water is the most abundant compound in nature. It covers 75% of the earth surface. About 97.3% of water is contained in the great oceans that are saline and 2.14% is held in icecaps glaciers and in the poles, which are also not useful. Barely the remaining 0.56% found on earth is in useful form for general livelihood.

It has become more important to appraise water quality on a continuous basis. There are three basic criteria to evaluate the quality of water viz the physical, chemical and biological. The physical and chemical methods are concerned with a variety of procedures, 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 water (Mathur, 1993). Some of the major parameters which are generally checked for assessing the water quality for a particular use are determination of fluoride, chloride, total hardness, pH, TDS, alkalinity and acidity etc.

More than two billion people worldwide live in the regions facing water related problems (Dugger and Celia, 2006). Millions of Indians currently lack access to clean drinking water, and the situation is only getting worse day by day. The operations involved in water quality assessment are many and complex. During the 1950s, in the early days of modern water quality monitoring, activities were rarely focused on particular issues. However, the water quality assessment process has now evolved into a set of sophisticated monitoring activities including the use of water chemistry and aquatic biota. Many manuals on water quality assessment methods already exist (Alabaster, 1977; UNESCO/WHO, 1978; Krenkel and Novotny, 1980; Sanders *et al.*, 1983; Barcelona *et al.*, 1985; WMO, 1988; Yasuno and Whitton, 1988; WHO, 1992). However, most of these consider only one type of water body (i.e. rivers, lakes or ground waters) or one approach to monitoring (e.g. chemical or biological methods). Water quality assessment is the overall process of evaluation of the physical, chemical and biological nature of the water.

The drinking water quality criteria require the water to be safe and wholesome. The safe water could be termed as one, which is free from infective agents, harmful chemical impurities such as toxic metals and compounds and whose prolonged use does not cause any adverse effect or disease. The wholesome water is considered to be the one, which is good in appearance and agreeable to taste. Both of these criteria should be met together while supplying water to be communities. The water, that is safe and wholesome, is called potable water.

1.1. Ground Water Contamination

A vast majority of ground water quality problems are caused by contamination, over-exploitation, or combination of the two. The adverse effects on ground water quality are the results of man's activity at ground surface, unintentionally by agriculture, domestic and industrial effluents, unexpectedly by sub-surface or surface disposal of sewage and industrial wastes. The intensive use of natural resources and the large production of wastes in modern society often pose a threat to ground water quality and have already resulted in many incidents of ground water contamination (Finfrock, 1994).

The percolating water picks up a large amount of dissolved constituents and reaches the aquifer system and contaminates the ground water. Generally higher proportions of dissolved constituents are found in ground water than in surface water because of greater interaction of ground water with various materials in geologic strata (Robert et al., 1994). The contamination of ground water by heavy metals and pesticides has also assumed great significance during recent years due to their toxicity and accumulative behaviour (George, et. al., 2005). Many activities can cause groundwater contamination. Contaminated water serves as a mechanism to transmit communicable diseases such as diarrhoea, cholera, dysentery, typhoid and guinea worm infections.

2. Materials and Methods

2.1. Site Description

The study was carried out during the period from January, 2013 to July, 2013. The groundwater samples were collected from the eight blocks of Gorakhpur district namely Campierganj, Khorabar, Gola, Bansgaon, Brahampur, Sardar Nagar, Kauri Ram, Chargawan and Gorakhpur City. Samples of groundwater were collected from shallow as well as deep / India Mark-II hand pumps located in the selected blocks.

2.2. Sampling Method

Various shallow depth and India Mark-II hand pumps installed in Gorakhpur District were chosen for sample collection. The samples were collected in sterilized one litre plastic bottles for physico-chemical analysis. The samples were collected from shallow depth hand-pumps, which were installed by the local residents for getting drinking water and India Mark-II hand-pumps installed by government agencies. The analysis of the samples was carried out in accordance with the standard procedures. All the samples were taken from those sources, where ground water was being used for drinking purposes. In each block, four samples were collected from India Mark-II hand-pumps and remaining four were collected from shallow depth hand-pumps

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2.3. Laboratory Evaluation

For water quality assessment, 72 numbers of samples from shallow and deep hand pumps were taken from eight blocks of Gorakhpur district along with Gorakhpur city. These samples are brought to Environmental and Public Health Engineering Laboratory of M.M.M. Engineering College, Gorakhpur and were tested for fluoride, pH, alkalinity, total hardness, TDS, acidity and chloride. The analysis of the samples was carried out in accordance with the standard procedures.

3. Results and Discussion

The test results of physico-chemical characteristics of groundwater samples from India Mark-II and shallow depth hand-pumps are reviewed with respect to IS: 10500-1991. The block-wise compliance status based on different physico-chemical parameters of ground water in Campierganj, Khorabar, Gola, Bansgaon, Brahampur, Sardar Nagar, Kauriram, Chargawan and Gorakhpur City, as depicted in Table 1, reveals that 58.33% of shallow depth hand pumps and 77.77% of India Mark-II hand pumps are found compliant. The overall compliance status scenario exhibits that a total 68.05% of the shallow depth and India Mark-II hand-pumps are found to be compliant in eight blocks, namely, Campierganj, Khorabar, Gola, Bansgaon, Brahampur, Sardar Nagar, Kauri Ram and Chargawan as well as Gorakhpur City whereas, only 31.95% of Shallow depth hand-pumps and India Mark-II hand-pumps are found to be non-compliant. This reflects a very poor water quality scenario in all the blocks along with Gorakhpur city. However, the scenario is quite miserable in Kauriram block. Variation of different parameters (TDS, alkalinity, total hardness, chloride) is shown in Fig. 1-32 between shallow depth hand pumps and India Mark-II hand pumps in eight blocks of Gorakhpur district.

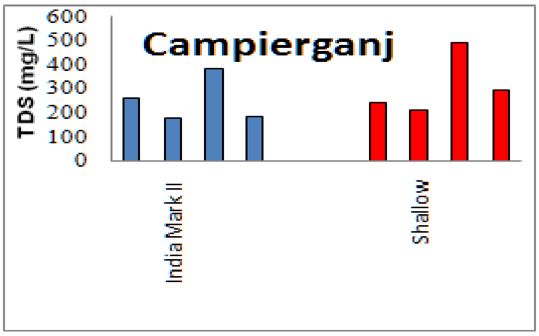

Fig. 1: Variation in TDS in mg/L

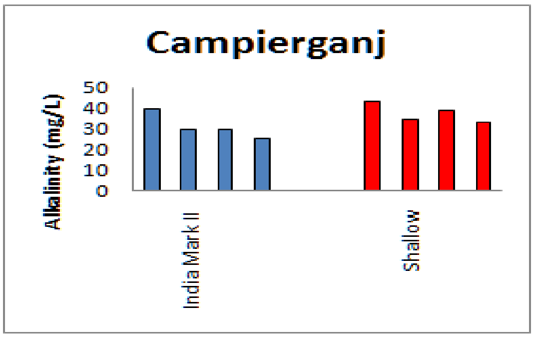

Fig. 2: Variation in Alkalinity in mg/L

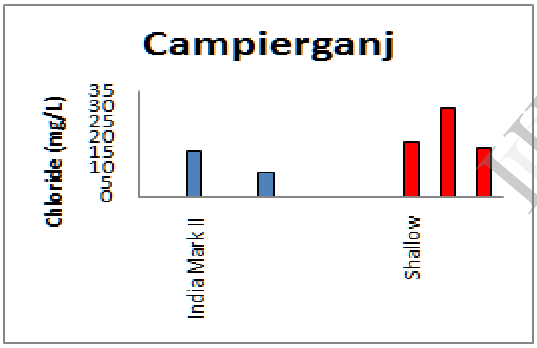

Fig. 3: Variation in Chloride in mg/L

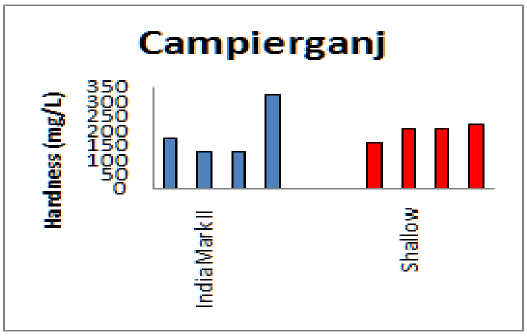

Fig. 4: Variation in Hardness in mg/L

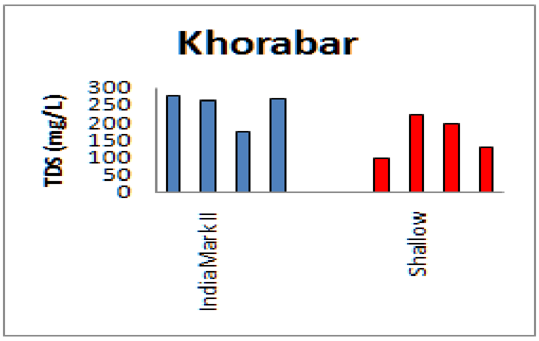

Fig. 5: Variation in TDS in mg/L

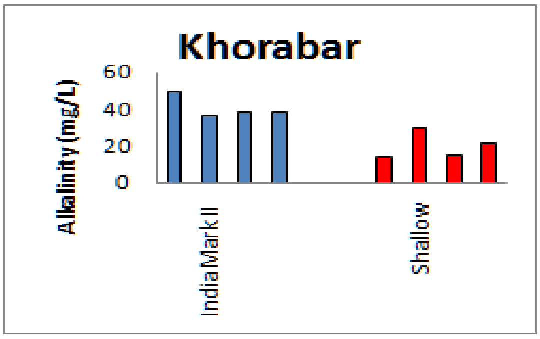

Fig. 6: Variation in Alkalinity in mg/L

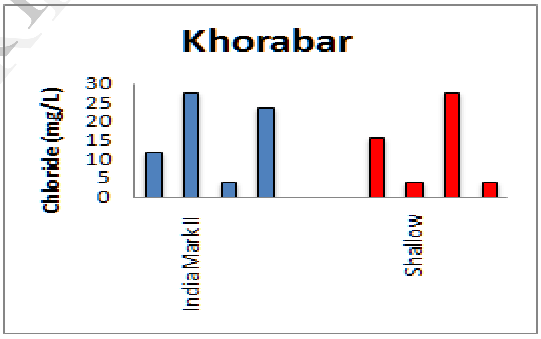

Fig. 7: Variation in Chloride in mg/L

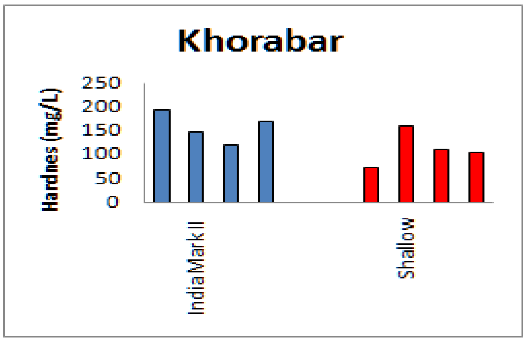

Fig. 8: Variation in Hardness in mg/L

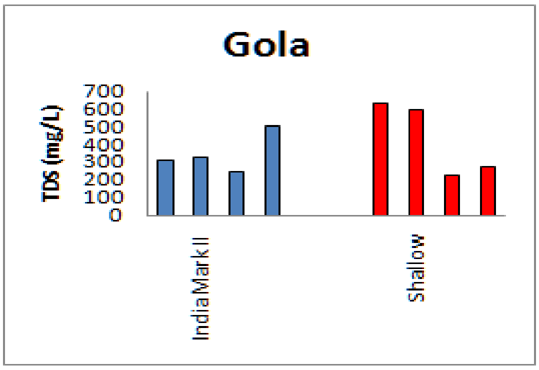

Fig. 9: Variation in TDS in mg/L

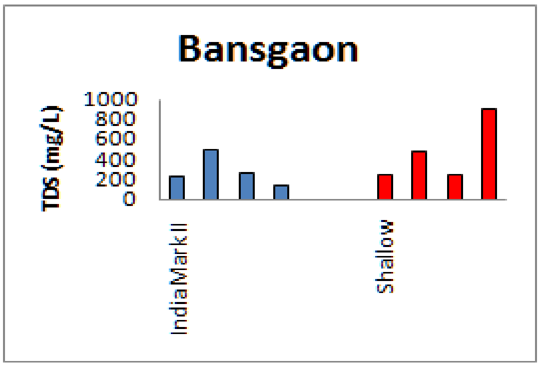

Fig. 13: Variation in TDS in mg/L

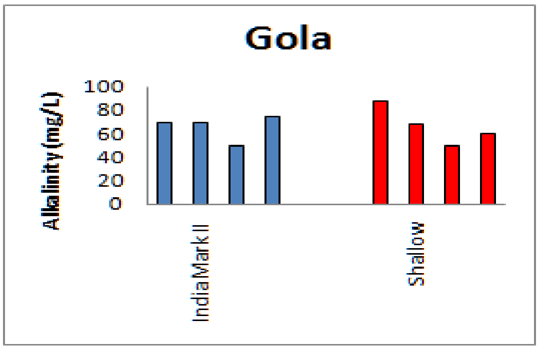

Fig. 10: Variation in Alkalinity in mg/L

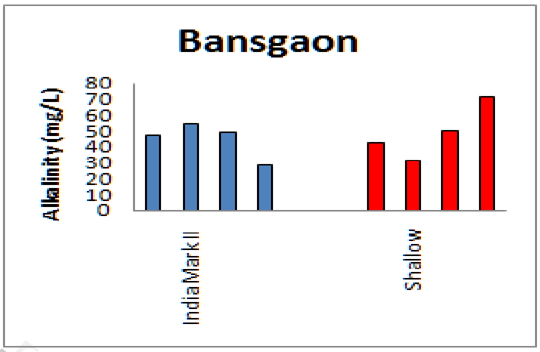

Fig. 14: Variation in Alkalinity in mg/L

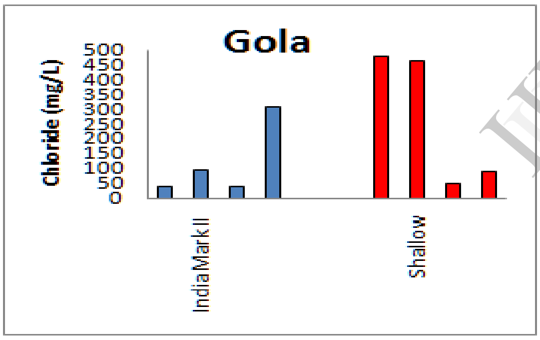

Fig. 11: Variation in Chloride in mg/L

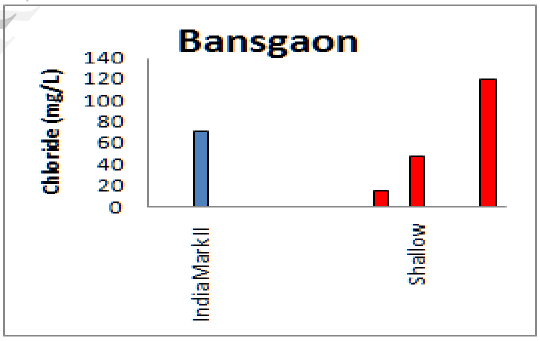

Fig. 15: Variation in Chloride in mg/L

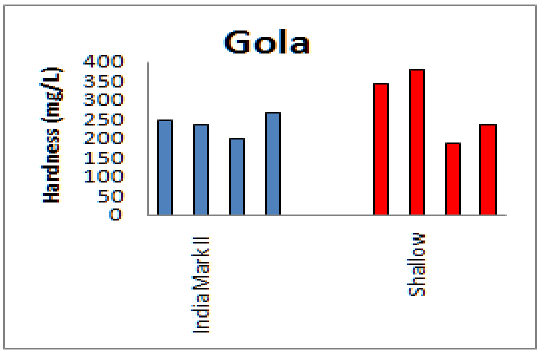

Fig. 12: Variation in Hardness in mg/L

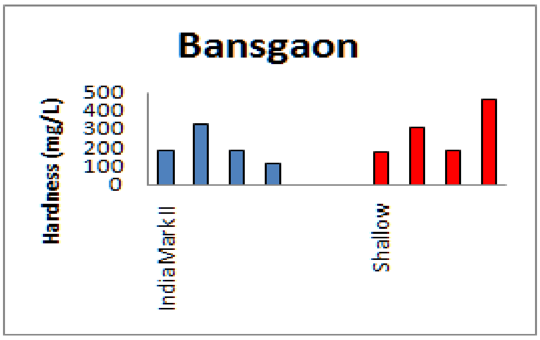

Fig. 16: Variation in Hardness in mg/L

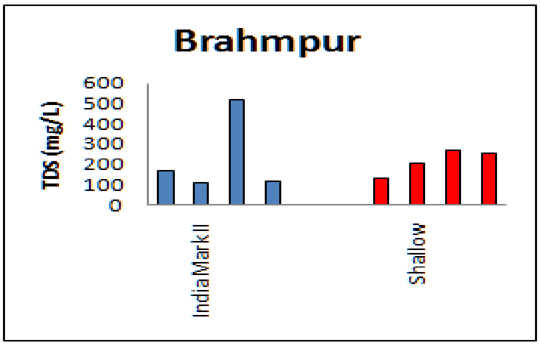

Fig. 17: Variation in TDS in mg/L

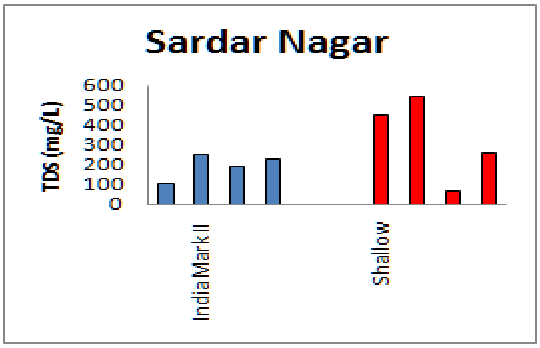

Fig. 21: Variation in TDS in mg/L

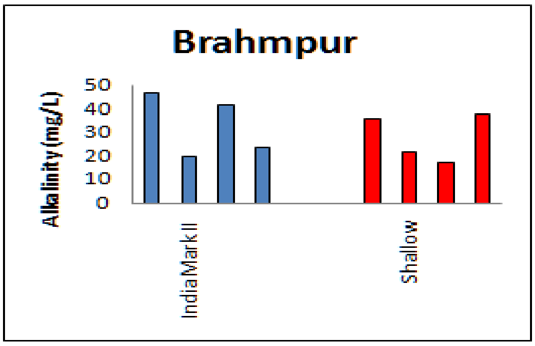

Fig. 18: Variation in Alkalinity in mg/L

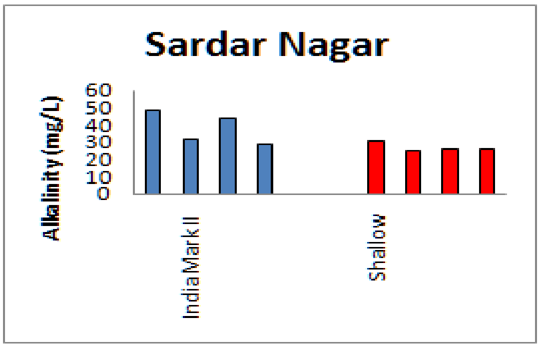

Fig. 22: Variation in Alkalinity in mg/L

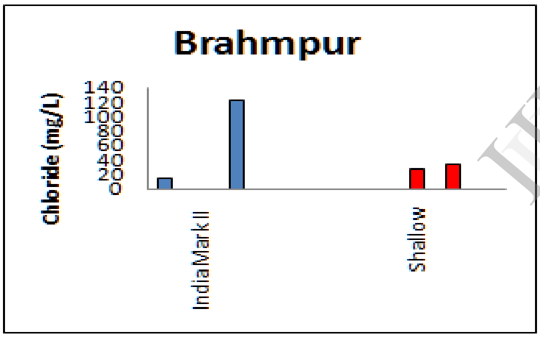

Fig. 19: Variation in Chloride in mg/L

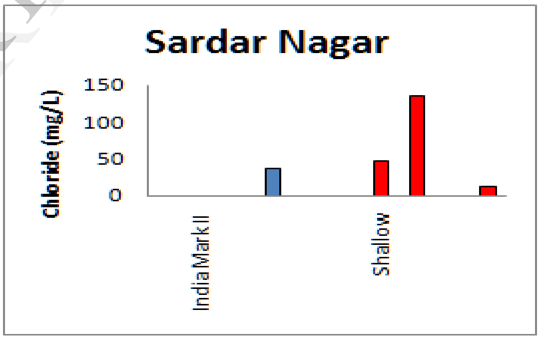

Fig. 23: Variation in Chloride in mg/L

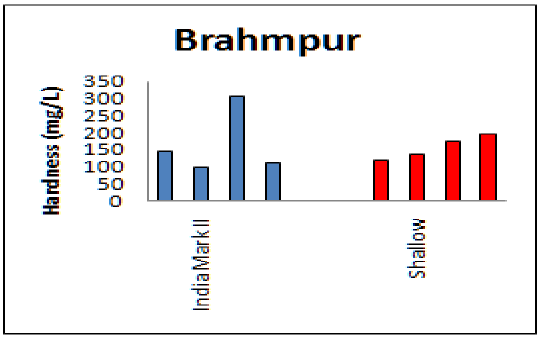

Fig. 20: Variation in Hardness in mg/L

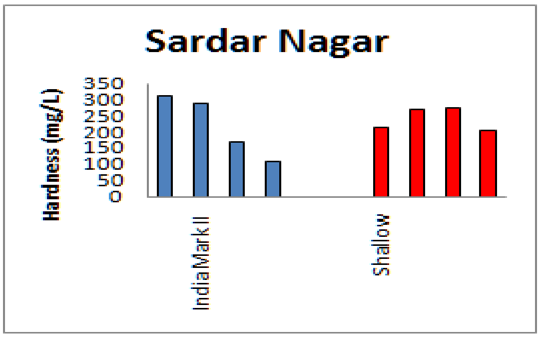

Fig. 24: Variation in Hardness in mg/L

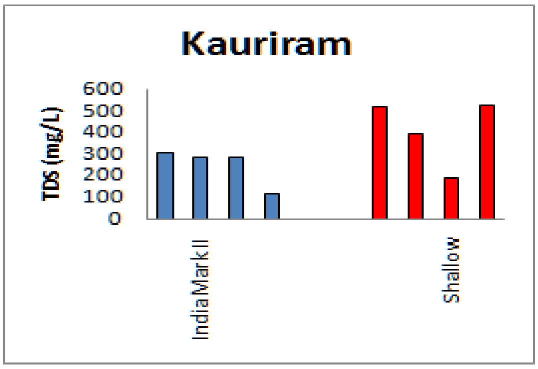

Fig. 25: Variation in TDS in mg/L

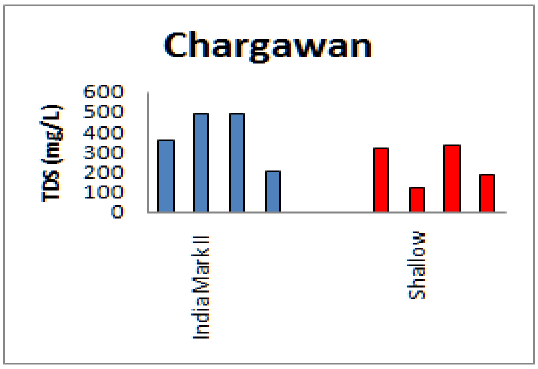

Fig. 29: Variation in TDS in mg/L

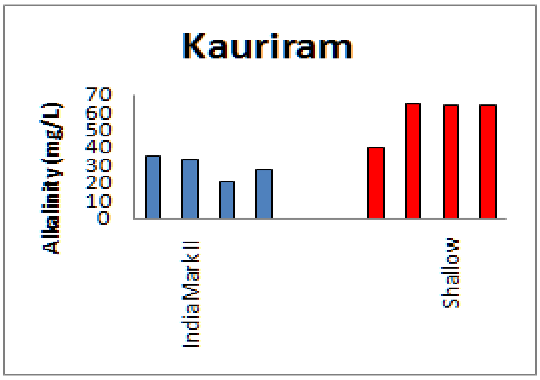

Fig. 26: Variation in Alkalinity in mg/L

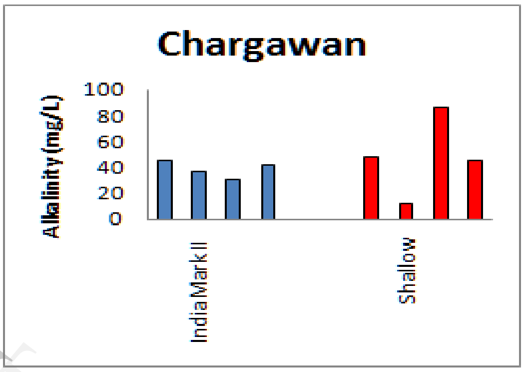

Fig. 30: Variation in Alkalinity in mg/L

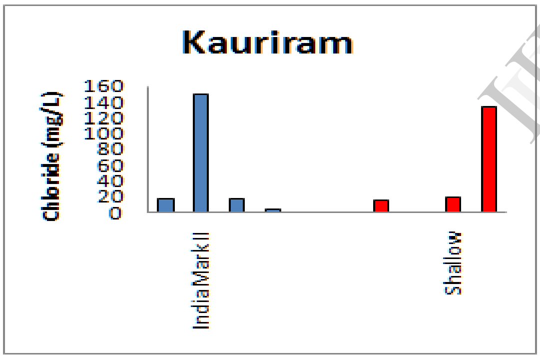

Fig. 27: Variation in Chloride in mg/L

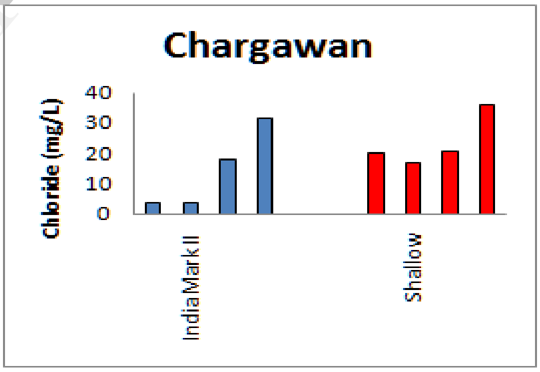

Fig. 31: Variation in Chloride in mg/L

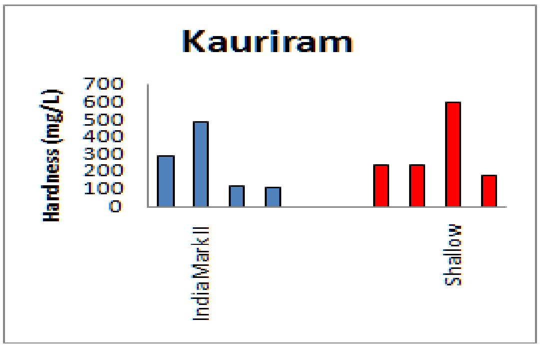

Fig. 28: Variation in Hardness in mg/L

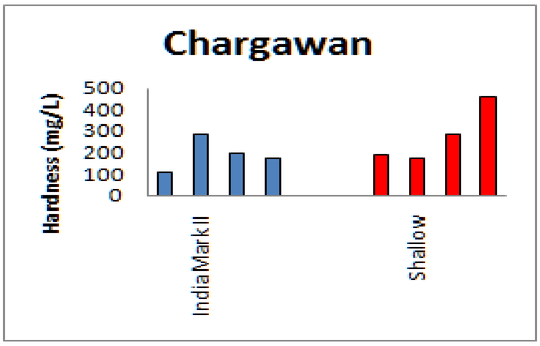

Fig. 32: Variation in Hardness in mg/L

Table.1. Overall Compliance status of hand-pumps in different blocks of Gorakhpur district and Gorakhpur city

S. No.	Block	No. Of Samples Tested	Compliance Status: Shallow depth hand pumps		Compliance Status: India Mark-II hand pumps		Overall Compliance Status		Parameters Requiring Attention	
			Compliant, no. (%)	Non-Compliant, no. (%)	Compliant, no. (%)	Non-Compliant, no. (%)	Compliant, no. (%)	Non-Compliant, no. (%)	Shallow Depth	India Mark-II
1	Campierganj	08	04 (100.00)	00	01 (25.00)	03 (75.00)	05 (62.50)	03 (37.50)	-	Hardness, Fluoride
2	Khorabar	08	02 (50.00)	02 (50.00)	04 (100.00)	00	06 (75.00)	02 (25.00)	pH	-
3	Gola	08	02 (50.00)	02 (50.00)	03 (75.00)	01(25.00)	05 (62.50)	03 (37.50)	TDS, Chloride, Hardness	TDS, Chloride
4	Bansgaon	08	02 (50.00)	02 (50.00)	03 (75.00)	01 (25.00)	05 (62.50)	03 (37.50)	TDS, Hardness	TDS, Hardness
5	Brahampur	08	03 (75.00)	01 (25.00)	03 (75.00)	01 (25.00)	06 (75.00)	02 (25.00)	pH	TDS, pH, Hardness
6	Sardar Nagar	08	02 (50.00)	02 (50.00)	03 (75.00)	01 (25.00)	05 (62.50)	03 (37.50)	TDS, pH	pH, Hardness
7	Kauriram	08	01 (25.00)	03 (75.00)	03 (75.00)	01 (25.00)	04 (50.00)	04 (50.00)	TDS, Hardness	Hardness
8	Chargawan	08	03 (75.00)	01 (25.00)	04 (100.00)	00	07 (87.50)	01 (12.50)	-	Hardness
9	Gorakhpur City	08	02 (50.00)	02 (50.00)	04 (100.00)	00	06 (75.00)	02 (25.00)	TDS, Hardness	-
		72	**21 (58.33)**	**15(41.67)**	**28 (77.77)**	**08 (22.23)**	**49 (68.05)**	**23 (31.95)**		

4. Conclusion and Recommendations

The analysis of physico-chemical parameters of the samples tested provided useful insight into the extent of problems in the study area. It is revealed that TDS, hardness and pH are the parameters requiring attention in most of the shallow depth hand pumps except in Campierganj and Chargawan blocks whereas pH and chloride also need attention in some cases. TDS and hardness are the main parameters requiring attention in case of India Mark-II hand pumps also but pH, chloride and fluoride attention in some cases.

The water quality scenario exhibits that Chargawan block has the highest overall compliance status (87.5%) whereas Kauriram shows a poor overall compliance status (50%). So, it may be necessary to focus special attention on water quality problem relating to hardness and TDS in Kauriram block. Even though the fluoride concentration is found to be within the permissible limit of 1 mg/l in two villages of Campierganj block yet it indicates a need for the examination of more number of water samples from this block with a view to ensure the safety of public health against adverse effects of fluoride. This also necessitates the need based provision of fluoride removal units with such India Mark-II hand pumps that might be found to yield water having fluoride concentration exceeding the permissible limit.

There should be an initiative taken for water quality assessment by the local and central regulatory bodies to improve and develop action plan to mitigate the increased levels of physico-chemical parameters. Also, there is a need to conduct periodic surveys in order to ensure sustainable development of water quality.

Suitable measures need to be adopted to improve co-ordination and co-operation between the relevant authorities and stake holders in establishing, implementing and maintaining efficient systems for water quality assessment and addressing water quality issues.

In addition, there is also a need to educate people about water quality hazards and make them aware about the importance of household cleanliness and community hygiene.

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