Analysis of Physiochemical Parameters of Ground Water: A Case Study

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Authors’ contributions
This work was carried out in collaboration among all authors. Authors SN and AS designed the study. Authors WM and SN performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors SN, WM, UR and MI managed the analyses of the study. Authors WM and AS managed the literature searches. All authors read and approved the final manuscript.

Article Information
DOI: 10.9734/AJARR/2019/v5i430138

Received 20 June 2019
Accepted 23 August 2019
Published 04 September 2019

ABSTRACT

The main sources of water are rain, surface and ground water. These resources are contaminated due to human and industrial activities. Both urban and rural areas, ground water is an eminent source of drinking water. The main objective of this study was to access the quality of ground water in Faisalabad city. From twelve different colonies of the Faisalabad water samples were collected to estimate their physiochemical parameters. The physiochemical parameters such as (pH, Electrical conductivity, Total dissolve solids, Calcium, Bi-carbonates, Total Hardness and chloride) were analyzed and their values were compared with the standard values given by the WHO. In majority of the colonies some parameters were found within permissible parameters of above standard such as pH and total hardness. But in few colonies EC, TDS, Bi-carbonates and chlorides values deviated with reference to the recommended values. On the completion of data physiochemical parameters of ground water, statistical analysis was applied. Descriptive statistics was carried out to evaluate the significant different between means of samples.

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Keywords: Water quality; groundwater; physiochemical parameters; analysis.

1. INTRODUCTION

The rain water sieve slowly through a permeable surface to down through unfilled spaces (fractures, crevices and pores) engrossed in the ground, rocks, gravel, and soil states as Groundwater [1]. Through wells and tube wells, the water can be obtained that found underground in the soaking coats of the rocks [2].

To sustain life on earth water is one of the most essential and dynamic components. Water accounts for about 70% of the total body weight almost in all organisms. The main causes for quick increase in water pollution that have raise the concern over its protection and future uses are rapid growth in population, fast industrialization, more increasing human requirements and increase in the use of agricultural fertilizers and chemicals [3].

Groundwater have significant importance for human drinking, also give support to surrounding, and it is extensively spread, renewable most essential reserve presents on earth [4]. Hygienic water is essential and significant for communal health and sustainability of marine ecosystems so, for these reason analyzing the quality of water is important. In different nations due to increasing living ethics and population growth, the need of advanced quality of water resources for various uses such as drinking, agricultural and industrial use [5].

Due to frequently raising quantity of soluble damaging ingredients from urban wastes, industrial wastes and present agricultural activities, the threat of contamination in ground water is increased. Water pollution is slightly biological, chemical and physical variation in water quality that have been harmful impact on prevailing organisms or marks water unsuited for desired uses. The chemical physiognomies of water can be calculated such as Dissolved oxygen, Chloride, alkalinity, Magnesium, hardness, Bi-carbonates, chloride, Phosphate, BOD, Nitrate, Calcium and pH, by the chemical parameters of water [1].

In Pakistan, the main reasons of surface and ground water pollution are side effect of several manufacturing industries such as dying chemicals, cement, textile, engineering, steel, pesticides, metal, power, leather, petrochemical, construction, sugar processing, mining, energy, food processing and fertilizers. Due to increase in water pollution, the total dissolved solids (TDS) increases, dissolved oxygen (DO) decrease, EC and Salinity also increase. Nearly 60% people has no access to clean and pure drinking water in growing countries [6] and nearly 3.4 million people decease each year in the globe due to transmitted diseases through polluted water. It is assessed that unfortunately, pure drinking water is not available to people in developing countries of Asia and Africa like China, Pakistan, India etc. [7]. One billion people from 6 billion peoples lack correspondence to harmless drinking water, and the satisfactory hygiene is not managed by 2.5 billion people on the planet [8].

The main intention to design this study was to determine the important physiochemical parameters, to estimate the parameters of ground water, and to observe that whether the water of these areas is suitable for domestic use and drinking purposes or not and to relate the acquire values of parameters with the drinking water quality strategies of National standards and WHO.

2. MATERIALS AND METHODS

2.1 Sample Collection

The present study was intended from different colonies of Faisalabad to estimate the water quality parameters. From different colonies of Faisalabad and these Sites were twelve in number i.e Fareed colony, Al-Najaf, Rehman town, Peoples colony, Zulfqar colony, Bawa chak, Muslim town, Gulshan colony, Bhatala colony, Awami colony, Sarfaraz colony and Dhodi-wala the water samples were collected. Sample was taken from borehole of different colonies.

2.2 Preparation of Samples

In clean polythene bottles the samples were collected deprived of any air foams. Before sampling the containers were washed and firmly closed after collection and tagged. The temperature of the samples was precisely determined in the field at the time of sample collection. Samples were kept at 4ºC in freezer.

2.3 Analysis of Water Sample

Several water quality parameters were analyzed such as Total Alkalinity, Total Dissolved Solids (TDS), Total Hardness, pH, Calcium and Chlorides.
2.4 Determination of Water Quality Parameters

Scholler’s diagram method is most popular and extensively used for drinking water quality estimation. The distinct variability of groundwater quality cannot be estimated simply and for this purpose, [4] had presented groundwater quality index (GQI) [9]. The quality parameters were analyzed as follow; Total Dissolved Solids (TDS) was estimated by standard methods, pH was measured using standard pH meter, calcium content by EDTA titrimetric method, methyl orange alkalinity, total hardness (TH) by EDTA titrimetric method, chloride content by argentometric method.

2.5 Statistical Analysis

On the complete data of the physiochemical parameters of ground water Statistical analysis was applied. Suitable tables were arranged, and means were assessed. Descriptive statistics was applied to check the difference at certain level.

3. RESULTS AND DISCUSSION

From different colonies of Faisalabad, the water samples were collected to analyze their physiochemical parameters like TDS, EC, Ca, pH, Mg, chlorides, total hardness and bicarbonates of ground water. According to (Table 2) results has been significant by varying the values of recorded data. Mean pH value was (7.3833) which is the fair in accordance with the WHO values and EC mean is 3566 which is very high compared with the given values. Whenever, TDS showed the mean value 1765.

In the graphical representation (Fig. 2) pH values from the water samples of all the mentioned areas are in normal range (6.5-8.5) which is given by the WHO standard and highest and lowest pH was recorded for Al-Najaf colony and Rehman Town respectively. While EC value was recorded highest for Gulsan colony (7880 µS/cm) and least for Bhatala colony and Al-Najaf colony (670 µS/cm) (Fig. 3). Exceeding EC from the normal range reveal that water of these colonies also contained contaminations which are not good for human health, whereas 58.33% samples exceeds the optimum limit of EC. These results are also according with the previous studies [10].

Muslim Town water sample showed minimum Calcium value. But Awami colony, Sarfraz colony, and Zulfiqar colony water samples Calcium values are in normal range. In case of Magnesium, recorded highest in Awami colony and lower in Al-Najaf colony But Rehman colony, Gulshan colony, and Awami colony water shows normal value of Magnesium (Fig. 4). According to value obtained from analysis of water samples, Gulshan colony water sample showed maximum TDS values while Bhatala colony water sample...
show minimum TDS value. Almost all samples fluctuate to normal range. The normal value for TDS is (1000 mg/L) that is given by the WHO standard and distribution of measured TDS values in the study area is shown in (Table1).

(Fig. 4) shows that almost all areas have normal Total Hardness of Water sample except of Awami Colony. The water having hardness up to 75 (mg/L) arrangement as soft, 76-150 (mg/L) as respectably soft, 151-300 (mg/L) as hard and more than 300 (mg/L) as hard [11]. Al-Najaf colony water shows less Total Hardness as compared to other colonies. Muslim Town water sample show highest value of Bi-carbonates but Sarfraz and Bhatala colony shows less amount as compared to other colonies, as previously study result [12]. According to values Bawa chak water shows highest value of Chlorides and Bhatala Colony shows less value as compared to other colonies water as in the previously assessment of ground water [13,14].

In the Fareed Colony water sample, the experiential value of chlorides, Total Hardness, pH, TDS, Bicarbonates and EC falls in the normal range. In most of the colonies calcium and magnesium are still less than standard range. But only the experiential quantity of magnesium is less than the normal range in the Sarfraz Colony water. For domestic purposes the water of both colonies is useful. Due to the difference in the depth of the ground, the observed value of parameters is different, where
Table 1. Physiochemical parameters of ground water

| Sr. no. | Identification         | pH  | EC (µS/cm) | TDS (Mg/l) | Ca⁺ (Mg/l) | Mg²⁺ (Mg/l) | Total Hardness (Mg/l) | Bi-carbonates (Mg/l) | Chlorides (Mg/l) |
|---------|------------------------|-----|------------|------------|------------|-------------|----------------------|---------------------|-----------------|
|         | WHO guideline          | 6.5-8.5 | 1000-2000 | 1000 | 75-200 | 50-150 | 10-500 | -- | 250 |
| 1       | Al-Najaf Colony        | 7.1 | 670 | 330 | 51 | 12 | 172 | 248 | 70 |
| 2       | People's Colony        | 7.4 | 3640 | 1800 | 53 | 45 | 312 | 596 | 446 |
| 3       | Dhodiwala              | 7.3 | 5280 | 2620 | 48 | 45 | 300 | 1024 | 670 |
| 4       | BawaChak               | 7.5 | 6240 | 3100 | 45 | 42 | 280 | 756 | 900 |
| 5       | Muslim Town            | 7.5 | 5160 | 2560 | 24 | 24 | 156 | 1140 | 616 |
| 6       | Rehman Town            | 7.6 | 5860 | 2910 | 54 | 72 | 424 | 680 | 320 |
| 7       | Gulshan Colony         | 7.4 | 7880 | 3910 | 59 | 77 | 452 | 784 | 570 |
| 8       | Awami Colony           | 7.4 | 4800 | 2370 | 109 | 84 | 608 | 584 | 726 |
| 9       | Fareed Colony          | 7.4 | 770 | 370 | 59 | 18 | 216 | 248 | 78  |
| 10      | Sarfraz Colony         | 7.4 | 700 | 340 | 118 | 19 | 220 | 236 | 84  |
| 11      | Bhatala Colony         | 7.3 | 670 | 320 | 53 | 17 | 200 | 236 | 74  |
| 12      | Zulfiqar Colony        | 7.3 | 1120 | 550 | 80 | 30 | 320 | 368 | 124 |

Table 2. Descriptive statistics of all parameters

| Descriptive statistics factors | pH  | EC (µS/cm) | TDS (Mg/l) | Ca⁺ (Mg/l) | Mg²⁺ (Mg/l) | Total Hardness (Mg/l) | Bi-carbonates (Mg/l) | Chlorides (Mg/l) |
|-------------------------------|-----|------------|------------|------------|-------------|----------------------|---------------------|-----------------|
| Mean                          | 7.383333 | 3565.833 | 1765 | 62.75 | 40.41667 | 305 | 575 | 391.3333 |
| Standard Error                | 0.036584 | 762.8609 | 379.64 | 7.763673 | 7.269132 | 38.39231 | 91.09452 | 87.4391 |
| Median                        | 7.4 | 4220 | 2085 | 53.5 | 36 | 290 | 590 | 392 |
| Mode                          | 7.4 | 670 | N/A | 53 | 45 | N/A | 248 | N/A |
| Standard Deviation            | 0.12673 | 2642.628 | 1315.111 | 26.89415 | 25.18101 | 132.9949 | 315.5607 | 302.8979 |
| Sample Variance               | 0.016061 | 6983481 | 1729518 | 723.2955 | 634.0833 | 17687.64 | 99578.55 | 91747.15 |
| Kurtosis                      | 1.564827 | -1.61764 | -1.61945 | 0.914498 | -0.93904 | 1.07347 | -0.90645 | -1.53211 |
| Skewness                      | -0.59553 | 0.081998 | 0.082708 | 1.12992 | 0.690199 | 1.1376 | 0.452672 | 0.250328 |
| Range                         | 0.5 | 7210 | 3590 | 94 | 72 | 452 | 904 | 830 |
| Minimum                       | 7.1 | 670 | 320 | 24 | 12 | 156 | 236 | 70  |
| Maximum                       | 7.6 | 7880 | 3910 | 118 | 84 | 608 | 1140 | 900 |
| Sum                           | 88.6 | 42790 | 21180 | 753 | 485 | 3660 | 6900 | 4696 |
| Count                         | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12  |
| Confidence Level (95.0%)      | 0.080521 | 1679.046 | 835.582 | 17.08773 | 15.99925 | 84.50091 | 200.4977 | 192.4522 |
the water was reserved pollutants and it also the reason of changes in the value of water parameters.

4. CONCLUSION

The assessment of the groundwater quality parameters from twelve different areas in the Faisalabad city demonstrate that the total hardness and pH value are well within the permissible limits while others are high or below of the WHO standard. Limited water samples of ground water from these areas were useful for residential use but rather these were bad to drink uses. From the results of the proposed study it may be concluded that the groundwater of Faisalabad is though unfit for domestic and drinking purpose and treatments should be applied to minimalize the pollution particularly the TDS, alkalinity and EC. As a result of high concentration of TDS, water drops its potability and decreases the solubility of oxygen in water.

ACKNOWLEDGEMENT

All the authors have contribution in work.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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Peer-review history:
The peer review history for this paper can be accessed here: http://www.sdiarticle3.com/review-history/51104