

Investigation of the Rain Water Quality Parameters in Savar Area, Dhaka, Bangladesh

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Abstract: Since rainwater is considered to be one of the safest sources of water, this study is focused on the rainwater quality parameters collected from the Savar area, Dhaka, Bangladesh. The main purpose of the study was to assess the rainwater quality variation in terms of drinking water quality standards given by the World Health Organization (WHO) to observe whether further treatment is needed or not for household applications. This location was selected due to the increased number of industries and textiles in the Savar area. For this investigation, four samples were collected in the months of April and May 2022 during rainfall. Several parameters were analyzed such as pH, electrical conductivity (EC), turbidity, salinity and total dissolved solid (TDS). The turbidity values varied from 0 to 2.21 NTU which suggested that the samples were optically clear enough. The pH, EC, salinity and TDS values, which are the chemical properties of the samples, ranged from 6.03 to 6.37, 21 to 62.2 $\mu\text{S}/\text{cm}$, 0 to 0.1% and 10.51 to 27.8 ppm respectively. The results revealed that the quality of the rainwater samples found in this investigation was in the good range in terms of drinking water quality standards and it is safe for further applications.

Keywords: Rain Water, pH, Salinity, Environmental Pollution, Acid Rain

1. Introduction

Bangladesh is situated in the Hindu Kush-Himalayan region, between latitudes 20°34' N and 26°38' N and longitudes 88°01' E and 92°41' E. The climate of Bangladesh is tropical monsoon, influenced mostly by the Himalayan Mountains to the north and northeast, and the Bay of Bengal to the south. High monsoon rains are related with Bangladesh's exceptional geographical position in the eastern delta of the world's second biggest river basin. According to certain research, the Himalayas and the Tibetan Plateau play a major contribution in the genesis of this country's boreal summer monsoon [1-6]. Bangladesh receives considerable rainfall each year during the monsoon season due to its geographical location. Monsoon usually lasts from May to October and occasional rainfall in November. During this period, it gets huge amount of rainwater, which could reduce

the dependency on groundwater at least for 6 months. Furthermore, Bangladesh is a land of rivers. As a result, Bangladesh is surrounded by about 230 rivers. Padma, Meghna, Brahmaputra, and Jamuna are the four central rivers. As a big volume of water evaporates from their surface, the likelihood of rain in this country increases [7, 8].

Rain is an integral feature of the never-ending water cycle, in which rain falls to the earth, dissipates, is captured by clouds, and then falls again to complete the loop. Rainfall really benefits the earth's atmospheric circulation, seasonal cycles, and the survival of every plant and animal life on the planet. Rain has had many environmental impacts, including restoring wild plants, moistening the air, creating streams and rivers, restoring the water table, and producing especially valuable negative ions. The most major advantage of rainfall is the rearrangement of clean, fresh water throughout the water cycle [9, 10]. Rain is very beneficial for the human being in many ways, but excess of it is not welcomed in the

environment. Rain has an even worse image these days. Rainwater is often preferred over synthetic agriculture technology because it reduces the additional toxins that artificial irrigation systems frequently include, such as chlorine. However, there is one potential complication: when a filthy atmosphere produces acid rain, which is extremely hazardous to the environment and human health, the benefits of rainfall are reduced [11, 12]. In the worst circumstances, major flooding destroys homes, companies, and even lives. On the other hand, flash floods are perhaps very much destructive and lethal since they can overwhelm those who are either unprepared for them or misunderstand their significant threat. Cities and towns are forced to repair, which has a negative financial impact [13, 14].

The average summer monsoon rainfall in Bangladesh is 1769.14 mm, with a standard deviation of 209.16 mm (coefficient of variation 11.82 percent), and the annual country average rainfall is 2456.38 mm. This implies that, except from this season, there is little rainfall in this nation. Although Bangladesh receives sufficient amount of rainfall during the monsoon season, both rural and urban areas face shortage of water during the dry season [15]. Water quality is determined by the composition of water as affected by natural processes and human activities. Water quality depends on the constituents dissolved or contained within the water. It is often presumed that the chemical composition of water is the only factor involved. However, especially (micro) biological factors are of main importance when considering water quality [16]. It is not possible to find completely pure water in nature, since water droplets already begin to dissolve a whole range of substances in the atmosphere, such as gases, airborne dust particles and salt from sea spray. Atmospheric pollution can have a major effect on the composition of rainwater. Water that reaches the earth as rain, acquires other substances from processes such as leaching, weathering, and dissolution. Living organisms may enter the water. All these processes affect the composition of the water [17].

There are a lot of parameters to be checked to ensure the quality of the rain water. Among them, pH, electrical conductivity (EC), turbidity, salinity and total dissolved solid (TDS) are considered the major parameters. When rainwater falls through the atmosphere, it reacts with Carbon dioxide, emitted gasses from industries and automobiles and becomes acidic. This is very much harmful for human and as well as crops and other animals. So, pH has to be in the considerable range. Based on the WHO Guidelines for Drinking Water Quality (2004), the pH value should be in between 6.5-8.5 [18-20]. The capacity of an aqueous solution to convey an electric charge is expressed numerically as conductivity. This capacity is affected by the presence of ions, their total concentration, mobility, valence, and relative concentrations, as well as the liquid's temperature. Most inorganic acid, base, and salt solutions are rather excellent conductors [16]. Pure water is not a good conductor of electric current rather it is a good insulator. Increase in ions concentration enhances the electrical conductivity of water. Generally, the amount of solid that is dissolved in water determines the electrical

conductivity. Electrical conductivity (EC) actually measures the ionic process of a solution that enables it to transmit current. According to WHO standards, EC value should not exceed 400 $\mu\text{S}/\text{cm}$ [20, 21]. Again, many dissolved substances can pollute the rain water. They can be toxic or carcinogenic. Thus, TDS should be given concentration to ensure the good quality of the rain water. According to the WHO guidelines, the palatability of water with a total dissolved solids (TDS) level of less than about 600 mg/l is generally considered to be good; drinking-water becomes significantly and increasingly unpalatable at TDS levels greater than about 1000 mg/l [22]. The WHO guideline value for drinking water salinity is 250 mg of Chloride per liter (mg/l) for Chloride (Cl) and 200 mg/l for Sodium (Na), and is based on taste threshold, not on health consideration. Sodium and chloride remain amalgamated in nature as salt and thus approving increased chloride consumption translates into allowing high sodium intake which is reported to have various health impacts [23]. Turbidity in water is caused by suspended particles or colloidal matter that obstructs light transmission through the water. It may be caused by inorganic or organic matter or a combination of the two. Turbidity is measured by nephelometric turbidity units (NTU) and can be initially noticed by the naked eye above approximately 4.0 NTU. However, according to the WHO standards in order to ensure effectiveness of disinfection, turbidity should be no more than 1 NTU and preferably much lower [16].

Dhaka City, the capital of Bangladesh, is one of the most overcrowded cities in the world with a population of more than 16 million [24]. Due to over population, the rain water quality of this city is deteriorating day by day. The industrial area, automobile industries, brick Kiln are the main reasons of the acidic rain. As Savar is situated about 40km away from the Dhaka city and it has many industrial activities like the capital city, it is very much important to check the quality of the rain water of this area [25]. The present study was performed on rainwater samples collected from four days in the months of April and May, 2022. The samples were taken from one point in Savar area, Dhaka, Bangladesh. The sample collection point is about 40 km away from the capital city of Bangladesh. The aim of this study was to assess the quality of rainwater in terms of drinking water quality parameters set by the World Health Organization (WHO). This study was also taken to find the possibilities of use of rainwater in agriculture and municipal applications and thus performed the tests of various parameters of the collected rain water samples.

2. Materials and Methods

For this investigation, four rainwater samples were collected using washed plastic pots from the rooftop of a five-storey building placed in the Savar area, Dhaka, Bangladesh, which is situated very near the capital city of Bangladesh. These samples were collected on 19 April, 11 May, 19 May and 21 May, 2022 respectively when rainfall happened.

The samples were checked for several physical (Turbidity) and chemical characteristics (pH, EC, Salinity and TDS). The pH values were measured using Smart Sensor-pH-818 meter, Walfront, USA. The EC, Turbidity, Salinity and TDS were assessed by Edge EC Metter-M-HI-2003, Hanna Instruments, USA. The turbidity of the samples was analysed by the Lutron-TU-2016, Lutron Electronics, USA. All of the instruments were calibrated before the experiments.

3. Result and Discussion

Table 1. Values of different parameters of rain water samples.

Parameters	Recommended Range [20]	Sample-1 (19 April, 2022)	Sample-2 (11 May, 2022)	Sample-3 (19 May, 2022)	Sample-4 (21 May, 2022)
pH	6.50 to 8.50	6.33	6.03	6.19	6.37
EC ($\mu\text{S}/\text{cm}$)	< 400.00	55.10	21.00	62.20	55.50
Turbidity (NTU)	< 5.00	2.21	0.00	0.00	0.00
Salinity (%)	0.10	0.00	0.10	0.10
TDS (ppm)	< 600.00	27.60	10.51	31.10	27.80

Figure 1 depicted the pH values against different collection dates of the rain water samples. The values of pH of rain water samples varied from 6.03 to 6.33. The recommended value of pH of fresh drinking water is 6.5 to 8.5 which suggested that the obtained values are slightly lower than the recommended values. This is to be noted here that many industries are situated in Savar area and thus the emission of some gases might be responsible for the lower values of pH in that area [26].

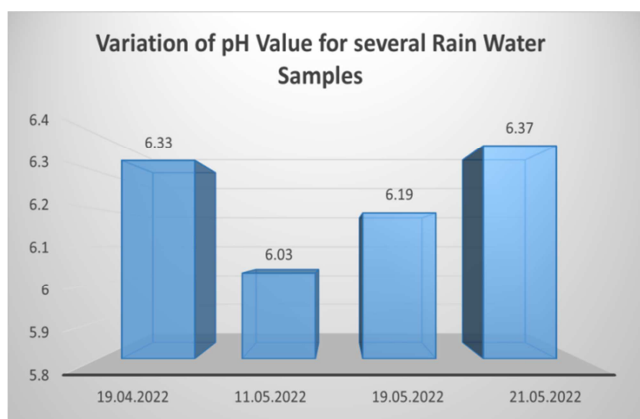


Figure 1. Variation of pH Value for Rain Water Samples.

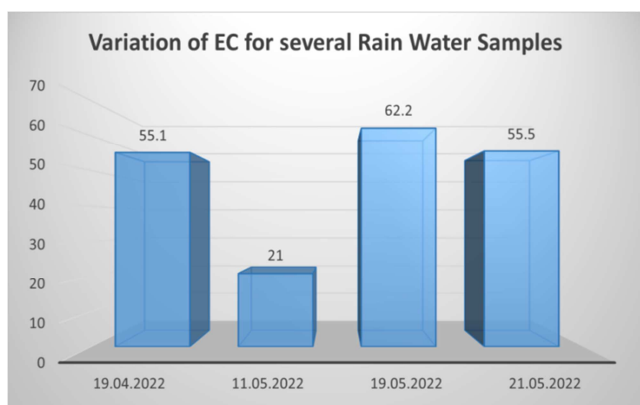


Figure 2. Variation of EC Value for Rain Water Samples.

The rain water samples were collected from the Savar area, Dhaka, Bangladesh. During rainy days four samples were collected. Several parameters such as pH, EC, turbidity, salinity and TDS of the rain water samples were analysed. The values of different parameters of rainwater samples are shown in Table 1 where the sample collection days are mentioned. The observed values are compared with the recommended values of the rain water quality parameters.

The EC values of the rain water samples are represented in Figure 2. The EC values varied from 21.00 $\mu\text{S}/\text{cm}$ to 62.20 $\mu\text{S}/\text{cm}$ which suggested that the EC values are in the recommended range. The turbidity values of the samples were in the range 0.00 NTU to 2.21 NTU which is mentioned in the Table 1 that indicated the rain water is optically clear enough. The salinity values of the rain water samples were slightly higher than the recommended range.

The TDS values of the rain water samples found in the range of 10.51 ppm to 31.10 ppm which is shown in Figure 3. The recommended value of TDS for fresh drinking water is less than 600ppm [22]. Thus, the rain water samples are good enough with respect to fresh drinking water quality parameters.

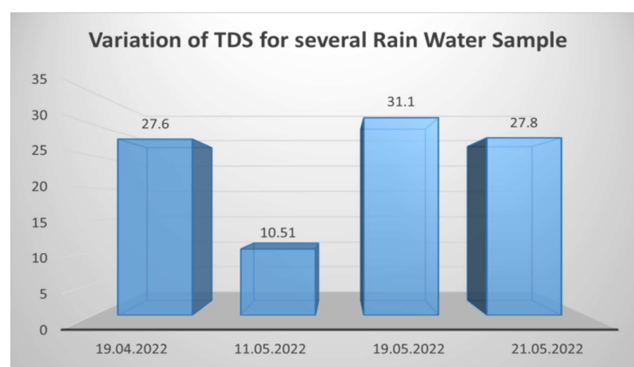


Figure 3. Variation of TDS for different Rain Water Samples.

4. Conclusion

The parameters of the rain water quality of Savar area were investigated. This research work was carried out in the months of April and May 2022. It was noticed that the rain water quality is good enough for the application in general and municipal purposes by following general water treatment procedures.

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