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Assessment of Boreholes and Hostels Water Quality in an Academic Setting: A Case Study

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ABSTRACT

The aim of this study was to inspect the potability of water samples collected within the university premises. A total of 26 samples were evaluated of which 8 samples were collected from the boreholes dug inside the university while the rest of the 18 samples were collected from the outlets at 6 on-campus boys' hostels. The objective of the study was to determine the quality and deterioration of water between source and outlets. Therefore, the samples were subjected to physical and chemical analysis including pH, electric conductivity, total dissolved solids, turbidity, and the concentration of metal ions like sodium, potassium, and calcium. Almost all the water samples inspected in the study showed values of physical and chemical parameters within the safe limits advised by the WHO and hence considered safe for drinking.

KEYWORDS: Water Quality, Physiochemical Assessment, University Hostels.

1 INTRODUCTION

Water is the necessity of life. It is essential for the survival of all living beings on earth [1]. It covers about 70% of Earth's surface. If we further break down this percentage then we come to know that 97% of water exists as saltwater in the form of oceans while only 3% of water exists as our freshwater resource in the form of groundwater, polar ice caps, and glaciers that is suitable for drinking [2]. With the passage of time, the increasing population is affecting our freshwater resources. The condition is getting worse especially in the developing countries. The shallow and underground water quality is falling little by little. The unpredictable release of industrial and residential wastewater into open water and groundwater bodies is the primary danger to any nation's water-reserves [3]. This problem is getting intense, because most of the aquifers and open water bodies, for example, lakes, rivers, and streams, are progressively polluted by the waste coming from agriculture, municipal, and industries [4].

One of the UN reports states that up till now the world's 40% population is deprived of potable clean drinking water and it is predicted that 1.8 billion of the world's population will be surviving in water scant areas by 2025. Pakistan is among water-deficit countries. As indicated by the International Monetary Fund also known as IMF, the country that ranks 3rd is Pakistan in the list of extreme water-deficient nations. Pakistan Council of Research in Water Resources also known as PCRWR has also declared that the availability of fresh water in the country will be almost

vanished by 2025. The per capita accessibility of water during the 1950s was around 5000 m^3 for each year, which has now reduced under 1000 m^3. This limit is universally seemed as an edge of water shortage [5].
According to a World Resources Institute (WRI) 2019 report about the most stressed water countries in the world, Pakistan ranks 14th having a status "Extremely High" water-stressed country. About 1 billion inhabitants in developing countries have no approach to fresh potable water. For good public health, accessible and safe water is essential, in case it is used for domestic use or drinking, for purposes like production of food or entertainment [6].

2 METHODOLOGY AND FRAMEWORK

This study was conducted at new campus of International Islamic University Islamabad, which is also known as IIUI, is a public sector research university, located in the H-10 Sector of Islamabad having an area of 704 acres (245 ha). Capital Development Authority (CDA) used to provide water to the university's main campus but as the university expanded with the passage of time and decided to bore its boreholes and thus gradually decreased its dependence on CDA water supply. Now IIUI has total of 8 boreholes each having depth of 350 ft. 6 boreholes have 15 Horsepower pumps while the two others have 20 horsepower pumps. The university has a huge system for water storage and boreholes system meeting the daily water demand. On-campus boys' hostels is a home of approximately 2600 students. The students that reside in hostels has shown their concerns over the water quality therefore this study is conducted to check the quality of water. The study will help the hostel administration to take relevant steps to improve the water quality.

2.1 Water Sample Collection and Physiochemical Analysis

A total of 26 water samples were collected from the university. Which included eight samples from boreholes (BH1-BH8), and the rest of eighteen samples from university's boys' hostels. The samples were collected in October 2020, during the dry season of the year. Each sample was collected in 150 mL sterile plastic bottle which were thoroughly washed with the distilled water before sampling. The water samples were then analyzed within twenty-four hours of collection at environmental science laboratory of IIUI. The water samples collected were analyzed for temperature, odor, color, taste, pH, electrical conductivity, turbidity, total dissolved solids, and for the traces of metals like sodium, potassium, and calcium ions.

3 RESULTS AND DISCUSSIONS

In this study, the water samples collected from boreholes and boys' hostels of IIUI, has been examined for the physicochemical properties. The results have been shown in Tables 1 and 2.

3.1 Temperature, Color and Odor

All the tested water samples exhibited comparable and satisfactory color and odor. The samples' temperature was ranging between 25.9 C and 28.7 C.

3.2 pH

The samples taken at boreholes have exhibited pH values between **7.1** and **7.4** while the samples taken from boy's hostels exhibited pH values between **7.1** and **8.2** and within the safe limits of WHO as shown in Table 3.

3.3 Electrical Conductivity

It was recorded that the electrical conductivity of the collected water samples from boreholes, ranged between **610** and **688 µS/cm,** and from six boys' hostels, ranged between **605** and **650 µS/cm** respectively**.** Thus, the samples contain salts much less than the maximum allowable limit of 1000 µS/cm as shown in Table 3.

3.4 Turbidity

The samples collected from boreholes and six boys' hostels showed turbidity ranging from **0.38** to **1.26 NTU** and **0.32** to **0.93 NTU** respectively which is less than 5 NTU as shown in Table 3.

3.5 Sodium

The levels of sodium in water samples collected from boreholes and six boys' hostels range from **54.1** to **57.5 mg/L** and **55.1** to **57.9 mg/L** respectively and lie under the maximum permissible value of 200 mg/L as shown in Table 3.

3.6 Potassium

The levels of potassium in water samples collected from boreholes and six boys' hostels range from **1.3** to **2.1 mg/L** and **1.2** to **1.7 mg/L** respectively and under the maximum allowable value of 12 mg/L as shown in Table 3.

3.7 Calcium

The levels of calcium in water samples collected from boreholes and six boys' hostels range from **41.2** to **54.3 mg/L** and **34.1** to **51.5 mg/L** respectively and are beneath the maximum acceptable value of 200 mg/L as shown in Table 3.

Table 1: The pH, Electric Conductivity, Total Dissolved Solids, Turbidity and Metal Concentration values of Borehole water samples from IIUI

Water Sample	pH	Electric Conductivity µS/cm	Total Dissolved Solids mg/L	Turbidity NTU	Concentration of Metals		
					Na mg/L	K mg/L	Ca mg/L
BH1	7.2	608	304	0.59	57.5	2.1	54.3
BH2	7.3	642	321	0.58	54.1	1.4	44.0
BH3	7.3	645	322	0.59	55.3	1.3	43.7
BH4	7.4	647	323	1.26	56.3	1.3	45.3
BH5	7.2	620	310	0.57	55.3	1.4	41.4
BH6	7.1	688	344	0.45	56.9	1.3	47.1
BH7	7.1	610	305	0.38	55.7	1.4	41.2
BH8	7.1	617	316	0.43	54.6	1.4	41.5

Table 2: The pH, Electric Conductivity, Total Dissolved Solids, Turbidity and Metal Concentration values of Boys Hostel from IIUI

Water Sample		pH	Electric Conductivity µS/cm	Total Dissolved Solids mg/L	Turbidity NTU	Concentration of Metals		
						Na mg/L	K mg/L	Ca mg/L
Hostel 1	WD-H1	7.9	621	311	0.47	56.9	1.4	35.1
	K-H1	8.2	619	310	0.58	57.9	1.4	35.0
	WR-H1	7.9	624	310	0.53	57.2	1.3	34.6
Hostel 2	WD-H2	8.0	638	319	0.47	55.1	1.4	40.1
	K-H2	7.9	624	312	0.63	55.3	1.5	39.9
	WR-H2	7.9	630	315	0.42	55.8	1.7	38.7
Hostel 3	WD-H3	8.0	635	318	0.35	56.1	1.2	34.8
	K-H3	7.9	643	322	0.52	57.2	1.5	41.9
	WR-H3	7.9	616	309	0.32	56.6	1.4	50.2
Hostel 4	WD-H4	7.3	639	310	0.43	57.9	1.3	34.1
	K-H4	7.1	637	318	0.93	57.8	1.4	41.3
	WR-H4	7.3	650	325	0.92	55.7	1.4	50.2
Hostel 5	WD-H5	7.8	634	317	0.62	56.5	1.7	34.1
	K-H5	7.9	605	303	0.67	57.3	1.6	40.6
	WR-H5	7.7	641	320	0.56	57.2	1.3	51.7
Hostel 6	WD-H6	7.3	638	321	0.41	57.9	1.4	34.4
	K-H6	7.1	639	317	0.90	55.6	1.4	40.2
	WR-H6	7.2	649	323	0.91	55.5	1.4	51.5

*WD=Water Dispenser, K=Kitchen, WR=Washroom

Table 3: Parameters Range and their WHO limits

Parameters	**Units**	**Min-Max Range**	**WHO Limits**
pH	-	7.1-8.2	6.5-8.5
Electric Conductivity	µS/cm	605-688	1000
TDS	mg/L	303-344	1000
Turbidity	NTU	0.32-1.26	5
Na	mg/L	54.1-57.9	200
K	mg/L	1.2-2.1	12
Ca	mg/L	34.1-54.3	200

4 CONCLUSION

Based on the mentioned physicochemical properties, we conclude that almost all the water samples examined in this study exhibited values of physical and chemical parameters within the maximum safe limits advised by the WHO shown in Table 3 and the water samples collected from boreholes and hostels are safe for human consumption and for alternative uses such as bathing, cleaning, gardening and flushing toilet.

It was noticed that the water that is drawn from the boreholes to reach the end-users at hostels by passing through a long network of pipes has shown values slightly above the source values but still lies within the maximum allowable limits set by the World Health Organization for potable water. Thus, no significant deterioration was detected between the water samples taken from the source i.e. boreholes and outlets at hostels.

While the study may have found that the water currently poses no immediate threat, it's crucial to recognize that water quality can fluctuate over time due to various factors such as environmental and seasonal changes, and delays in changing filter machines installed on dispensers which can pose health-related issues. Therefore, the existing water filtering machines installed on each dispenser should be monitored and rehabilitated by the hostel's administration regularly to ensure the safety and health of hostel residents. Individuals are also advised to boil water before consumption to ensure their health and safety.

5 LIMITATIONS OF THE STUDY

Because of limitations imposed by the school environment, the investigators were unable to access the female hostels of the university. Consequently, the evaluation of environmental conditions was confined to the male hostels only. Moreover, the tests for heavy metals as well as biological tests were not conducted in this study due to limited resources.

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