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A Study on Physicochemical Properties and Water Quality in Selected Areas of Ethiopia

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Abstract: For industrial, agricultural, and drinking needs in inland regions, rivers and lakes serve as the main water sources. The factors that impact water quality on a chemical, physical, and biological level are always important. The microbiological quality is crucial and must never be sacrificed in order to provide visually appealing and acceptable water. The most important water quality properties—temperature, pH, turbidity, conductivity, total dissolved solids, total suspended solids, heavy metals, chlorides, nitrates, fluorides, sulfates, bacteria, COD, BOD, DO, etc.—are basic evaluation parameters. This study aimed to review the physicochemical characteristics of water quality in selected areas of Ethiopia. The concentration of those physicochemical properties in water was compared with WHO permissible levels. As a result, turbidity, K, and Na were found beyond WHO permissible levels and the others were found within the acceptable range. Existence beyond acceptable range is a result of daily human activity, the lake closest to the city, and poor household waste management. From this study, we recommend that it is better to study water quality assessment properly and regularly. It's also suggested to create an effective waste management system and prevent the untreated discharge of industrial waste into nearby lakes and rivers. Likewise, creating and raising awareness about treating water with modern waste management technologies is also important.

Keywords: Ethiopia, Physicochemical, Quality, Water

1. Introduction

In inland areas, rivers and lakes are the main suppliers of water for industrial, agricultural, and drinking purposes. The availability of trustworthy water quality data is a need for successful and efficient water management [25]. In the context of this study, water quality refers to water meant for human consumption as well as all domestic and drinking purposes, including personal hygiene [26]. Water quality needs to be in relation to the use for which the water is required and the value of biological indicators needs to be judged on a similar basis [7]. The chemical, physical, and biological parameters that influence water quality are in a constant state of change [13]. In order to offer visually beautiful and acceptable water, the microbiological quality is of the utmost significance and must never be compromised [12].

Different standards are set in accordance with the different risks of infection associated with different water uses (e.g., for drinking water, recreation, and wastewater such as industrial effluents). Recreational water activities like swimming, boating, and others all require physical contact with water and sometimes food consumption, which increases the risk of illness and toxin poisoning. In addition to seasonal runoffs, constant polluting causes include poor sanitation, improper disposal of human waste, industrial and municipal waste, and manure discharge [5].

The physical and chemical environments of ground water make it different from surface water. Aquifers are underground reservoir rocks and soils that store and distribute water [1]. Due to its lengthy retention time and the natural filtration effect of earth minerals, ground water is the largest source of drinking water [19]. Practically all sectors of many countries, it is now the main supply of water. Ground water will be contaminated by both anthropogenic disturbances and natural processes (geological formation, dissolution and precipitation of minerals, groundwater velocity, infiltration

rate, quality of recharge streams, and interaction with different types of water aquifers) [17, 20].

Low-quality water has an influence on both plant growth and human health [8]. Poor water quality and unhygienic conditions are directly responsible for almost 80% of all infections in developing countries like Ethiopia [30]. To determine if ground water is suitable for residential, agricultural, and industrial uses, it is vital to understand its quality. Several factors must be taken into account before drawing any judgments about the quality of ground water [15]. Analyzing water quality using physicochemical and bacteriological methods gives a decent indicator of how polluted a body of ground water is [24], which aids in determining the chemical status and pollution levels of the aquifer [21]. In many parts of Ethiopia, including Bahir Dar, borehole (deep well) water is the most frequent source of drinking water [22].

This investigation was motivated by the potential for groundwater contamination by natural source contaminants from geologic sources and anthropogenic activities such increased fertilizer use, settlement growth, and unregulated residential household waste discharge into the subsurface [6, 23] The objective of this paper was to review the physical and chemical properties of the water quality in some selected areas of Ethiopia.

2. Parameters of Drinking Water Quality

The main water quality evaluation parameters are temperature, pH, turbidity, conductivity, chlorides, nitrates, fluorides, sulfates, bacteria, Total Dissolved Solid (TDS), Total Suspended Solid (TSS), Chemical Oxygen Demand (COD), Biological Oxygen Demand (BOD), Dissolved Oxygen (DO), and heavy metals [18].

2.1. Temperature

The trend of physical, chemical, and biological processes that are sped up or retarded by temperature can be determined with great accuracy by measurements. High temperatures in the past may have accelerated the growth of bacteria and raised water testing [32].

2.2. Turbidity

Turbidity is one of the indications of the plant's treatment effectiveness. Turbidity levels in treated water that are too high show a problem with the treatment process [11].

2.3. pH

A crucial factor in determining the quality of water since it affects a variety of biological and chemical activities in a water body and all processes involved in water supply and treatment [18].

2.4. Total Dissolved Solid

Inorganic salts form the majority of dissolved solids, with a small concentration of organic matter. Carbonate, bicarbonate, chloride, sulfate, nitrate, potassium, calcium, and magnesium are key contributory ions [4] Total dissolved solids in water are significantly influenced by natural interactions with rocks and soil. The overall amount of dissolved solids in drinking water comes from a variety of natural sources, including sewage, urban runoff, and industrial waste [2]. According to the WHO standards, Total dissolved solids at the highest desired and the acceptable ranges are 500 and 1000 mg/l, respectively [25].

2.5. Conductivity

Conductivity is a critical element in determining the quality of water [10].

2.6. Toxic Compounds and Heavy Metals

Toxic Compounds and Heavy metals-chlorides, nitrates, fluorides, sulfates, bacteria, COD; BOD, DO, etc. are basic water quality evaluation parameters [14].

Table 1. *Physicochemical parameters of water.*

Location	Temperature (°C)	Turbidity (NTU)	TDS (mg/l)	EC (µS/cm)	Reference
Wondo Genet	28.49	0.98	118.56	192.14	[36]
Lake Hawassa	21.22	8.44	450.14	750.09	[32]
Andasa Water Shade	-	-	394.04	627.55	[9]

Table 2. *Chemical constituents of water.*

Location	PH	Ca	Mg	K	Na	Cl^-	SO_4^{2-}	NO_3^-	Reference
Wondo Genet	6.66	5.08	13.67	23.14	31.23	3.70	0.33	2.67	[30]
Lake Hawassa	7.54	-	-	- 77.5	-331.14	30.83	-	5.27	[29]
Andasa Water Shade	7.08	30.18	20.72	4.99	30.79	9.26	6.60	4.64	[9]

Table 1 displays the physicochemical characteristics of water. The physicochemical characteristics of water, with the exception of turbidity, are generally within WHO-permissible concentration ranges. Table 2, on the other hand, shows the chemical constituents of water quality parameters. According to WHO guidelines, K and Na concentrations are above the allowable limit.

3. Conclusion

The results of this review were used to assess the water quality in relation to threshold levels and protect the public's

health by comparing them to recommendations made by the World Health Organization. The information presented above pertains to the main physicochemical indicators of water quality in selected areas of Ethiopia. The levels of temperature, turbidity, TDS, EC, pH, and concentrations Ca, Mg, Na, K, Cl^-, SO_4^{2-} and NO_3^- were compared with the range of WHO permissible levels except Lake Hawassa. Water quality comparisons of Wondo Genet, Andasa Water Shade, and Lake Hawassa; with Lake Hawassa's turbidity and K and Na concentrations exceed WHO permissible levels. The other parameters were found to be within the concentration range. The proximity of the lake to the city was the cause of the deviation of physicochemical parameters above permissible levels. The reason for this is due to the nearby lake, daily human activities, and poor household waste management. Based on the findings of this study, we recommend that water quality assessments be studied thoroughly and on a regular basis. It is also recommended that a good waste management system be developed and that industrial waste not be discharged into nearby lakes or rivers without treatment. It is also critical to create and raise awareness about water treatment using modern waste management technologies.

Data Availability

Data sharing is not applicable to this article as no datasets were generated, since this is a review paper.

Conflicts of Interest

There is no conflict of interest that any of the authors can identify with regard to the publishing of this review study.

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