Water Quality Analysis Techniques for Fresh Water Ecosystem

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Abstract

In this wonderful earth water is viewed as a valuable common asset for the endurance of greenery. The all-Out level of water present on earth will be 97% in sea and 3% as new water with thinking about icy mass. In that 2% new water is accessible as surface water and subsurface water. The estimation of water quality is a lot of significant for the compactness and homegrown use. In this examination we can talk about the various boundaries which can be surveyed for the estimation of water quality. The Physic synthetic and natural boundaries are a lot of valuable for examination of water quality. Hyperion WQI (Water quality index), Hazard Quotient, Harmful algal sprouts, Fecal pointer examination are other Important boundaries for serious checking to improve the water quality for better and feasible administration.

Keywords: *Water quality Index, Biological Oxygen Demand (BOD), Total Dissolved Solids (TDS), Water-Quality Analysis, Water Quality Parameters.*

1. Introduction:

Clean and safe water is very important natural resources for the property of life and a healthy economy. Freshwater handiness is one in all the key issues facing the globe and about one third of water requirement of the globe is obtained from surface sources like rivers, dams, lakes and canals These sources of water conjointly function best sinks for the discharge of domestic and industrial wastes. Since 2000, there has been a dramatic increase within the episodes of waterborne diseases in many countries. One in all the key threats to public health by the utilization of such contaminated water is that the presence of high concentration of pathogens capable of compromising the health of those that drink and use the water for recreational and agricultural functions.Fecal contamination is one in all the priority environmental issues related to the utilization of surface water.

Water resources are often directly contaminated by natural runoff when precipitation events, effluents from waste matter treatment facilities, agricultural and industrial effluents and a number of other and several other phylogeny activities.Many indicator organisms and pathogens want to assess the microorganism contamination of water embrace total coli forms count, unclean coli forms, unclean streptococci, coli phages, C. *perfringens, Enterobacteria* and heterotrophic plate counts. E. coli may be a wide accepted indicator organism for drinking water; though its use has been criticized by some scientists, it's still wide used for routine observance of domestic water.

2. Literature Review:

2.1. Shivaraju H. P 2011 discussed Regarding to potability of drinking water supply of VVWW in the Mysore city with respect to analyzed parameters consideration we can conclude that; the water was physically and chemically satisfied except excess of iron, nitrate and nitrite content of over permissible limit in some areas (I, G, H, J, K, F, G, I). The drinking water in some areas has been highly contaminated by microorganisms and they were bacteriologically unsafe for drinking purposes. It needs more detailed study on chemical contamination including sewage contamination throughout the water supply system, drinking water at the locations of each overhead tank and storage tank needs to be continuously disinfected.

2.2. Gonfa Duressa et al. (2019) explained the bulk of the water samples from the untreated source, main distribution tank, and tap water supply systems of Nekemte town that were analyzed for physicochemical and bacteriological quality in this study fell within the permissible range of both Ethiopian and WHO drinking water standards. Approximately 85% of the examined tap water samples had FRC values below the WHO standard, which suggests that the treatment system's chlorination was insufficient. TC and FC contaminated every sample of water taken from the sources as well as from household taps. Conversely, the majority of household tap water samples did not contain FC, suggesting that water contamination occurs both in the supply network and at the source. The current study's scope was restricted to evaluating the physiochemical and biological parameters of the water supply system during the dry season, from the source to household tap connections. Additional water-quality parameters, such as heavy metals and their source, should also be taken into account in future research.

2.3. Rajesh Prajapati and Ram Bilas explained in their study that the WQI method is more methodological and makes it easier to compare the drinking water quality of multiple sampling sites. 55.56 percent of sampling stations have good drinking water, while 22.23 percent have proven to have poor water quality. The percentage of drinking water that is unsafe to drink is only 11.12%. It is unmistakably showing that over 50% of the water samples have good and drinkable quality. The combined WQI values from all seven stations show that the water quality is not suitable for drinking and that treatment is necessary before use. The water quality at the Araziline Development Block's S5 and S6 stations is excellent. The majority of the study area, which includes the blocks of Harhua, Braga-on, and Sevapuri, has good water quality. The water quality in the Kashi Vidyapeeth and Chi-rajigan blocks is subpar.

The Karkhiaonv water resource in the development block of Pindra and Cholapur has extremely low-quality parameters because of inadequate sanitation systems, a lack of awareness regarding conservation, and dirty water.

2.4. In their 2013 study, G. Venkatesan, B. Balaji, et al. described how the water quality assessment was carried out in Tiruchirappalli, Southern India.It was questioned whether the presence of distillery industry effluents in the mentioned area would contaminate the area's water supplies and create an unpleasant atmosphere. Samples were taken in different parts of the distillery unit using clean plastic bottles. Parameters such as BOD, COD, TDS, copper, zinc, lead, cadmium, nickel, and manganese are measured in surface water samples. After that, the parameters were examined to make sure they met WHO guidelines. Consequently, it has been noted that certain parameters, like groundwater hardness, are ten times higher than those of pure drinking water within acceptable bounds. Because this water is physically very contaminated and smells bad, it is advised that it not be used for drinking or other household purposes. To determine the reasons behind the elevated levels of hardness and chlorides in the ground water, more research may be done.

2.5. According to a study conducted in 2023 by Fatima Abou Abbass, et al., high concentrations of arsenic and mercury were found in class 1 sites in the drinking water of Beirut and Mount Lebanon. Numerous locations, including ashrafieh 3, jdaydeh, cola, dawra, sad El bouchrieh 1, Msaytbeh, and ghoubeiry 1, 2, have elevated mercury levels as a result of laboratory and hospital waste, according to an analysis of the water quality. People who live in these mercury-exposed areas may experience a range of neurological and behavioral problems, including migraines, tremors, insomnia, memory loss, and motor and cognitive dysfunctions. The high calcium content in the water is a result of the presence of carbonate rocks, such as dolomite and limestone, which make the water harder. Although the body benefits from calcium in normal concentrations, high amounts can change the taste of water because of elevated levels of Pseudomonas aeruginosa, E. coli, total coliform, and fecal coliform, the water samples under examination were deemed hazardous. The majority of the water samples under test had higher than average bacterial counts. Many patients are also suffering from typhoid and hepatitis A as a result of contaminated water. Given these results, Lebanon's water resources need to be used, conserved, and protected with immediate and serious action Strict enforcement of environmental laws and regulations is necessary, and this should include higher fines and taxes. Water resources must be managed and protected while minimizing their negative effects, and this requires decision-makers to prioritize the principles of sustainable development.

2.6. The goal of Remya, R.S., and Ebin Antony's 2022 article was to categorize Kerala's various water sources' quality. Based on factors like pH, BOD, dissolved oxygen, electrical conductivity, andthe number of total coliforms in the water sample, the quality of water is divided into several classes. Of these classification models, the accuracy score of Naïve Bayes was 787.79 percent. Accuracy for SVM was 82.83%. In this case study, the decision tree classifier's accuracy is 93.94%, while the XG Boost classifier's accuracy was 94.95%. With a score of 94.96%, Random Forest achieved the highest accuracy. After analysing these outcomes, it can be said that Random Forest produces the best outcomes.

2.7. In 2020, Miss Bhagwatgeeta Prabhu Vairale outlined the findings of the current study, which show that high levels of TDS, hardness, pH, chloride, salinity, carbonate, and alkalinity have severely contaminated some of Udgir City's water resources. When water has a high TDS content, health issues arise. It is simple to alter these abnormal parameter values by periodically testing the water. Reverse osmosis can be used if there is also a high concentration of nitrate ions present. Nearly all of the samples that were taken from various residential and commercial areas in the Udgir region of Maharashtra state were discovered to be above the recommended ICMR and BIS limits. Thus, in the residential area mentioned above, the quality of the tap water, tube well water, well water, and hand pump water is inadequate and not entirely safe for human consumption.

2.8. Amira M. Ell-Amin, Abdel Moneim E. Sulieman, and Elamin A. El-Khalifa conducted research to identify the dominant microflora in water samples and to determine the microbiological analyses for drinking water samples in order to compare theresults with the Sudanese and international standards for drinking water quality. Every month, samples were collected from various locations within Wadmedani district and Khartoum State. These samples (groundwater, treated and untreated surface water) were collected from various locations. In comparison to drinking water samples from Khartoum, the microbiological analyses revealed that Wadmedani groundwater samples were also highly contaminated with the same microbial groupsand this contamination decreased in the surface water samples. Total and fecal coliform contamination was also found to be highly present in the Wadmedani drinking water samples. These microbial groups were found in surface water samples but were not found in groundwater samples from Khartoum. The majority of the samples that underwent identification testing revealed the presence of the same genus, Bacillus, and this genus was found in higher concentrations in drinking water samples from Khartoum than from Wadmedani.

2.9. In their study, Hanafiah, M. M., Yussof, M. K. M., Hasan, M., Abdul Hasan, M. J., and Toriman, M. E. described how physio-chemical parameters and bio-monitoring analysis were used to assess the Tekala River in Selangor's water quality. The Tekala River's water quality index ranged from 85.45 to 94, indicating that the six sampling stations and both sampling times' water quality statuses fall into Class I and Class II categories. It was discovered that there are important differences in temperature, pH, and ammoniacal nitrogen. According to the Pearson's correlation test, temperature, DO, and ammoniacal nitrogen are related to E. coli. There is a correlation between BOD and pH in the case of coliform. The majority of the parameters in this study's data were categorized under Class I to Class IIB of the National Water Quality Standard (NWQS), indicating that it is safe to use this river for recreational purposes. To obtain a more accurate assessment of the water quality, it is advised that additional research be done on various river parameters.

2.10. In their study, Zamfira Stupar, Erika Andrea Levei, et al. described how the microbiological features of six karst springs from a rural Romanian area in the Apuseni Mountains were examined. These exposed karst waters are used by the local communities without any sort of treatment or quality assessment.

High levels of fecal contamination were found by the microbiological analysis, which could seriously endanger the consumers' health. The European Directive 98/93/EC and the WHO's maximum limits were surpassed by five of the six karst springs that were tested. Water contaminated with pathogenic E. coli has a high probability of illness and a high daily infection risk, according to the quantitative microbial risk assessment. The area requires long-term water quality monitoring in addition to raising resident awareness of public health issues. In general, the data obtained provides additional understanding regarding the microbial contamination of Romania's karst groundwaters, increases public awareness , and establishes new research priorities—all of which are intended to spark interest in the priceless resource known as groundwater.

2.11. R. Udhayakumar, P. Manivannan, K. Raghu, and S. Vaideki conducted research to evaluate the main objectives of the current project, which are to evaluate the groundwater quality and its effects in Tamil Nadu's Villupuram District. Through the collection of water samples from various locations for physio-chemical analysis of the ground water, the current study aims to raise public awareness of the quality of ground water. The analysis's findings were compared to the drinking water quality standards set by the WHO, ICMR, and USP Hand in Europe. The parameters that were compared included pH, electrical conductivity, Cl, Na, K, Ca, Mg, total dissolved solids, total hardness, dissolved oxygen, fluoride.

2.12. In their study, Deepak Gupta, Reetika Shukla, Mahesh Prashad Barya, Guru Datta Singh, and Virendra Kumar Mishra described how the Narmada River—the third-longest river in India—was assessed for water quality. Six major sampling stations totaling seventeen sampling points were used to gather water samples. The water quality index (WQI) was calculated by analyzing nine water quality parameters, and multiple variabilities statistical evaluation came next. The findings showed that the upper Narmada's water quality ranged from excellent to very poor, with excellent water found in about 12% of pre-monsoon samples, good water in 17%, poor water in 59%, and very poor water in 12% of post-monsoon samples, and excellent water in 17%, good water in 12%, and poor water in 71% of post-monsoon samples. Although the Narmada's overall water quality was low, human inputs like household sewage and agricultural runoff had an impact on certain metrics like BOD, nitrate, and total coliform. To finish the evaluation of water quality, more research is needed.

2.13. According to Hareb Al-Jabri, Probir Das, Shoyeb Khan, Mahmoud Thaher, and Mohammed AbdulQuadir, treating various waste waters through physicochemical or biological (i.e., without the use of microalgae) methods can frequently be energy-intensive or inefficient. Microalgae are omnipresent microscopic creatures that flourish in bodies of water that are nutrient-rich. Nitrogen, phosphorus, and other trace elements that microalgae need for cell growth are typically found in wastewaters. Thus, for the purpose of effectively treating wastewater, microalgal bioremediation may be used alone or in conjunction with other biological treatment techniques. The mechanisms by which microalgae remove pollutants, the potential for microalgal bioremediation of various wastewater types, the potential use of waste water-grown microalgal biomass, current obstacles, and the direction of microalgal application in wastewater treatment were all summarized in this review paper.

2.14. According to the current study's V.G. Vyas., etal (2015) explanation, the drinking water's physicochemical and microbiological characteristics were determined in November 2014 from various locations in Gujarat, India's Junagadh region. Twenty-two water samples in total were taken from various locations within and surrounding the city of Junagadh. For various water samples, analyses were performed. The findings showed that W-12 had the highest levels of salinity, TDS, and E.C. In W-5, W-11, and W-6 samples, higher levels of pH, hardness, and DO were noted, respectively. The majority of the water samples contained Enterobacter, while the enteric pathogen E. coli was discovered in samples W-22**.** The study's conclusions address the water sufficiency of springs, drills, water tanks, and supply networks, as well as potential causes of issues with water quality. From the source to the internal water supply network and ultimately to the consumer, the water is susceptible to infection.

2.15. According to research by V. Pradhan, M. Mohsin, and B. H. Gaikwad [06], the water quality of Chilika Lake was assessed in January 2012. With the exception of the sample site S2, all parameters were found to be above the allowable limit. The outcomes are examined in relation to the discoveries made by other researchers.

3. Assessment of water Quality:

Due to increase in population, industrialization and urbanization, large quantities of sewage and industrial wastewater are discharged into lake and other water bodies has significantly contributed to the pollution of the water. Water quality assessment studies on several water bodies were conducted from time to time for the last two decades by several agencies and implemented pollution control measures.

3.1. Parameters to be Analyzed:

For the assessment of water pollution status of the water bodies, the following water quality parameters were analyzed (1)Ph ,(2)Conductivity, (3)Alkalinity, (4)Dissolved Oxygen, (5)BOD, (6)COD, (7)Phosphorus, (8)Nitrogen, (9)Water Quality Index, (10)TDS, (11)Hardness, (12)Microbiological Parameters,(13)TSS.

3.1.1 PH:

The pH scale can be used to determine the acidity or basicity of an aqueous solution. Higher hydrogen (H+) ion concentration solutions are referred to as acidic solutions and their pH values are measured to be lower than those of basic or alkaline solutions. Solutions with a pH of less than 7 are acidic, whereas those with a pH of more than 7 are basic at 25 °C (77 °F). At 25 °C, solutions with a pH of 7 are neutral, meaning they contain the same amount of H+ ions as OH- ions, or the same amount as pure water. Depending on the temperature, the pH neutral value is less than 7 as the temperature rises above 25 °C. Although the pH scale is generally expressed as zero to 14, very concentrated strong acids can have a pH value less than zero, and very concentrated strong bases can have a pH value more than 14.

3.1.2 Conductivity:

An aqueous solution's conductivity is a numerical representation of its ability to conduct electricity. It is dependent upon the liquid's temperature as well as the presence, total concentration, mobility, valence, and relative concentrations of ions. The majority of inorganic salt, base, and acid solutions are comparatively excellent conductors.

3.1.3 Alkalinity:

Alkalinity is the strength of a buffer solution composed of weak acids and their conjugate bases. It's important to distinguish it from basicity, which is a pH scale absolute. It is determined by titrating the solution with an acid, like HCl, until the pH changes sharply or reaches a predetermined endpoint. Units of concentration used to express alkalinity include mill equivalents per Liter (meq/L), micro-equivalents per kilogram (μeq/kg), and milligrams per Liter of calcium carbonate (mg/L Ca-CO3). The amounts of acid added as a titrant correspond to each of these measurements.

3.1.4 Dissolved Oxygen:

The dissolved gaseous form of oxygen is called D.O. It is necessary for aquatic organisms to breathe. D.O. is released into water by plants and algae during photosynthesis, and it also enters through diffusion from the atmosphere. To maintain 100% D.O. saturation, the concentration of D.O. in Epilimnetic water continuously equilibrates with the concentration of atmospheric oxygen. When the rate of photosynthesis exceeds the rate of oxygen diffusion to the atmosphere, excessive algal growth can cause the water to become over-saturated (above 100%).

3.1.5 BOD:

The amount of dissolved oxygen (DO) that aerobic bacteria growing on the organic material in a water sample consume at a given temperature over a given amount of time is represented by the analytical parameter known as biochemical oxygen demand, or BOD. The BOD value, which is frequently used as a proxy for the level of organic water pollution, is most commonly expressed in milligrams of oxygen consumed per liter of sample over the course of five days at 20 °C incubation.

3.1.6 COD:

The chemical oxygen demand, or COD, indicates how much oxygen can be used by reactions in a measured solution. The mass of oxygen consumed over the volume of solution is commonly expressed as milligrams per Liter (mg/L) in SI units. It is simple to measure the number of organics in water with a COD test. Quantifying the amount of oxidizable pollutants present in wastewater or surface water (such as lakes and rivers) is the most popular use of COD. Similar to biochemical oxygen demand (BOD), COD is a useful metric for water quality assessment as it indicates the impact an effluent will have on the receiving body.

3.1.7 Phosphorus:

An important nutrient for plants, phosphorus primarily regulates the growth of aquatic plants in freshwater, including algae and macrophytes. Fertilizers, animal and human waste, and yard waste all contain it. Algae and rooted aquatic plants' ultimate growth and productivity may be restricted by the relative lack of phosphorus. Because phosphorus reduction can lower algae production, management efforts frequently center on lowering phosphorus input to a receiving waterway.

3.1.8 Nitrogen:

The air, yard waste, human and animal waste, and fertilizers all contain nitrogen, which is a crucial nutrient for plants. Nitrogen gas makes about 80% of the atmosphere. Diffuse nitrogen gas into water allows blue-green algae to "fix" it into ammonia for use by the algae. Ammonia and inorganic nitrogen can also find their way into lakes and streams.

3.1.9 Water Quality Index:

By normalizing values to subjective rating curves, the Water Quality Index (WQI) is a dimensionless number that combines multiple water-quality factors into a single number. The WQI model's component selection may change based on the approved water uses and regional preferences. Temperature, nutrients (nitrogen and phosphorus), pH, BOD, COD, total coliform bacteria, and others are some of these variables.

3.1.10 TDS:

Total dissolved solids (TDS) are a measurement of the total amount of dissolved organic and inorganic materials in a liquid that are suspended in molecular, ionized, or micro-granular (colloidal sol) form. Parts per million (ppm) are commonly used to measure TDS. A digital meter can be used to measure TDS in water.

3.1.11 Hardness:

Water with a high mineral content is called hard- water.Water that percolates through deposits of chalk, gypsum, or limestone contains carbonates, bicarbonates, and sulfates primarily composed of calcium and magnesium. This is known as hard water.

3.1.12 Microbiological Parameters:

Coliform bacteria can be differentiated using the IMVIC test, the most probable number (MPN) of Coliform bacteria, and the total aerobic microbial count (TAMC).

3.1.13 TSS:

Total suspended solids (TSS) are the dry weight of suspended particles in a water sample that can be trapped by a filter and is measured using a filtration device called a sintered glass crucible. These particles are not dissolved. TSS is a water quality metric that can be used to evaluate the state of any kind of water or body of water, including ocean water or wastewater that has been treated in a wastewater treatment plant.

4. Conclusion remark:

1. To improve the water quality includes total ban on the activities that causes pollution.
2. Result of water quality assessment showed that most of the water quality parameters were higher in the wet season than in the dry season.
3. Water quality relies on the type of the pollutant added and the nature of self-purification of water.
4. Wherever necessary, the epidemiological surveys carried out by health care services authority will contribute to measure undertaken in the foreseeable future.

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Conflicts of Interest

The authors declare no conflict of interest.

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