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Assessment of Water Quality and its Significance an Over View

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Abstract

The freshwater on the surface of the world Just 2.5% is usable. In this sense, lakes are one of the most significant water resources. They have traditionally been utilized as a source of drinking water and make up around 0.3% of all surface water bodies. As a result, rising anthropogenic activity near lakes have caused their state to continuously worsen. In general, numerous physico-chemical and biological characteristics chosen from the Designated Best List are used to assess the quality of lake water (or water from other surface sources). Usage of the lake's water body for a variety of applications. As a result, the Water Quality Index (WQI) is a crucial instrument for identifying the lake water quality. Natural lakes are often small, enclosed pools of water without a sufficient flow to self-cleanse the water, which causes a buildup of different contaminants. In these situations, many indices, such the Heavy Metal Index (for heavy metals), eutrophication potential (due to nutrients), and other related indices system, are used to assess the quality of these contaminants. Determining existing properties aids in decision-making. of potential trends for these pollutants and, consequently, the lake water quality in the future. For the purpose of predicting future changes in lake water quality, a variety of modelling techniques are used, including watershed models, ground water models, and lake models. In order to provide an understanding of the various tools and techniques used for comprehensive water quality monitoring and management, the current study provides an overview and critically evaluates the literature on all aspects of water quality.

Keywords: *Eutrophication, Heavy metals, Modelling techniques, Water Quality Index (WQI).*

Introduction:

Water is essential to human existence because it is nutrient- and mineral-rich (Versari *et al.,* 2002). Due to deteriorating environmental concerns, tight restrictions and control have rapidly expanded in monitoring of surface water bodies during the last few years. The quality of the lake's water is influenced by both the earth's

geological structure and the anthropogenic activities that take place nearby, such as farming, dumping garbage, and construction (Lahiry,1996.,Tamiru 2004.,Mahananda *et al.*,2010) as these activities limit the amount of water that can be used (Tank *et al.,* 2013). A significant quantity of soluble and insoluble materials is incorporated into the water as it percolates through the soil, changing its characteristics and making it less drinkable and occasionally unpleasant (Sawyer,1967., Frape *et al.,* 1984) Physico-chemical property fluctuations essentially change on both time and geographical scales (Hartman *et al.,* 2005). The primary sources of fresh water are surface water features including lakes, rivers, and springs (Campbell *et al.,* 1996). People are dependent on groundwater for their regular water supply due to a lack of surface water supplies. Lakes, which may be either man-made or natural and have been exploited as a source of water supply for human use, are among the most significant water resources in this context (Bhateria,2016).These lakes may become eutrophicated due to an imbalance between water intake and outflow (Yogendra *et al.,* 2007)From the disposal of human waste and agricultural wastes that are rich in fertilizers including nitrogen, phosphorous, and potassium, the nutrients reach the lake water. Phosphorus is the main element restricting the growth of algae and eutrophication in the lake water (Kira,2000). The current emphasis is on increasing the quality of existing water sources, particularly lakes, by using characterization for enhancing and restorating the water quality because water shortage is already a significant environmental concern. (Carlson, 1977). The determined physico-chemical parametric values(Diersing,2009) are used to define the water quality. The parametric values show the water body's current condition and the Long-term analyses of these metrics clearly show the hydrological changes occurring in the water bodies (Thitame *et al.*,2010). The Bureau of Indian Standards (BIS permitted)'s limits for drinking water quality are (Bureau ISPDWQ,2010). The requirements of one or more species, such as flora, wildlife, or humans, may be used to evaluate the water quality (Johnson *et al.*,1997).

Material and Methods:

Study Site: Bhadrakali Lake is a lake in Warangal, Telangana built by Ganapati of Kakatiya dynasty. The lake is situated near the famous Bhadrakali Temple. This massive lake is spread over an area of 10000 acres. The surreal atmosphere and scenic backdrop entice tourists to come over to the lake and get indulged in various activities like boating, this lake formed the drinking water resource for this area for a long time and is connected to the maneru dam via the kakatiya canal.

Fig No-1 Indicating Bhadrakali Lake

Water quality Parameters, their importance, and how they affect quality of water:

The quality of the water in the bodies of water depends mostly on the elements' interactions with one another at the physical, chemical, and biological levels, asserts that because lakes offer a distinct ecosystem that is unlike that of land or the atmosphere, they are an ideal laboratory to research the interplay between various water quality indicators. Before choosing the precise use of water, a significant number of physical, chemical, and biological factors must be assessed (Bhateria *et al.*,2016). The relationship between the numerous physicochemical and biological characteristics and the overall quality of the water depends on the deviation from the permitted range. The total quality of the results is impacted by the change in one parameter's value since it has a considerable impact on the other parameters. water body, which in turn causes a general alteration in a water body's features.

Results and Discussion:

Water quality indices for assessment of lake water:

Due to the large number of sites present within the lake system, samples from various locations are monitored, creating a large databank that is challenging to analyse. Both the general public and regulatory agencies can

grasp the outcomes of the study using straightforward techniques for interpretation (Palmer,1980). One method that might be used to analyse this complicated data is the Water Quality Index (WQI) where each parameter is determined and assigned a certain weightage and
the WQI is calculated depending on the chosen method.

Table No-1 Parameters for drinking water quality according to BIS.

Chemical Parameters	Standards BSI
pH	6.5–8.5
Total dissolved solids (mg/L)	500
Chloride (mg/L)	250
Fluoride (mg/L)	1
Nitrate (mg/L)	45
Sulphate (mg/L	200
Bicarbonate (mg/L)	200
Calcium (mg/L	75
Magnesium (mg/L)	30
Total Hardness (as CaCo3) (mg/L)	200

Based on the many physico-chemical factors and the goal of the study, there are numerous Water Quality Indices accessible internationally, and the best match index is selected (Meon,2016). There isn't a well-known WQI approach that consistently produces the best results, but a variety of water quality indices are available that may be assessed to determine the general water quality of lake water and which may be useful for a variety of uses (Rana *et al.*,2018).

Eclipsing and ambiguity are the two fundamental issues with water quality indexing, and they raise questions about the restrictions, opacity, and potential for misinterpretations in these indexes. are often built using aggregation techniques (Ott,1978). The phrase "ambiguity" clearly indicates that the indexing process cannot be accomplished in a specific number of stages and may require more phases with various interpretations. By

using a typical water quality indicator, geographical dispersion in the water body may not be taken into account and measurement ambiguities may also exist (Nasari *et al.*,2016).

Assessment of Trophic status of Lake:

Natural lakes are immobile bodies of water that don't directly adjoin any other bodies of water, like the ocean. the bodily, Within the lake ecosystem, chemical and biological characteristics are constrained. Lack of significant inflow and outflow causes lakes' nutritional status to rise. The lakes are also categorized. According to their nutrient status as either oligotrophic with low productivity, mesotrophic with intermediate productivity, eutrophic with high productivity due to an increase in nitrogen and phosphorus concentrations leading to the growth of aquatic plants making the water clear or an increase in algae making the water black in colour, or hyper-eutrophic with high levels of chlorophyll and phosphorous leading to excessive algal blooms and the formation of dune systems (Jain,2016).

To assess the trophic status of the lake, a numerical method was used to create a trophic state index. The index is a resource for trophic state research. The trophic state of several tropical and subtropical lakes from around the world is summarized in Table 2 below, along with the numerous metrics that may be used to assess the trophic status of these lakes.

Table No-2 shows the correlations between and impacts on several water quality measures.

Parameter	Permissible range	Effect	Reasoning
Temperature	18C to 22C	The temperature effects dissolved Oxygen	When the temperature rises, the amount of dissolved oxygen and other gases decreases due to a decrease in molecular forces of attraction between gas molecules. The Reduced temperature, on the other hand, increases the quantity of D.O. in water, which influences biodiversity as well as other chemical reactions. (Gopalkrishna 2011)

pH	6.5-8.5	pH decreases with increase in temperature which leads to a negative effect on flora and fauna in water. The dissolution of salts and chemicals in water is possible at a particular pH	The change in the equilibrium of the process involved in the dissociation of H2O to H2 and O2 causes an increase in H2 ions in water, which causes acidity. The breakdown of salts and metals into ions at low pH causes contamination of people and animals, resulting in negative health consequences. The rate of various biological activity is likewise affected by pH. The addition of carbonates and bicarbonates raises CO2, influencing lake productivity. (Verma *et al.*,2012)
Dissolved Oxygen (D.O.)	D.O.>6mg/L	The availability of nutrients is influenced by dissolved oxygen. The concentration of dissolved oxygen changes with depth.	DO is a direct indicator of the level of pollution in a body of water. DO levels drop as a result of bodily changes. Water qualities including colour, flavour, and odour diminish the usefulness of lake water. When oxygen levels are low, the nutrients can be released from the sediments. As photosynthetic activity is restricted to the upper layers of surface water bodies where the availability of sunlight is optimal, the photosynthetic activities at the surface of lakes and other water bodies evolve significantly more oxygen than the surface layers. (Krishnamurthy 1990).

Biological Oxygen Demand (BOD)	B.O. D<4mg/L	Amount biodegradable waste in water is indicated by BOD levels.	The rise in BOD demonstrates the severe organic contamination in the water. Increased waste water intake might cause a drop in DO and fish slaughter. The microorganisms use the oxygen in the water to break down surface water bodily waste and release energy for their development and reproduction, which raises BOD levels and lowers water oxygen levels. This water can be treated with chlorine, but it must first be neutralized at the supply end (APHA 2005).
Phosphorous (P), Nitrate (NO3) and Ammonia (NH4), Sulphate (So4)	100mg/L-400mg/L	The dissolved inorganic nutrients in the water cause a rise in lake production.	The discharge of sewage water, as well as runoff from agricultural areas coated with fertilizers and pesticides, can result in the intake of inorganic nutrients into the soil, which promotes plant growth. Lake productivity, and hence algal bloom development, is analogous to agricultural production (Guildford *et al.*, 2000).
Total Dissolved Solids (TDS) and Total Suspended solids (TSS)	2000mg/L	The amount of TDS and TSS shows the level of pollutants in water bodies.	Whether it is dissolved mineral salts or runoff from fields transporting sediments, foreign particles in the water body are present. The increasing presence of foreign particles such as silt, clay, and sand Phytoplankton and organic debris, particularly dissolved ions of mineral salts, enhance turbidity and hence water conductivity (Lathrop 2009)

Detection and indexing of heavy metals:

Heavy metals are often quantified by determining their concentration in water. As a result, water quality is altered by the high concentration of heavy metals in water. The many human activities such as industrialization, urbanization, and increased agricultural operations that input huge loads of sewage, waste industrial water, and hazardous chemicals into lakes, resulting in heavy metal deposition in the ecosystem. This long-term intake causes harmful metals to bioaccumulate in the environment and food chains, causing damage to species and plants. The concentration of various heavy metals such as Pb, Zn, Cd, Mn, Fe, Ni, Cr, Cu, Co, As, and Hg were taken from the studies referred in above section, (Table No-3) pre-monsoon, monsoon seasons .The maximum numbers of heavy metals are without exceeding the permissible limits, almost all the parameters were beyond in permissible limits.

Table No-3 Indicating Heavy metal values determined.

Metals (mg/L)	Bhadrakali Lake	
	Pre-Mon	Mon
Pb	**9.3**	**57.1**
Zn	**69.3**	**105.2**
Cd	**3.5**	**2.1**
Mn	**89.9**	**173.6**
Fe	**4200.6**	**4124**
Ni	**30.0**	**43.8**
Cr	**43.5**	**64.8**
Cu	**32.8**	**46.2**
Co	**N.D**	**N.D**
As	**N.D**	**N.D**
Hg	**N.D**	**N. D**

The continued use of water with high levels of heavy metals in agriculture not only causes lasting harm to the area's flora and soil, but also influences the activity and size of soil microorganisms. Heavy metals such as Co, Cu, Fe, Mn, Mo, Ni, and Zn are highly beneficial for plant development and sustenance, but their excessive amounts cause toxicity inside the plants; other heavy metals such as As, Cd, Hg, Pb, or Se do not even contribute to plant growth and sustenance (Garrido,2002). Heavy metals are resistant to bacterial breakdown,

resulting in bioaccumulation in aquatic food chains, which causes ecological disruption and destruction of ecological balance, limiting variety (Rascio,2011).

Water pollution from microplastics

With the development in globalization, the usage and manufacture of plastic has substantially expanded to 300 million tonnes globally in the previous 50 years, generating a lot of garbage that, like other types of waste, does not disintegrate or rot, resulting in a global buildup of plastic waste. This plastic often washes away in lakes or seas via streams, rivers, or small rivulets and becomes a part of the water bodies, where it is broken down into smaller particles by the action of wind, sunshine, or wave disturbances, resulting in microplastics or secondary plastics (Ramasa,2016). Microplastics have an impact on more than just the soil. As low-density polyethylene has been identified as a common kind of microplastic endangering the lake's fish population. The greatest food source is fish, and while the impacts have not yet been reported, bioaccumulation of microplastics might pose a hazard. It is crucial to practice proper waste management in order to prevent the entry of harmful components into the water, soil, sediments, etc. that could endanger the health of people and animals. The impact of microplastics on lakes has only been studied in a small amount around the world, particularly in India.

Conclusion:

While establishing and maintaining water quality, physical, chemical, and biological factors are taken into account. The many parameters, including the temperature, pH, BOD, COD, and TDS. The levels of phosphorous, DO, bacteria, phytoplankton, SO4, calcium, magnesium, NO3, and nitrate-nitrogen are measured and compared to the standard limits set by organizations like the, WHO, and BIS, among others. The variation of these elements is then compared to the current norms to assess the usage for various activities like drinking, bathing, fishing, and agriculture, among others, in accordance with the prescriptions made by the central board. Water quality Index is a measure that displays the overall quality of water since the parameters provide enormous data sets. Water quality Index is a measure that displays the overall quality of water since the parameters provide enormous data sets. There are several accessible water quality indexes utilized all around the world for a variety of applications, including determining the quality of surface water, ground water, heavy metals, overall pollution, trophic status, and irrigation. The index value outputs a single value that may be contrasted with the range values designated for categorizing water quality as High, Medium, or Low, respectively. In addition to assessing the physical, chemical, and biological components of water

quality, toxicological components such heavy metals must also be evaluated. and the high nutrients from the use of pesticides and chemical fertilizers, which, even in small levels, exceeding the legal limits, can cause serious injury to aquatic creatures, plants, and humans. These heavy metals may build up and then bioaccumulate in the environment, entering the food chain and seriously harming the health of people, animals, and plants. During the monsoon, the nutrients created by the usage of fertilizers and pesticides wash into the water bodies and improve their productivity, leading to a variety of visible and invisible problems. Consequently, it can be inferred that a comprehensive water quality criterion should not only comprise determining the fundamental water quality parameter but also contain a thorough examination of the water. To assess all the potential applications of the water body, a quality that includes physical, chemical, biological, and toxicological component analysis is used.

Compliance with ethical standards:

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Disclosure of conflict of interest

The authors (Dr Raju Potharaju, Prof M. Aruna) declare no conflict of interest.

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