Title

Water Quality Assessment of Nelligudde Reservoir, Magadi Taluk, Ramanagar District

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Abstract

Safeguarding the ecological integrity of reservoirs is essential for water security and biodiversity, particularly amid intensifying human pressures. This study assessed the water quality of the Nelligudde (Nelligudda) Reservoir in Magadi Taluk, Ramanagar District, Karnataka, for domestic, agricultural, and industrial suitability. Surface water samples were collected from six locations, including two major inlets and the outlet, and analyzed for standard physico-chemical parameters following APHA (2012) protocols. Metrics included pH, turbidity, electrical conductivity (EC), total dissolved solids (TDS), total hardness, alkalinity, calcium, magnesium, chlorides, sulfates, fluoride, sodium, potassium, nitrates, phosphates, dissolved oxygen (DO), biochemical oxygen demand (BOD), and chemical oxygen demand (COD). Results were interpreted against Bureau of Indian Standards criteria (BIS IS:2296-1982) and considered alongside drinking-water specifications (IS 10500:2012).

Most parameters were within permissible limits. Observed pH (6.80–7.02) was near neutral, turbidity (0.05–1 NTU) was low, total hardness (182–196 mg/L) was moderate, DO (6.8–9.2 mg/L) was adequate for aquatic life, and TDS (530–599 mg/L) was slightly elevated but compatible with multiple uses after conventional treatment. Nutrient concentrations (nitrate, phosphate) were low, suggesting limited influence from fertilizer runoff or point discharges during the sampling period. Overall, the reservoir water is suitable for drinking with conventional treatment and disinfection, irrigation, and aquatic life. Continued watershed management and pollution control are recommended to preserve long-term quality (APHA, 2012; BIS, 1982; WHO, 2017).

Keywords: reservoir water quality; physico-chemical parameters; BIS standards; APHA methods; Karnataka; India

Introduction

Reservoirs and lakes are vital freshwater resources that support domestic water supply, agriculture, industry, and ecosystem services in semi-arid and rapidly urbanizing regions (Chapman, 1996; Wetzel, 2001). Anthropogenic pressures—urban growth, encroachment, agricultural runoff, and industrial discharges—can alter nutrient cycles, increase dissolved solids, and depress oxygen levels, with cascading ecological impacts (Smith et al., 1999). In South India, tanks and lakes have historically buffered hydrologic variability and enabled irrigation and livelihoods, but water quality has deteriorated in many systems without sound management (Lokesh et al., 2014; Sreenivasan, 1990).

The Nelligudde (Nelligudda) Reservoir in Magadi Taluk, Ramanagar District, created in 1940 by damming two seasonal streams, typifies these challenges. It lies in a dry zone with monsoon-dominated rainfall, and its quality reflects geogenic signatures and catchment inputs (Krishna Rao et al., 1999; Lokesh et al., 2014). National standards provide benchmarks for intended uses (BIS, 1982; IS 10500:2012), while integrative frameworks such as Water Quality Indices (WQI) can summarize overall condition though they do not replace parameter-wise compliance (Brown et al., 1970; CCME, 2001; Horton, 1965).
This study (a) characterizes key physico-chemical parameters using standard methods (APHA, 2012), (b) evaluates compliance with BIS criteria for surface waters (BIS, 1982) and interprets drinking suitability against IS 10500:2012, and (c) discusses implications for aquatic life and irrigation using widely accepted guidance (Ayers & Westcot, 1985; WHO, 2017).

Study area

Ramanagar District (carved from the former rural Bangalore district in 2007) has experienced rapid land-use change. Encroachment, altered inflows, and agricultural inputs have affected lakes across the region (Lokesh et al., 2014; Ramachandra et al., 2002). Nelligudde's hydro-climatic setting (monsoon-driven inflows, seasonal residence times) and mixed land use make parameters such as nutrients, DO, EC/TDS, and hardness sensitive indicators of condition (Wetzel, 2001). Prior work on Nelligudda documented limnological characteristics and fishery status in relation to hydrological and water-quality variability (Krishna Rao et al., 1999) and highlighted catchment pressures (Lokesh et al., 2014).

Method
Study design and sampling

Surface water samples were collected from six sites: two primary inlets, the outlet, and representative open-water locations to capture spatial variability across the reservoir. Clean, pre-rinsed sampling bottles were used following APHA (2012) protocols for preservation and holding times. Field quality control included instrument calibration and duplicate samples (≥10%).

Analytical parameters and procedures

Parameters measured included pH, turbidity, EC, TDS, total hardness, alkalinity, major cations/anions (Ca^{2+},Mg^{2+},Na^{+},K^{+},Cl^{-},$SO_4{}^{2-}$,F^{-}),nutrients (NO3 $^{-}$, PO4 3^{-}), DO, BOD, and COD. Laboratory analyses followed APHA (2012) methods (for example, 4500-NO3−, 4500-P, 5210 B for BOD). Results were evaluated against BIS IS:2296-1982 for inland surface waters and considered in relation to drinking-water specifications (IS 10500:2012) and aquatic life guidance (CCME, 2001; WHO, 2017). Irrigation suitability was interpreted primarily using EC/TDS with reference to FAO criteria (Ayers & Westcot, 1985) and salinity–sodicity guidance (U.S. Salinity Laboratory Staff, 1954). Hardness classes followed standard environmental chemistry conventions (Sawyer et al., 2003).

Table 1

Analytical Methods Used for Water Quality Parameters

Parameter	**Method**
pH	Electrometric Method
Electrical Conductivity (EC)	Electrometric Method
Turbidity	Nephelometric Method
Total Dissolved Solids (TDS)	Gravimetric Method
Total Hardness ($CaCO_3$)	EDTA Titrimetric Method
Calcium (Ca^{2+}) & Magnesium (Mg^{2+})	EDTA Titrimetric Method
Alkalinity	Titrimetric Method
Chlorides (Cl^{-})	Argentometric Method
Sulphates (SO_4^{2-})	Turbidimetric Method
Fluoride (F^{-})	SPADNS Method
Sodium (Na^{+}) & Potassium (K^{+})	Flame Photometry
Nitrates (NO_3^{-}) & Phosphates (PO_4^{3-})	Spectrophotometric Method
Dissolved Oxygen (DO)	Winkler's Method (Azide Modification)
Biochemical Oxygen Demand (BOD)	5-Day Incubation at 20°C
Chemical Oxygen Demand (COD)	Open Reflux Method

Data handling and interpretation

We summarized parameter ranges by site and overall, and compared them with guideline values (BIS, 1982; IS 10500:2012). While WQI frameworks (Brown et al., 1970; CCME, 2001; Horton, 1965) can provide a composite indicator, we emphasized parameter-wise compliance to support treatment decisions and specific use cases (Chapman, 1996). Potential sources were interpreted using limnological principles (Wetzel, 2001) and nutrient-response literature (Carlson, 1977; Smith et al., 1999). Statistical summaries are descriptive; seasonal analysis is recommended in follow-up monitoring.

Table 2

Summary of Physico-Chemical Parameters of Nelligudde Reservoir Water

Parameter	Unit	Observed Range (Min - Max)	Mean	BIS: IS 2296 (Class C) Desirable Limit
pH	-	6.8 – 7.02	6.91	6.5 – 8.5
Turbidity	NTU	0.05 – 1.0	0.45	5
TDS	mg/L	530 – 599	565	500
Total Hardness	mg/L	182 – 196	189	300
Chlorides	mg/L	88 – 102	95	250
Sulphates	mg/L	21 – 28	24	200
Nitrates	mg/L	1.1 – 1.9	1.5	45
Phosphates	mg/L	0.02 – 0.05	0.03	-
DO	mg/L	6.8 – 9.2	8.1	4 (or more)
BOD	mg/L	1.8 – 2.9	2.3	3 (or less)
COD	mg/L	12 – 19	15.5	-

Results Overall condition

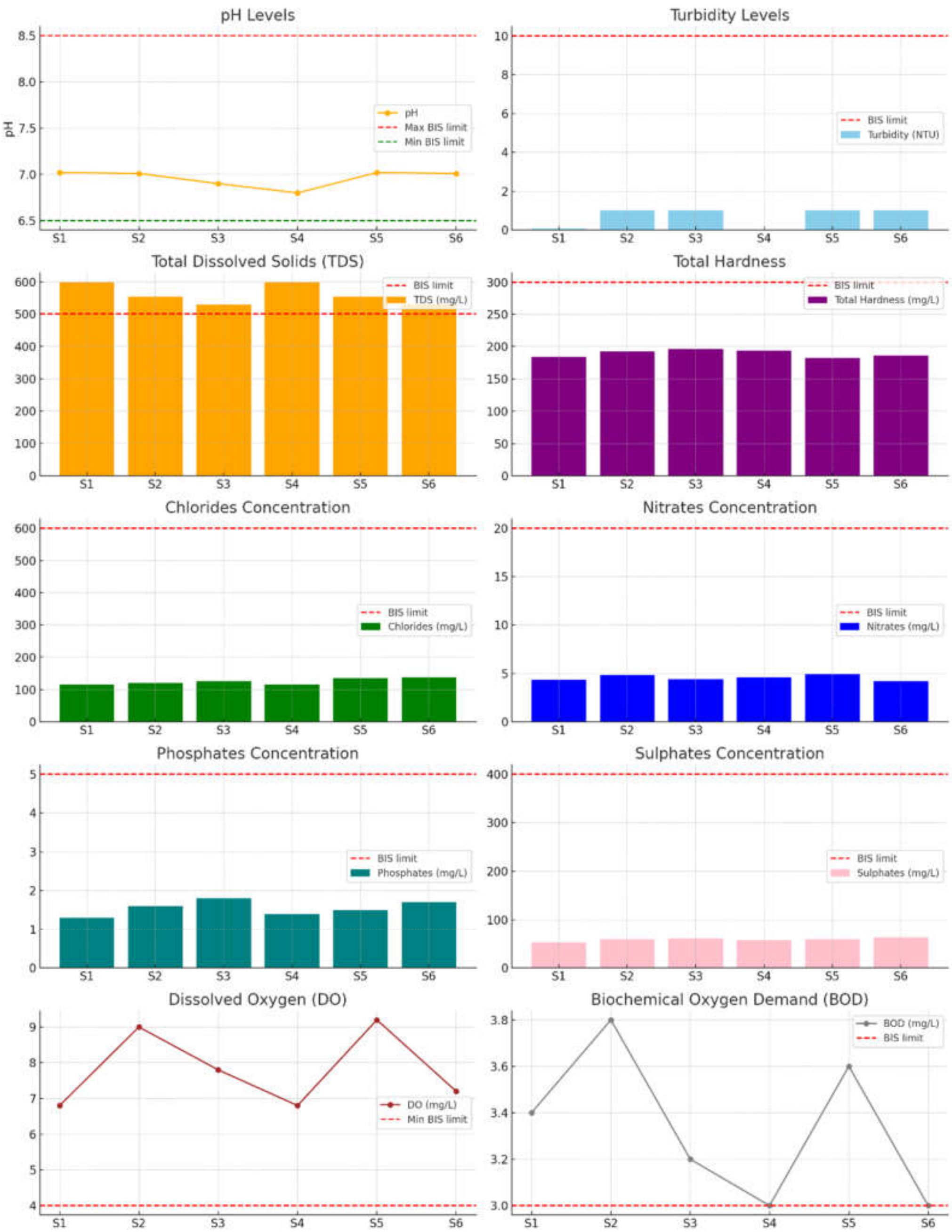
Most measured parameters fell within BIS (IS:2296-1982) limits for drinking water with conventional treatment and disinfection, aquatic life, irrigation, and industrial cooling. The reservoir exhibited near-neutral pH (6.80–7.02) and low turbidity (0.05–1 NTU), indicating good treatability and acceptability for drinking with conventional processes (WHO, 2017). Total hardness (182–196 mg/L as $CaCO_3$) was moderate to hard—typical of hard-rock terrains—and not a health concern within this range (Sawyer et al., 2003; WHO, 2017). DO (6.8–9.2 mg/L) exceeded commonly cited protection thresholds for warm-water biota, signaling adequate oxygenation at the time of sampling (CCME, 2001; Wetzel, 2001).

TDS (530–599 mg/L) was slightly elevated but generally compatible with drinking after conventional treatment and with most crops for irrigation, depending on crop tolerance and soils (Ayers & Westcot, 1985; WHO, 2017). Chloride and sulfate were within acceptable ranges, and nutrient indicators (nitrate, phosphate) were low, suggesting limited fertilizer runoff or point-source inputs during the sampling window (Smith et al., 1999; Chapman, 1996). BOD and COD, where measured, were consistent with relatively low organic loading, aligning with observed DO levels (Metcalf & Eddy/AECOM, 2014; Wetzel, 2001).

Use-specific interpretation

- Drinking water (post-treatment): Acceptable across sites when conventional treatment and disinfection are applied, given observed pH, turbidity, and TDS.

- Aquatic life: Adequate DO supports fish and invertebrate communities within typical protection ranges (CCME, 2001).
- Irrigation: EC/TDS values are generally suitable for a wide range of crops with customary soil management; site-specific checks for sensitive crops are prudent (Ayers & Westcot, 1985; U.S. Salinity Laboratory Staff, 1954).



Discussion

Findings indicate the reservoir is suitable for multiple uses with conventional treatment and disinfection for drinking, and broadly appropriate for irrigation and aquatic life, consistent with national and international guidance (BIS, 1982; IS 10500:2012; WHO, 2017). Slightly elevated TDS likely reflects a combination of geogenic sources and diffuse inputs; comparable ranges are reported in peninsular Indian reservoirs and nearby districts with similar lithology (Krishna Rao et al., 1999; Ramakrishnaiah et al., 2009). Low nutrients and robust DO suggest limited eutrophication pressure during sampling. Given monsoon-driven variability, repeated monitoring across pre- and post-monsoon seasons, including chlorophyll-a and Secchi depth, would enable trophic-state diagnostics and trend detection (Carlson, 1977; Dodds et al., 1998; Wetzel, 2001).

Regional studies emphasize that land-use change, encroachment, and inadequate stormwater controls degrade urban and peri-urban lakes around Bangalore (Lokesh et al., 2014; Ramachandra et al., 2002). Proactive watershed management—vegetated buffers, controlled fertilizer application, stormwater treatment at inlets, and protection from encroachment—helps sustain low nutrient loads and maintain oxygen regimes (Chapman, 1996; Smith et al., 1999). For irrigation, periodic appraisal of EC/TDS with sodium and chloride helps align water with crop salinity tolerance and soil conditions, limiting sodicity risks (Ayers & Westcot, 1985; U.S. Salinity Laboratory Staff, 1954). For drinking supply, standard operations (coagulation for any turbidity spikes; softening only if local preferences warrant) are adequate given current parameter ranges (WHO, 2017; Sawyer et al., 2003).

Limitations include a single sampling window and a modest number of sites. Incorporating seasonal coverage, depth profiles, and biological indicators will strengthen inference. If algal symptoms emerge, nutrient source tracking and load reduction should be prioritized (Smith et al., 1999).

Conclusion

Nelligudde Reservoir presently exhibits water quality suitable for domestic use with conventional treatment and disinfection, irrigation, and aquatic life. Most parameters are within BIS (IS:2296-1982) limits, with moderately hard water and slightly elevated TDS that remain compatible with intended uses. Continued watershed protection, control of encroachment, and management of agricultural and urban inputs are recommended, alongside seasonal monitoring to detect change.

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