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Article

# Water Quality Assessment of Urban Lake Pedda Cheruvu, Mahabubnagar, Telangana State, India

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**ABSTRACT**

Pollution poses a serious threat to water bodies everywhere in the world. The wetlands are transitional areas on the Earth that is crucial to the dynamics of nutrients and control primary productivity. It has become quite difficult to guarantee the availability of fresh water from nearby water sources. The main objectives of this paper carried out to evaluate the seasonal variation of the physical-chemical parameters of water quality and the water quality index (WQI) of Pedda Cheruvu, Mahabubnagar. Water samples were collected 4 sites of Peddacheruvu and were analyzed for Temperature, pH, Dissolved oxygen, Free Carbon Dioxide, Total Alkalinity, Total Hardness, Calcium, Magnesium, Chloride, Nitrogen, Phosphate, and Biological Oxygen Demand according to standard protocols of APHA-1995 (American Public Health Association). Seasonal variation in water quality parameters was recorded and compared with standards with the WQI.

**Key words:** Pedda Cheruvu, Wetlands, Dynamic, Primary productivity, Water quality index.

## 1. INTRODUCTION

Water is the most abundant substance, covering more than 70% of the Earth's surface and existing in many places and forms: Mostly in the oceans and polar ice caps, but also as clouds, rainwater, rivers, freshwater aquifers, and sea ice [1]. On Earth's surface, the small portion is covering by the lakes and rivers. Surface water is an integral part of the natural environment and its quality is a very sensitive and critical issue in many countries [2]. Furthermore, with an increased understanding of the importance of drinking water quality to public health and raw water quality to aquatic life, there is a great need to assess surface water quality. It is affected through colorful factors substantially by anthropogenic conditioning [3].

Brackish ecosystems are deteriorated because of experimental conditioning and the loftiest declination is caused by humans and their affiliated conditioning in their immediate catchment areas and drainage basins [4]. The world scientific community is presently amicable about similar non-request/impalpable benefits handed by lake gutter washes. Sweats were made by all to quantify and value the benefits handed by natural capital such as abysses, timbers, champaigns, washes, and lake gutters [5].

A lake is the most beautiful and expressive feature of a landscape. Several artificial water bodies were constructed, during the past 1000 years in western and peninsular India [6]. Lakes are divided into three categories based on the salinity of their water: freshwater, brackish, and saline lakes. They are additionally characterized as oligotrophic (low nutrients), mesotrophic (mid nutrients), and eutrophic (high nutrients) lakes based on their nutrient level [7].

Studies in nature, water quality affects the condition of ecosystems and alters the existence of living beings. The similar works on Patancheru block, Hussain sagar, Himayat sagar, Telangana, India. The main objective of this research is to find the effect of different land uses on water and protect it from contamination without hampering the environmental balance.

Because they get nutrients from their catchments, the great majority of lakes in India are either eutrophic or mesotrophic [8]. According to the literature, several explorations on the evaluation of the water quality in water bodies similar to Halai, Koloroi, Kalyani, Salim Ali, Dahi-Khura, and Ramgarh have been carried out in India [9].

The water quality index (WQI) converts complex data on water quality into information that the general public can use. It is a single number that indicates the total water quality at a specific point. It is one of the stylish styles for informing concerned citizens and decision-makers about the quality of the water [10]. The first WQI was proposed by Horton (1965), and several indicators followed, especially the National Sanitation Foundation (NSF) of the United States, which is conceded as a more practical WQI grounded on expert or panelists' perspectives [11].

Water quality evaluation aims to identify the sources of water pollution and develop a strategy for sustainable water source management, maintaining and promoting human health and other social and economic growth.

Other water quality indices besides the NSFWQI include the British Columbia WQI, Oregon WQI, and Canadian Council of Ministers of the Environment WQI [12].

The "Overall Index of Pollution" for Indian rivers was created by Sargaonkar and V. Deshpande (2003) [6] based on measurements of

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pH, turbidity, dissolved oxygen (DO), BOD, hardness, total dissolved solids, total coli forms, arsenic, and fluoride [13].

The WQI converts complex data on water quality into information that the general public can use. It is a single number that indicates the total water quality at a specific site. It is one of the best methods for informing concerned citizens and decision-makers about the quality of the water [14].

### *1.1. About Pedda Cheruvu*

Mahabubnagar Pedda Cheruvu, or "Great Lake," is a sizable natural lake that was created by nature over 98 acres of land and is located in the center of the Mahabubnagar District Office. The lake's natural depth ranges from 20 to 40 feet. Its coordinates are Latitude 16.7421° N and Longitude 78.0003° E. In Mahabubnagar, this is similarly placed in a good location next to the stadium. Around the lake is a bund road made of metal and soil that is approximately 1.5 km long. The bund road is used every day by thousands of locals who live close to the lake since it is the quickest way to get to the main road or bus stop [Figure 1].

## 2. MATERIALS AND METHODS

### *2.1. Collection of Samples*

Each month, samples of water were taken. Collections were made on particular dates of every month which is based on the seasonal wise as North East Monsoon (NEM) Season from October 2018 to January 2019, the Summer season from February 2019 to May 2019, and the Southwest monsoon (SWM) from June 2019 to September 2019 which is repeated similarly in the 2019–2020 year. For the investigation of several Physical-Chemical characteristics, surface samples were obtained using a clean plastic container.

The examination of samples for parameters relating to water quality was done using the accepted practices of analysis of APHA-1989.

### *2.2. Temperature*

Using centigrade mercury thermometers, the air and water temperatures at each site were measured to the nearest 0.1 C. Yet at a depth of roughly 5 cm below the water's surface, the water's temperature was measured.

### *2.3. pH*

A digital portable pH meter was used at seven different sites to capture the pH (ELICO Li-120 model).

### *2.4. DO*

Before beginning the estimate process, water samples were carefully placed in 250 mL reagent vials without causing any movement. The samples were taken to the laboratory for additional calculations after being fixed with alkali-iodide and manganese sulfate. The results were represented in mg/L and the total dissolved solids were measured using a computerized ultraviolet (UV)-visible spectrophotometer (computer-based Dathelie, Secomom, France).

### *2.5. Total Dissolved Solids*

The results were represented in mg/L and the total dissolved solids were measured using a computerized UV-visible spectrophotometer (computer-based Dathelie, Secomom, France).

### *2.6. Free Carbon Dioxide*

Using phenolphthalein indicator and sodium hydroxide (0.05 N), the titrimetric method was used to quantify the free carbon dioxide content, with results given in mg/L.

### *2.7. Total Alkalinity (TA)*

By employing the titrimetric method and hydrochloric acid to measure the TA, carbonate, and bicarbonate alkalinity were estimated. The numbers were shown in mg/L.

### *2.8. Total Hardness (TH)*

By titrating the water samples with standard EDTA (0.01 N), buffer solution, and Eriochrome Black-T indicator, the TH of the water is assessed. The results are provided in mg/L.

### *2.9. Calcium*

By titrating with ethylenediamine trichloroacetic acid (EDTA) and utilizing murexide as an indicator, calcium was measured. In mg/L, the values are expressed.

### *2.10. Magnesium*

Magnesium was identified using the Eriochrome Black-T indicator and EDTA. In mg/L, the values are expressed.

**Table 1a:** Data of 2018–2019 years.

| Months | Atmosphere temperature | Water temperature | pH | DO | $CO_2$ | TA | TH |
|---|---|---|---|---|---|---|---|
| October 2018 | 36.3 | 30.1 | 8.2 | 4.2 | 4.2 | 119.8 | 234.3 |
| November | 35.2 | 30.4 | 8.1 | 3.4 | 4.3 | 138.7 | 238.1 |
| December | 31.2 | 26.5 | 8.3 | 4.6 | 6.7 | 148.5 | 221.5 |
| January 2019 | 32.7 | 26.3 | 8.4 | 3.7 | 7.0 | 167.7 | 243.8 |
| February | 36.2 | 29.2 | 8.7 | 5.5 | 2.1 | 211.4 | 164.4 |
| March | 39.6 | 32.4 | 9.9 | 6.2 | 3.4 | 243.1 | 153.2 |
| April | 39.5 | 33.3 | 10.0 | 7.23 | 1.4 | 251.5 | 160.1 |
| May | 40.2 | 35.2 | 10.1 | 7.1 | 1.3 | 246.1 | 168.3 |
| June | 32.1 | 26.2 | 8.1 | 4.3 | 4.25 | 209.5 | 238.5 |
| July | 31.3 | 27.5 | 8.2 | 2.7 | 3.6 | 156.4 | 245.9 |
| August | 32.2 | 27.5 | 8.0 | 2.2 | 3.2 | 135.5 | 223.7 |
| September | 34.3 | 28.2 | 7.8 | 1.9 | 2.3 | 115.2 | 226.2 |

DO: Dissolved oxygen, TH: Total hardness TA: Total alkalinity

### *2.11. Chloride*

By titrating with silver nitrate and utilizing a potassium chromate indicator, the chloride concentration was ascertained. The numbers were shown in mg/L.

**Figure 1:** Photograph of Pedda Cheruvu Mahabubnagar.

**Table 1b:** Data of 2018–2019 years.

| Months | Ca+ | Mg+ | Chlorine | Nitrogen | Phosphate | BOD |
|---|---|---|---|---|---|---|
| October 2018 | 134 | 99.14 | 61.26 | 7.48 | 4.13 | 12.42 |
| November | 134.8 | 97.85 | 55.74 | 8.11 | 4.1 | 21.85 |
| December | 144.1 | 76.14 | 48.49 | 6.34 | 3.23 | 24.71 |
| January 2019 | 183.8 | 74.85 | 55.72 | 7.18 | 3.34 | 25.57 |
| February | 125.8 | 50.14 | 79.02 | 6.22 | 2.09 | 31.53 |
| March | 130.8 | 38.57 | 84.04 | 6.19 | 2.04 | 30.71 |
| April | 125 | 38.02 | 95.75 | 5.53 | 1.42 | 23.71 |
| May | 125.1 | 54.85 | 112.7 | 5.30 | 1.1 | 24.14 |
| June | 161.8 | 82.21 | 55.65 | 6.37 | 3.2 | 26.85 |
| July | 159.7 | 85.71 | 54.33 | 7.22 | 4.17 | 19.84 |
| August | 153.8 | 70.21 | 54.41 | 7.43 | 4.22 | 19.84 |
| September | 159.2 | 70.85 | 55.47 | 7.63 | 4.38 | 15.42 |

### *2.12. Nitrogen*

Nessler's reagent method was used to measure the ammoniacal nitrogen concentration, and readings were taken at +420 nm using an Elico model CL-24 spectrometer. Using a standard graph, the amount of ammonia nitrogen in the sample was determined, and the results were represented in mg/L.

### *2.13. Phosphate*

The phosphate content of the samples was determined using the stannous chloride method. Using a spectrometer, the resulting blue color intensities were measured at the 690 nm range (Elico model, CL-24). Readings were recorded in mg/L, and the values of phosphates present in the samples were estimated using the standard graph.

### *2.14. Biochemical Oxygen Demand*

The Computerized UV-visible spectrometer (computer-based Dathelie, Secomom, France) was used to calculate the biological oxygen demand, and the results were represented in mg/L.

## 3. RESULTS AND DISCUSSION

Every water sample was transparent, salty taste, and light smell. The interplay of different compounds in water and several biological phenomena results in pH, which is regarded as a significant ecological component [15] [Tables 1a,1b,2a &2b].

The pH ranges are as in NEM 2018 – pH 8.1–8.4, summer 2019 – 8.7–9.1, and in SWM 2019 as 7.8–8.2: And in the year 2019–20 also repeated the same procedure, the results are NEM season -2019, Ph range is 8.0–8.4; summer pH is 8.7–10.2; and SWM season-2020, pH 7.9–8.1. The pH ranges are recorded average from pH 7.8 to pH 10.2 determined that it is neutral to alkaline turn is showing of Peddacheruvu water. pH is essential for the development of flora and fauna and serves as a gauge for the safety of water [16].

DO is a significant and crucial aspect of evaluating water quality. The health of the water body depends on its presence since it is necessary to preserve the higher form of biological life and to maintain the right balance of different populations [17]. It greatly influences how an aquatic system behaves as a whole. The predetermined investigation found as determined average range from 1.9 to 7.6 mg/L. The water is negligibly polluted and it is suitable for irrigation and fishery culture

**Table 2a:** Data of 2019–2020 years.

| Months | Atmosphere Temperature | Water Temperature | pH | DO | $CO_2$ | TA | TH |
|---|---|---|---|---|---|---|---|
| October 2019 | 36.3 | 30.2 | 8.4 | 3.0 | 4.0 | 125.2 | 233.7 |
| November | 35.2 | 30.6 | 8.1 | 3.0 | 4.5 | 136.5 | 235.7 |
| December | 31.2 | 26.4 | 8.3 | 4.0 | 6.7 | 145.6 | 224.8 |
| January 2020 | 32.8 | 26.2 | 8.0 | 2.9 | 6.8 | 180.7 | 241.5 |
| February | 36.1 | 29.5 | 8.7 | 5.8 | 2.0 | 215.1 | 162.2 |
| March | 39.7 | 32.5 | 10.2 | 5.9 | 3.6 | 236.2 | 158.4 |
| April | 39.5 | 33.1 | 9.5 | 6.8 | 1.6 | 264.3 | 164 |
| May | 40.1 | 35.1 | 10.1 | 7.6 | 1.3 | 198.5 | 174.5 |
| June | 32.0 | 26.2 | 8.1 | 4.6 | 4.3 | 200.9 | 243.7 |
| July | 31.4 | 27.6 | 8.0 | 2.8 | 3.7 | 160.7 | 240.8 |
| August | 32.3 | 27.1 | 7.9 | 2.0 | 3.4 | 138.2 | 224.4 |
| September | 34.3 | 28.2 | 7.9 | 2.1 | 2.5 | 109.3 | 224.4 |

DO: Dissolved oxygen, TH: Total hardness TA: Total alkalinity

**Table 2b:** Data of 2019–2020 years.

| Months | Ca+ | Mg+ | Chlorine | Nitrogen | Phosphate | BOD |
|---|---|---|---|---|---|---|
| October 2019 | 136.5 | 101.51 | 67.12 | 7.50 | 4.12 | 10.23 |
| November. | 130.4 | 102.23 | 57.42 | 8.00 | 3.18 | 22.22 |
| December | 146.2 | 74.21 | 47.13 | 6.14 | 3.10 | 22.56 |
| January 2020 | 182.3 | 75.25 | 51.23 | 7.10 | 3.41 | 27.56 |
| February | 128.2 | 51.26 | 76.95 | 6.31 | 2.13 | 30.68 |
| March | 134.4 | 40.34 | 80.86 | 6.25 | 1.93 | 20.59 |
| April | 126.5 | 34.54 | 97.23 | 5.35 | 1.42 | 19.78 |
| May | 126.3 | 58.56 | 118.23 | 5.29 | 1.21 | 19.84 |
| June | 160.2 | 83.85 | 57.10 | 6.25 | 3.31 | 17.52 |
| July | 160.3 | 81.36 | 54.20 | 7.14 | 4.28 | 20.95 |
| August | 154.3 | 78.65 | 54.72 | 7.48 | 4.42 | 26.23 |
| September | 164.5 | 75.89 | 49.97 | 7.61 | 4.51 | 16.36 |

not for drinking or domestic purposes.

Dissolved carbon dioxide is essential for aquatic photosynthesis in minimum ranges but when it reaches high concentrations above 10 ppm, toxic to aquatic organisms. The ranges of in this study are 2.1 mg/L–6.8 mg/L as determined. The dissolved carbon dioxide results are normal.

TA, the quality and types of substances present, such as bicarbonate, carbonate, and hydroxide, is referred to as the water's TA [18] which is determined as 115.2 mg/L–264.5 mg/L. Water's alkalinity is influenced by the concentration of bicarbonates, which together with free $CO_2$ and carbonic acid make up the inorganic carbon in the freshwater carbonic system. H+ and OH- ions are displaced as a result of their interaction with water molecules.

TH-calcium and magnesium are added to the sources of hardness through surface runoff from agricultural and other catchment areas. Hardness and calcium are directly connected [19]. The detected values range from 153.2 to 245.7 mg/L. Calcium ranges are recorded 125 mg/L to 183.8 mg/L, Magnesium detected ranges from38.2 mg/L to 160.3 mg/L, Chloride detected ranges 48.49 mg/L to 118.23 mg/L, Nitrogen ranges are detected 5.30 mg/L to 8.11 mg/L, Phosphorus detected ranges are 1.1 mg/L to 4.51 mg/L are detected in samples of Peddacheruvu water.

Biological oxygen demand (BOD) levels are 10.23 mg/L–31.53 mg/L. BOD levels are within the permissible ranges [20] (2–20 mg/L) but in this Pedda Cheruvu lake in the summer season reaching the maximum level of 31.53 mg/L.

Based on the above results, the Pedda Cheruvu WQI levels are in Normal ranges in SWM Season, Moderate levels in NEM season, and in the summer season the lake status reaches to High risk due to decrease water levels and water turned to harder.

## 4. CONCLUSION

The current study offers significant insight into the characteristics of Pedda Cheruvu water. Based on the results the lake turned from Mesotrophic to Oligotrophic state. The study might also aid in understanding how a specific water body interacts with its people in terms of structure and function [21]. In the absence of immediate action to reduce pollution, scientific management predicts a rapid decline in water quality. The purpose of evaluating water quality is to pinpoint the causes of contamination and create a plan for managing water sources sustainably in order to preserve and advance social and economic development as well as human health.

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## 6. REFERENCES

1. F. Meng, Q. Yuan, R. A. Bellezoni, J. A. De Oliveira, S. Cristiano, A. M. Shah, G. Liu, Z. Yang, K. S. Seto, (2023) Quantification of the food-water-energy nexus in urban green and blue infrastructure: A synthesis of the literature, ***Resources, Conservation and Recycling***, **188:** 106658.
2. S. K. Sahoo, S. S. Goswami, (2024) Theoretical framework for assessing the economic and environmental impact of water pollu-tion: A detailed study on sustainable development of India, ***Journal of Future Sustainability***, **4(1)**: 23-34.
3. S. Aloui, A. Mazzoni, A. Elomri, J. Aouissi, A. Boufekane, A. Zghibi, (2023) A review of soil and water assessment tool (SWAT) studies of Mediterranean catchments: Applications, feasibility, future directions, ***Journal of Environmental Management***, **326:** 116799.
4. M. A. Al-Obaidi, A. A. Alsarayreh, I. M. Mujtaba, (2023) Reduction of energy consumption of brackish water reverse osmosis desalination system via model based optimisation, ***Journal Technology***, **5(1)**: 1-7.
5. O. Singh, S. Rai, V. Kumar, (2008) ***Water Quality and Eutrophication Status of Some Lakes of the Western Himalayan Region (India)***, p286-291. Available from: https://hpccc.gov.in/PDF/water ecosystem/water quality and eutrophication status of some lakes of the western himalayan region, India.pdf
6. S. V. Smith, W. H. Renwick, J. D. Bartley, R. W. Buddemeier, (2002) Distribution and significance of small, artificial water bodies across the United States landscape, ***Science of the Total Environment***, **299(1-3)**: 21-36.
7. P. Sudarshan, M. K. Mahesh, T. V. Ramachandra, (2019) Assessment of seasonal variation in water quality and water quality index (WQI) of Hebbal Lake, Bangalore, India, ***Environment and Ecology***, **37(1B)**: 309-317.
8. M. Karydis, (2009) Eutrophication assessment of coastal waters based on indicators: A literature review, ***Global NEST Journal***, **11(4)**: 373-390.
9. P. Chardhry, M. P. Sharma, R. Bhargava, S. Kumar, P. J. S. Dadhwal, (2013) Water quality assessment of sukhna lake of chandigarh City of India, ***Hydro Nepal Journal of Water Energy and Environment***, **12(12)**: 26-31.
10. M. J. Amores, M. Meneses, J. Pasqualino, A. Antón, F. Castells, (2013) Environmental assessment of urban water cycle on Mediterranean conditions by LCA approach, ***Journal of Cleaner Production***, **43:** 84-92.
11. R. M. Brown, N. I. McClelland, R. A. Deininger, R. G. Tozer, (1970) A water quality index: Do we dare? ***Water Sewage Works***, **10(117)**: 339-343.
12. N. Bharti, D. Kathyal, (2011) Water quality indices used for surface water vulnerability assessment, ***International Journal of Environmental Sciences***, **2(1)**: 154-173.
13. A. Sargaonkar, V. Deshpande, (2003) Development of an overall index of pollution for surface water based on a general

classification scheme in Indian context, ***Environmental Monitoring and Assessment,*** 89(1): 43-67.
14. J. Mahender, K. Ramesh, A. V. Rajashekhar, (2016) Assessment of water quality with reference to fish production in chenugonipally Pedda Cheruvu, mahabubnagar dist, Telangana, ***International Journal of Applied Biology and Pharmaceutical Technology***, **7:** 229-235.
15. R. Bhateria, D. Jain, (2016) Water quality assessment of lake water: A review. ***Sustainable Water Resources Management,*** **2(2)**: 161-173.
16. V. Pradeep, C. Deepika, G. Urvi, S. Hitesh, (2012) Water quality analysis of an organically polluted lake by investigating different physical and chemical parameters, ***International Journal of Research in Chemistry and Environment***, **2(1)**: 105-111.
17. Y. Wu, Y. Wen, J. Zhou, Y. Wu, (2014) Phosphorus release from lake sediments: Effects of pH, temperature and dissolved oxygen, ***KSCE Journal of Civil Engineering***, **18(1)**: 323-329.
18. R. R. Kumar, C. S. Purushothaman, G. B. Sreekanth, N. M. Lekshmi, K. P. Sandeep, P. K. Pandey, (2013) State of water quality of two tropical urban lakes located at Mumbai Megacity, ***International Journal of Scientific Research***, **4(5)**: 1991-1998.
19. S. Kükrer, E. Mutlu, (2019) Assessment of surface water quality using water quality index and multivariate statistical analyses in Saraydüzü Dam Lake, Turkey, ***Environmental Monitoring and Assessment,*** **191(2)**: 71.
20. A. A. M. Ahmed, S. M. A. Shah, (2017) Application of adaptive neuro-fuzzy inference system (ANFIS) to estimate the biochemical oxygen demand (BOD) of Surma River, ***Journal of King Saud University-Engineering Sciences***, **29(3)**: 237-243.
21. S. Suhag, (2023) One-Step Fabrication of the ZnO/g-$C_3N_4$ Composite for Visible Light-Responsive Photocatalytic Degradation of Bisphenol E in Aqueous Solution, ***Journal of Aeronautical Materials***, **43(1)**: 144-150.

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