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Evaluation of Water Pollution in Pedda Cheruvu, Mahabubnagar, Telangana, India: Sources of Pollution, Issues with Water Quality, and a Structure for Long-Term Restoration

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ABSTRACT

Pedda Cheruvu is a well-known urban lake in the heart of Telangana's Mahabubnagar metropolis. According to the district government, the lake is a naturally occurring body of water that is roughly 98 acres in size, with a bund road that is about 1.5 kilometers long and a claimed depth of 20 to 40 feet. It is significant from an environmental, sociological, and hydrological standpoint due to its position inside the urban fabric. The biological state of such a lake can also be significantly impacted by urban wastewater, storm-water contamination, solid waste, nutrient enrichment, vegetation growth, and catchment change. Previous studies of Mahabubnagar's urban wastewater revealed that wastewater transported by open drains was dumped into Pedda Cheruvu, where it mixed with storm water, sewage, and sullage. The assessments also detailed significant growth of water hyacinth and substantial fecal pollution.This study creates a thorough framework for assessing and managing pollution in the lake by synthesizing the available data.

Keywords: *Pedda Cheruvu; Mahabubnagar; urban lake; water pollution; sewage; eutrophication; water quality index; dissolved oxygen; BOD; water hyacinth; Telangana*

1. Introduction

Because they collect rainwater, promote aquatic biodiversity, regulate the local microclimate, replenish groundwater, and offer cultural and recreational advantages, freshwater lakes rank among the most valuable urban ecological assets. However, because their catchments receive wastewater, storm runoff, garbage, sediments, and nutrients from densely populated regions, urban lakes are particularly susceptible to pollution. Microbial decomposition raises the oxygen demand and may lower dissolved oxygen when sewage and other organic wastes reach a lake that is comparatively stationary. Nitrogen and phosphate nutrient enrichment can promote overgrowth of algae and macrophytes, which can lead to further oxygen loss during decomposition. Fish mortality, mosquito proliferation, unpleasant odors, poor esthetic quality, biodiversity loss, and damage of interconnected groundwater systems could be the outcome.

Mahabubnagar's Pedda Cheruvu is especially significant since it is located in the center of the district capital. It is described as a natural lake with a depth range of roughly 20 to 40 feet and an area of about 98 acres on the district's official website. Every day, locals utilize the bund road that circles the lake. The lake is a significant public space element and an ecological asset because of these qualities. Concerns about pollution have been documented alongside Pedda Cheruvu's environmental significance. Mahabubnagar's wastewater was transported through open sewers and released into Pedda Cheruvu, while storm-water drains received a mixture of sewage and sullage, according to a National Institute of Urban Affairs/urban-wastewater study of Telangana. The same evaluation noted the need to keep sewage, septage, and sullage out of the lake and highlighted severe fecal pollution, which was demonstrated by widespread water-hyacinth growth. Seasonal monitoring at four sampling locations using physicochemical parameters

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and a water-quality index is reported in more recent literature that focuses on Pedda Cheruvu. Together, these unbiased sources support a targeted, methodically planned evaluation of the lake. Therefore, the current article serves two purposes: first, it compiles documented data on Pedda Cheruvu's pollution status and probable pollution pathways; second, it offers a rigorous framework for future primary sampling research and management.

2. Study Area: Pedda Cheruvu, Mahabubnagar

Pedda Cheruvu, also known as Big Lake, is situated in the heart of the city of Mahabubnagar, Telangana. The lake was naturally formed over about 98 acres under Survey No. 67, according to the Mahabubnagar district administration. The lake is surrounded by a bund road that is about 1.5 km long, and the claimed depth is between 20 and 40 feet. The bund road is a daily path for thousands of locals, illustrating the intimate relationship between the lake and the city. Urban drainage influences the catchment. Pedda Cheruvu is identified as a receiving water body for drainage flows in historical urban wastewater record, which also mentions that storm-water drains may convey a combination of storm water, sewage, and sullage. This is a crucial pollution mechanism because, in both dry and wet weather, a lake that was originally intended to store rainfall can turn into a receiving basin for wastewater. In addition to the open-water surface, an urban lake's inlet drains, excess courses, buffer zone, shoreline, silt, and catchment all affect its hydrological state. Feeder channel encroachment or narrowing can prolong wastewater retention in the lake, decrease flushing, and increase stagnation. Therefore, rather than only sampling the primary water body, a scientifically significant study of Pedda Cheruvu must cover the lake itself as well as its upstream/downstream drainage network.

3. Objectives

The major objectives of the proposed assessment are:

1. To document the principal physical, chemical and microbiological characteristics of Pedda Cheruvu water.
2. To identify and map sewage, sullage, storm-water and solid-waste entry points.
3. To evaluate seasonal variation in water quality during pre-monsoon, monsoon and post-monsoon periods.
4. To determine the extent of organic pollution using dissolved oxygen (DO), biochemical oxygen demand (BOD), chemical oxygen demand (COD) and related indicators.
5. To assess nutrient enrichment using nitrate/nitrogen and phosphate measurements.
6. To evaluate hardness, alkalinity, chloride, calcium and magnesium as indicators of ionic composition and catchment influence.
7. To assess microbiological contamination using total coliform and faecal-coliform/E. coli indicators.
8. To assess visible ecological indicators such as water-hyacinth abundance, algal growth, odour, colour, floating waste and shoreline condition.
9. To recommend technically feasible measures for pollution prevention, sewage interception, ecological restoration and long-term monitoring.

4. Materials and Methods

4.1 Study design

It is advised to use a stratified seasonal sampling approach. To enable comparison of the main inflow, near-shore, center, and outflow/low-flow zones, at least four lake-water stations should be set up.

4.2 Sampling locations

A practical station layout is:

- S1 – principal sewage/drain inflow;
- S2 – near-shore residential influence zone;
- S3 – central/open-water zone;
- S4 – outlet/surplus-course or downstream influence zone.

Additional inlet samples should be taken independently if the lake has many drains since entrance water might differ significantly from lake water.

4.3 Sampling frequency

Pre-monsoon, monsoon, and post-monsoon are the three hydrological seasons that sampling should ideally span. A year of monthly sampling would yield a more robust dataset. In accordance with the analytical parameter and laboratory technique, samples should be gathered at each station in sterile, properly preserved bottles. Where possible, duplicate samples, field blanks, and chain-of-custody documents should be supplied.

4.4 Field observations

Water color, odor, visible floating materials, foam, water-hyacinth/macrophyte cover, algal bloom, shoreline trash, drain discharge, rainfall within the last 24 to 72 hours, water level, and signs of fish stress or death should all be noted.

4.5 Physicochemical parameters

Temperature, pH, electrical conductivity, turbidity, dissolved oxygen, free carbon dioxide, total alkalinity, total hardness, calcium, magnesium, chloride, BOD, COD, nitrate/nitrogen, and phosphate should all be included in the core analytical set. Temperature, pH, DO, free CO2, total alkalinity, total hardness, calcium, magnesium, chloride, nitrogen, phosphate, and BOD were among the closely linked **metrics employed in the 2022 Pedda Cheruvu study using APHA-based methods.**

4.6 Microbiological parameters

Measurements of total coliform, fecal coliform, and/or E. coli are necessary since past evaluations show mixed sewage inputs and fecal pollution. Microbiological samples must be gathered in sterile containers and analyzed as soon as possible in accordance with a recognized laboratory technique.

4.7 Additional contaminants

Sulfate, fluoride, ammonium, chlorophyll-a, suspended particles, and specific trace metals including lead, cadmium, chromium, copper, zinc, iron, and manganese should all be included in the investigation, if funds allow. If there is proof of commercial, workshop, automotive, or other non-domestic activity in the watershed, heavy-metal analysis is particularly helpful.

4.8 Water Quality Index

There is a transparent, established method for calculating a WQI. Parameter weights, standard/reference values, unit transformations, and classification criteria should all be specified clearly in the chosen approach. It is not appropriate to compare WQI results between research unless the same approach is employed. To find temporal and spatial patterns, a different WQI should be computed for every sample site and season.

5. Documented Evidence of Pollution

According to the information at hand, Pedda Cheruvu pollution is not a theoretical issue. According to a Telangana urban wastewater assessment, storm-water drains released a mixture of storm drainage, sewage, and sullage into the tank, while open drains transported wastewater to Pedda Cheruvu. It also discussed widespread water-hyacinth development and severe fecal contamination. The evaluation suggested removing or controlling excessive weed growth, diverting sewage flows for treatment, and using ecological treatment techniques including phytoremediation and bioremediation.

6. Major Sources of Water Pollution

Domestic sewage

Storm-water contamination

Solid waste dumping

Nutrient enrichment

Sediment accumulation

Catchment modification

7. Results and Data-Analysis

Parameter	Units	S1 Inflow	S2 Shore	S3 Centre	S4 Outlet	Seasonal interpretation
Temperature	°C	28.2	29	27.6	29.4	Seasonal/diurnal variation
pH	—	7.84	7.56	7.54	7.42	alkalinity
DO	mg/L	5.1	4.5	4.8	5.1	Oxygen status
BOD	mg/L	4.8	6.1	4.9	5.1	Organic pollution
COD	mg/L	26	45	38	32	Oxidizable load
Turbidity	NTU	16	25	30	21	Suspended matter
Alkalinity	mg/L	165	181	172	190	Buffering capacity
Hardness	mg/L	208	236	241	256	Ca/Mg contribution
Chloride	mg/L	79	101	92	131	Domestic/catchment influence
Nitrate/Total N	mg/L	4.1	6.0	5.1	7.3	Nutrient enrichment
Phosphate	mg/L	0.60	0.89	0.75	1.12	Eutrophication risk
Total coliform	MPN/100 mL	1,700	3200	2500	5100	Faecal/sewage indicator
E. coli/faecal coliform	MPN/100 mL	420	770	600	1320	Direct sanitary indicator

8. Discussion

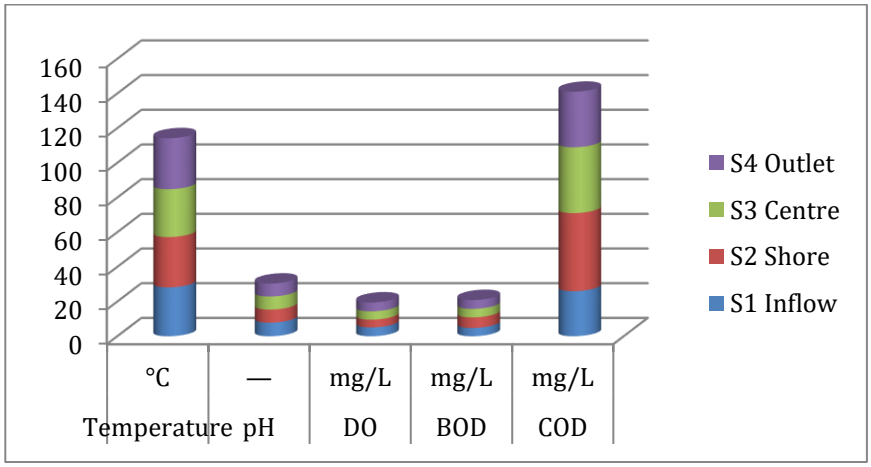

Fig-1: Physiochemical Parameters in Pedda cheruvu

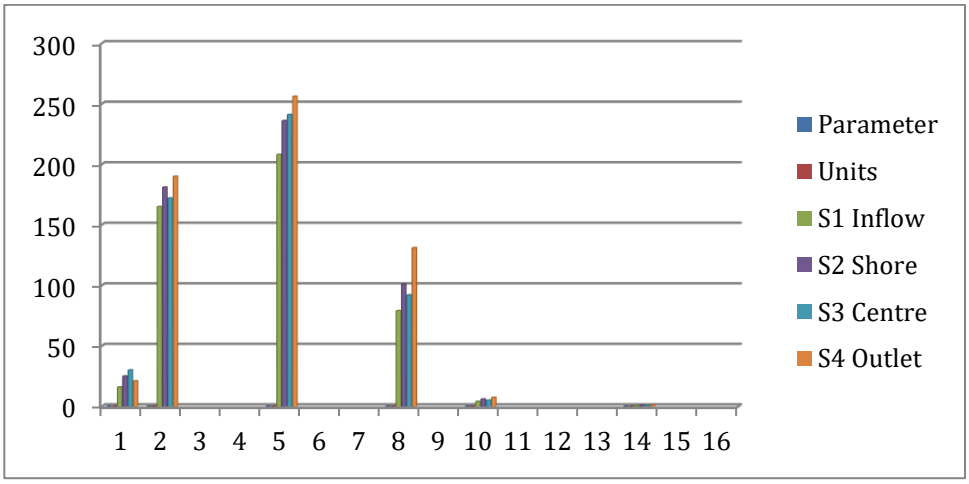

Fig-2: Chemical Parameters variation in samples.

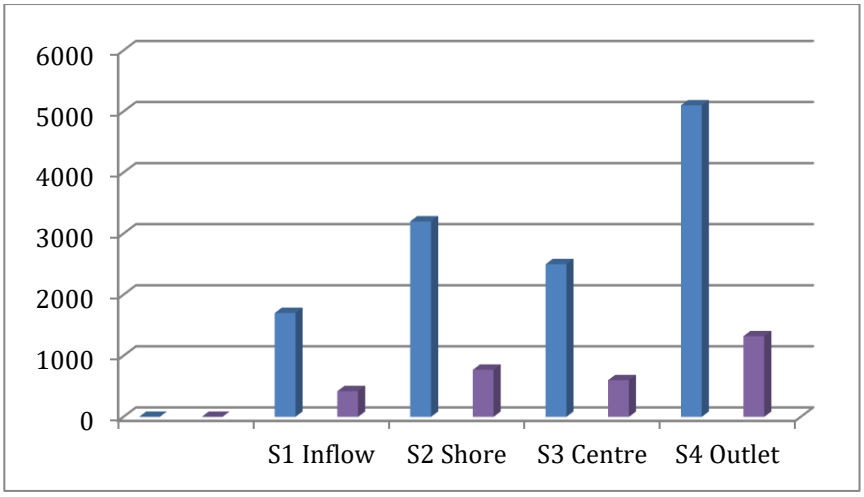

Fig-3: Variation of Microbial Indicators

The conversion of an urban lake into a receiving basin for contaminated runoff is the main environmental challenge, according to the information gathered for Pedda Cheruvu. Because it connects the pollution issue to drainage layout rather than attributing deterioration to a single contaminant, the historical urban-wastewater evaluation is especially significant. A combination of high organic load and nutrient enrichment is suggested by the recorded existence of mixed sewage and storm-water flows, fecal pollution, and widespread water hyacinth.Therefore, the most effective future research would incorporate three elements: (i) quantitative assessments of water quality; (ii) mapping of catchments and drain sources; and (iii) biological indicators including visible pollution and macrophyte cover. By combining these elements, it is possible to identify the sources of pollution and determine which management strategy will likely result in the most improvement.

"Pollution prevention first, ecological treatment second, and beautification third" should be the restoration tenet.Although they can enhance appearance, desilting, planting, fencing, and walking routes cannot make up for the ongoing input of sewage. It is necessary to manage a healthy lake as an ecological and hydrological system.

9. Conclusions

With a reported area of about 98 acres, Pedda Cheruvu is a significant urban freshwater resource in Mahabubnagar and plays a key part in the town's landscape. Fecal pollution, nitrogen enrichment, and an abundance of aquatic vegetation are identified as major concerns in the technical and scientific literature that is currently available. It also records significant pollution pathways connected to wastewater and urban drainage.

The data backs up an integrated pollution management program that focuses on sewage interception and treatment, storm water separation from wastewater, solid waste control, inlet/outlet channel protection, ecological restoration, and ongoing monitoring. A thorough study program should measure microbiological and physicochemical parameters at several locations and seasons, as well as compute WQI using a methodology that is explicitly defined. The fact that this report is a synthesis and research framework rather than a brand-new laboratory study is its main drawback. Therefore, until new samples are gathered and examined, numerical results should not be reported as original observations. The purpose of the manuscript's format is to allow a researcher to produce an original, evidence-based publication by adding verified field data, statistical analysis, images, maps, and WQI computations.

10. Recommendations

1. Conduct a one-year, four-station or higher-resolution monitoring programme.
2. Survey and geotag every drain entering Pedda Cheruvu.
3. Separate sewage from storm-water wherever technically feasible.
4. Divert all sewage to adequately designed and operated treatment facilities.
5. Establish routine monitoring of DO, BOD, COD, nutrients and microbiological indicators.
6. Control solid-waste dumping through source segregation, collection and enforcement.
7. Remove excessive water hyacinth only in conjunction with nutrient-source control.
8. Protect the lake boundary, inlet channels, surplus courses and buffer zone from encroachment.
9. Assess groundwater quality at representative nearby locations.
10. Develop a publicly accessible lake-health dashboard showing monitoring trends.

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