



"Spatio-Temporal Assessment Of Water Quality Parameters In Dindi Reservoir Using Remote Sensing And Ground-Truthing: A Baseline For Ai-Driven Monitoring"

Dr. A Prasannata
Department of Zoology
Uppal

Abstract

This research examines seasonal and spatial patterns of water quality over the Dindi Reservoir in Telangana using a hybrid approach that integrates Sentinel-2A satellite imagery with in-situ field sampling. Remote sensing-derived indices including the Normalized Difference Water Index (NDWI), Floating Algae Index (FAI), and Total Suspended Solids (TSS) were used to map surface water conditions across pre-monsoon, monsoon, and post-monsoon periods. Ground-truthing was conducted by taking readings of physico-chemical parameters like temperature, pH, dissolved oxygen (DO), turbidity, nitrates, phosphates, and total dissolved solids (TDS) at several GPS-tagged sampling sites. Statistical analysis revealed good agreement between satellite indices and measured water quality parameters, especially for monsoon months when the amount of runoff was maximum. These results present a baseline dataset for machine Learning model development to forecast zooplankton abundance and ecologic risk areas. This integrative strategy facilitates scalable, cost – efficient monitoring systems for freshwater ecosystem in semi and environment.

Keywords : Remote Sensing, Sentinel-2, Water Quality, Dindi Reservoir, NDWI, AI, Spatio-Temporal Monitoring, Freshwater Ecosystems, Telangana

1. Introduction :

Water bodies across India are increasingly vulnerable to pollution, eutrophication, and seasonal hydrological changes due to agricultural runoff, industrial activity, and climate variability (Patra & Azadi, 2022). Dindi Reservoir, located in the Nalgonda district of Telangana, serves as a crucial water source for irrigation and domestic use. Traditional water limited (Sharma et al., 2020). Recent advances in remote sensing, particularly through the use of Sentinel-2 satellites, provide high-resolution temporal and spectral imagery that can be used to monitor inland water bodies at scale. Integrating artificial intelligence (AI) with remote sensing and field data offers a revolutionary framework for environmental monitoring. AI models require robust, labeled

datasets — a key focus of this paper — to accurately forecast ecological patterns, including zooplankton biodiversity, which is highly sensitive to water quality changes (Kumar & Rani, 2021). This study aims to identify spatio-temporal patterns in water quality using a combination of field and satellite data, laying the groundwork for future AI-based ecological prediction models.

2. Materials and Methods

2.1 Study Area

Dindi Reservoir (17.1251°N, 79.0821°E), situated in Nalgonda District, Telangana, is a medium-sized reservoir in a semi-arid region with a catchment area dominated by agricultural activities. The reservoir is subject to monsoonal inflows and seasonal water level fluctuations.

2.2 Satellite Data Acquisition

Satellite: Sentinel-2A

Time Frames:

Pre-monsoon (March)

Monsoon (July)

Post-monsoon (October)

Indices extracted:

NDWI (Normalized Difference Water Index) = $(\text{Green} - \text{NIR}) / (\text{Green} + \text{NIR})$

FAI (Floating Algae Index)

TSS (proxy using Band 4 and Band 8)

2.3 Ground Data Collection

Field sampling was carried out at 6 GPS-tagged sites using standard APHA methods:

Parameters measured: pH, DO, temperature, TDS, turbidity, nitrate, phosphate

Tools used: Multiparameter water quality meter, UV spectrophotometer, portable kits

2.4 Data Analysis

Software: QGIS for spatial mapping, Python (Pandas, Seaborn, Scikit-learn) for statistical

modeling Analyses: Correlation matrix, ANOVA, linear regression between satellite indices and in-situ

data Visualization: Time-series plots, spatial heatmaps, scatterplots with regression lines

3. Results and Discussion

3.1 Temporal Water Quality Trends

During the monsoon season, nitrate and phosphate concentrations increased due to agricultural runoff. DO levels dropped post-monsoon, likely due to increased organic matter and decomposition. NDWI values peaked during monsoon (0.42), indicating high water presence and suspended load.

3.2 Correlation Between Satellite and Field Data

Parameter NDWI Correlation TSS Proxy

Turbidity 0.83 0.76

TDS 0.78 0.82

DO -0.41 -0.38

NDWI and FAI values were effective in identifying eutrophic zones near inflow points and agricultural discharge areas.

3.3 Spatial Hotspots

Maps revealed high nutrient concentrations in northern and northeastern zones. These regions coincided with elevated FAI values, indicating potential algal bloom formation.

4. Conclusion

The integration of Sentinel-2A imagery and in-situ water quality measurements successfully captured spatial and seasonal variability in Dindi Reservoir. The results demonstrate the effectiveness of remote sensing in freshwater quality surveillance and form a reliable input dataset for developing AI-based predictive models for zooplankton distribution and ecological risk zones. This paper establishes the foundation for a scalable, smart monitoring framework suitable for semi-arid inland water bodies in India.

5. References

1. Patra, P., & Azadi, S. (2022). Climate change and water bodies: A study on changing trends in reservoir ecosystems. *Environmental Sustainability Journal*, 15(3), 211–225.
2. Sharma, V., Kulkarni, R., & Singh, M. (2020). Sentinel-2 satellite data for monitoring inland water quality: An Indian case study. *Remote Sensing Applications: Society and Environment*, 19, 100325.
3. Kumar, A., & Rani, S. (2021). Application of Artificial Intelligence in aquatic ecosystem Modeling: A review. *Ecological Informatics*, 64, 101384.
4. Mishra, S., & Tripathi, R. (2023). Evaluation of Sentinel-2 derived NDWI and turbidity indices for lake health monitoring. *Journal of Applied Remote Sensing*, 17(1), 110345.
5. American Public Health Association (APHA). (2017). *Standard Methods for the Examination of Water and Wastewater* (23rd ed.). Washington, D.C.