



GUJARAT TECHNOLOGICAL UNIVERSITY

(Established by Government of Gujarat under Gujarat Act No. : 20 of 2007)

ગુજરાત ટેકનોલોજીકલ યુનિવર્સિટી

(ગુજરાત સરકારના ગુજરાત અધિનિયમ ક્રમાંક : ૨૦/૨૦૦૭ દ્વારા સ્થાપિત)

Accredited with A+ Grade by NAAC

Abstract of the Thesis



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Faculty: Engineering

Discipline/Branch: Civil Engineering

Title of the Thesis: COMPUTING WATER QUALITY INDEX USING
INTELLIGENCE ENSEMBLED TECHNIQUE

Abstract

Effective water quality assessment plays a pivotal role in securing safe water release across all scales, ranging from household taps to expansive river basins. Conventional water quality assessment relies primarily on laboratory-based monitoring and point observations, which often provide limited environmental interpretation, and restricted spatial coverage. Addressing these challenges requires analytical methodologies capable of improving intelligent assessment with environmental interpretation and scalable monitoring. The study considers river systems of Gujarat region as Daman Ganga River in Vapi, and the Sabarmati Riverfront in Ahmedabad, to develop an environmental intelligence framework for surface water quality assessment.

Multivariate Statistical Analysis (MSA) techniques, including Principal Component Analysis (PCA) and Varimax Rotation Factor Analysis, were applied using historical data from 2000–2019. MSA aided to identify dominant physicochemical parameters influencing Canadian Council of Ministry of Environment (CCME) & British Columbia (BC) Water Quality Index



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(WQI) variation. The analysis identified hardness, salinity related parameters, carbonate concentration, and phosphorus content as significant contributors affecting water quality conditions in the Daman Ganga River. To enhance predictive intelligence, ensemble machine learning techniques were implemented for multiclass WQI prediction with Weighted Arithmetic (WA) approach. Among individual models, CatBoost demonstrated superior performance with an accuracy of 0.857 and Macro ROC-AUC of 0.955. Further, stacked ensemble learning frameworks integrating multiple base learners (Random Forest, Extra Trees, AdaBoost, XGBoost and CatBoost) with meta learners (Logistic Regression, Random Forest, XGBoost, and Linear SVC) improved classification capability, with the GridSearchCV based ensemble attaining an accuracy of 0.889 and F1 score of 0.858. SHAP (SHapley Additive exPlanations) based Explainable Artificial Intelligence (XAI) technique was incorporated to interpret model predictions. Total Phosphorous (P-Tot), Total Hardness (HAR_Total), Chloride (Cl), Magnesium (Mg), and Sulphate (SO₄) were identified as dominant contributors affecting water quality.

Further, for data scared region Sabarmati Riverfront in Ahmedabad, a remote sensing and GIS based monitoring framework was developed using Sentinel-2 satellite imagery with ArcMap and Google Earth Engine (GEE) for mapping multiple water quality parameters. The regression-based models demonstrated strong predictive capability for pH ($R^2 = 0.80$), Total Suspended Solids ($R^2 = 0.76$), and Total Phosphorus ($R^2 = 0.75$), thereby establishing the applicability of geospatial approaches for scalable and cost-effective water quality monitoring. The proposed research establishes analytical and interpretable framework with statistical analysis, ensemble learning, explainable AI and geospatial monitoring, for sustainable water quality assessment and useful for environmental decision support applications.



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This PhD Thesis will help in

Developing data driven approaches for river water quality assessment, identifying key physicochemical parameters influencing water quality, and estimating water quality parameters using remote sensing, GIS, and explainable machine learning. The findings can support practical water quality monitoring, prioritization of water quality investigations, and water resource management. The research contributes to Sustainable Development Goal 6 (SDG 6: Clean Water and Sanitation) by advancing scientific assessment and monitoring of water quality to support the protection and sustainable management of water resources.

List of Publication(s):

S. No.	Publication Details	Journal Details
1.	Seth, M., Dholakia, M., Dhiman, S., Khare, U. K., Amin, J., & Bhangaonkar, P. (2025). Multivariate analysis of inland water quality index in parts of Vapi district, Gujarat, India. <i>Water Supply</i> , 25(2), 193–211. https://doi.org/10.2166/ws.2024.264	IWA Water Supply ISSN: 1606-9749 (Scopus Indexed)
2.	Seth, M., Dholakia, M. (2025). A Review On The Application Of Remote Sensing And GIS In Water Quality Monitoring And Management. <i>International Journal of Engineering Technology and Computer Research (IJETCR)</i> (13)03, p 16-23.	International Journal of Engineering Technology and Computer Research ISSN: 2348-2117
3.	Seth, M. S., Dholakia, M. B., Dhiman, S., Khare, U. K., Amin, J., Bhangaonkar, P., & Shah, D. (2026). Assessing water quality through remote sensing: A regression-based approach with Sentinel-2 data. <i>Nature Environment and Pollution Technology</i> , 25(1), B4340. https://doi.org/10.46488/NEPT.2026.v25i01.B4340	Nature Environment and Pollution Technology ISSN: 2395-3454 (Scopus Indexed)