ABSTRACT

The construction industry plays a pivotal role in global economic development but simultaneously contributes significantly to environmental degradation and social inequities. This research presents a comprehensive consilient approach towards sustainability in construction, integrating environmental, economic, and social dimensions through advanced decision-making frameworks, quantitative modeling, and geospatial analysis. The study aims to holistically evaluate and enhance sustainability in construction practices, with particular emphasis on contractor performance, waste management, green materials, healthcare infrastructure, and risk assessment.

A multi-methodological framework is developed across certain thematic domains. Contractor performance evaluation is carried out using Fuzzy AHP, Fuzzy TOPSIS, and K-Means clustering, followed by an intuitionistic fuzzy reliability-based analysis to incorporate risk considerations.

For sustainable waste management, the research employs Rough TOPSIS for municipal solid waste site selection, supplemented by GIS-based spatial suitability mapping.

The study of sustainable building materials involves comprehensive study on green concrete and development of strength prediction models for green concrete, contributing to circular economy practices.

Social sustainability is addressed through an assessment of green healthcare infrastructure using Principal Component Analysis and regression modeling.

Risk management in construction is further explored using an enhanced Failure Modes and Effects Analysis (FMEA) model tailored for development of sustainable construction projects.

This research contributes a unified sustainability assessment architecture, validated through real-world data and expert opinions. The outcomes provide actionable insights for policymakers, construction managers, and urban planners aiming to foster resilient, efficient, and socially responsible construction ecosystems.