"Gheorghe Asachi" Technical University of Iasi, Romania

OPTIMAL ROUTE SELECTION FOR SOLID WASTE TRANSPORTATION USING HYBRID GIS AND FUZZY AHP APPROACH

Sunderraj Kapilan[1], Krishnan Elangovan[2], Vincent Jayaraj Joevivek[1]*

[1]Akshaya College of Engineering and Technology, Kinathukadavu, Coimbatore 642 109, India
[2]Department of Civil Engineering, PSG College of Technology, Coimbatore 641 004, India

Abstract

Municipal corporations are encountering numerous challenges when it comes to the transportation of solid waste from urban areas to open dump sites via roadways. Predominant issues include heavy road congestion, limited road accessibility, and the difficulty of navigating rugged and narrow roads. To address these persistent problems, a computational risk assessment combined with optimal route selection proves to be an effective solution. This research endeavors to tackle this issue by introducing a hybrid Geographic Information System (GIS) model for selecting the most optimal routes. This model incorporates the fuzzy-analytic Hierarchical Process (AHP) and Multi-Criteria Decision Analysis (MCDA).

The analysis takes into account five primary criteria: slope, turning distance, road type, maximum speed limit, and traffic density, along with their respective sub-criteria. Fuzzy comparison matrices are constructed for each criterion, utilizing fuzzy triangular membership functions. The weighting of criteria is determined by assessing the minimum degree of possibility of superiority for each criterion. Furthermore, the weight factors for sub-criteria are estimated through MCDA analysis. Subsequently, a Route Optimization Index (ROI) is computed based on the weight factors assigned to criteria and sub-criteria. The resultant outcomes are then integrated into a GIS platform to facilitate the selection of the most optimal routes.

The validity of this approach has been confirmed through rigorous validation, which demonstrates that it yields low-risk, cost-effective routing solutions. Furthermore, the suggested routes derived from this approach are practical and financially viable for efficient waste transportation. This simplified model can be readily implemented by Municipal Corporations in densely populated areas with significant anthropogenic activities, thereby enhancing the effectiveness of solid waste transportation processes.

Key words: MCDA, Municipal Corporation, road network, traffic, route optimization, solid waste

Received: January, 2023; Revised final: April, 2023; Accepted: July, 2023; Published in final edited form: July, 2023

---

* Author to whom all correspondence should be addressed: e-mail: vjoevivek@gmail.com; Phone: +91 9994565580