

ABSTRACT

Development of road infrastructure is essential for accelerating the economic growth and development of a country. However, road development projects may cause detrimental effects on the environment. The concern about protection of environment while planning and executing developmental projects has evolved the concept of Environmental Impact Assessment (EIA). Traditional methodologies for carrying out EIA of highway projects normally do not consider spreads and spatial variation of impacts on different environmental resources and their attributes. Even when spatial data is utilized, the use is normally limited to presentation of results rather than carrying out spatial analysis. Therefore, EIA carried out with traditional methods are often incomplete and inaccurate. In traditional approaches, the aggregation of impacts is influenced by qualitative judgment of experts, and the outcome of EIA is often not reproducible.

In order to overcome the lacunas of traditional approaches for carrying out EIA of highway projects, a Spatial Environmental Impacts Assessment Model (SPENVIAM) is developed in GIS environment. SPENVIAM carries out spatial analysis for assessment and quantification of impacts on different attributes. It also carries out quantitative aggregation of impacts by using logically derived relative weights of different attributes and resources. Analytic Hierarchy Process is used for estimating relative weights based on experts' views. Quantitative logical aggregation carried out in SPENVIAM makes EIA more reproducible and less dependent on qualitative judgment of experts. For logical decision-making, SPENVIAM compares project alternatives using quantitative measures (impact indices) and predefined rule base.

The application of SPENVIAM for carrying out EIA and evaluation of project alternatives is demonstrated with reference to a 56 km stretch of National Highway (NH-60) from Jaleswar to Kharagpur, India. This stretch of National Highway is in the process of being upgraded from two lanes to four lanes. For the study road, two alternative development scenarios are considered. Scenario-I is taken as upgrading the existing two-lane road to a four-lane road, whereas Scenario-II is taken as "Do nothing" situation. Three different vehicle categories namely Heavy Vehicles, Medium Vehicles and Light Vehicles, are considered for the study road. The base year and horizon year is taken as 1999 and 2025, respectively. Spatial quantification of impacts on air quality, noise level, water quality, socioeconomic and ecological attributes are carried out for both development scenarios. Logical aggregation of impacts is done for various attributes and resources. Finally, both scenarios are compared using rational quantitative basis and pre-defined rule base. A sensitivity analysis is also carried out for identifying more sensitive attributes and prioritizing mitigation measures.

Key Words: Environmental Impact Assessment (EIA), Geographic Information System (GIS), Highway Project, Analytic Hierarchy Process (AHP), Public Perception, Quantitative Approach