

The Need and Use of Geographic Information Systems for Environmental Impact Assessment in Nepal

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Abstract: Geographical applications in EIA studies is appropriate to build up and extend their knowledge and skills in using Geographic Information Systems (GIS) in Environmental Impact Assessments (EIA), and obtain practical experience in the application of GIS technologies and disciplines. This article highlights emerging topics related to the principles and practice of EIA, including concepts, tools and methods, and related issues. GIS as a tool will be used to visually illustrate the implications of spatial decisions. GIS is applied in all EIA stages: from the acquisition, storage and display of thematic information relative to the vulnerability of the affected resources, to impact prediction and qualification, evaluation, and finally, presentation. This paper highlights how GIS applications using in EIA process in different countries and find out possibility to incorporate those applications in EIA studies in Nepal.

Key words: Environmental Impact Assessment, Geographical Information System, Nepal

Introduction

Many Developing countries have experienced untold environmental degradation and ecological deterioration in the past century, with little or no real solution to alleviate many of these concerns. Poorly planned human interference has been the major cause. Adequate information and appropriate technology are limiting factors for effective environmental management. Hence, efforts to improve, conserve and protect the environment will include not only the resolution of political policies but also the application of a state-of-the-art scientific approach to planning and implementation. The process of Environmental Impact Assessment (EIA) was developed as an effective planning tool. The genuine conduct of this process will go a long way in reducing environmental deterioration. Because of the dynamic characteristics and multivariate nature of the environment, it has often been difficult to collate, analyze and interpret its data sets. This great complexity can be overcome, however, with the innovation and application of a system of computer tools such as the Geographic Information System (GIS) and related technology. GIS also offers graphical presentation of Environmental Impact Assessment (EIA) for easy analysis during the decision-making processes. Because GIS is proficient in data collection and collation, it has become an appropriate mechanism for creating environmental information system database. This storage facility makes environmental data easier to upgrade, update and retrieve as desired. The conclusion is that the technology is now available in Nepal equal to anywhere else in the World. The issue comes from the need to ensure that this is properly applied within the regulatory and monitoring system. It strongly recommends the use of GIS for proper EIA processes to help contribute to the resolution of the many environmental problems plaguing in Nepal.

In Nepal, development projects are being proposed and executed on a daily basis, many of which involve large-scale vegetation cover removal and ecosystem damage. Many of these projects do not have genuine EIA studies carried out for them. Nepal has extensive human and natural resources. The exploitation of these resources over the past few decades has left a wasteland of environmental problems. Because

the socioeconomic development of any nation depends on the exploitation of her natural resources, both renewable and non-renewable (Anneveldt & Pasman, 2001), many therefore believe that these resources should be quickly explored and exploited in order to develop and improve the undernourished economy. In the face of this accelerated development, many projects are carried out to extensive scales and for extended periods, with little or no concern for the environment.

Many environmental disasters would have been averted or minimized if the authorities and agencies concerned had carried out the proper EIA studies before embarking on activities (Arimoro, 2001). It is noteworthy, however, that some developing countries are beginning to know and appreciate the long-term effects and dire consequences of environmental deterioration. With increased awareness campaign and public enlightenment, many more have come to the knowledge of how and what they need to do to keep the environment.

The EIA generates a substantive and valuable environmental resource database. This database should be properly kept for future decision-making, management planning, and monitoring of the nation's resources. International agencies have emphasized the need and importance of developing EIAs as a powerful methodological tool to manage data and allow this management to extend into the long-term (Eedy, 1995). Simulations and models of environmental problems and their resolution can be designed within the GIS platform.

Since the GIS is a dependable tool for problem solving and decision-making, its versatile applicability and utility could be deployed for carrying out meaningful and effective EIA in Nepal, where new developmental projects with multidisciplinary and environmental characteristics abound.

The integration of GIS into EIA

Erickson (1994) identified four methodologies associated with impact assessment, each with its own strengths and

weaknesses. As such, it might be futile searching for an ideal technique. A more realistic approach is to identify the relative merits of these alternatives. This way, a combination of techniques can be chosen to meet the needs of a particular problem.

The four methodologies are: *Overlay*, *Checklist*, *Matrix* and *Network*.

The Overlay method of impact assessment requires physical or computerized overlays of individual maps of social and physical attributes of the project area. The data it uses include topological data, air dispersal patterns, land and resource use data, wildlife, surface and ground water intakes. Such data may be obtained from aerial photography and satellite remote sensing. This method thrives on graphical display of data, but it is limited in that it lacks analytical capabilities. GIS is the ultimate tool for overlay EIA.

The Checklist method can be a very simple or complex list of environmental components, attributes and processes, which are categorized under disciplinary headings such as geology, vegetation and air. GIS provides a computer platform for organizing, storing and analyzing these checklists.

The Matrix method, which is a modification of Checklist, facilitates relating specific project activities to specific types of impacts. Matrices are required because they emphasize only direct impacts. They force consideration of impact of each aspect of a proposal for a range of environmental concerns and they consider both the magnitude and importance of impacts. Again, GIS provides a powerful tool for organizing, analyzing and storing matrices.

The Network methodology defines a network of possible impacts that may be triggered by project activities and that require the analyst to trace out project actions and direct and indirect consequences. From the network methodology, direct, secondary, tertiary and other higher order impacts of action may be traced out. This method cuts across disciplinary lines and it forces the identification of site-specific factors and conditions necessary for the establishment of a proposed cause-effect relationship. This technique however requires that the analyst be knowledgeable in the various types of environmental components and dynamics (Erickson, 1994). On a GIS platform, the analyst is further aided as large volumes of data can be better analyzed in a short while.

The use of GIS

Geographic Information System can be used and applied extensively for environmental impact assessment issues prevalent in many other developing nations including Nepal. Some areas where GIS will be useful include:

- Storage, analysis and display of large data sets. Often EIAs are in undeveloped areas resulting in new and valuable databases for future monitoring or environmental management programs.
- Database creation, documentation and management; Environmental impact modeling. Models and GIS

are both computer based and thus easily integrated (Erickson, 1994).

- Environmental data and EIA analyses.
- Habitat Suitability Index. Habitat quality for wildlife population has a spatial component across large geographic areas (Lai, Mills & Cheng, 2000). Habitat Suitability Index (HSI) models have been widely used to document the quality and quantity of available habitat for a specific wildlife species. In impact assessment, HSI represents the best long-term evaluator of the overall project (Eedy, 1995).
- Aid in decision-making or policy formulation.
- Environmental Impact Auditing.

Environmental Impact Mapping and Analysis

GIS can be used to map the sensitivity of the environment and its components to proposed projects. It also has the capabilities of carrying out various analyses on both locational and non-locational data. GIS analyses include statistical analysis, trend analysis, overlays, buffering, distance analysis, cost analysis and many more. In relation to EIA, Eedy (1995) has identified the following analyses which are appropriate to GIS:

- Site Impact Prediction
- Wider Area Impact Prediction
- Corridor Analysis
- Cumulative Effects Analysis and EA Audits
- Real-Time Environmental Impacts Prediction

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