

GIS as a vital tool for Environmental Impact Assessment and Mitigation

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Abstract. Environmental Impact Assessment (EIA) is a course of action which provides information to various stakeholders such as planners and relevant authorities about the planned development and its subsequent effects of the environment and the immediate ambiances. Furthermore, the EIA and mitigation are the inclusive process of collecting, analyzing information and the determination of the application for development or construction approval, which could be accessible by the concerned communities and organizations. Although the set regulations of EIA and mitigation vary from jurisdictions, they are, however, very precise and need to be integrated with the specific geographical data. In addition, the Geographical Information System (GIS) is a software intended to encapsulate and present all types of physical, biological, environmental, ecological and geological information. Conversely, GIS is the integration of statistical analysis and information technology, and can also be further broken down into two different categories of; Topological Modelling and Map overlay. To ensure that the EIA and mitigation are receptive the GIS will provide the decisive apparatus. Using GIS not only improves the overall EIA and mitigation process, but also provides valuable mapping strategies, including holistic environmental system approach. Accordingly, the main objective of this paper is to discuss the importance of the GIS and Environmental Data integration progression, to further enhance the overall EIA and Mitigation processes.

1. Introduction

Shielding and enhancing the environment is becoming an obligation rather than an excessiveness [1]. Rapid urbanization in the developing world not only has endangered the environment but also deteriorate it significantly [2]. Accordingly rigorous Environmental Impact Assessment (EIA) needs to be carefully carried out to ensure the overall ecosystem is vigilantly protected. EIA is a process and practice which bestow environmental and related information to the necessary populous. Furthermore, effective EIA needs to carefully consider some of the mitigation matters, including, Pursuing a strategic approach [2]. Moreover, the Pursuing a strategic approach includes the consideration of Impact Statement incorporating environmental assessment of; noise and vibration; groundwater and geology; soils, contamination and water quality; and sustainability factors [3].

All of these environmental strategies, including to avoid, mitigate and manage potential impacts also needs to be identified and developed as a part of the Environmental Impact Statement. According the Environment Impact Assessment also needs to consider delivering effective environmental, social and economic improvements. Consequently, sustainable ecological measures too need to be established to reduce environmental impacts such as; Waste Management, Land use integration, and Biodiversity conservation. These impacts need to be carefully integrated holistically to represent both



Environmental and Sustainability issues as a part of the Receptive Environmental Impact Assessment and Mitigation [4].

2. Receptive Environmental Impact Assessment and Mitigation

As already discussed EIA is a process and practice which deliver information to local authority planners, authorized bodies, other interested parties about intended development. EIA is furthermore, the complete process of retrieving, and analyzing information for the purpose of determination of the application for any development or construction approval [5]. The set regulations vary from state to state, however, they are very precise and cannot be disregarded [6]. The general aim of receptive EIA and mitigation is to ensure not only a cohesive impact assessment, but also ensuring that all the involved and relevant parties are successfully aware of the overall environmental implications [4]. Moreover, this receptive EIA and mitigation process not only needs to cover the main alternative environmental studies, but also provide a non-technical summary, to represent the overall environmental finding and recommendations.

In addition, the receptive EIA and mitigation needs to carefully portray and depict some of the more important Environmental and Sustainability issues, including; Ecological conditions such as condition assessment and any deterioration of the existing species [6]. To further assist with the receptive EIA, mitigation and their application the Geographical Information System (GIS) presents an excellent apparatus [7].

3. GIS

As already noted, GIS is a software intended to encapsulate, store, analyze, manage and present all types of physical, biological, environmental, ecological and geological data. Conversely, GIS is the integration of statistical data and analysis together with the Information Management utilization. For application purposes, GIS can then be broken down further into two different categories; Topological Modelling and Map overlays [8]. While the Topological Modelling involves Measurement and Mapping methodologies, Map overlays, on the other hand, shows specific overlays and restrictions implemented on the land.

Furthermore, GIS is employed in feasibility studies and economic advancements, site suitability analysis and determination. As GIS technology is advancing rapidly, it presents a manifesto for more efficient and effective planning and decision making. Accordingly, GIS not only provides mapping and visualization techniques but also illustrates the spatial analysis such as aerial representations. Moreover, GIS is being utilized ubiquitously to facilitate genuine issues and confronting additional concerns. Within EIA and Mitigation compass, GIS is exploited to sustain the emerging trend of Environmental implications by closely monitoring any detrimental environmental changes.

As [9] correctly conversed, some of the main benefits of using a GIS include easy tacking and recording the geographical changes together with effectively administrating geographic space in order to plan a course of action. For Receptive Environmental Impact Assessment and Mitigation, these benefits ensure that GIS creates a specific Environmental and physical geography mapping. This important mapping process also creates a systematic economic and development overview such as urban and transportation plotting schematics. This in all generates receptive strategies, which could be utilized as a part of the comprehensive Environmental Systems approach.

4. Environmental Systems Integration

From the above discussions, it is evident that environmental system approach is a major challenge for any EIA and mitigation process. Thus, the disposition and severity of environmental issues together with the characteristics of probable intervention approaches depends on many ecological factors. Some of these factors include scopes and magnitude of environmental problems together with the most appropriate remedies available. These remedies in-turn create the most relevant and appropriate level of responsibility and decision-making needed to solve various environmental problems [10].

While Environmental system may consist of Ecology, Environmental law, and land resources, it is the behaviour and interrelationships of such issues, which are of a great focus. Such behaviour and

interrelationship may also include Air and water quality, pollution, and other global changes; all of which require a significant level of analysis, planning and decision making [11].

Accordingly, the overall environmental system approach, including the technical urban environmental management also needs to be carefully contemplated and integrated. This consists of Solid Waste Management, Water, Sanitation and Air Quality Management, together with and specific Environmental Protect Agency (EPA) requirements. In addition, the creation of an integrated urban environmental management plan that exemplifies short and long-term goals and phased targets for meeting these goals. All of these matters need to be carefully considered and implemented within the effective Environmental System Integration, which is illustrated in figure 1.

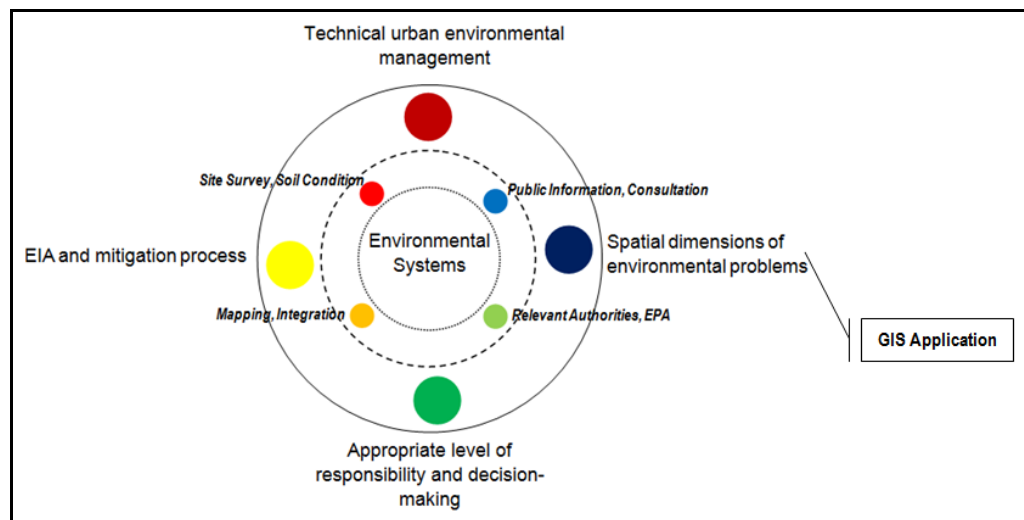


Figure 1. Environmental System Integration.

As it can be noticed, an effective Environmental System involves the integration of all the main considerations, including EIA and the mitigation process. In addition, each of these main considerations is further expanded into sub-levels such as mapping process. Moreover, a key component of this amalgamation is the GIS and Environmental data integration.

4.1 GIS and Environmental Data Integration

The relationship of GIS and Environmental Data Integration are a unique association which must preserve a premeditated roadmap for future development of any environment. This association also needs to carefully consider the involvement of innovative technologies and the growing difficulties of effective and successful environmental management processes. In addition, this connection would further offer a configurable phase to assemble, analyze, and present environmental information [12]. The integration of GIS and Environmental Data, needs to operate proactively by surveying, up-loading, configuring and validating data. Appropriately, this integration would then allow for environmental data to be accessed anywhere, anytime and be able to be updated. In addition, the GIS and Environmental Data integration also need to visualize data, explore and report information, model outputs, and other records that change the response workflow.

More importantly, the relationship of GIS and Environmental Data integration will provide for real-time analysis, and the complex permutation of spatial and temporal data sets. This unique GIS and Environmental Data Integration are exemplified in figure 2.

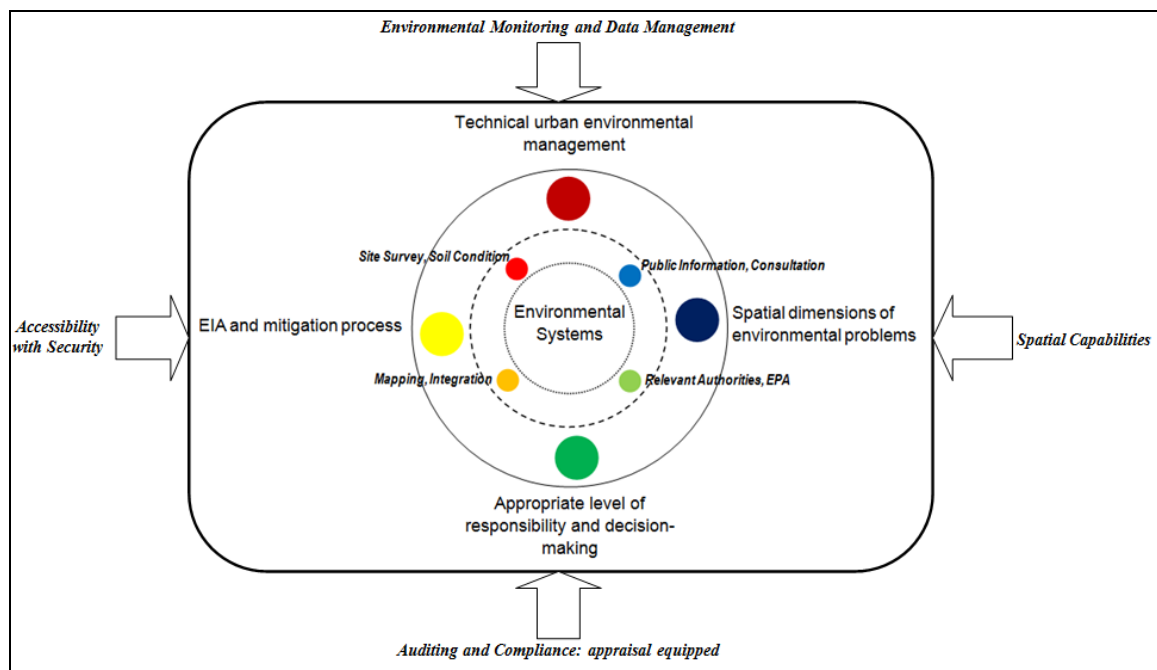


Figure 2. GIS and Environmental Data Integration.

As it can be noticed, the receptive method of GIS and Environmental Data Integration can be categorized based on:-

- Spatial Capabilities: including map's integration, and data amalgamation enabling spatial representation.
- Environmental Monitoring and Data Management: monitor and regulate information to reduce the ecological risk, and better application of monitoring programs.
- Accessibility with Security: access, validated and protect historical data and allow approved individuals to monitoring programs and admittance the stored data sites.
- Auditing and Compliance: permitting the environmental data, including historical for the auditing purposes as required by the specific jurisdictions.

A key aspect of the GIS and Environmental Data Integration is the ability to further navigate, modify, calculate data and store specific technical information, including precise schematics and photographs via customized system dashboards. This customized system dashboards will not only entail natural environment information such as Hydrography and soil geology but also Flora and Fauna facts, thus creating a responsive approach.

Nevertheless, GIS will further assist with improving the EIA through careful and optimised amalgamation of ecosystem specific information such as any short and long-term deterioration evaluation and assessment. Accordingly, such evaluation requires effective environmental strategy as a part of the precise data integration.

4.2 Effective Environmental Strategy as a part of the precise data integration

To further promote the GIS and Environmental Data Integration, valuable environmental strategies need to be sympathetically implemented. These environmental strategies include [13]:-

- Institutional urban environmental management considerations. This includes in cooperating sustainability with environmental conditions during increasing local procedures. As a part of this global sustainability attitude they also needs to be regularly updated.
- Informational urban environmental management deliberation. This comprises of contemporary Software and Information Systems (for example, spatial capabilities) as a part of the flexible and functional approach.

- Technical urban environmental management contemplation. This consists of Solid Waste Management, Water, Sanitation and Air Quality Management, together with Traffic Management. All of these are based on the relevant acts a regulation, including the AS/NZS 1547:2000 and the Commonwealth Radioactive Waste Management Act 2005.

As it can be noticed these environmental strategies require careful planning and development in alignment with the Environmental Dynamics and Sustainability factors. Accordingly, the overall planning strategies as a part of the GIS and Environmental Data integration are [14], [15] and [16]:-

- Protecting and improving the environment in both urban and rural areas through institutional strengthening. Utilizing the institutional strengthening to minimize the urban and rural impact on natural resources at the local, state and federal jurisdictions [17] and [18].
- The creation of an integrated urban environmental management that symbolizes short and long-term goals and policy reforms of the EIA and mitigation processes.
- Integrated management of environment and natural resources through informed consultation with all the relevant entities and establishing set of achievable priorities as the basis of effective EIA and mitigation.
- Integration of the nature and severity of environmental problems, to initiate a set of agreed programs to further improve the effectiveness of the EIA and mitigation processes.

In addition, as the basis of such date integration, Sydney Metro project in Australia can be exploited. For this mega transportation project, the GIS was a vital tool for assisting with the EIA data integration through:-

- Determining the unique natural features of Sydney and its urban areas. This included the determination of the local ecosystem characteristics.
- Establishing the diverse spatial dimensions of Sydney environmental problems and the subsequent severity of various impact.
- Deciding the actual roles of local actors and authorities involved in this project.

5. Conclusion

Environmental Impact Assessment and mitigation are the complete process of collecting, analyzing information and the determination of the application for development or construction approval, which could be accessible by the concerned communities and organizations. Moreover, GIS is a software intended to encapsulate, store, analyze, manage and present all types of physical, biological, environmental, ecological and geological data.

To ensure that environmental impact assessment and mitigation are receptive the GIS will present the crucial tool. Using GIS not only improves the overall EIA and mitigation process, but also provides valuable mapping strategies, including holistic environmental system approach. Accordingly, this paper carefully discussed the main advantages of GIS to further present responsive EIA and Mitigation processes. In doing so, this paper also presented and discussed the receptive elements of the Environmental System Integration. Finally, this paper also conversed the significance of the GIS and Environmental Data Integration.

6. References

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