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ENVIRONMENTAL IMPACT ASSESSMENT FOR URBAN PLANNING AND DEVELOPMENT USING GIS

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Abstract

Cites are the magnet for the growth of the social, economic and political development of the country. It has a power for the development of large-scale and small-scale industries, educational institutions, administrative offices, public and commercial establishments etc. In turn it attracts more migration from the rural area to the urban area, or shifting from one urban center to another urban center. So the population density is getting magnified in certain pockets of the cities.

There will be an incredible need for basic amenities like housing, water, sewage management and transportation. The vital on urban land availability is tremendous and there will be a certain chance of deviation in the city plan (eg. master plan i.e. changes in the land use). As a result there will be a categorical damage of historical, biological, archeological, aesthetic and visual impacts and pollution in land, water, air and noise,. There should therefore be a definite impact assessment for any such type of development to safeguard the city environment.

The conventional way of Environmental Impact Assessment (EIA) study is a less accurate and more time consuming process because it has more dependant and independent variables which have to be taken in to account (eg. Landuse, land price, population density, socio-economic level, road accessibility, railway accessibility, air quality, ground water quality, noise level, biological content, historical value, archeological and visual importance), which also have different consequences. There needs to be a tool or support system, which can handle the larger volume of spatial and non-spatial data, to be capable of complexity of analysis and produce an alternative plan. Remote Sensing, Photogrammetry and GIS are the latest technologies and tools, which will produce much more accurate results and perform various geographic analyses even in complex situations. This paper will articulate the different factors to be considered for impact assessments for urban planning and development, and lists about the data which can be useful for this study, the previous study which was done in a similar area in another part of country, and detailed methodology which can be adopted for this are discussed.

Introduction

The urban population of India has rapidly increased in recent years. In 1961 about 79 million persons lived in urban areas of the country, by 2001, their number had gone up to over 285 million, an increase of over 350 percent in the last four decades, which will increase to over 400 million by the year 2011 and 533 million by the year 2021.

Census	Total Population (Million)	Urban Population (Million)	% Of Urban population to total Population	Decadal Urban growth rate (Percent)	Number of UA Towns	Number million cities
1951	361.08	62.44	17.29	-	2,843	5
1961	439.23	78.93	17.97	26.41	2,365	7
1971	548.15	109.11	19.91	38.24	2,590	8
1981	683.32	159.46	23.34	46.15	3,378	12
1991	846.30	217.61	25.71	36.47	3,378	23
2001	1027.01	285.00	27.78	36.47	-	-

Tamil Nadu has been one of the widely urbanized States, in a country with more than 1/3 of the population living in the 469 urban settlements. Tamil Nadu contributes 6.05% of the total Indian population, out of which rural population is 56.14% and urban population is 43.86%. The percentage of the Urbanization of Chennai district is 100%, Coimbatore (66%), Kaniyakumari (65%) and Nelgiries (59%).

Cites are the magnet for the growth of socio, economic and political development of the country. It has the power for the development of large-scale and small-scale industries, educational institutions, administrative offices, public and commercial establishment etc. In turn it attracts more migration from the rural area to the urban area or the shifting from one urban center to another. So the population density is getting magnified at certain pockets of the cities.

So there will be an incredible need for basic amenities like housing, water, sewer and transportation, which leads to tremendous pressure on urban land availability and there will be a certain chance of deviation in the city plan (eg. master plan i.e. changes in the land use). As a result there will be categorical damage of historical, biological, archeological, aesthetic and visual impacts and pollution in land, water, air and noise, so there should be a definite impact assessment for any such type of development to safeguard the city environment.

Environmental Impact Assessment (EIA)

What is EIA?.

It is defined as the systematic identification and evaluation of the potential impacts (effects) of proposed projects, plans, programs or legislative actions relative to the physical, chemical, biological, cultural and socio-economic components of the environment.(Canter,1996)

When EIA is needed?

The two fundamental approaches for determining whether or not to conduct a comprehensive environment impact study for a proposed action are the use of the policy delineations based on project type and size or conduction of a preliminary study. The project type and size will be guided by the Ministry of Environmental and Forest (MOEF), Government of India. The second approach is to conduct a preliminary study, and pending the findings of the study or document, that the findings were such that a comprehensive study wouldn't be required.

An ideal EIA system would

a)..apply to all projects that are expected to have a significant environmental impact and address all impacts that are expected to be significant.

b). Compare alternatives to a proposed project (including the possibility if not developing sites) management technique and mitigation measure.

c). Result in a clear EIS which conveys the importance of the likely impacts and their specific characteristics to non-experts as well as experts in the field.

d). Include broad public participation and significant administrative review procedure.

e). To be timed so as to provide information for decision-making

f). Be enforceable

g) .Include monitoring and feed back procedures

The Asian Development Bank defines the project cycle, consisting of the project identification, fact-finding, preparation, pre-appraisal, appraisal, Negotiation, unlimited attention and supervision, completion and post evaluation. A similar project cycle with environmental consideration is used by the world bank (1991).

The seven step / seven phase model for planning and conducting environmental study is shown in fig.1.0.

An overall framework for identifying the direct and indirect and ultimate impacts of a proposed actions are shown in fig.2.0.

EIA Using GIS

Geographical Information System (GIS) is a computer system that can store, integrate, analyze and display spatial data. The first systems evolved in the late sixties, and by mid seventies they have been used for EIA. One of the main methods of analysis in GIS is the overlay technique, mentioned above. In 1972 a computerized version of the technique was used for siting power lines and roads (Munn, 1975). It is noteworthy that the so called "first GIS" (Canada GIS or CGIS) was used for EIA in the late 1970's for the preparation of an EIS for a dam on the river Thames. GIS offers a special environment for dealing with the spatial properties of a project. Those special attributes

of the GIS are very important for the analysis of environmental issues, since most of them are spatial by nature, and no other computerised system can handle them properly (Schaller,1990). In recent years two important developments have helped in reduce the complexity of spatial analysis. In the last decade, due to the evolution of computer technology, and especially their graphic capabilities, GIS's have become more user friendly and powerful.

In addition the availability and quality of digital spatial data sets have improved, to the level where they are now adequate for routine analysis (Batty,1993). These two trends make possible the set up of and use of GIS at lower cost in terms of time and money then ever before.

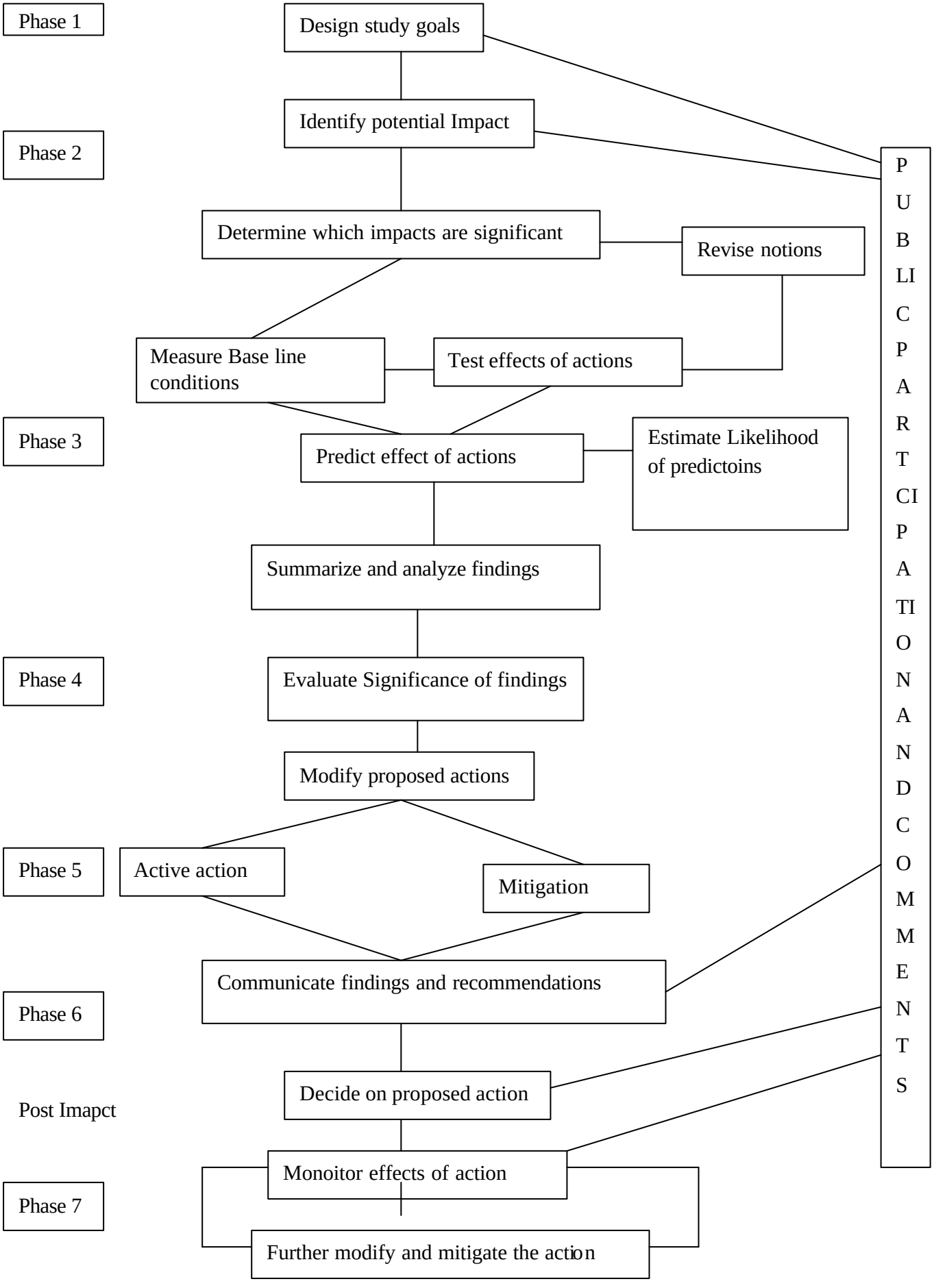
However, the use of GIS in EIA process in general, and for scoping in particular has been limited, due in part to their cost in terms of time and money relative to the time and budgets allocated for EIA preparation, and especially for scoping.

Recent surveys of the use of GIS in EIA found that while GIS is widely utilised, its use is largely limited to the basic GIS functions such as map production, classic overlay or buffering (João, 1996). This utilisation does not make use of the key advantage of GIS for EIA, its ability to perform spatial analysis and modeling (João & Fonseca, 1996). Noteworthy are some more complex, though sporadic, reports on the uses of GIS for EIA - such as using GIS in complex modeling representation techniques (Schaller, 1990), or its potential as a repository of data and cumulative impact assessment (Johnston *et al*.).

Application of Expert System For EIA

The various methods, approaches and techniques presented in chapters three to seven for identifying, measuring, and assessing impacts all have two aspects in common. First, they are designed to deal with the considerable amount of information that must be processed and analysed as a part of an environmental impact assessment (EIA). Second, they rely on expert judgments.

Fig.1.0. PHASES OF IMPACT ASSESSMENT



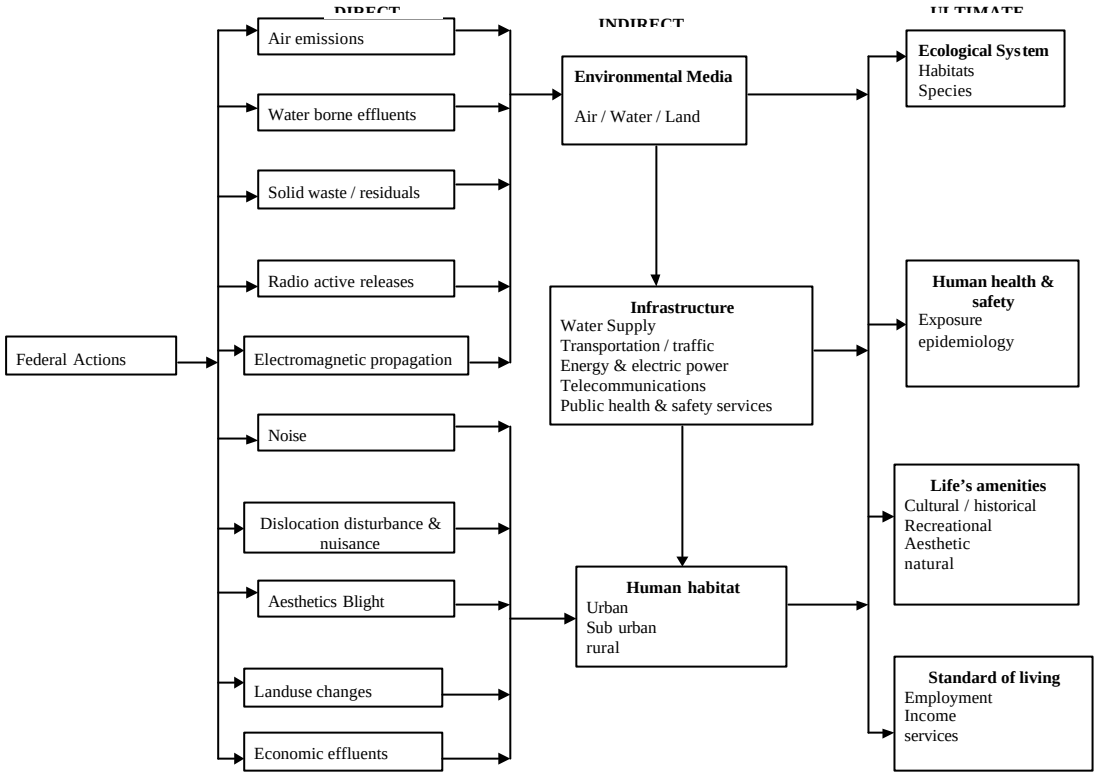


Fig.2.0. SYSTEMATIC APPROACH FOR IMPACT IDENTIFICATION

The challenge of collecting, processing, analyzing, and reporting information can be partially met by use of various computer and information technologies. The use of predictive computer models are becoming more prevalent. The use of geographic information systems (GIS) for handling spatial data is also becoming more frequent where there are adequate personnel skills and financial resources to acquire the necessary data. In most cases, however, environmental problem solving is conceptual and cannot always be reduced to quantitative analysis (that is, modeling). Often, available information is incomplete, subjective, and inconsistent.

Experts are heavily in involved in all aspects of the assessment. Many checklists, matrices and models used in EIA are accumulation of the experience of many experts gathered over many years. Experts are used to help identify the potential for significant impacts, plan data collection and monitoring programs, provide judgment on the level of significance for specific impacts, and suggest ways of reducing or preventing impacts. The constraints on implementing EIA processes in developing countries concluded there is a critical lack of environmental scientific expertise to help government, industry, and development banks apply existing knowledge to meet the EIA requirements. When there are a large number of projects to consider, contracting outside experts for each one is not always practical, and EIA may be undertaken by those lacking either sufficient training or time to make sound decisions.

Expert systems are promising technologies that manage information demands and provide required expertise. They thus seem well suited to many of the tasks associated with EIA. Additional advantages of using expert systems for EIA are:

1. Expert systems help users cope with large volumes of EIA work:
2. Expert systems deliver EIA expertise to the non-expert.
3. Expert systems enhance user accountability for decisions reached and
4. Expert systems provide a structured approach to EIA.

Because the application of expert system technology to EIA is relatively new, one might consider the technology as "too" advanced and not appropriate for developing countries. This is not true, and expert systems are slowly being disseminated throughout developing countries in Asia and the Pacific.

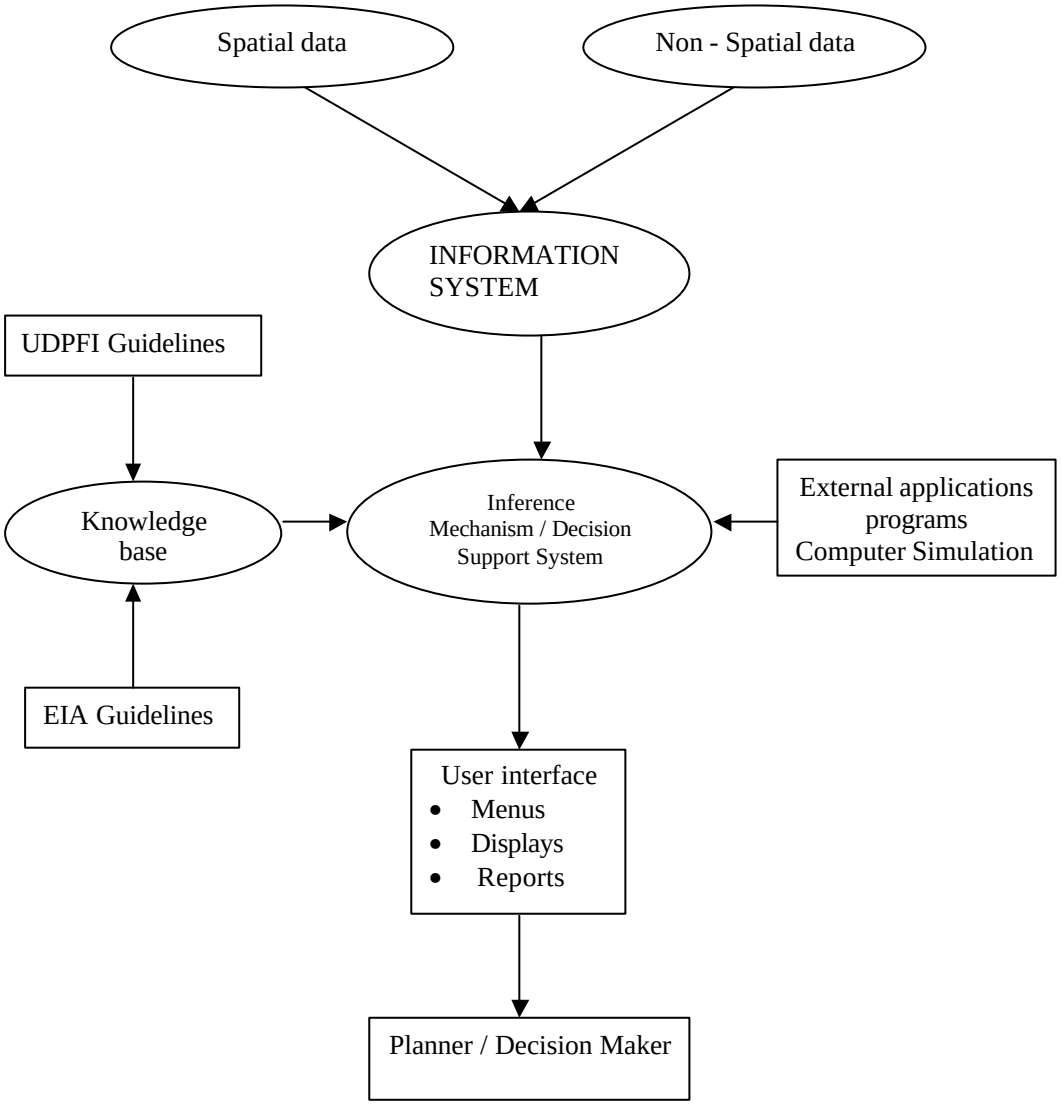
Before discussing the current application of expert systems in developing Asia and the Pacific, it is necessary to better describe the technology itself and discuss its present and potential application to EIA.

Expert Systems

The general structure of an expert system (Figure 3.0) can be described in terms of six main components:

1. The Various external data acquisition systems, which provide the input data for the specific application. These systems may be include spatial as well as non spatial data. The spatial data such as Remote Sensing data, Toposheets, Master plan / Detailed Development Plan, Infrastructure network details (Road, water and sewer, Electricity etc) and environmental zonal maps (Air and water quality) and soil maps etc. The non-spatial data include data such as land parcel information and infrastructure network information etc.
2. External application programs, with which the system exchanges information and data. For example, computer simulation models may provide quantitative estimates of air and water quality parameters or GIS may provide spatial data on the location and characteristics of key environmental components. Reports from expert systems may be exported to common word processing or database software programs.
3. The knowledge base, which is a collection of domain specific knowledge usually represented as rules based on IF- THEN logic;
4. The user, who controls the system, inputs information, selects options, and generates reports;
5. The user interface, which is the means by which the user communicates with other components. Most user interfaces are menu driven and have a number of display and reporting features; and
6. The inference engine, which is the reasoning mechanism that manipulates the rules in the knowledge base to provide conclusions. These specific conclusions depend on the information supplied by the user, external data acquisition systems, and external programs.

Fig.3.0.a.SCHEMA FOR PROPOSED EIA-GIS TECHNIQUE



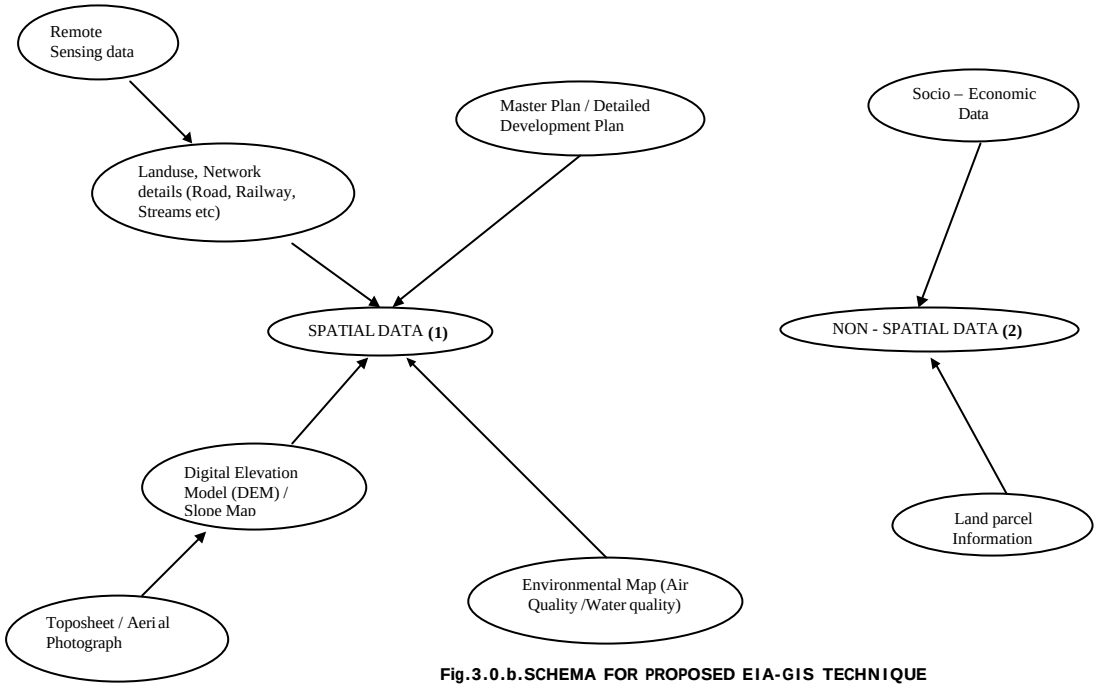


Fig.3.0.b.SCHEMA FOR PROPOSED EIA-GIS TECHNIQUE

Conclusion

This paper discussed the basic definition of EIA, when it is needed and what is the process for which the EIA has to be done and what are the factors to be considered in EIA for various urban planning projects etc. This study focused on the possibility of using GIS as a basis for scoping at the project level. It didn't address the issues related to the policy level. There are issues that need further work. This study however has shown within the limited scope of project level EIA and the scope of project level EIA and when the appropriate institutional capacity exists, GIS can serve as an important highly useful tool for environmental scoping and that this potential has not been tapped as yet.

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