Chapter 7: Application of Remote Sensing and GIS for EIA

7.1 Introduction

- The environment virtually encompasses everything in the world around us. This includes both natural, physical, biotic and abiotic as well as human socio-economic features.
- Geographers have long claimed interest not only in the unity that exists in the biosphere (ecosystem concept), but also in the intrinsic quality of individual places.
- Hence, geographers as resource analyst seek to understand the fundamental characteristics of natural resources and the process through which they could be and should be allocated and utilized to meet the needs of today and tomorrow.

- Hence, in resource development it is required that the overall or aggregate effect of the proposed development on the biophysical basic life constituents (air, water, soil, biodiversity, wildlife e.t.c) as well as socio-economic constituents (people and their livelihood, lifestyle, aesthetics, perception cultural heritage, security e.t.c.) be put into consideration in the benefit-cost analysis. This consideration of the benefit-cost analysis is known as environmental impact assessment.

- According to a survey undertaken by Joa˜o and Fonseca (1996), GIS was used for all EIA stages.
- The most frequent use was for the presentation of results, followed by analysis/modeling and data preparation.
- GIS have also been used for the presentation of environmental baseline information and project description, through the preparation of thematic maps for the several environmental descriptors.
- Also, the overlay of baseline information maps with project layouts is frequently used for impact identification.

The prediction of the magnitude of impacts is often undertaken by the application of simulation models (Fedora, 1993).

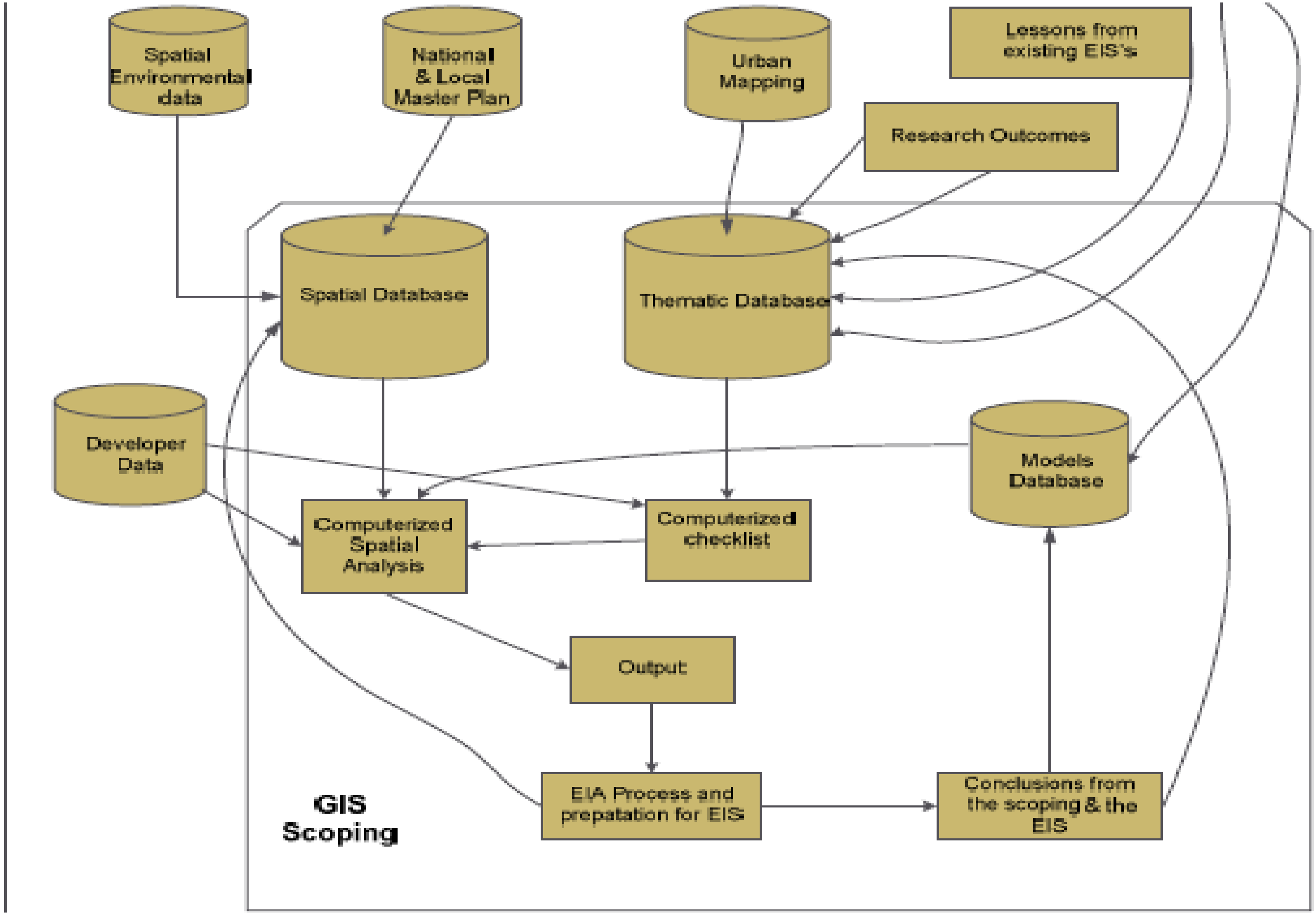

Fig. . GIS utilization within Environmental Impact Assessment (adapted from Hacklay et al., 1998).

- Given the spatial nature of many environmental impacts, GIS can have a wide application in all EIA stages, acting as an integrative framework for the entire process, from the generation, storage, and display of the thematic information relative to the vulnerability/sensitivity of the affected resources, to impact prediction and finally their evaluation for decision support (Antunes et al., 1996).
- Eedy (1995) also stresses the advantages of the use of GIS in EIA, namely for data management, overlay and analysis, trend analysis, as sources of data sets for mathematical impact models, habitat and aesthetic analysis, and public consultation.

Erickson (1994) suggested 4 four ways of using GIS for EIA. These are:

- **Overlay method: This involves overlaying of** different layers of interest of the study area to achieve the needed result.
- **Checklist method: This is the listing of** environmental components, attributes and processes categorized under different groups.
- **Matrix method: This is the relating of specific** project activities to specific types of impacts.
- **Network method: This defines a network of possible** impacts that may be triggered by project activities.

It involves project actions, direct and indirect impacts.

Eedy (1995) has described G IS as a veritable tool in environmental assessment because it:

- Stores large multidisciplinary datasets.
- Identify complex interrelationship between environmental characteristics.
- Evaluate changes over time.
- Can be systematically updated and used for more than one project.
- Serve as a dataset for a variety of mathematical models.
- Store and mampulate3D in addition to 2D files.
- Serve the interests of the general public as well as technical analyst.

Table 1: **Examples of the Possible Usage of GIS in Various Stages of the EIA Process (after Joao and Fonseca, 1996)**

Phase	Possible Usage of GISs
Screening and scoping	Useful in data gathering, spatial modeling, calculation of impact magnitude, and impact assessment.
Description of the project	Relationship of project to geographical context
Description of baseline conditions	Documentation and display of biophysical inventories (for example, vegetation, habitat, land use, etc.), hydrology, soils, archaeological and historical resources, land ownership, topography, roads, utilities, and others.
Impact identification	Use of overlay analysis to display pollutant distributions with resource maps or to integrate the results of air quality modeling and habitat suitability analysis.
Prediction of impact magnitude	Use for quantitative assessment of the percentage of resource base affected by a pollutant. Also, can create impact magnitude maps derived from the integration of the results of risk and air quality modeling with other data layers such as soil susceptibility to acidification.
Assessment of impact significance	Useful for spatially displaying the impact significance and how that variation changes with different alternatives, including the "do nothing" option.
Impact mitigation and control	Can be used to identify areas where mitigation measures should be applied. GISs can also be used to show the geographical location and the extent of mitigation activities over time.
Public consultation and participation	GISs can be used for preparing presentation material, to explain the project to the public, and also to allow a quick response to questions and suggested changes.
Monitoring and auditing	Can use GISs for designing monitoring programs, for processing and storage of monitoring data, for the comparison of actual outcomes with predicted outcomes, and for data presentation showing the variation of the location of pollutants with time.

EIA and remote senisng use

1. Remote sensing is used to generate new information and to study environmental change over time. Supported by raster GIS, which is used for comparisons, statistics and presentation of findings.

2. Visual interpretation is normally used for overviews. Supervised digital clasification is only used in smaller areas and in such cases where the field data is sufficient for a calibration and generalisation of findings.

3. The methods have to be cost effective and applicable also in a field situation.

4. Portable computer, raster GIS (MF Works). Presentation and discussions with local communities. Integration of local knowledge.

Remote sensing serves as a tool for environmental resources (biotic, abiotic and cultural) assessment and monitoring. Remote sensing has some fundamental advantages that make it a veritable tool in environmental monitoring and management and impact studies. These have been listed by Barret and Curtis (1976) to include:

- A capability for recording more permanently detected patterns
- Play-back facility at different speeds
- Opportunity for automatic (objective) analysis of observations to minimise personal peculiarities of observers
- Means of enhancing images to reveal or highlight selected phenomena

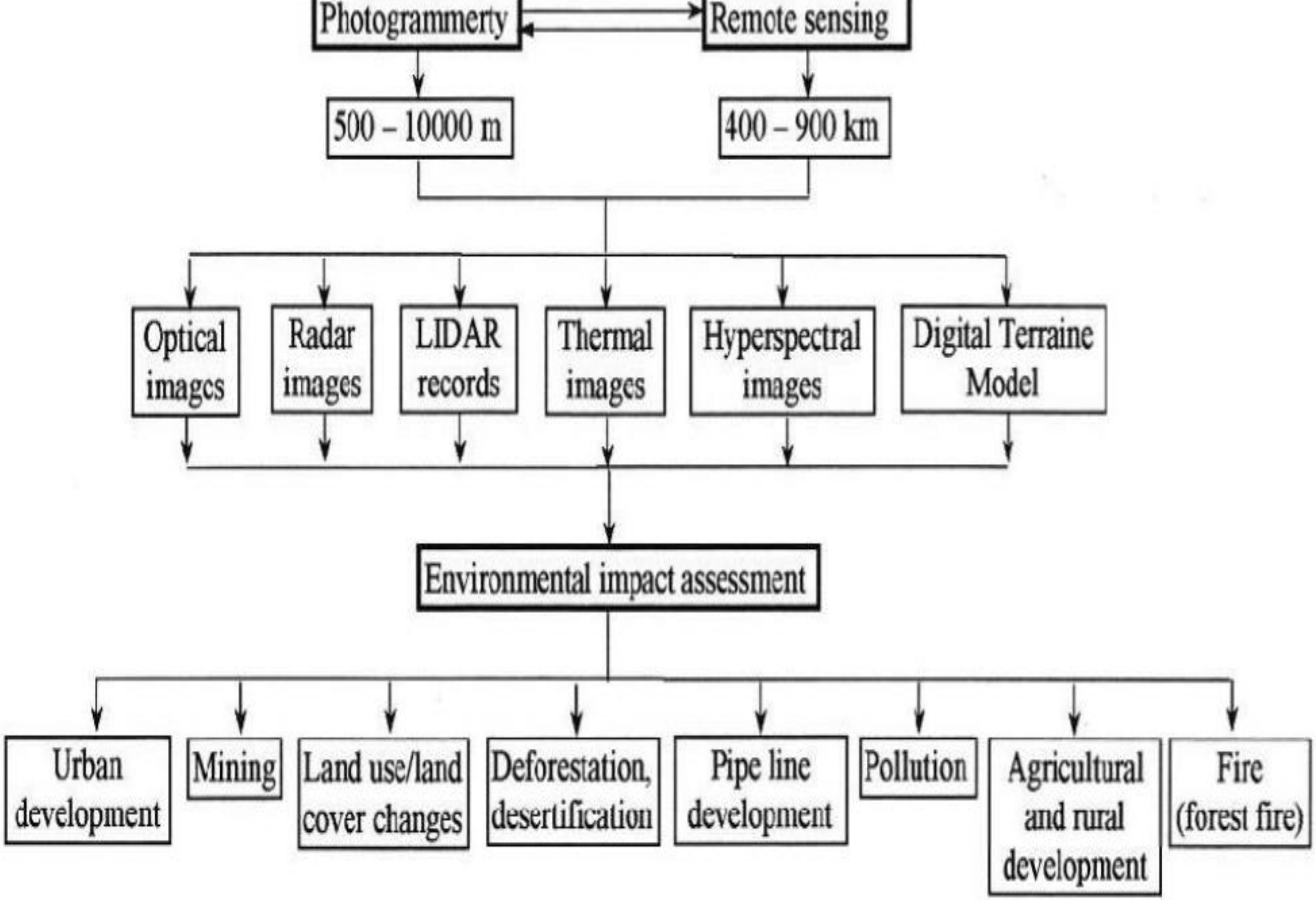

Fig. Type of satellite images used in environmental Monitoring and EIA Source; N.M. Avouris, B. Page (1995), [5]

Summery Objective (intended goal)

The capabilities of RS and GIS in this Environmental Monitoring phase of EIA, as a special type of spatial information used for decision making are;-

- To integrate and manage huge amounts of multi-source data,
- To perform spatial analysis and,
- To produce synthetic results that can prove useful in decision making.
- Allows land cover mapping and the inventory of natural resources,
- Provides quantitative estimations of biophysical properties of land surface features and,
- Is useful in tracking how landscape changes over time.

Chapter Application of Remote Sensing and GIS for EIA

End

Thank you!!!