

WHAT IS GIS - AN INRODUCTION

GIS DEFINITION

GIS is an acronym for: **Geographic Information Systems**

Geographic

This term is used because GIS tend to deal primarily with 'geographic' or 'spatial' features.

Information

This represents the large volumes of data, which are usually handled within a GIS.

Systems

This term is used to represent the systems approach taken by GIS, whereby complex environments are broken down into their component parts for ease of understanding and handling.

WHAT IS GIS?

A Geographic Information System (GIS) is a **computer-assisted system for the acquisition, storage, analysis and display of geographic data.** Today, a variety of software tools are available to assist this activity.

The software can differ from one another quite significantly, in part because of the way they represent and work with geographic data, and also because of the relative emphasis they place on various operations. Some of the softwares used for GIS are **ArcGIS, QGIS, ERDAS Imagine ENVI** among others.

Geographic Information System (GIS) is built on knowledge of various academic disciplines which makes a new interdisciplinary science which uses GIS as a unifying factor to all to solve a commons spatial problem in a holistic approach. Figures 1 below, shows a Visual approach to GIS definition all the monitors visualizing one globe from different angles.

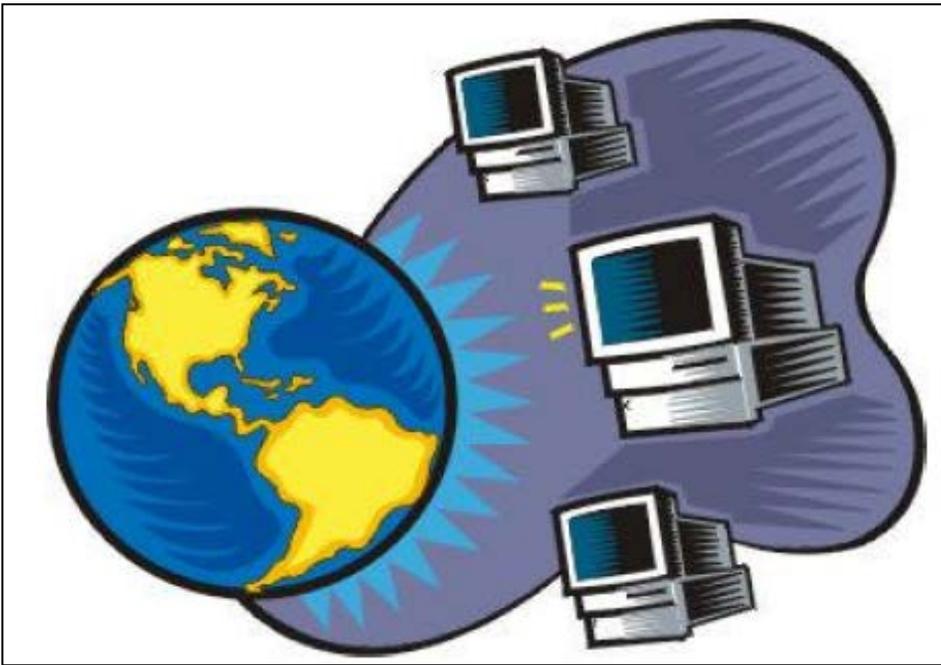


Figure 1: Visual approach to GIS definition.

OTHER DEFINITIONS OF GIS

GIS is a special-purpose digital database in which a common spatial coordinate system is the primary means of reference. Comprehensive GIS require a means of:

1. Data input, from maps, aerial photos, satellites, surveys, and other sources.
2. Data storage, retrieval, and query.
3. Data transformation, analysis, and modeling, including spatial statistics.
4. Data reporting, such as maps, reports, and plans.

GIS is a concept combining three types of spatially referenced data:

1. Map information
2. Spatially reference statistics
3. Remotely sensed images

That is integrated into one system.

Need for computer hardware and software in a GIS System

Because of the large amounts of data involved in GIS e.g. integrating field data, maps and aerial imagery visualization of many data sets, computers are required for the development of a GIS system to:

1. Capture digital data sets

2. Edit digital data
3. Reproduce digital data graphically as maps in the hope of saving on labour and cost
4. Has speed and flexibility

Because computer hardware doesn't work on its own, there is need for specialised software, to design a system which would produce a variety of maps quickly.

DATA IN A GIS SYSTEM

The data in a GIS is referred to as a database. A **database** is composed of several (a number) of **data planes** or layers or data elements.

Data elements are derived from data sources e.g. maps, satellite imagery, aerial photographs, thematic maps etc.

Data elements can be combined to yield data interpretations by the use of specialised softwares like ArcGIS. Figure 2 illustrates how data planes in a GIS system are integrated to give information of a spatial location.

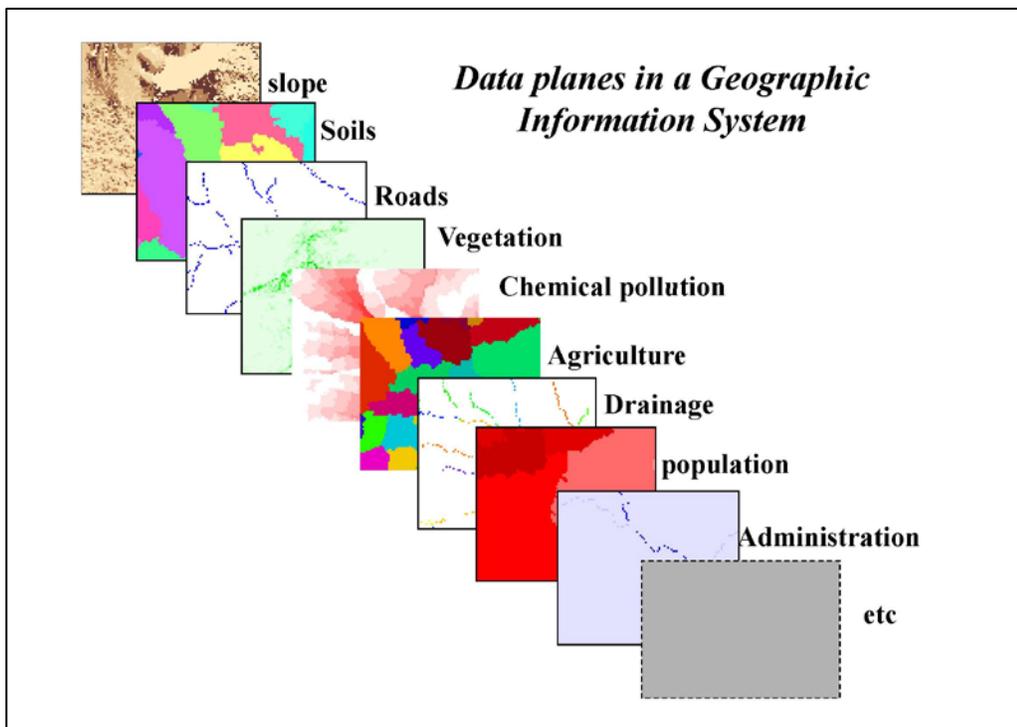


Figure 2: Data Planes is a GIS System.

Each data plane is of one data type e.g.

1. Real valued functions such as digitised elevation data, population, etc.
2. Vector valued functions such as terrain units, geological units etc.

3. Raster valued function such as vegetation signatures, soil signatures.
4. Functions taking general symbolic values such as place names, river names etc.
5. Data in a data plane have a specific "data structure" (NB by data structure, for example in a non-digital data, the structure can be written texts, maps, tables or photography).
6. A vector structure based on lines (digitised contours, rivers, roads, fall polygons grid, land use boundary, lithology or points - elevation, population, institutions).
7. Raster structure based on matrix of points - grid points or pixels - multi-spectral imagery.

The amount of data involved is vast, and the variety of location, topic and format wide.

All problems can be reduced to answering one or the other of the two questions:

1. Finding locations with specified properties (where – spatial))
2. Finding the properties with/of specified locations (what – attribute)

Answering these two questions, Leads to application of a GIS system in various areas addressing real world problems. Figure 3, shows some of the areas where a GIS system is applied in real world.

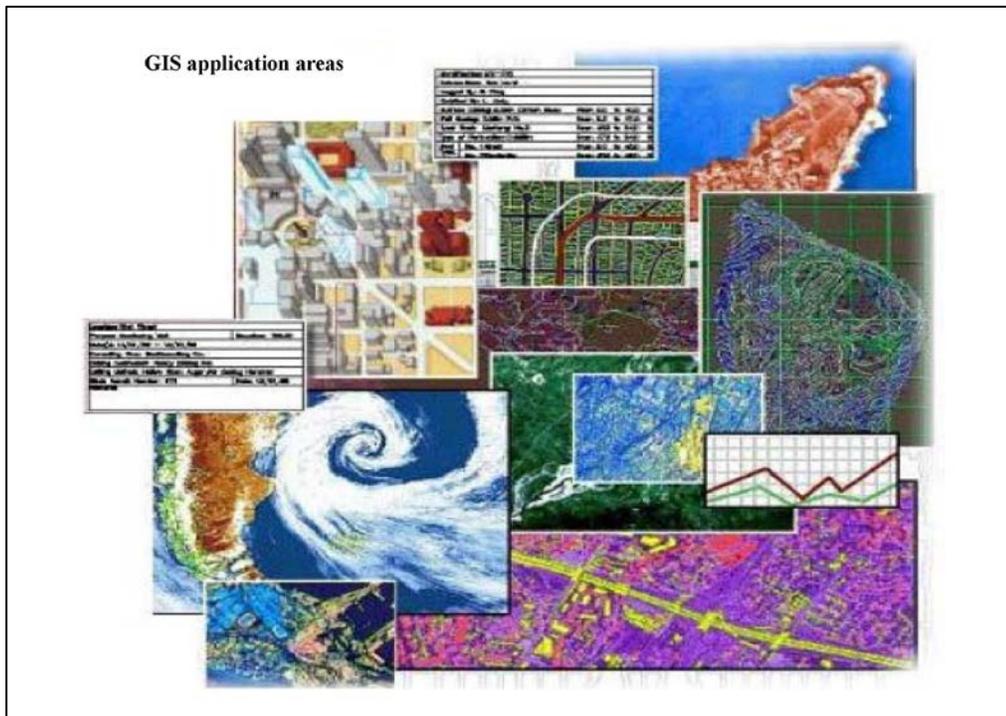


Figure 3: GIS application areas

GIS Application Areas

- Agriculture
- Forestry & Wildlife Management

- National, State, County, Regional, Local mapping and geographic inventory
- Archaeology
- Geology
- Oil and gas exploration and production
- Municipal Applications
- Streets
- Properties/Cadastre
- Facilities
- Agriculture
- Forestry & Wildlife Management
- National, State, County, Regional, Local mapping and geographic inventory
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- Facilities

GIS DATA ANALYSIS EXAMPLES

1. Terrain Analysis

Various set of data are used for terrain analysis of a spatial location. The use of GIS system helps the analyst to bring in different data planes of the same spatial location together and come out with a comprehensive terrain analysis. Data planes as shown in Figure 4 are analyzed using the GIS specialist softwares like ArcGIS to produce a map showing Terrain of the location under study.

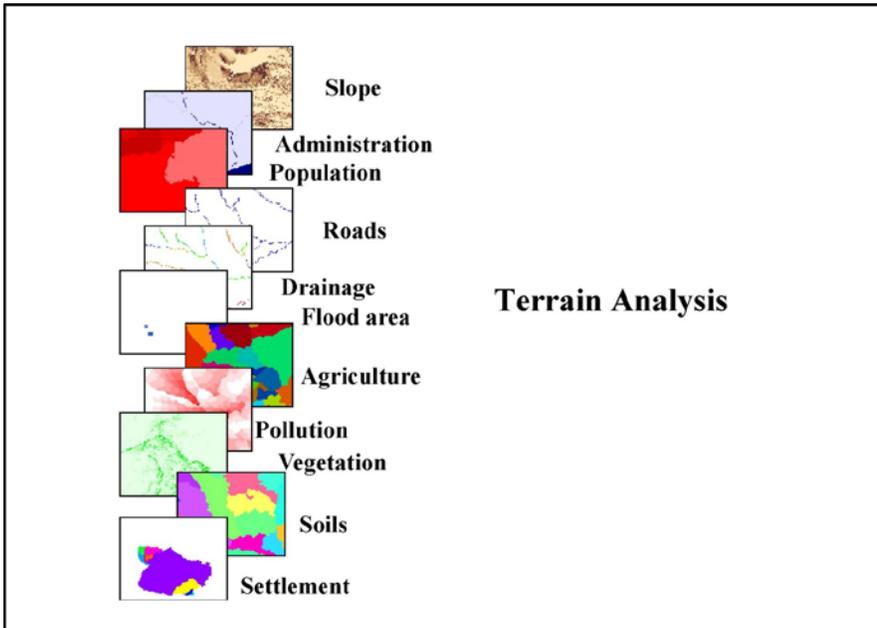


Figure 4: Terrain Analysis.

2. Integrated Land Analysis

Integrated Land use analysis entails various data planes that give information on how a particular parcel of land is used. Comprehensive analysis gives an integrated approach in the analysis of land use touching all features existing on that particular parcel. The features may be natural or manmade which are true representations of the real world. GIS system help to model this real word picture for Land use analysis. Figure 5 shows data planes required to model a real world for integrated land analysis.

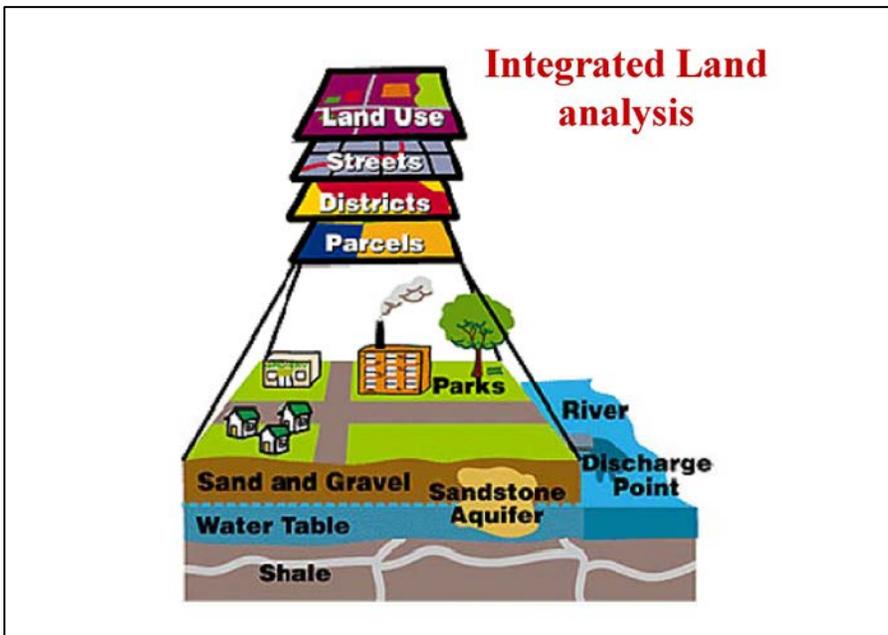


Figure 5: Integrated Land Analysis

3. Hydrological Analysis

Flow direction of water is dependent on the gradient, flowing from higher to lower grounds. Hydrological analysis of a river or stream will need more data than just the gradient. All the data planes are stacked together in layers, each layer giving a particular set of data for that particular river/stream. The capability of GIS system to combine multiple layers for analysis to give one set of information of a particular feature is awesome. Figure 6, shows a hydrological grid produced in terrain analysis of a river.

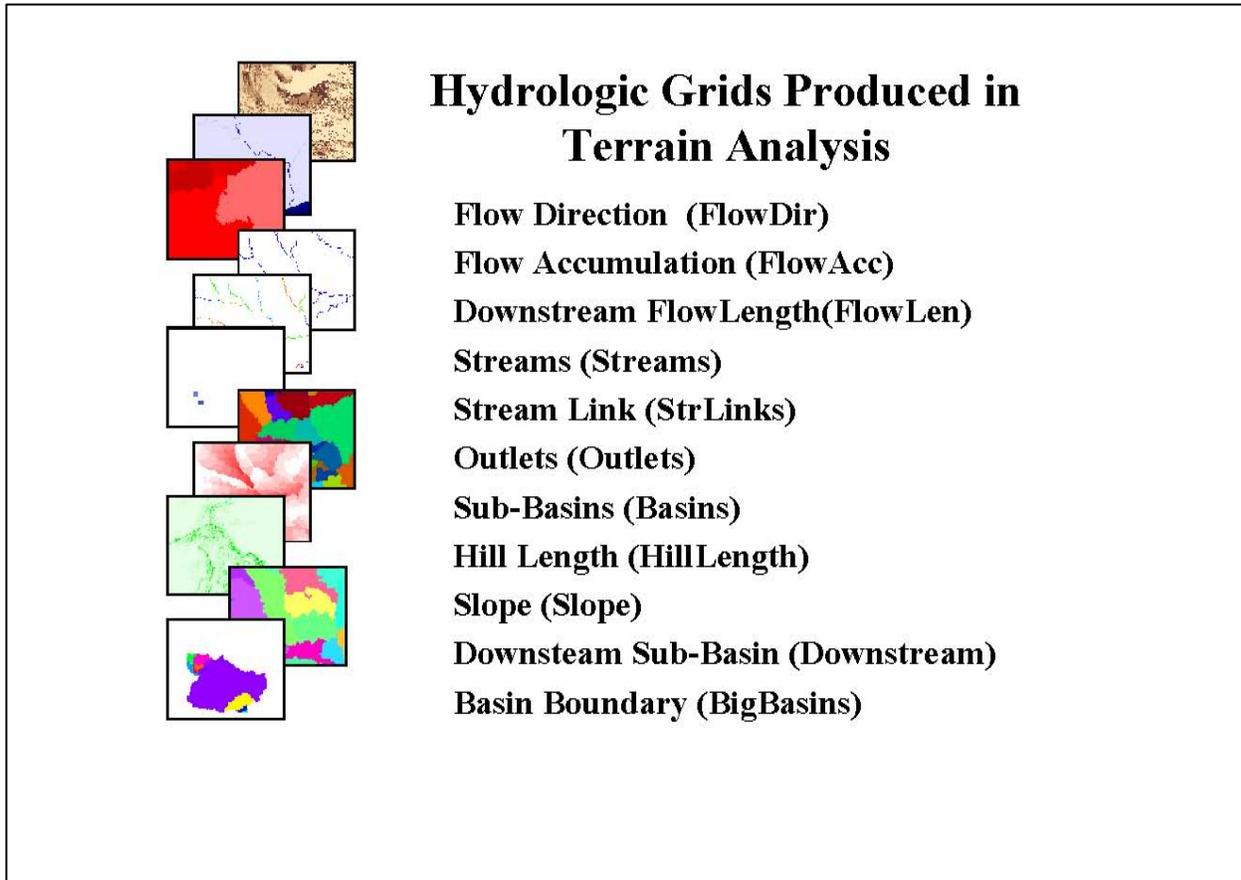


Figure 6: Hydrological Analysis

Graphical representation of GIS components

Figure 7 shows a summary of graphical representation of GIS components that make up a GIS system. Maps and images forms the input components needed for spatial data base. Attribute data base of a particular feature is then update by GIS personnel forming the five elements of a GIS system. Map, Statistical reports and tabular data are the end product of a GIS system analysis.

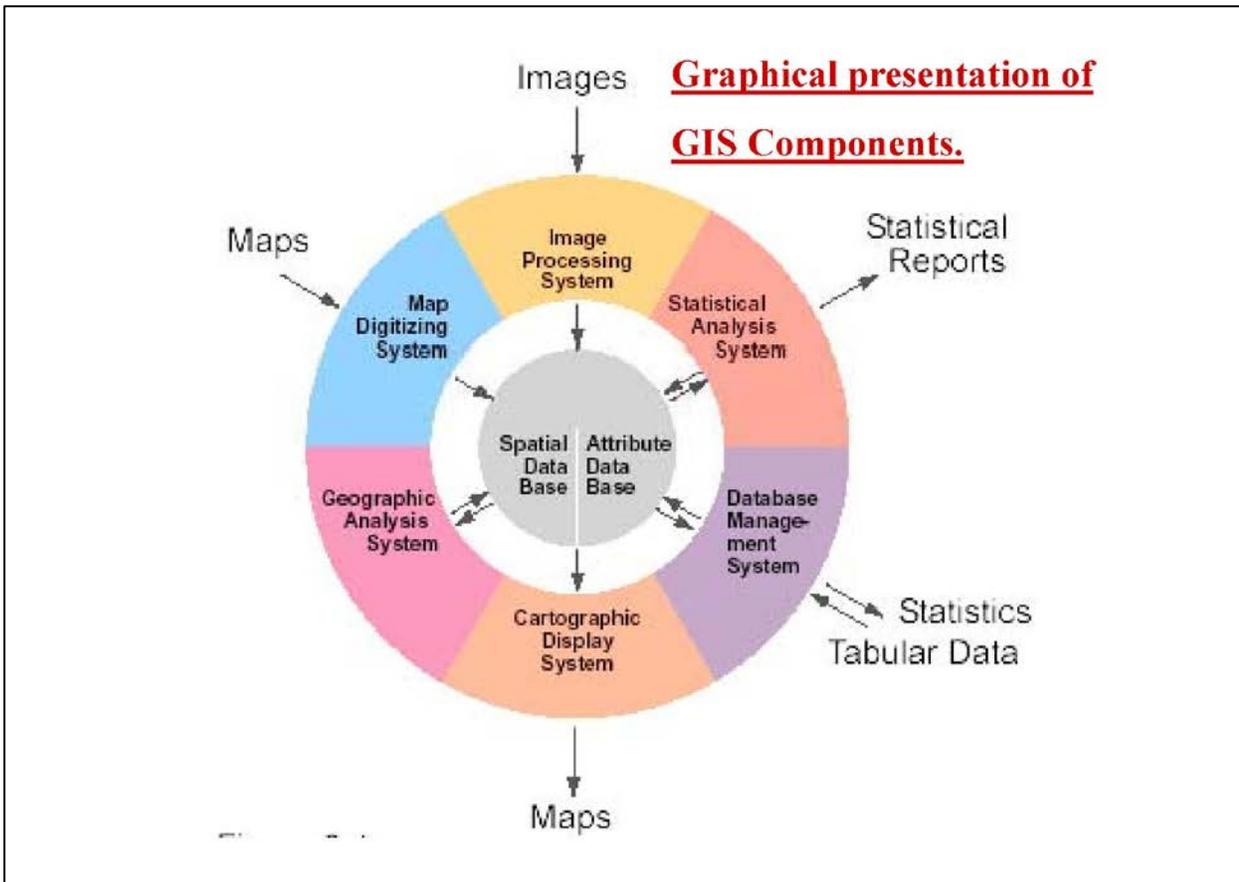


Figure 7: GIS Components

System diagram to represent GIS

The system diagram shown in figure 8 illustrates three interfaces of a GIS system.

The inputs interface which includes maps, tabular data and other GIS data feeds into the GIS data processing interface.

The data processing interface has the data base management system as the core engine and the user requirements as the driver of the process.

The outputs interface represent the end product which is inform of; textural reports, maps, data model photographic products etc. These products inform the consumer of the processed data in decision making.

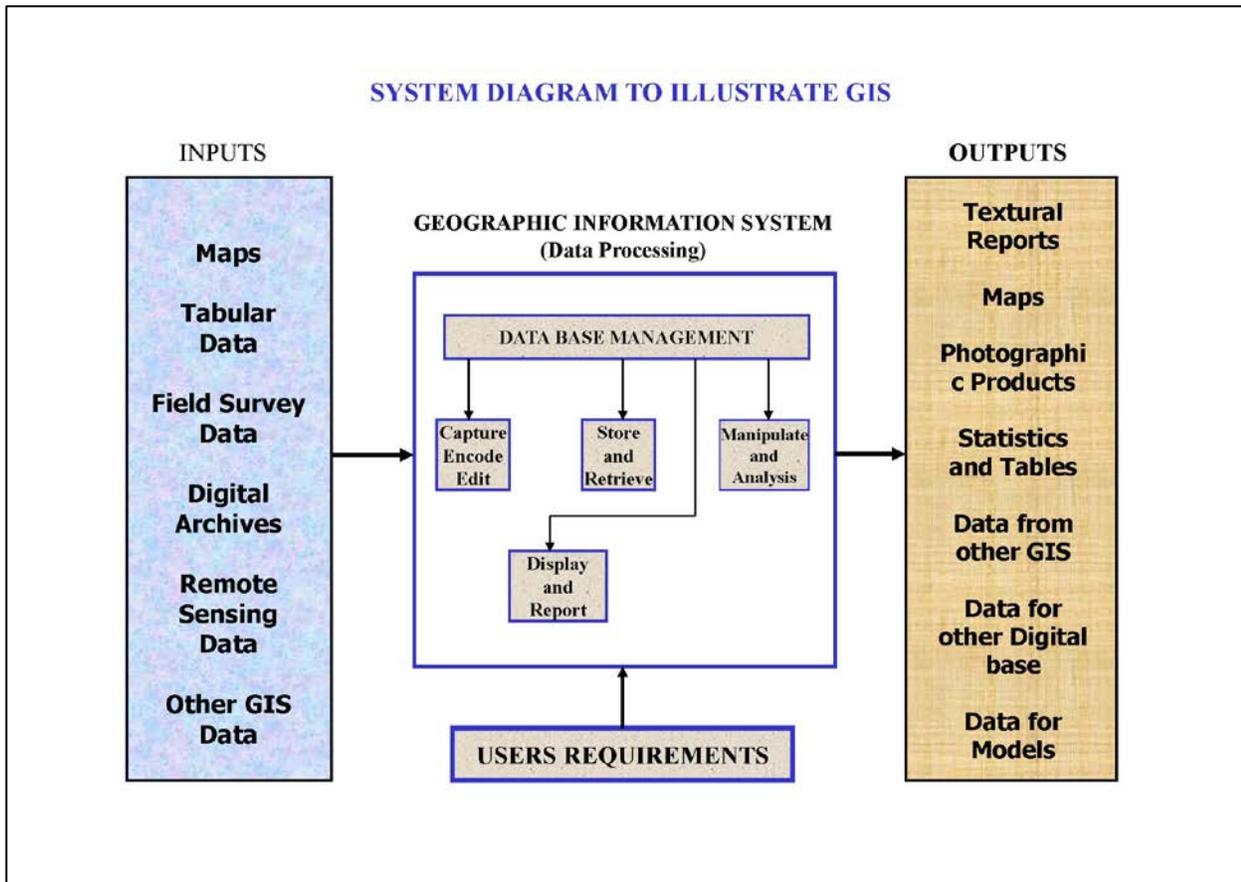


Figure 8: A GIS System Diagram

Stages of a true GIS System

To be a true GIS system, an essential group must be found. A true GIS system consists of 6 stages which can be viewed as subsystems in the operation of the total system:

1. Data acquisition, surveys and research operation
2. Data input and Data storage (data and image processing)
3. Data processing (analysis and modelling)
4. Data output (editing, computation, reports and public relations)
5. Data use (continuous observation by the use of land properties and feedback)
6. Management

Computer automation can be used to some extent at all stages.

An integrated GIS System in National Spatial Data Infrastructure (NSDI)

To have a NSDI that address national spatial problems, key stake holders must come together and think spatially.

The main stakeholder being government departments and institutions, need to be supported to realize this noble dream. Research and academic institutions for example need to work closely with the regional/County Planning authority to advise the National government on matters pertaining to spatial planning.

The private, NGOs and the district development committees, need to have a voice into the shaping of spatial information system of a Nation. To realize this enormous task, a GIS system can act as a common Data administration unifier for all the stakeholders. This will allow all data from every Key stakeholder be available to the other stakeholders for transparent and accountability.

Leveraging on the capability of a good GIS system, data will be updated by one stakeholder in their mandated dockets and availed to the other users in an updated status without duplication of the same set of data. A summary of a conceptual framework of an NSDI is illustrated in Figure 9.

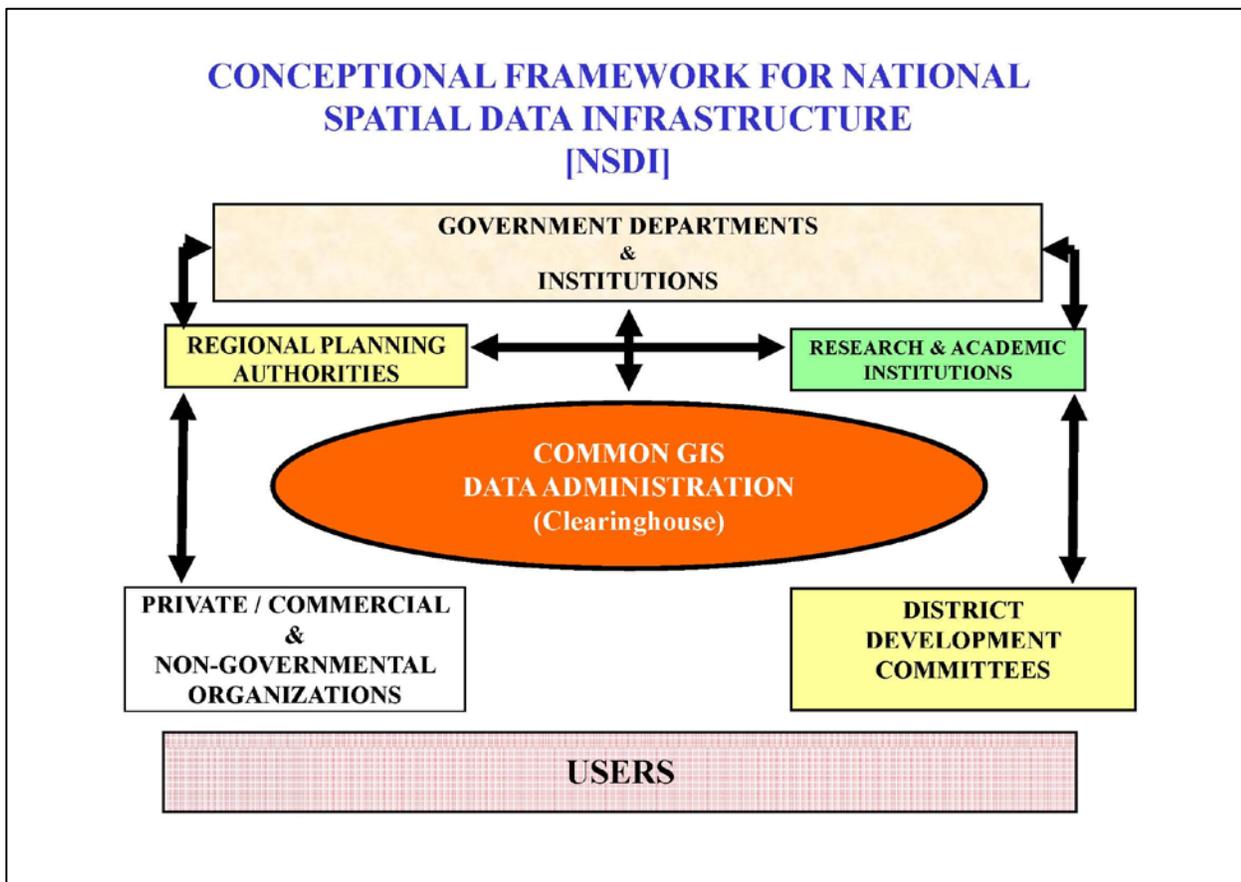


Figure 9: Conceptual Framework for NSDI