srijan सृजन
Self-Reliant Initiatives through Joint Action

Getting Familiar with GIS

Understanding role of GIS in Planning

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What is GIS?

- GIS (Geographic Information Systems), are computer-based tools used to store, visualize, analyze, and interpret geographic data.
- Geographic data is also called spatial, or geospatial data. Identifies the geographic location of features.
- These data include anything that can be associated with a location on the globe, or more simply anything that can be mapped.
- Roads, country boundaries, and address are all types of spatial data.

GIS in other words:

Geography (from the Greek word Geo (γη) means "Earth", and graphein (γραφειν) meaning "to describe" or "to write“ or "to map") is the study of the earth and its features, inhabitants, and phenomena. A literal translation would be "to describe or write about the Earth". Features can be calculated, in terms of Geographic coordinates (Latitude, Longitude)

Remote Sensing

- Is the Science and Art of acquiring information about objects from measurements made at a distance without any physical contact with the objects.
- Remote Sensing refers to gathering and processing of information about earth's environment and its Natural & Cultural Resources through Aerial photography and Satellite imaging.
- National Remote Sensing Centre (NRSC) is the central agency providing various services related to Remote Sensing. In recent years NRSC has launched a Web Map Service Portal named "Bhuvan" (http://bhuvan.nrsc.gov.in) serving multiple development programmes i.e. watersheds to e-governance.

What is the Purpose of Geographic Information Systems?

- **Visualizing data geographically** can help people spot patterns that would have been difficult or impossible to detect in a huge spreadsheet.
- Ascertain **land forms for planning**. Identification of **work sites for water resources**. Tracking climate change.
- Environmentalists were some of the earliest adopters, using GIS to **track melting glaciers** and deforestation.
- **Military** relies manage logistics, location intelligence and satellite data.
  Local police forces use GIS for predicting policing and investigative analysis.
- Today, GIS continues to expand into diverse areas including **archaeology, education and transportation**.

Benefits of GIS (Geographic Information Systems)

- Businesses and governments by giving them the ability to ask complex questions about **location-based data**.
- GIS analysis uses **spatiotemporal data** to provide visual clues that help people discover deeper insights than they could with a paper map or traditional spreadsheet.
- This is important when dealing with big issues like **climate change, population dynamics and natural disasters**.

Understanding Layers Arrangement in GIS

Layer 1. Spatial reference framework

Spatial Reference Framework is known as a spatial reference system (**SRS**) or coordinate reference system (**CRS**)

Layer 2. Spatial data model

Spatial Data Models represent the spatial reality in two spatial data models, **i**)**Vector data model** and **ii**) **Raster data model**

Layer 3. Spatial data acquisition systems

Spatial Data Acquisition Systems will cover how to acquire and produce spatial data.

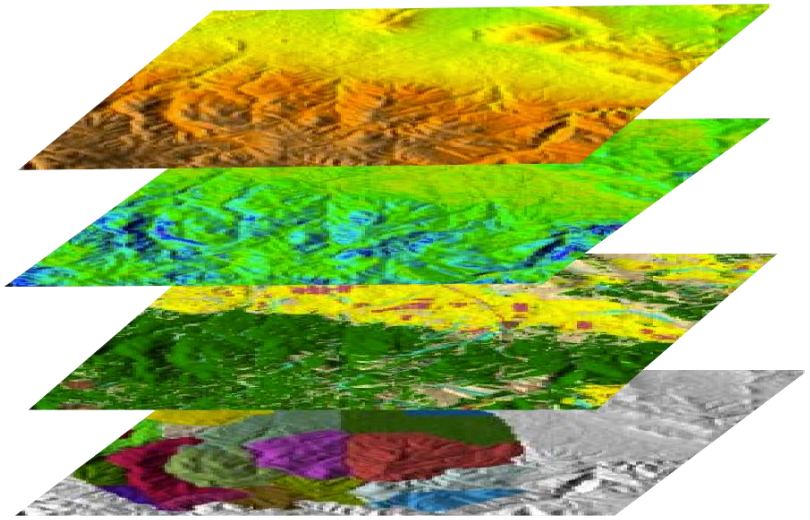
Layer 4. Spatial data analysis

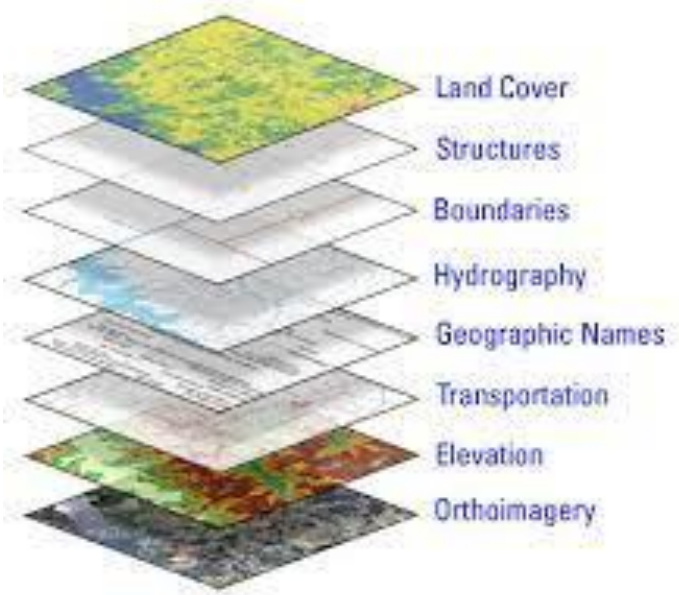
Spatial Data Analysis is, how to extract useful and valuable information from spatial data.

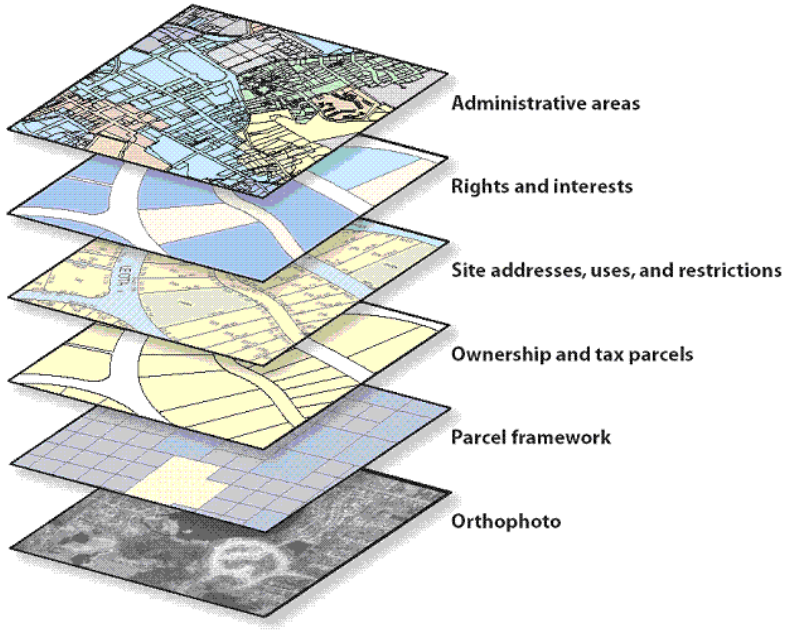
Layer 5. Geo-visualization and information delivery

Geo-visualization and Information Delivery is a powerful aspects, and negative potentials of cartographic representations of the spatial

Layer Arrangements in a Typical GIS Environment





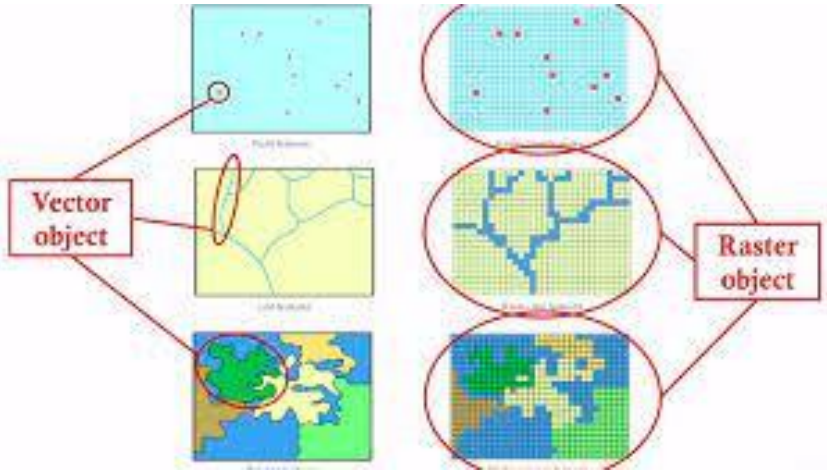


GIS Answers the Following Questions

Location	**Where is the feature located?**
Conditional	**Where is the feature which satisfies?**
Trends	**What has changed since?**
Modelling	**What if ?**

Pieces of GIS

- **People**
- **Data**
  - **Vector data** includes spatial features (points, lines, and polygons) and attributes about that data (descriptive information)
  - **Raster data** are stored electronic images (e.g., pictures taken as an aerial photograph or satellite images)
- **Analysis**
- **Hardware**
- **Software**
  - Google Earth, Bhuvan, India-WRIS, ArcGIS and QGIS. They can be used as the functions required.



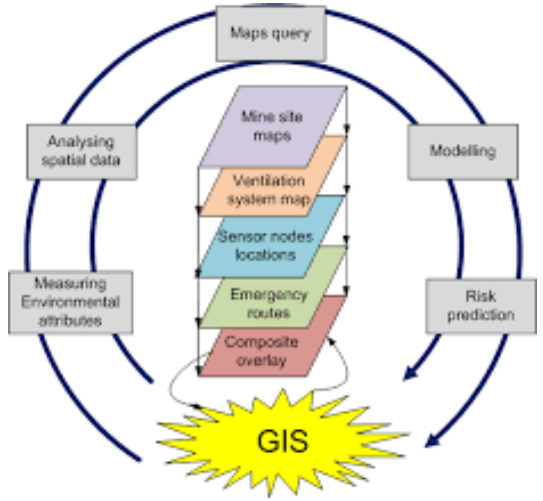
How GIS Works?

GIS systems generally consist of the following elements:

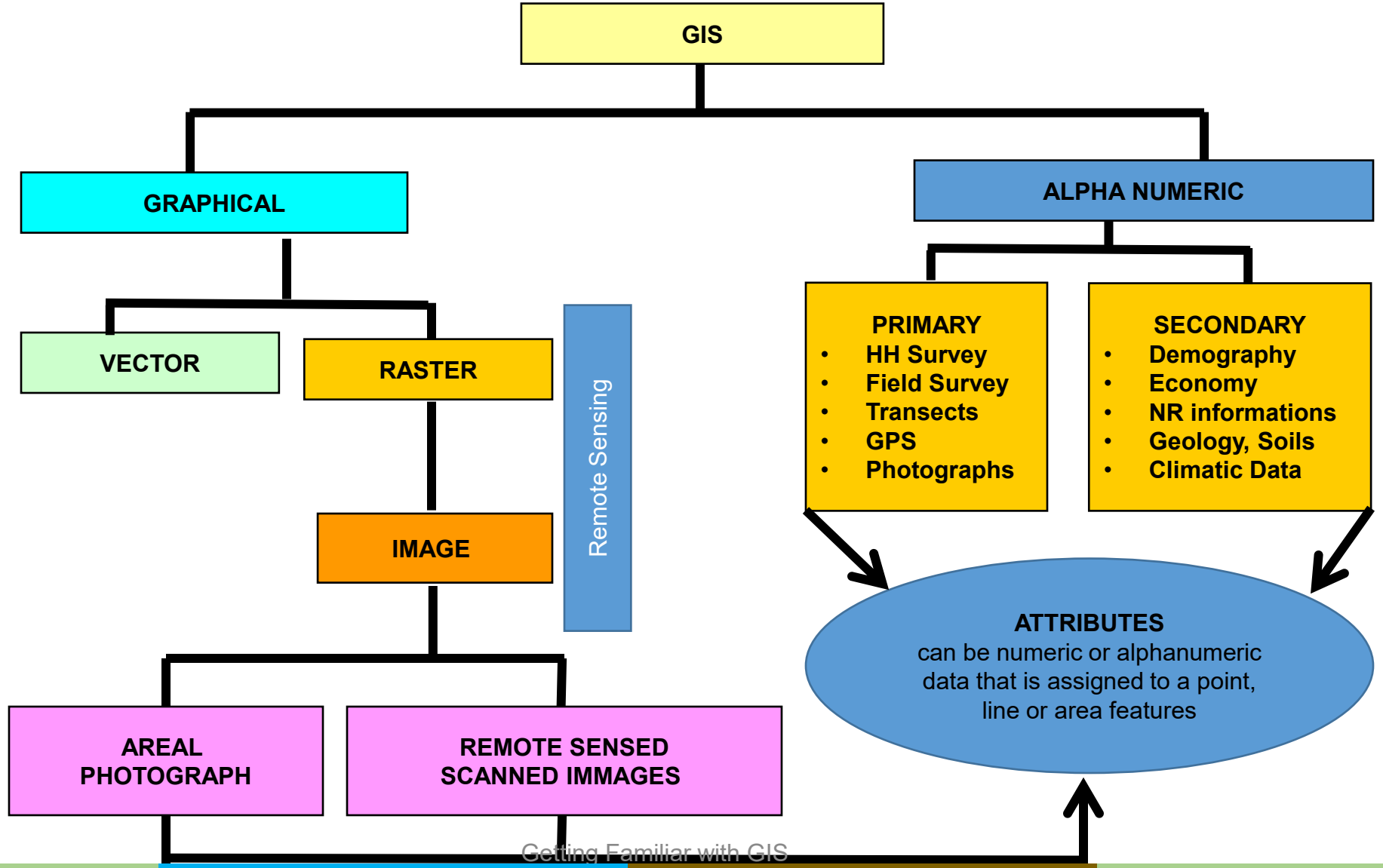
- Maps - Shareable maps that contain geographic data layers
- Data - Spreadsheets, tables and imagery with a geographic component that ties data to a particular location
- Analysis - Spatial analysis enhances decision-making process by providing insights that give users more confidence when interpreting and predicting situations
- Apps - GIS is no longer tied to a desktop. Mobile apps allow GIS data to be used anywhere, at any time
- All GIS tools analyze and visualize spatial data, which includes location information like address, latitude or longitude.

3 step Geographic Information Systems process

1. **Visualize data** Geographic data is displayed in GIS software
2. **Combine data Layers** of data are combined to form maps
3. **Query data Geographic** queries search for values in layered data

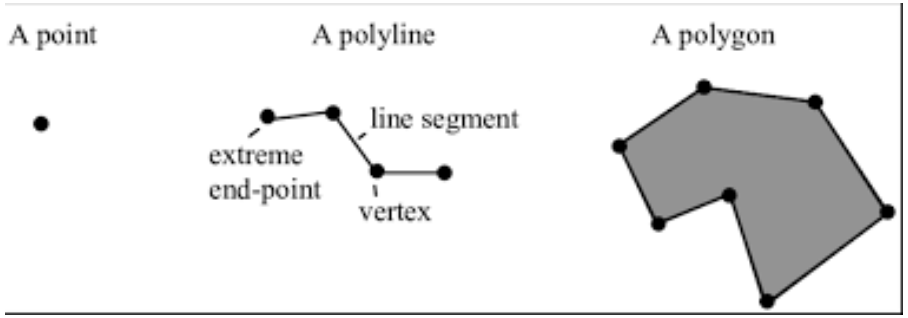


Process of Data Extraction



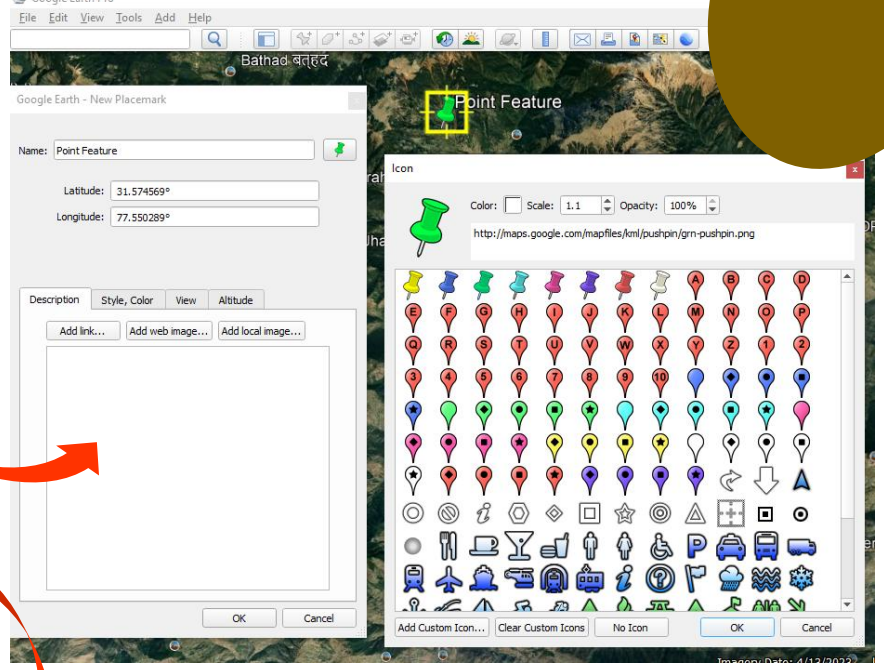
Types of Geographic Information Systems

- Numeric data: Statistical data collected with a geographic component and displayed as a layer on a map. US Census demographics are an example of numeric data.
- Vector data: Consisting of X and Y coordinates, vector data can describe points, lines or polygons connected to a geographic space. Vector formats are best for data with strict borders, like a street or political district. (Save in .kml and .kmz (containing .kml) formats)
- Raster data: Typically digital images in JPEG, TIF or GIF format, raster data is formed from grids of cells or pixels. Satellite imagery is a good example of raster data. (Only save in .kmz formats)
- Point, linear networks, area spread: A layered line that can represent multiple elements, such as a road that is also the boundary of a city or political district.

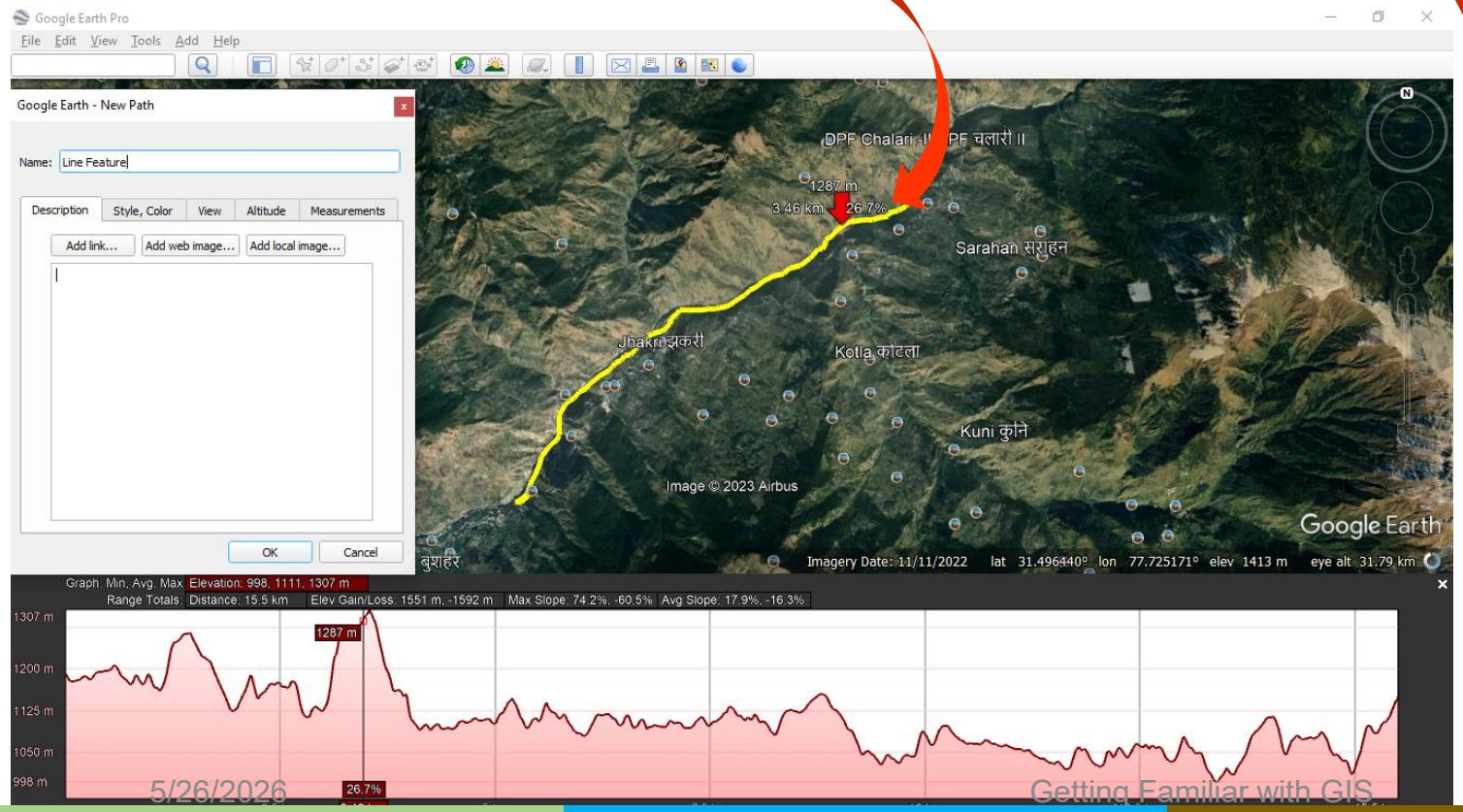


Vector Features in Google Earth Pro

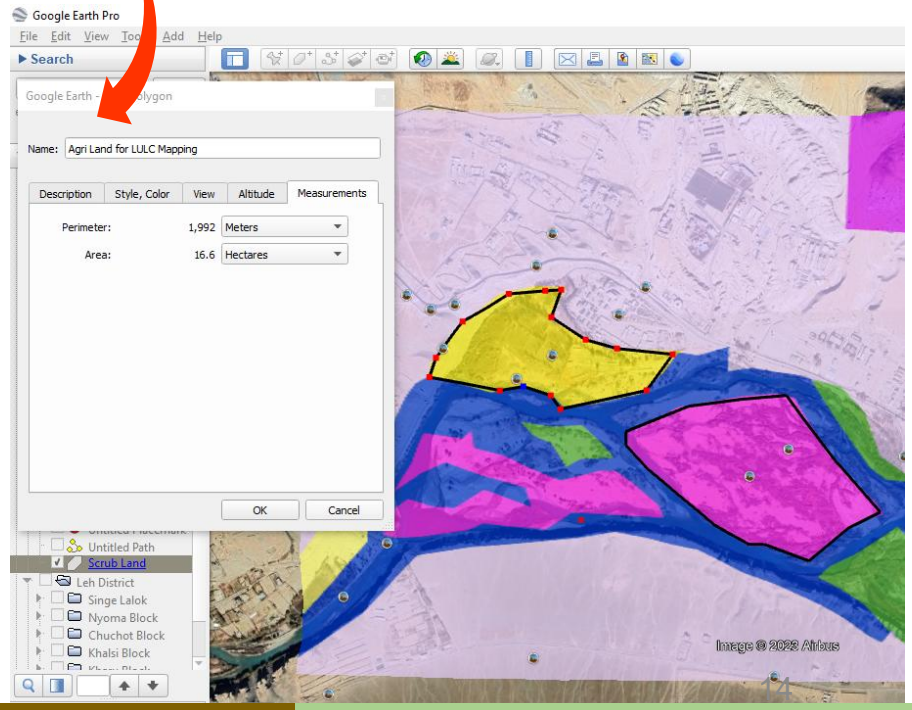
Point Feature



Line Feature



Polygon Feature



Applications of Vector features of GIS in Google Earth Pro

Line (m, km)

Drainage 1st, 2nd, 3rd, 4th, etc

Linear Plantation on Both Side

Joint/ Fracture Lineament

Drainage Parallel Lineament

Diversion Channel

Gul

Canal

Water course

Gray water drain

Point (Latitude, Longitude)

Percolation Tank (PT)

Bavri

Open and Community Well

Khatri

Checkdam

Govt Buildings

Cow shed

Goat shed

Soak pit

Polygon (Ha, km^2, m)

Agriculture Crop Land

Agriculture Fallow Land

Built-up, Rural

Forest Deciduous

Forest Scrub

Scrub Land (Wasteland)

Water bodies

Gully Erosion

Sheet Erosion

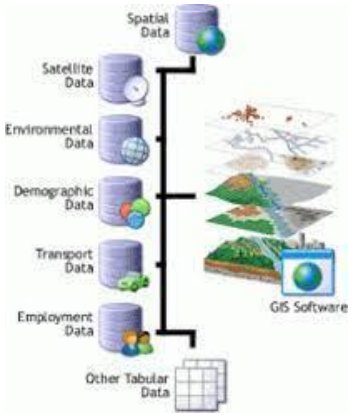
Ravine Erosion

Pond

Block plantation

…and other similar proposed works

Techniques of Geospatial Data Management



Data modeling

- GIS data represents phenomena that exist in the real world, such as roads, land use, elevation, trees, waterways, and states.
- Used to store data in a GIS for both kinds of abstractions mapping references: raster images and vector. Points, lines, and polygons represent vector data of mapped location attribute references.
- A new hybrid method of storing data which combine three-dimensional points.

Data acquisition

- Includes several methods for gathering spatial data into a GIS database, e.g., remote sensing, the global positioning system

Types of Data Modeling

- DEM
- Path elevation model
- Contour modeling
- Hydrogeological modeling
- LULC modeling
- Watershed modeling
- Lineament modeling
- Hydrology modeling

Georeferencing Element of GIS

Rubber Sheeting

1. The map has to be checked within theoretical dimensions
2. Scanned into a raster format
3. Has to be given a theoretical dimension by a rubber sheeting/warping technology process

Raster to Vector

1. Convert a satellite image map to a vector structure
2. Generate lines around all cells with the same classification, while determining the cell spatial relationships, such as adjacency or inclusion