Course of English, 2sd year territtory planning , S2, 22 April 2024
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GIS: Geographic Information Systems

INTRODUCTION

Geographic Information Systems, also known as GIS! In this presentation, we'll delve into what GIS is, how it works, and why it's an essential tool for geographers. GIS empowers us to understand the world around us in a whole new way, by bringing geographic data to life. Geographic Information Systems, commonly abbreviated as GIS, are powerful tools used to capture, store, manipulate, analyze, manage, and visualize spatial or geographic data.

What is GIS?

GEOGRAPHIC INFORMATION SYSTEM (GIS)

- Geographic/Geospatial Information
  - Information about places on the earth's surface
  - Geographic/geospatial: synonymous

- GIS--what's in the S?
  - Systems: the technology
  - Science: the concepts and theory
  - Studies: the societal context

- GIS helps in decision support system involving the integration of spatial referenced data in a problem solving in different fields.

What is practically GIS?

- A computer system for capturing, storing, analyzing, and displaying geographic data.
- Integrates spatial data (location) with attribute data (descriptive information).
- Used to create maps, analyze patterns, and solve real-world problems.

GIS is essentially a digital toolbox for working with geographic information. It allows us to capture data about the Earth's surface, such as the location of rivers, mountains, or cities. This data is then stored in a special format that the GIS software can understand. But GIS goes beyond just storing data. It also allows us to analyze it, looking for patterns and relationships between different geographic features. Finally, GIS lets us create maps and visualizations that communicate those patterns and relationships in a clear and compelling way.

COMPONENTS OF GIS

- **Hardware**: is the physical equipment, like computers and GPS devices, servers that runs the GIS software
- **Software**: is the brain of the system, allowing us to input, analyze, and visualize geographic data. GIS software enables users to perform various tasks such as data capture, analysis, visualization, and management. •

Data: Spatial data (location) and attribute data (descriptive information). The data itself is the fuel that powers GIS. It comes in two main forms: **spatial data**, which tells us where things are located, and **attribute data**, which provides additional information about those features.

- **People**: GIS professionals, analysts, and users. GIS involves individuals with expertise in geography, cartography, remote sensing, computer science, and other related fields. These professionals use GIS tools and techniques to analyze spatial data and derive meaningful insights.
- **Methods**: Techniques for data collection, analysis, and visualization.

Components of GIS

A Geographic Information System (GIS) links locational (spatial) and database (tabular) information and enables a person to visualize patterns, relationships, and trends. This process gives an entirely new perspective to data analysis that cannot be seen in a table or list format. The five components of a GIS are listed below.

SOFTWARE

GIS software provides the functions and tools users need to store, analyze, and display geographical information. The key software components are

- GIS Software
- Database Software
- OS Software
- Network Software

HARDWARE

The hardware is the computer and peripherals on which the GIS operates. Today, this could be a centralized computer server running the UNIX or Windows NT operating systems, a desktop PC, or an Apple Macintosh. The computer may operate in isolation or in a networked configuration.

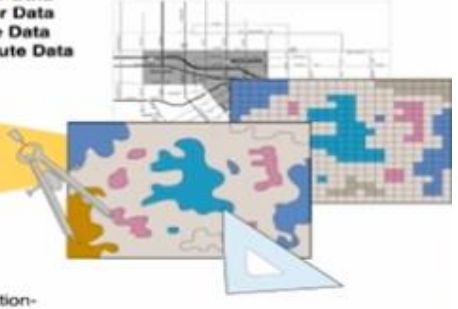
- Computers
- Networks
- Peripheral Devices
  - Printers
  - Plotters
  - Digitizers

GIS

DATA

One of the most important component of GIS is the data. It is absolutely essential that data be accurate. The following are different data types:

- Vector Data
- Raster Data
- Image Data
- Attribute Data



PEOPLE

GIS technology is clearly of limited value without people to manage the system and to develop plans for applying it. Users of GIS range from highly qualified technical specialists to planners, foresters, and market analysts who use GIS to help with their everyday work.

- Administrators
- Managers
- GIS Technicians
- Application Experts
- End Users
- Consumers

METHODS

Methods are well designed plans and application-specific business rules describing how technology is applied. This includes the following:

- Guidelines
- Specifications
- Standards
- Procedures

HOW THE REMOTE SENSOR TAKE PLACE

(A) Energy Source

(B) Radiation and the Atmosphere

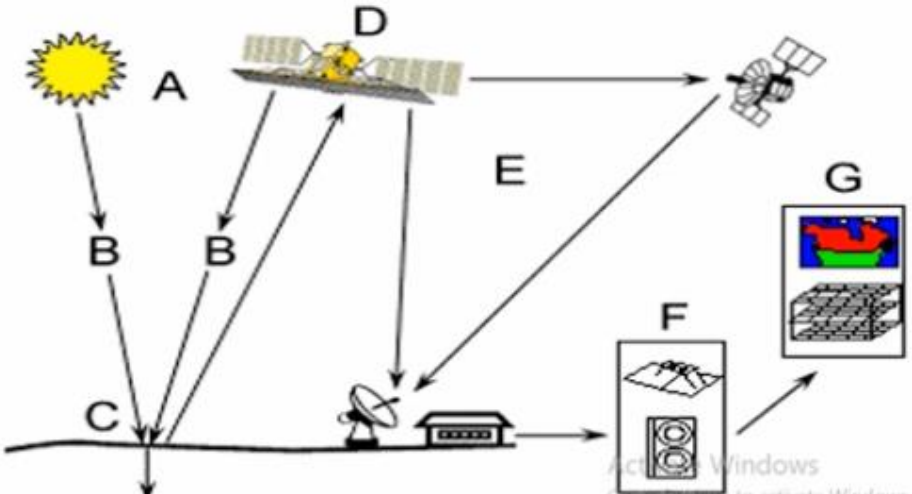
(C) Interaction with the target , It can be land , water, forets etc.)

(D) Recording of Energy by the Sensor , Recording station)

(E) Transmission, Receiving and Processing

(F) Interpretation and Analysis

(G) Application



BENEFITS OF GIS

- GIS benefits organizations of all sizes and in almost every Industry. There is a growing awareness of the economic and strategic value of GIS. The benefits of GIS generally fall into 5 categories:-
- 1)Cost saving and increased efficiency.
- 2)Better Decision making.
- 3)improved communication
- 4)Better record keeping.
- 5)Managing geographically.

Breakdown of what GIS does:

- **Collects data**: This data can come from all sorts of sources, like satellites, GPS devices, and even social media.
- **Stores data**: GIS software stores this data in a special way that links it to specific locations on Earth.
- **Analyzes data**: GIS can be used to find patterns, trends, and relationships in the data. For example, you could use GIS to see if there's a correlation between crime rates and poverty levels in a city.
- **Interprets data**: GIS helps you make sense of the data by creating maps, charts, and other visualizations.

What can you do also with GIS?

- Create maps for various purposes (e.g., tourism, environmental planning, disaster management).
- Analyze spatial patterns and relationships (e.g., identifying areas with high crime rates or disease outbreaks).
- Model and predict future scenarios (e.g., climate change impacts or urban growth patterns).
- Solve real-world problems with a spatial component (e.g., finding the most efficient route for emergency vehicles or identifying suitable locations for new wind farms).

The applications of GIS are vast and ever-expanding. Geographers use GIS to create all sorts of maps.

Data Acquisition

Data for GIS can come from a variety of sources:

- Satellites orbiting Earth can capture high-resolution images of the planet's surface.
- Ground surveys involve people going out and collecting data on location.
- Public records can provide information on things like demographics and property boundaries.

Spatial Analysis Tools

Once data is collected and organized in layers, GIS software allows us to perform spatial analysis. This involves analyzing the relationships between different data points. For example, we can see how population density relates to the availability of green spaces, or how traffic patterns are affected by road construction projects.

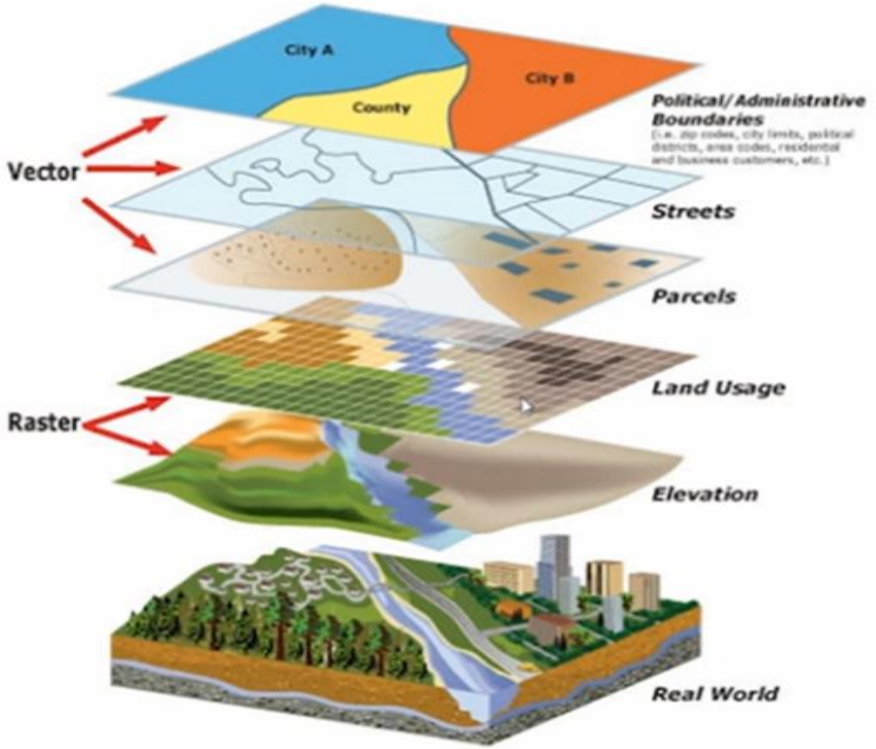
Real-World Applications of GIS

GIS is used in a wide range of fields, including:

- Urban planning: Optimizing city layouts, zoning regulations, and emergency response routes.
- Environmental management: Monitoring deforestation, tracking wildlife populations, and assessing the impact of climate change.
- Public health: Identifying areas with high disease rates and allocating resources to combat them.
- Business and marketing: Identifying potential customers based on demographics and location.

APPLICATION

- Transportation
- Watersheds Analysis
- Urban development
- Landfill site selection
- Mineral mapping
- Pollution monitoring
- Remote Sensing
- Target Site Selection



Use of Remote sensing & GIS in Disaster management

- Earthquake
- Tsunami
- Forest fire
- Drought
- Volcano
- Man med Disaster

Forest fire

Tsunami Alert Disaster Management

TRANSPORTATION

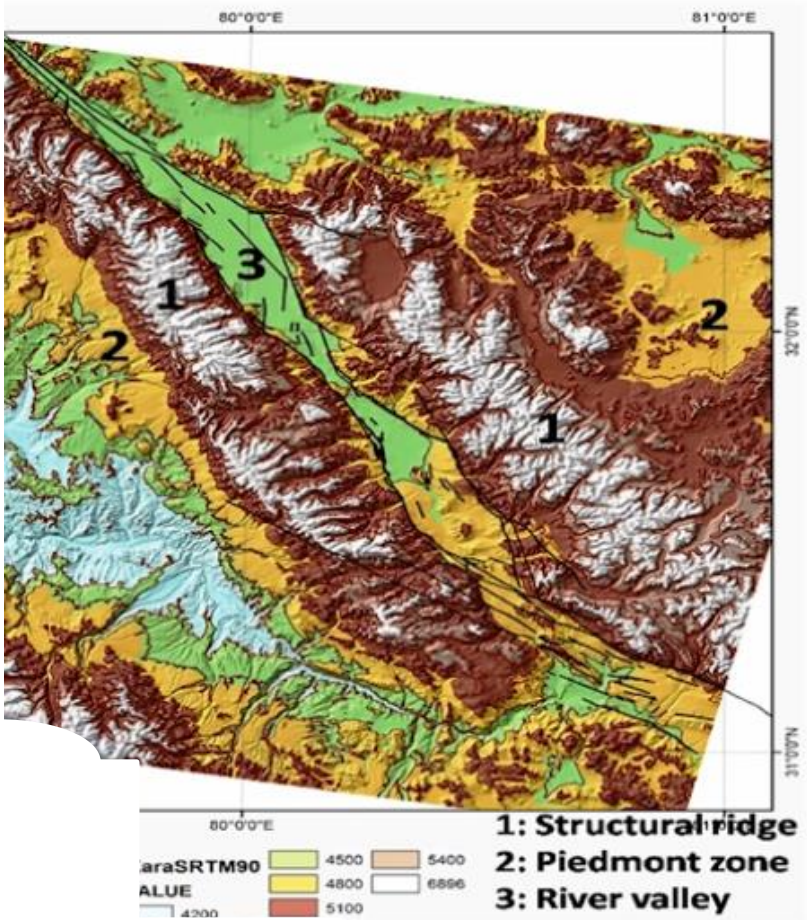
- To find the shortest routes
- To create a networking using existing GIS data.
- To find out the most efficient and fastest routes
- To locate closest service facilities.

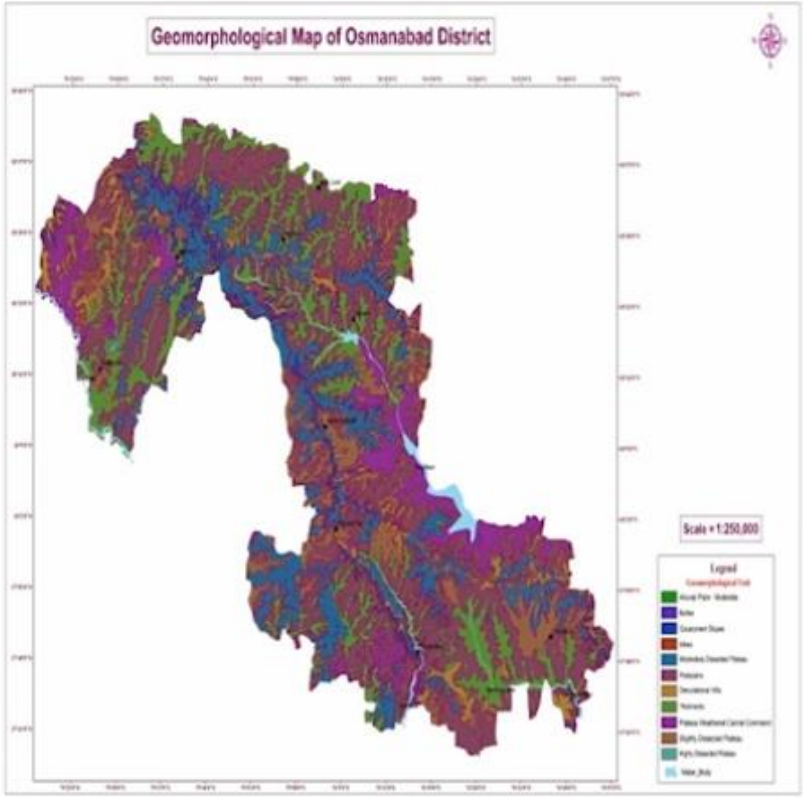
GPS

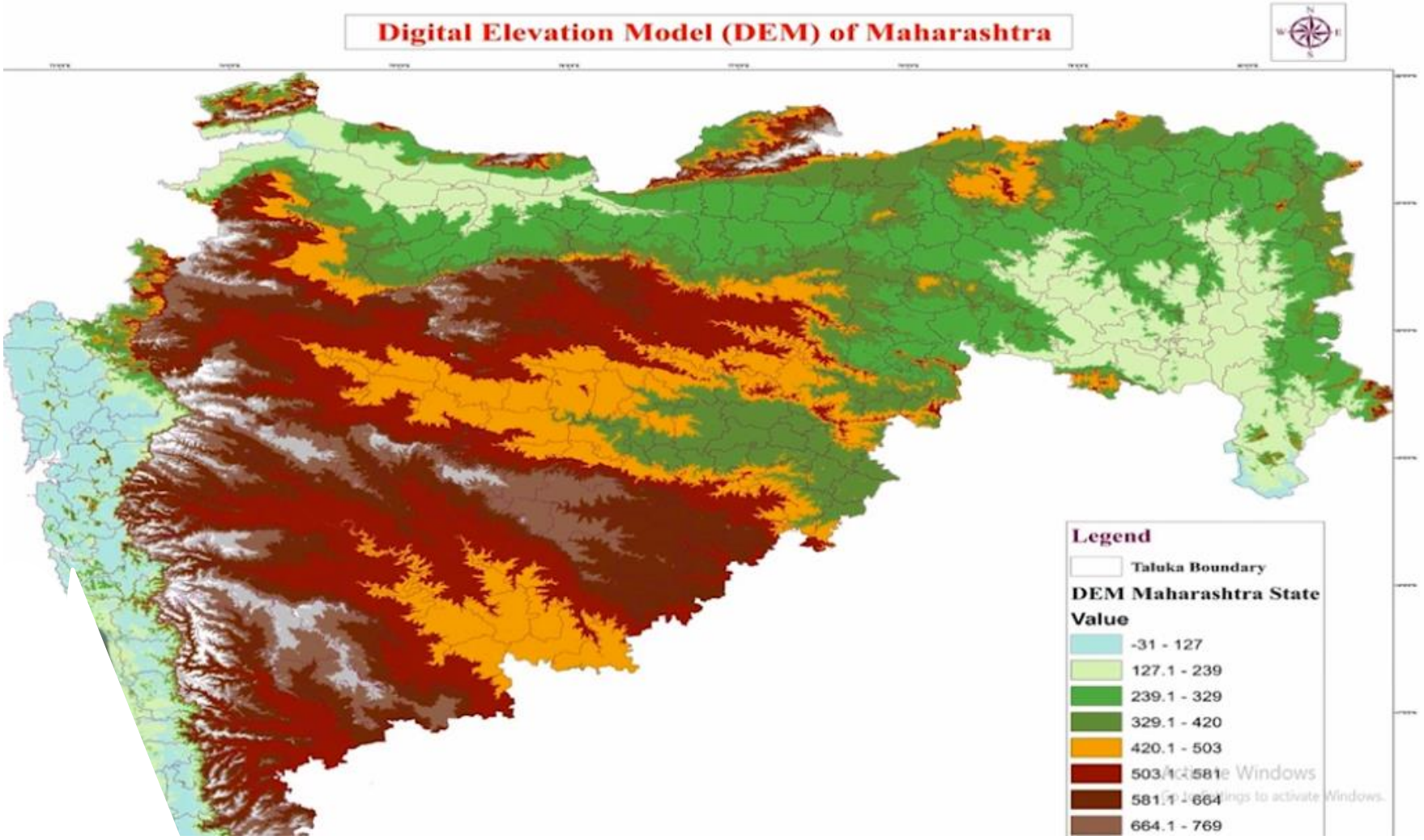
- 1. Location – determining a position
- 2. Navigation– getting from one location to another(Ship,Aircraft)
- 3. Tracking – monitoring object or personal movement
- 4. Mapping – creating maps of the v
- 5. Timing – bringing precise timing to the world.

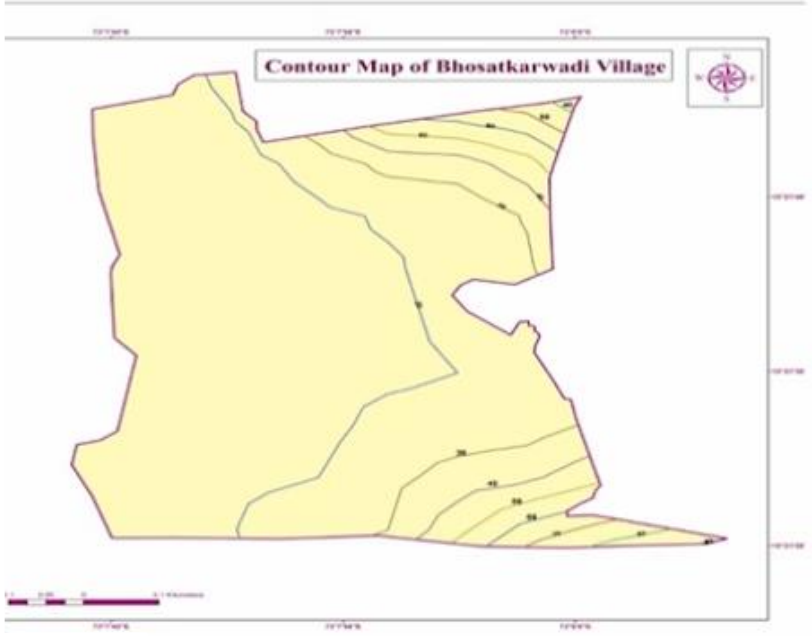
Visualization and Maps

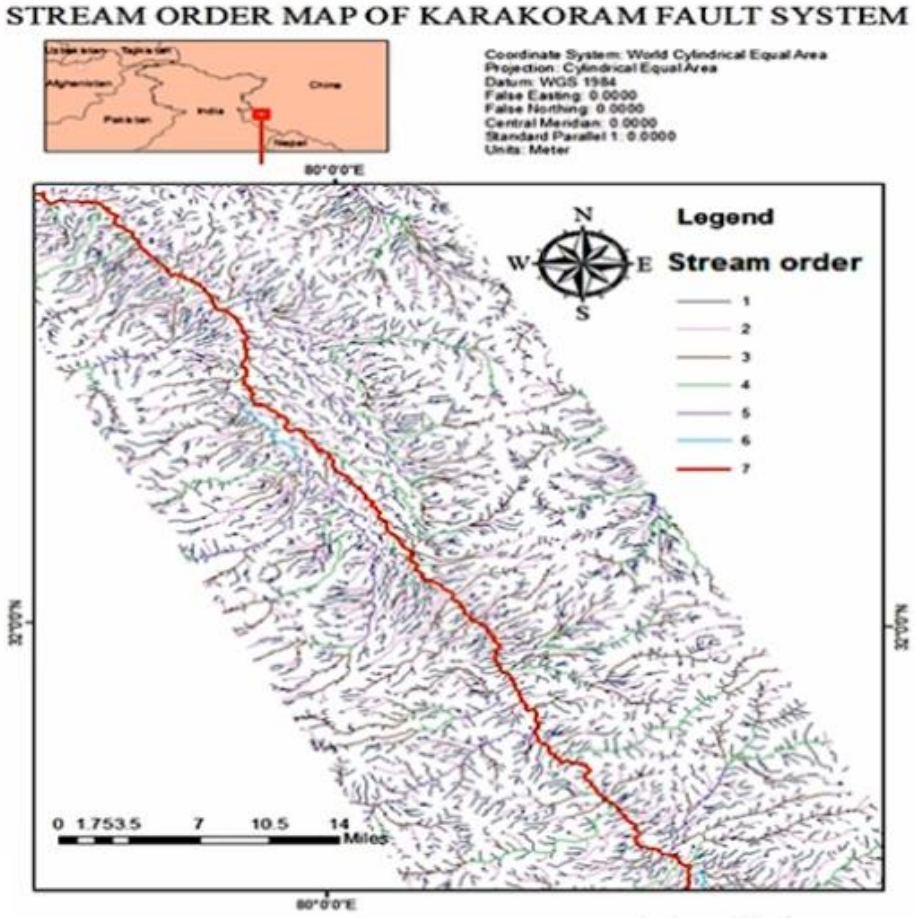
- GIS excels at creating visually compelling maps and graphics that help communicate complex information in an easily understandable way.
- We can use different colors, symbols, and shading to represent various data points, making it easy to identify patterns and trends.



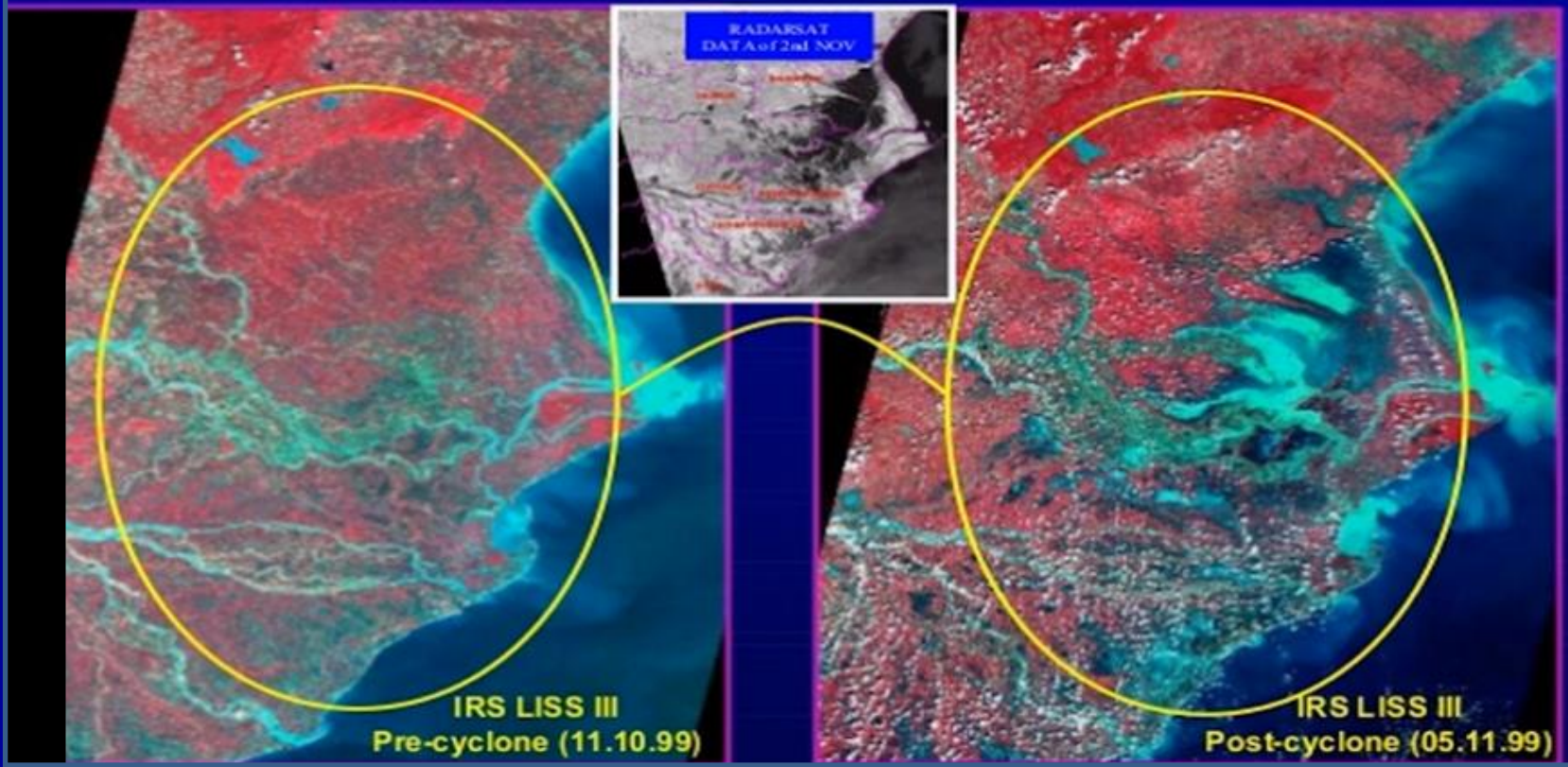



Digital Elevation Model (DEM) of Maharashtra
Legend
Taluka Boundary
DEM Maharashtra State
Value
-31 - 127
127.1 - 239
239.1 - 329
329.1 - 420
420.1 - 503
503.1 - 581
581.1 - 664
664.1 - 769

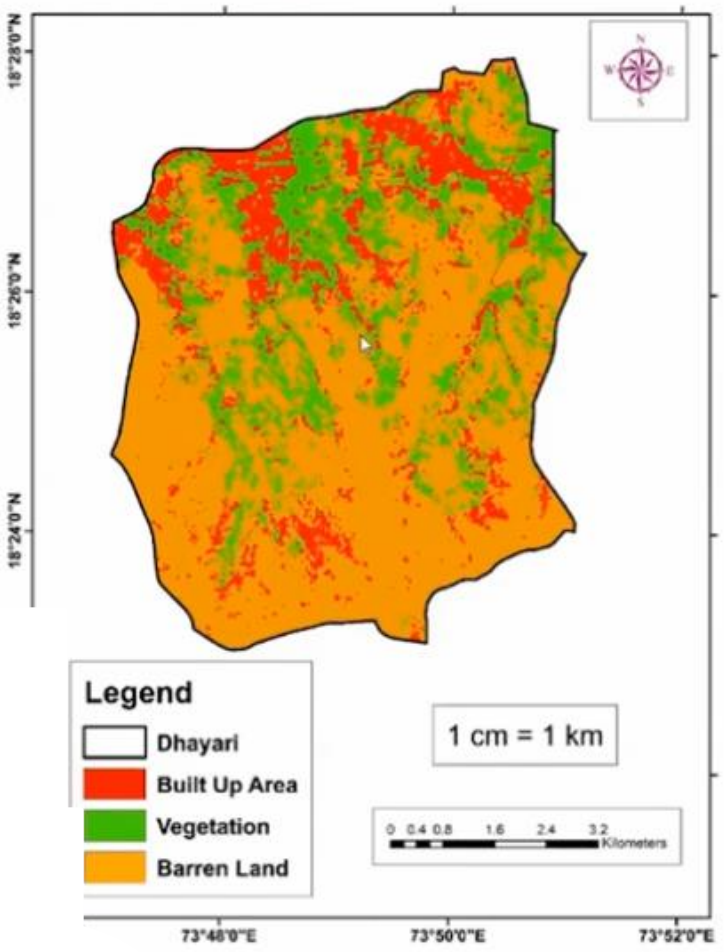

Contour Map of Bhosatkarwadi Village
CONTOUR
20
30
40
50
60
70
80
90
Bhosatkarwadi Village Boundary


STREAM ORDER MAP OF KARAKORAM FAULT SYSTEM
Coordinate System: World Cylindrical Equal Area
Projection: Cylindrical Equal Area
Datum: WGS 1984
False Easting: 0.0000
False Northing: 0.0000
Central Meridian: 0.0000
Standard Parallel 1: 0.0000
Units: Meter
Afghanistan
Tajikistan
China
Pakistan
India
Nepal
80°0'0"E
Legend
Stream order
1
2
3
4
5
6
7
N
S
E
W
0 1.753.5 7 10.5 14
Miles
80°0'0"E

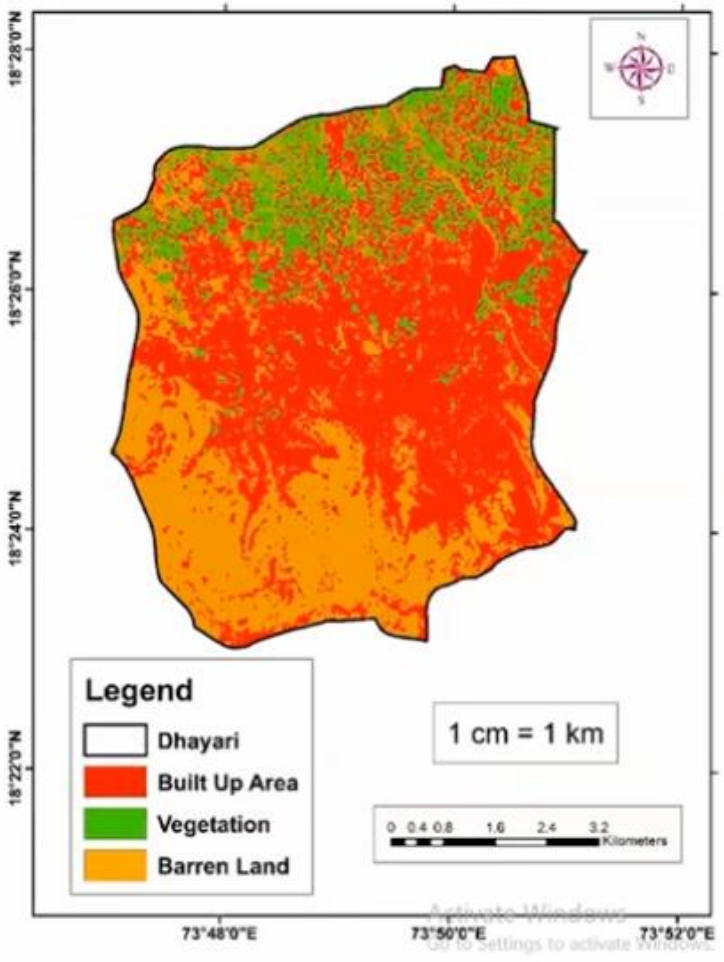
Flood due to cyclone (29th October 1999) off Orissa coast



Land use Map of 2001



Land Use Map of 2020



GIS Data

The information used in GIS comes in from:

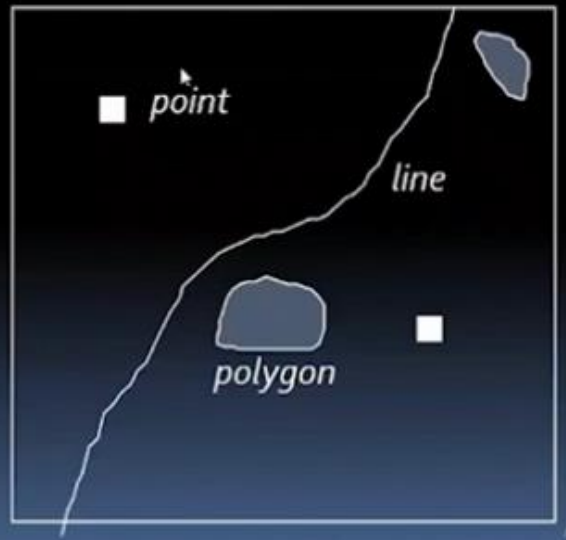
- **Spatial Data**: Refers to information that has a geographic or locational component. Examples include coordinates, boundaries, and distances.
- **Attribute Data:** Descriptive information associated with spatial features. This could include population counts, land use categories, or any other non-spatial data linked to geographic locations.
- **Vector Data**: This represents features on Earth's surface using geometric shapes like points (representing locations), lines (representing roads or rivers), and polygons (representing areas like buildings or parks). Imagine a digital map where streets are lines and buildings are squares.
- **Raster Data**: This portrays geographic information as a grid of tiny squares, each containing a color value. Satellite imagery, for instance, is a type of raster data, where different colors represent land cover types like vegetation, water, or urban areas.

Concept of Vector and Raster

Raster Representation

	0	1	2	3	4	5	6	7	8	9
0								R	T	
1							R			T
2		H					R			
3							R			
4					R	R				
5				R						
6			R		T	T		H		
7			R		T	T				
8		R								
9		R								

Vector Representation

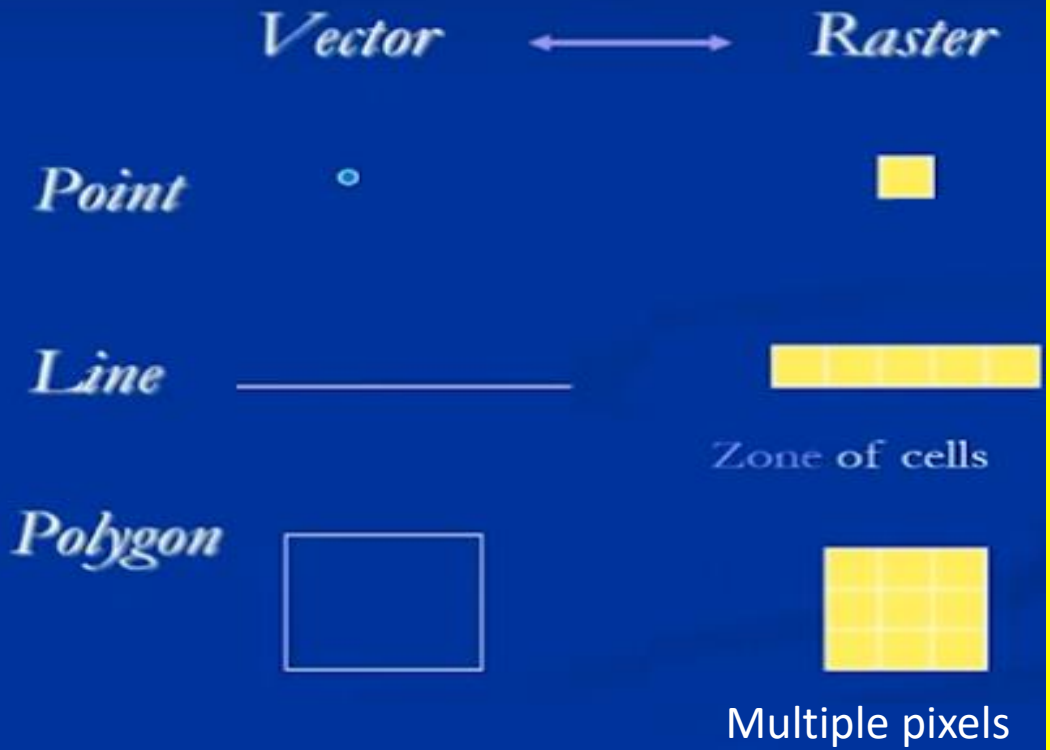


Vector data model

- The fundamental concept of vector GIS is that all geographic features in the real work can be represented either as:
- **points or dots (*nodes*)**: trees, poles, fire plugs, airports, cities
- **lines (*arcs*)**: streams, streets, sewers,
- **areas (*polygons*)**: land parcels, cities, counties, forest, rock type
- Best for describing discrete features

Raster and Vector Data

Raster data are described by a cell grid, one value per cell



- Vector data: Represents features with points, lines, and polygons (e.g., roads, rivers, buildings).
- Raster data: Represents geographic information as a grid of cells (e.g., satellite imagery, elevation data).

Geographic data comes in two main flavors: vector and raster. Vector data depicts features on the Earth's surface using points, lines, and polygons. Imagine a digital map where streets are represented by lines, buildings by squares, and lakes by polygons. Raster data, on the other hand, portrays the Earth's surface as a grid of tiny squares, each containing a color value. Satellite imagery, for instance, is a type of raster data, where different colors represent various land cover types like vegetation, water, or urban areas.

vector data

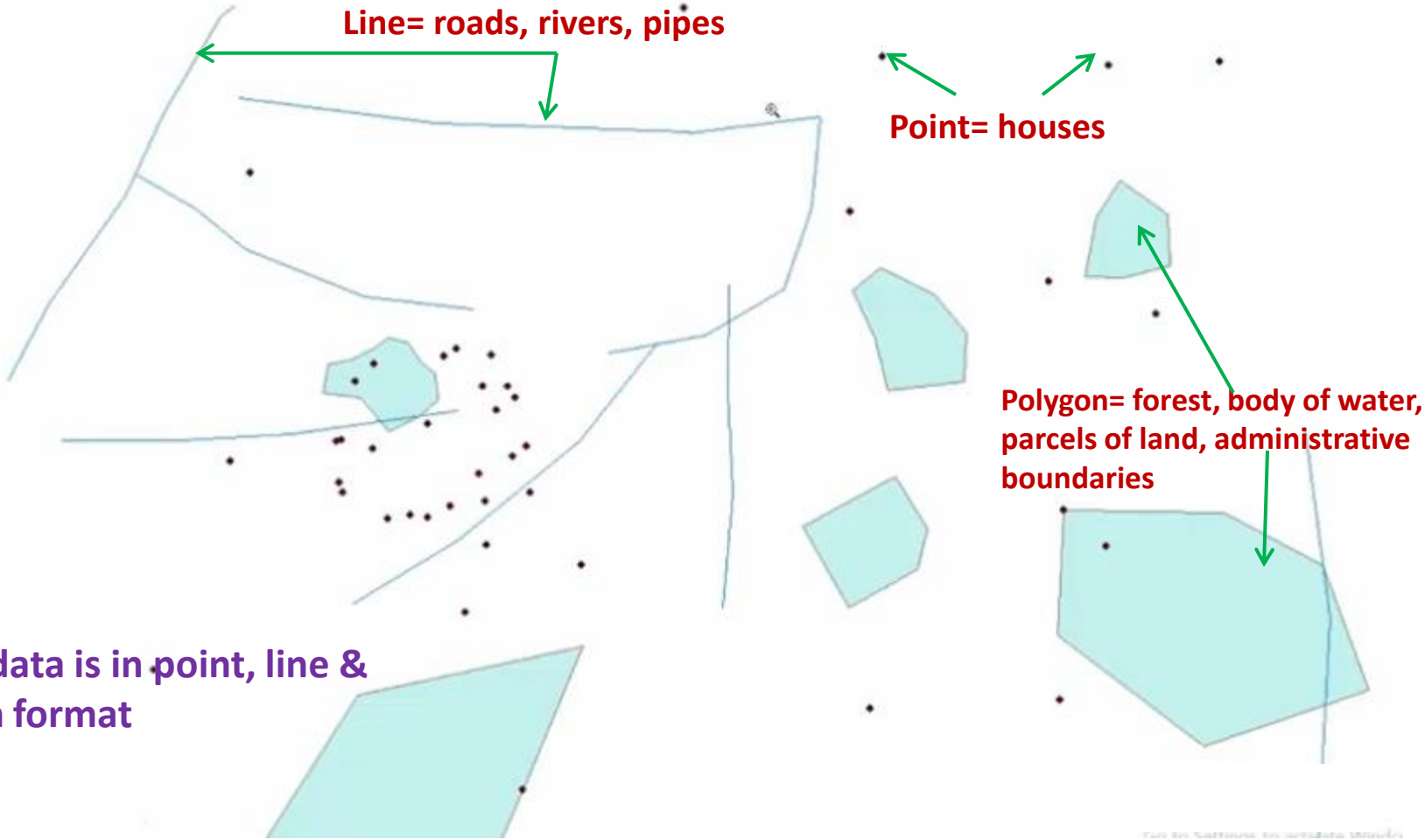
These spatial data types :points, lines and polygons, form the building blocks of vector data models used in geographic information systems (GIS). They allow for the representation and analysis of various geographic features and phenomena in a digital environment.

1. **Points:** Points represent discrete geographic locations or features with zero dimensions. Each point is defined by a single pair of coordinates (latitude and longitude in geographic coordinate systems, or x and y in projected coordinate systems) that specify its exact location on the Earth's surface. Points can represent various features such as landmarks, cities, wells, sampling locations, and other point-like entities.

2. Lines (or polylines): Lines represent linear features with one-dimensional extent, such as roads, rivers, trails, railroads, boundaries, and pipelines. A line is composed of a sequence of connected vertices (points) that define its path. Each vertex represents a specific point along the line, and the line segments between vertices form the continuous path of the line. Lines can have attributes associated with them, such as road names, speed limits, or pipe diameters.

3. **Polygons** represent a two-dimensional shape with a closed boundary composed of straight lines. It is commonly used to represent geographic features such as parcels of land, administrative boundaries, bodies of water, and other spatial entities with defined boundaries.

Vector data (points, lines and polygons)

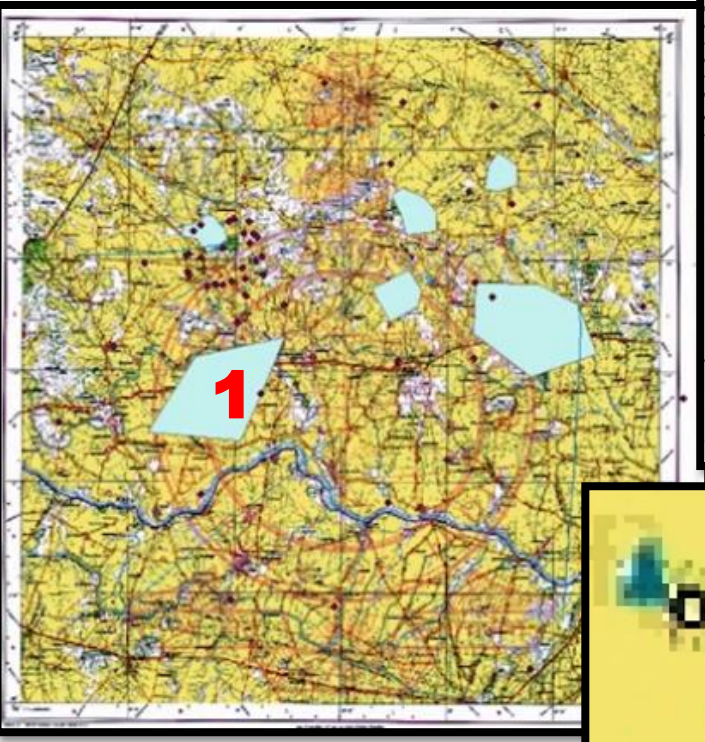


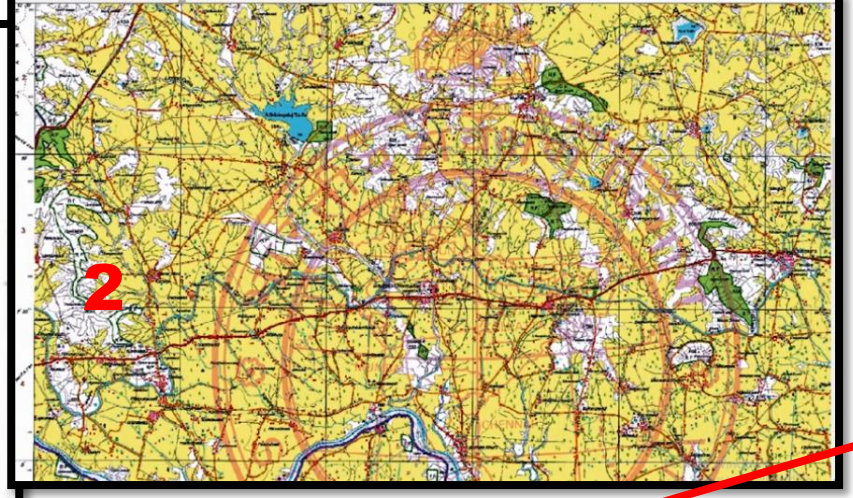
Vector data is in point, line & polygon format

Raster data

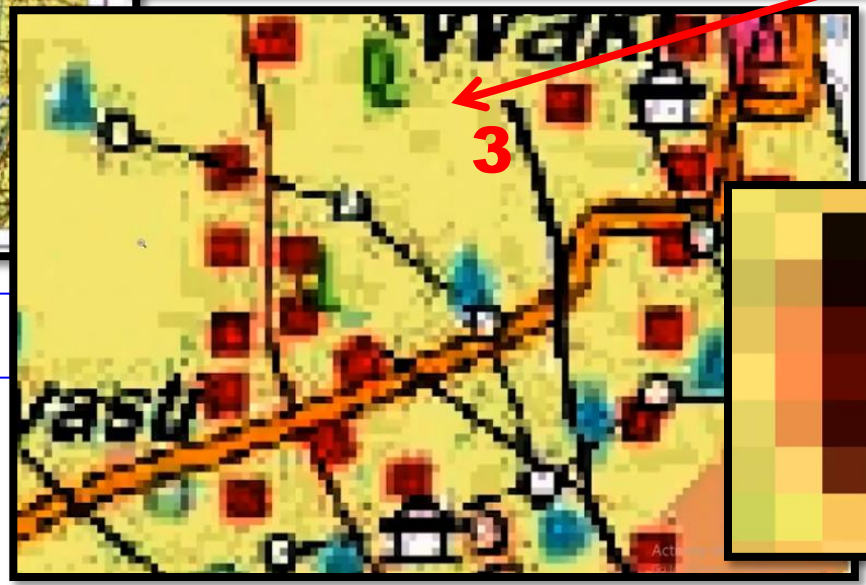
Raster data in GIS (Geographic Information Systems) refers to data that is represented as a grid of cells or pixels. Each cell or pixel in a raster dataset contains a value, which could represent information such as elevation, temperature, land use, population density, or any other measurable quantity.

Raster datasets can be used to classify land cover types such as forests, urban areas, agricultural land, water bodies, etc. Each cell in the raster grid is assigned a specific land cover class based on analysis of satellite imagery or other data sources.



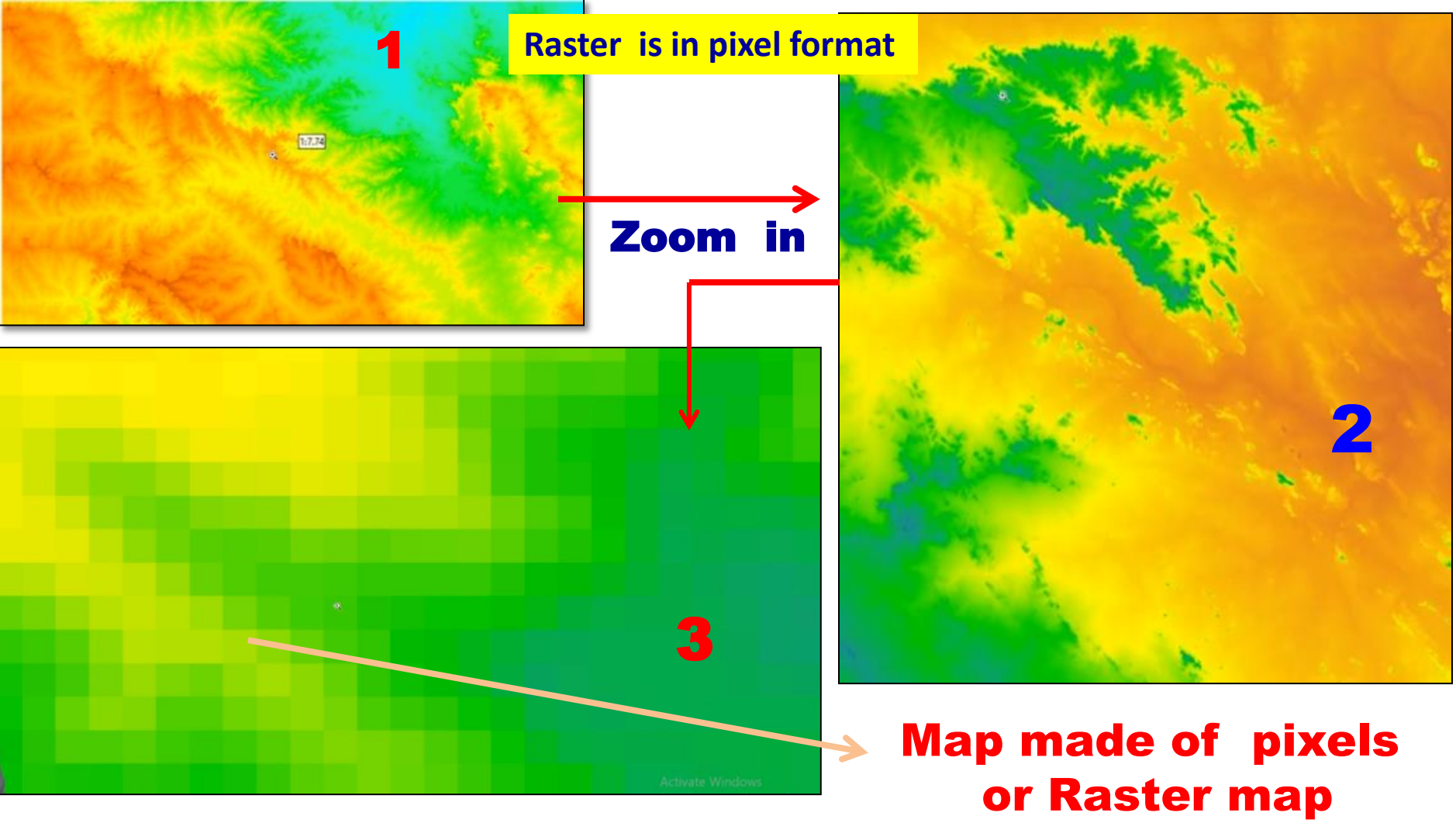


When we zoom in we can see the raster data in the map



Normal size of the map

Pixels represent the raster data


Raster is in pixel format
1
Zoom in
2
3
Map made of pixels
or Raster map

Softwares involved in GIS

Several software programs are used in GIS, each with its strengths and functionalities. Here are a few popular examples:

- **Esri ArcGIS**: A widely used commercial GIS software offering a comprehensive suite of tools for data management, analysis, and visualization.
- **QGIS**: A free and open-source GIS software that provides powerful functionalities for professional users.
- **Google Earth**: A user-friendly virtual globe that allows users to explore geographic data and imagery.