

# SPATIAL DATA EDITING

# Spatial Data

The data or information that identifies the geographic location of features and boundaries on Earth, such as natural or constructed features, oceans, and more.

- is usually stored as coordinates and topology, can be mapped.
- is often accessed, manipulated or analyzed through GIS.

# Data Editing

Errors affect the quality of GIS data. Once the data is collected, and prepared for visualization and analysis it must be checked for errors.

## □ categories for sources of error :

1. Common sources of error
2. Errors resulting from original measurements
3. Errors arising through processing

# Common Sources of error

## ❑ Old data sources

The data sources used for a GIS project may be too old to use. Data collected in past may not be acceptable for current time projects.

## ❑ Lack of data:

The data for a given area may be incomplete or entirely lacking. For example the land-use map for border regions may not be available.

## **Map scale:**

The details shown on a map depend on the scale used. Maps or data of the appropriate scale at which details are required, must be used for the project.

## **Observation:**

High density of observations in an area increases the reliability of the data. Insufficient observations may not provide the level of resolution required for adequate spatial analysis as expected from the project.

# Errors Resulting from Original Measurements

- **Positional accuracy:**

Representing correct positions of geographic features on a map depend upon the data being used. Biased field work, improper digitization and scanning errors result in inaccuracies in GIS projects.

- **Content accuracy:**

Maps must be labeled correctly. An incorrect labeling can introduce errors which may go unnoticed by the user. Any omission from map or spatial database may result in inaccurate analysis.

# Errors Arising through Processing

## ❑ Numerical errors:

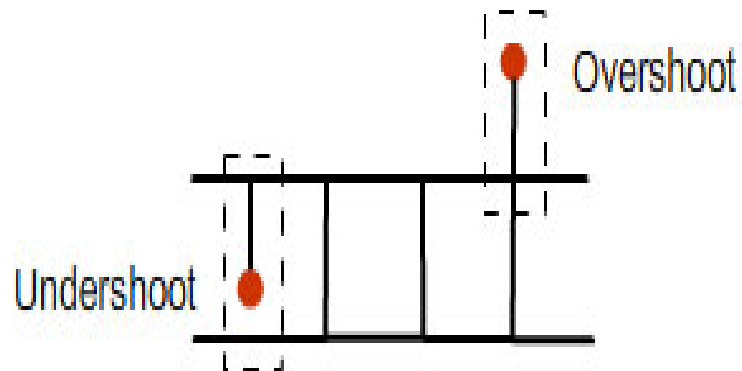
Different computers have different capabilities for mathematical operations. Computer processing errors occur in rounding off operations and are subject to the inherent limits of number manipulation by the processor.

## ❑ Topological errors:

Data is subject to variation. Errors such as dangles, slivers, overlap etc. are found to be present in the GIS data layers.

# Dangle

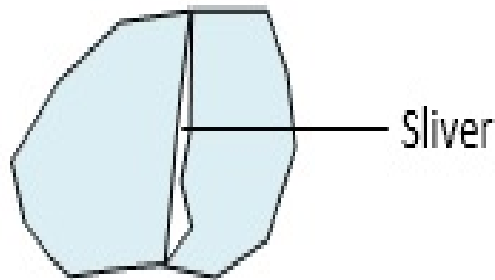
An arc is said to be a dangling arc if either it is not connected to another arc properly (undershoot) or is digitized past its intersection with another arc (overshoot).





# Sliver

It refers to the gap which is created between the two polygons when snapping is not considered while creating those polygons.



- These errors can be corrected using the constraints or the rules which are defined for the layers.
- Topology rules define the permissible spatial relationships between features.

### **Digitizing and geocoding:**

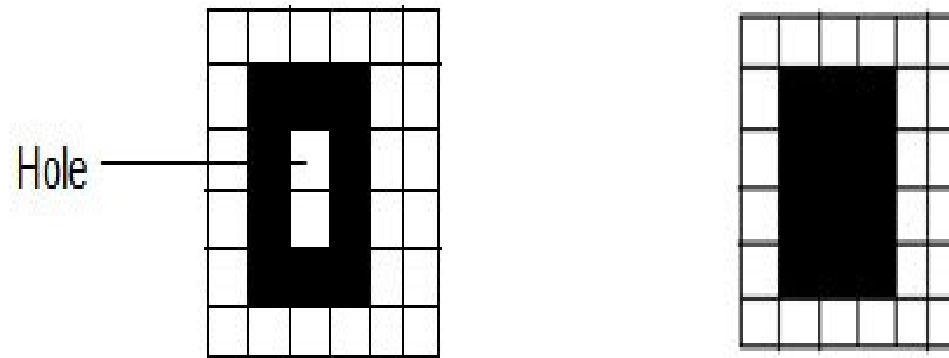
Many errors arise at the time of digitization, geocoding, overlaying or rasterizing. The errors associated with damaged source maps and error while digitizing can be corrected by comparing original maps with digitized versions.

# Raster data editing

- is concerned with correcting the specific contents of raster images than their general geometric characteristics.
- The objective of the editing is to produce an image suitable for raster geoprocessing.
- Following editing functions are mostly used for raster data editing:

# Filling Holes and Gaps:

To fill holes and gaps that appear in the raster image



# Edge Smoothing:

to remove or fill single pixel irregularities in the foreground pixels and background pixels along lines

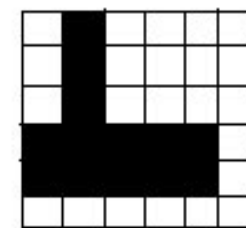
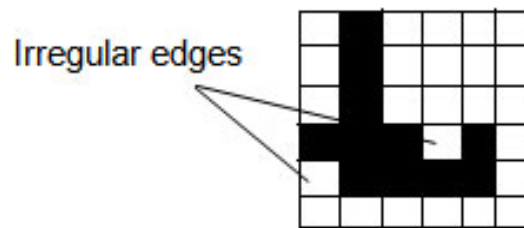
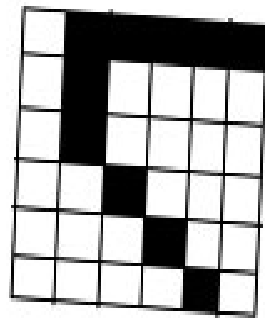


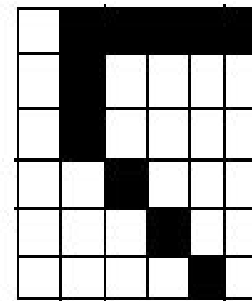
Image with smooth

# Deskewing

To rotate the image by a small angle so that it is aligned orthogonally to the x and y axes of the computer screen



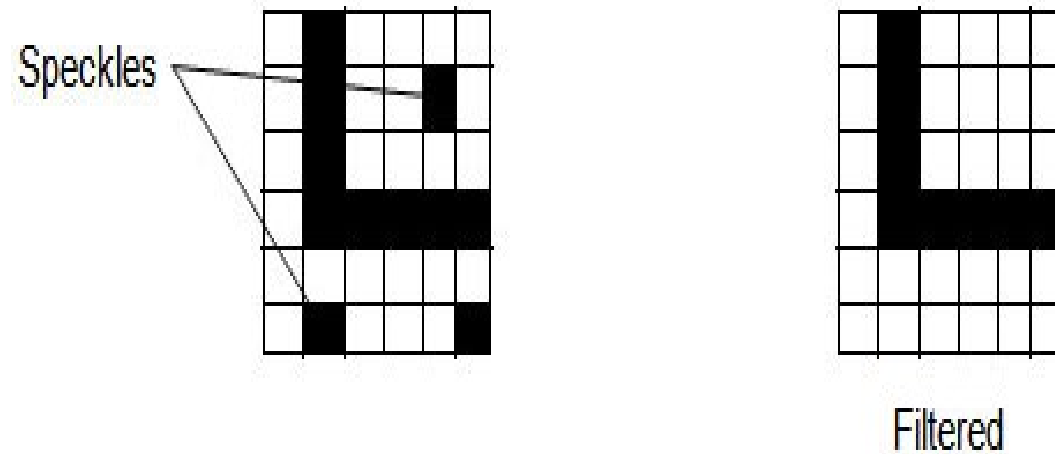
Skewed



Deskewed Image

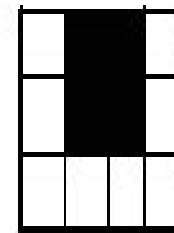
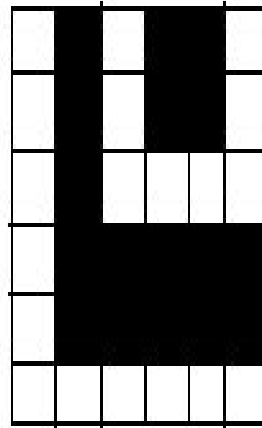
# Filtering

to remove speckles or the random high or low valued pixels in the image



# Clipping and delete

To create a subset of an image or to remove unwanted pixels



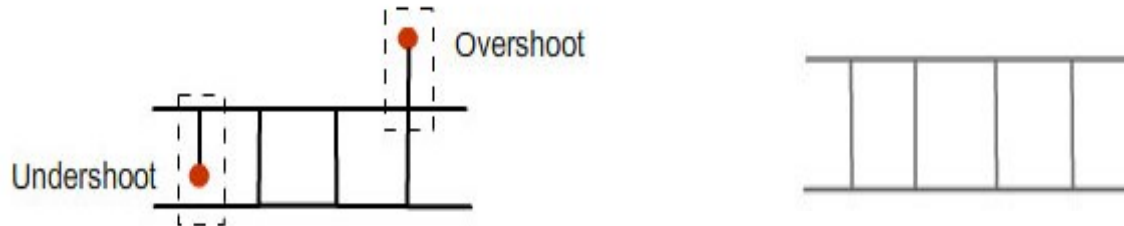
Clipped



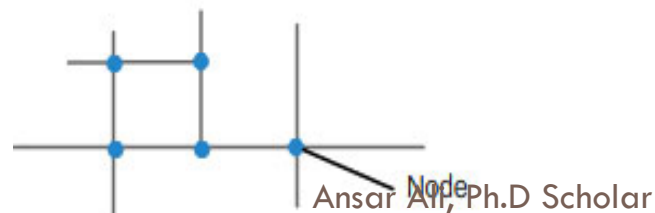
# Vector data editing

is a post digitizing process that ensures that the data is free from errors. It suggests that

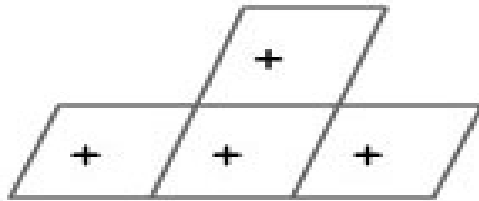
- Lines intersect properly without having any undershoots or overshoots



- Nodes are created at all points where lines intersect



- All polygons are closed and each of them contain a label point and topology of the layer is built



# Spatial data Editing and geo processing

- Purpose:

Manipulation of vector-based map features.

- Goal:

to rework existing map , point and polygon map features into more useful map elements.

# Functions

## □ Merge

use the merge process when you want to create a new theme containing two or more adjacent themes of the same shapefile type.

## □ Clip

use the clip operation when you want to cut out a piece of one theme using another theme as cookie cutter.

## **Dissolve**

Use the dissolve process when you want to remove boundaries or nodes between adjacent polygons or lines that have the same value for a specified attribute

## **Intersect**

Use the intersect process when you want to integrate two spatial data sets while preserving only those features falling within the spatial extent common to both themes

## **Union**

Use the union process when you want to produce a new theme containing features and attributes of two polygon themes

# Principles in map making

# How to make sound maps

## Thinking Spatially

## Basics of Map making

### ■ Map Elements

- Scale,
- Legend,
- Compass,
- Title and Source

## Visual considerations when Mapping

### ■ Types of visualisation

# Thinking Spatially

*What's going on around you?*

*"The most incomprehensible thing about the world is that it is comprehensible"*

- Albert Einstein



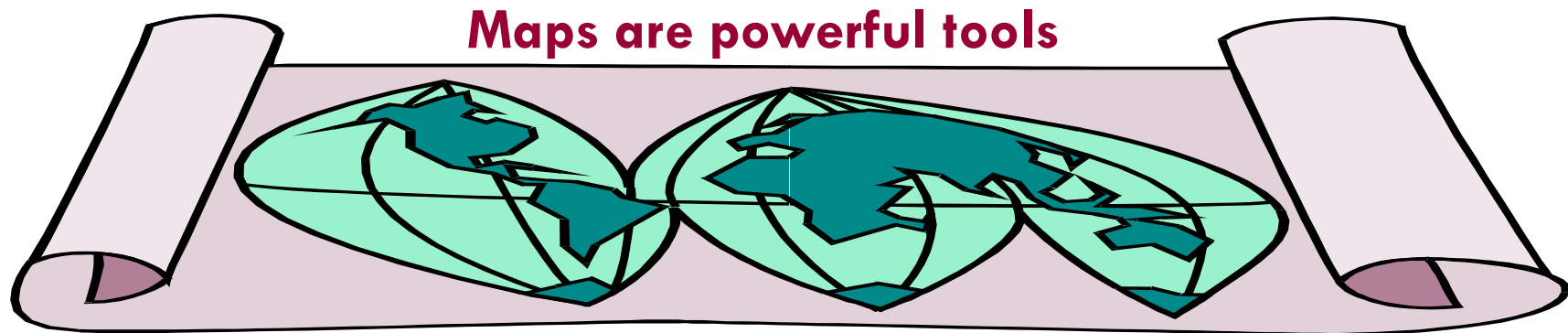
People who are familiar with water scarcity in Pakistan can visualize the situation. They know where the problematic areas are, the issues at these localities, and the types of programs in these areas.

We call this a **mental map** that has been generated from the information stored in the person's mind over the years, consciously or unconsciously.



These mental maps are not sufficient if we want to know about the problem in more detail or communicate it to others and make decisions.

The Generals, planners, engineers and so on... all make use of maps and drawings to guide them.



Maps help us –

- to visualize the situation
- to make decisions
- to implement the plans

# How does this relate to GIS

GIS is a tool that can allow US to create maps of our data so WE can start

***THINKING SPATIALLY***

What is GIS

**Geographic Information Systems**

can

capture, store, retrieve, analyse and display information based on their *LOCATION*

## How do Maps Help do this?

– *Improve our Understanding of the world!*

A map is a picture of a place and gives you better understanding of that place.

Map is a two-dimensional representation of a particular place.

Maps are made for many reasons and therefore they vary in content and context. Different maps show different information.

Different symbols are used to represent the features on earth onto a map, which are explained in the legend. The legend in a map tells what each symbol shows.

So Well Made Maps can Quickly and Easily give  
***Content and Context***

The usefulness of a map depends upon the following factors.

### **Who is going to use them?**

The map audience or the users will influence how a map should look like. A map made for school children will be very different from one made for scientists. Similarly, tourist maps and topographic maps of the same area are very much different in their contents and look as they are made for different users.

### **What is their purpose?**

The purpose of the map determines what features are included and how they are represented. The different purposes such as orientation and navigation, physical planning, management, and education lead to different categories of maps.

## What is their content?

The usefulness also depends upon the contents of a map. The contents can be seen as primary content (main theme), secondary content (base map information) and supportive content (legends, scale, etc).

## What is the scale of the map?

The map scale is the ratio between a distance on a map and the corresponding distance in the terrain. Scale controls the amount of detail and extent of area that can be shown. Scale of the output map is based upon considerations such as - the purpose of the map, needs of the map user, map content, size of the area mapped, accuracy required etc.

Summary- Usefulness of the map

What do the following influence the map?

Who is using the Map?

Who is making the Map?

The Purpose

The Content

The Scale

# Important Properties of Maps and GIS

When using GIS or creating Maps there are Four factors that are important

Scale

Legend

Title

Source

affect the Context of Data displayed and How the Data is and can be *INTERPRETED*



# Scale of a Map

What is scale?

Scale is the '*representative fraction*' it states the relationship between the distance on the map and the distance on the ground

Why is Scale so IMPORTANT?

The scale affects the level of detail a map/GIS dataset can show.

# ***Map Scale***

Large-scale maps cover small areas, but can include a higher level of detail than small-scale maps which depict larger areas at lower detail.

There are no precise definitions of large- or small-scale, but for most map users, the following general scale categories apply:

- Large-scale: 1:250 to 1:1,000
- Medium-scale: 1:1,000 to 1:10,000
- Small-scale: 1:10,000 to 1:100,000
- Very Small-scale: 1: 100,000 to above



1:50,000

Small Scale



Large Scale



1:500,000



ale

here is the scale information for GIS datasets

dataset do not state the scale on the map, because you can change the scale (zoom In and Out).

scale of GIS datasets can be found in the Metadata!!!!

ow does scale effect our use of GIS datasets

scale effects the use of GIS dataset in two ways

How far we can zoom in and out reliably on a dataset

Which GIS datasets we can integrate together

- What are the General rules with Scale issues
  - ▣ Do not zoom below the scale as stated for the dataset (that is scale at which the data was collected)
  - ▣ Only integrate GIS dataset that have been collected at the same or at a similar scale
  - ▣ The maximum scale a dataset should be view is approximately 100 times the Scale that is stated in the Metadata.
  - ▣ For Example: Data collected at 1:5000 it should not be viewed above 1:500000

# Legend, Title and Source

## Legend

- Needs to Clearly define the category breakdowns

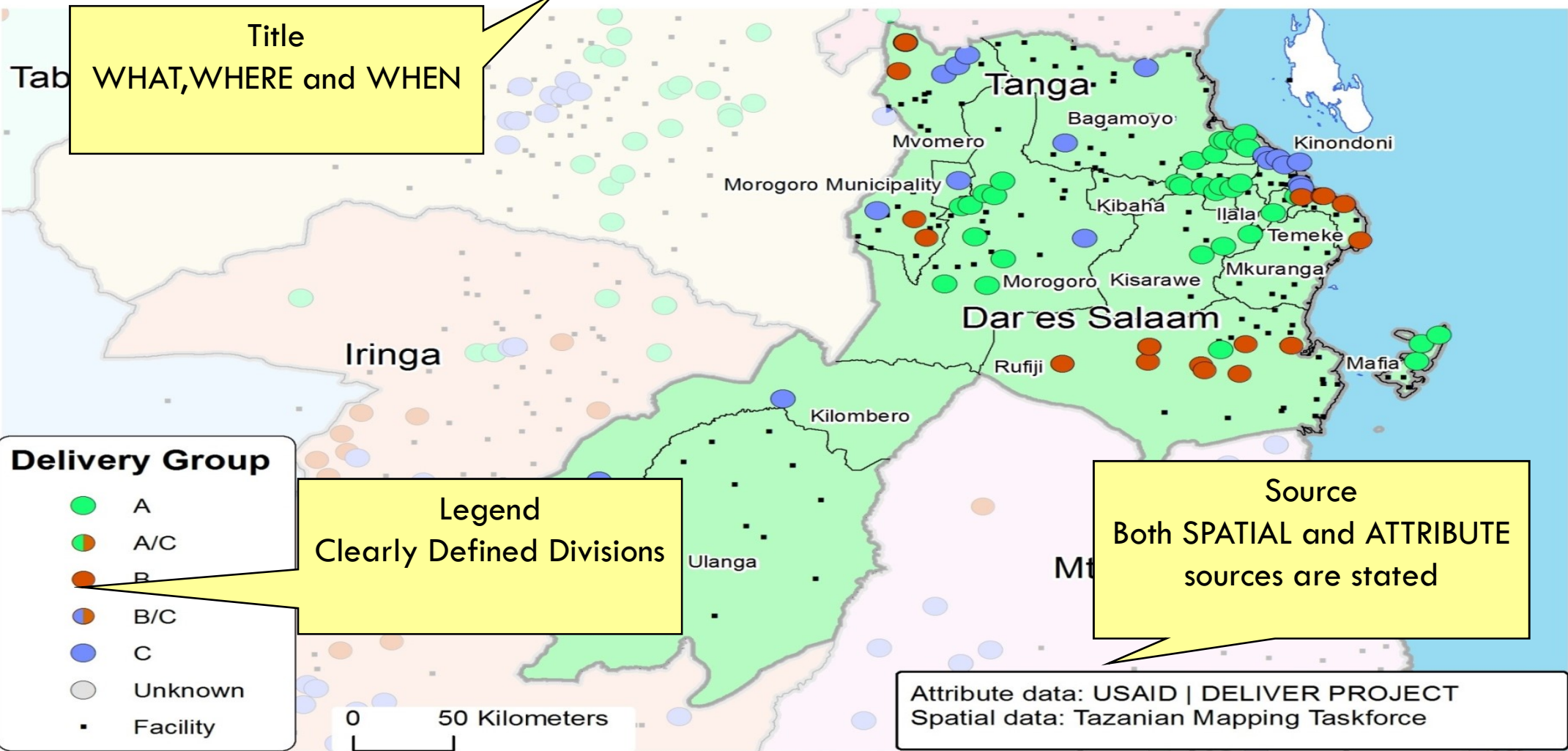
## Title

- Needs to define WHAT, WHERE and WHEN is been mapped!

## Source

- The source for both the Geographic data and Attribute Data

# The MSD Delivery Groupings of Health Facilities for Dar es Salaam in 2010



s to Remember

s can LIE!!

aps are just one person's representation of the Real World

ke any source of information they can be misleading specially when  
ed out of context

ow maps can be deceiving

Inappropriate Legend

Inappropriate Scale



# Practical

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How to add

- ▣ Title – What, Where and When
- ▣ Legend – Clear and Precise
- ▣ Scale Bar
- ▣ Source – Concise
- ▣ Compass

# BASIC CARTOGRAPHIC CONCEPTS



# Basic Cartographic concepts

Map Design

Cartographic standards

Generalization

Graphic Variables

Use of Color

Classification of Data

Methods of Mapping

# *Map Design*

Map making is both science and art.

Maps influence people's perception of space. This influence is partly because of convention and partly because of the graphics used.

People understand the world differently, express this understanding differently in maps, and gain different understanding from the maps.

# Cartographic standards

## Basic Map Elements

### Administrative boundaries

- Either Black or Grey
- Higher Administrative unit the thicker the line

### Roads

- Red
- Tracks dashed lines (light red/brown)

### Rivers and Lakes

- Blue
- Streams dashed lines light blue

What do you think Health Centres should be symbolized

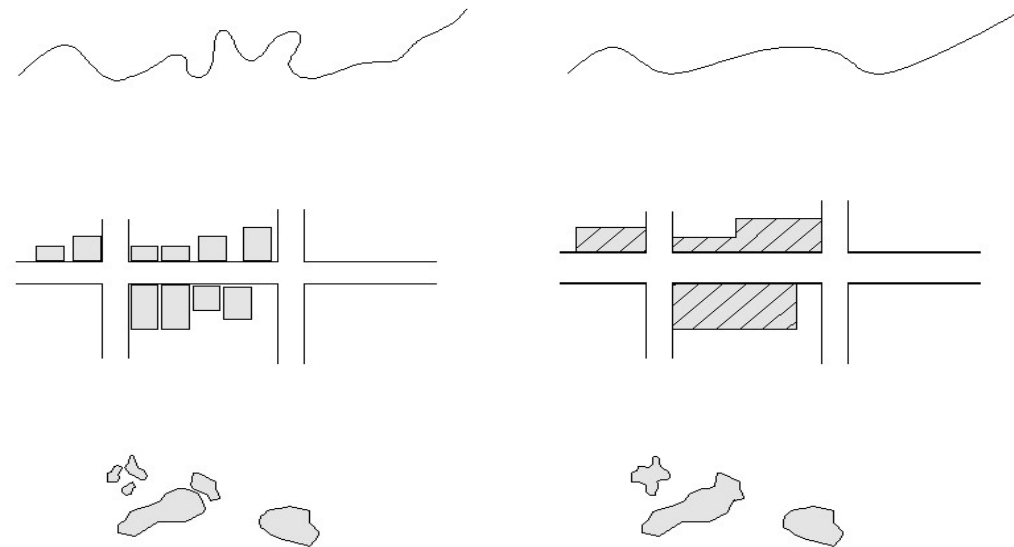
# Map Design

## Generalization

Maps contain a certain level of detail depending upon its scale and purpose.

**The process of reducing the amount of detail in a map in a meaningful way is called generalization.**




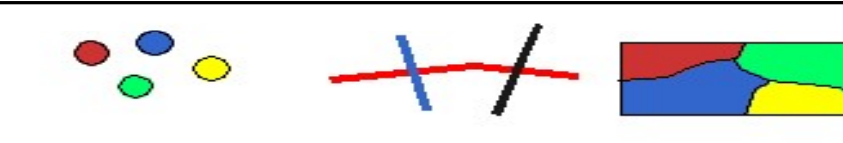
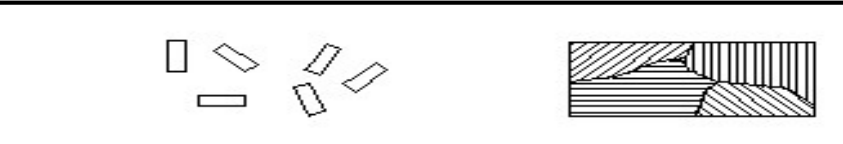
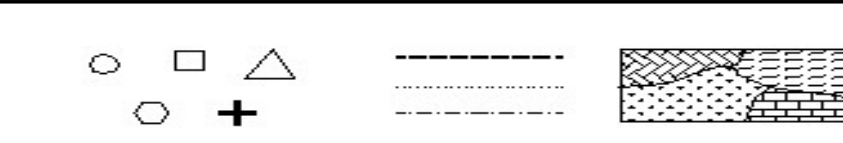
Generalization is done normally when the map scale has to be reduced. However, the essence of the contents of original map should be maintained. This implies maintaining geometric and attribute accuracy as well as the presentation quality of the map.



# Map Design

## Graphic Variables

The differences in the graphic character of symbols give different perceptions to the map reader. These graphic characteristics are termed as graphic variables which can be summarised as *size*, *Lightness or grey value*, *Grain or texture*, *Colour*, *Orientation*, and *Shape* or form.

|             |   |
|-------------|---|
| Size        |    |
| Value       |    |
| Texture     |    |
| Colour      |    |
| Orientation |   |
| Shape       |  |

## Use of Colour

Colour perception has psychological, physiological and conventional aspects.

It has been noted that it is difficult to perceive colour in small areas, and more contrast is perceived between some colours than between others.

In addition to distinguishing nominal categories, colour differences are also used to show deviations or gradation.





## Classification of Data

The representation of data for mapping will depend on the measurement scale of the data.

**Nominal scale:** The differences in data are only of qualitative nature, e.g., differences in facility type, land use or geology.

**Ordinal scale:** Only the order of the attribute values is known, such as more than or less than, “small - medium – large” or “cool - tepid - hot”.

**Interval scale:** Both the hierarchy and the exact distance is known, but it will not be possible to know the ratios, e.g., the temperature or the altitude values.

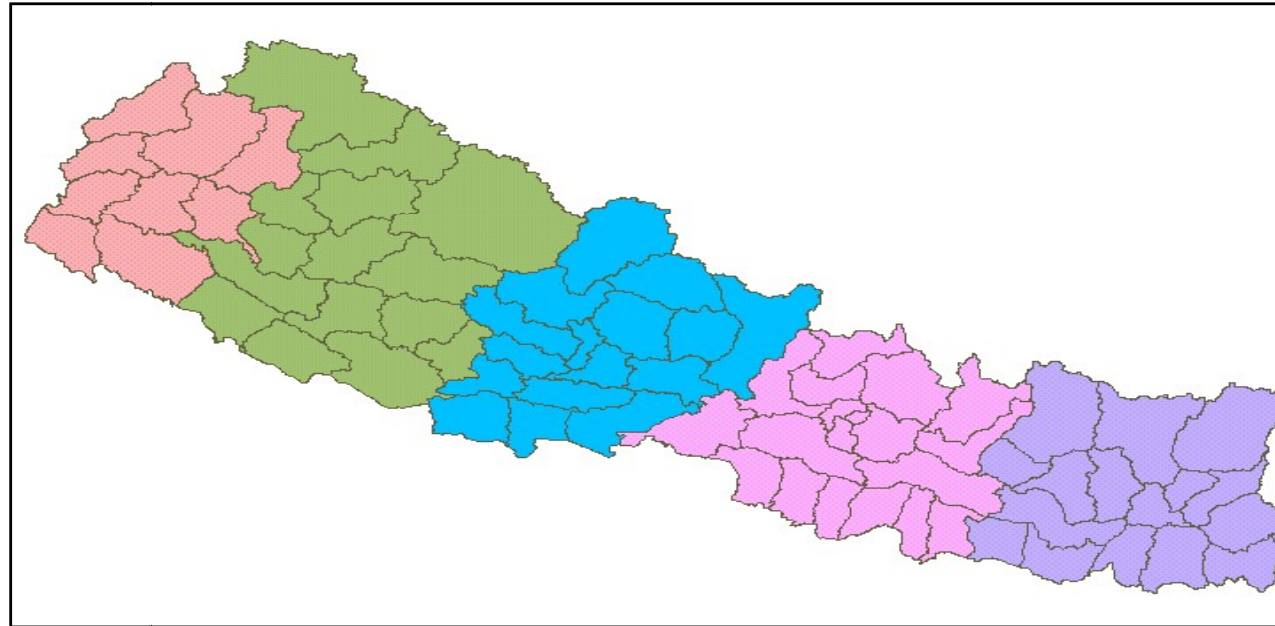
**Ratio scale:** Data can be measured on a ratio measurement scale, e.g., the number of children in a family or income.

## Mapping Methods

- standardized ways of applying graphic variables for rendering information components
- based on the measurement scale and nature of the distribution of objects

### *Chromatic maps:*

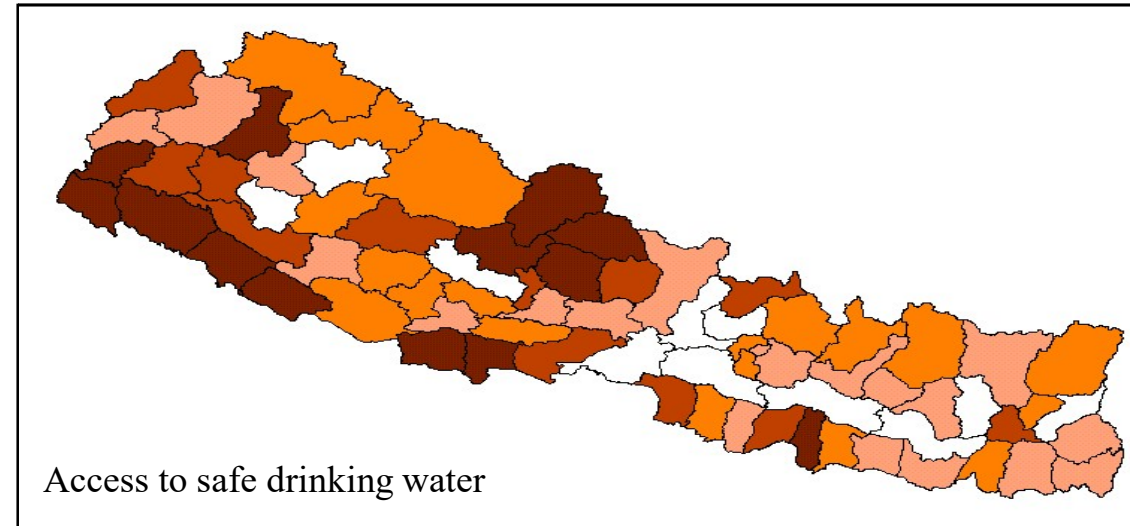
Renders Categories of areas with different colours. This for nominal scale,



## Mapping Methods

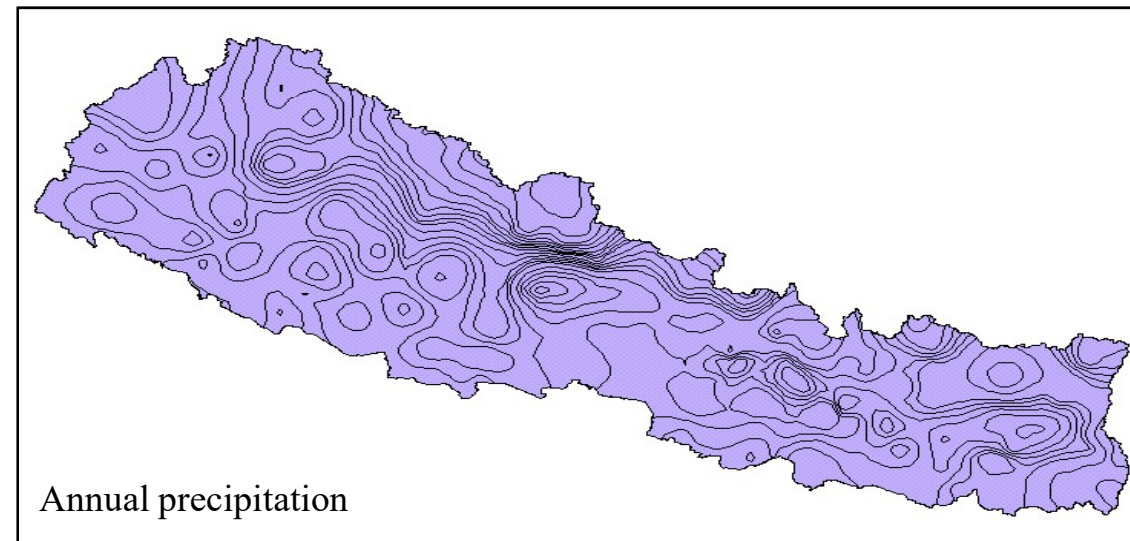
### *Choropleth maps:*

Values are calculated for area and expressed as stepped surface, showing a series of values. The order between the classes can be seen.



### *Isoline maps:*

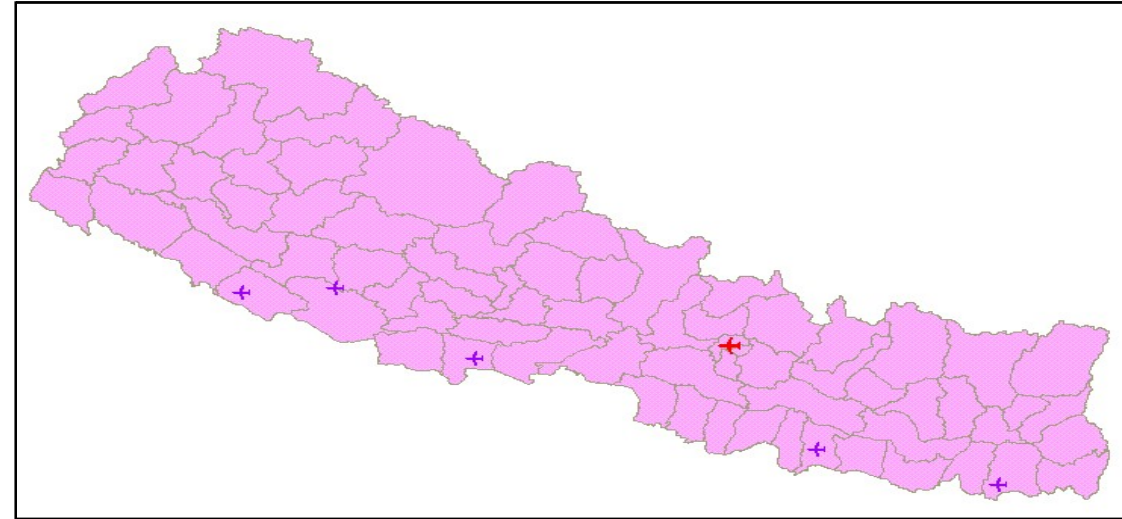
Isoline maps represent continuous phenomena. Isolines connect the points with an equal value and show the trends.



# Mapping Methods

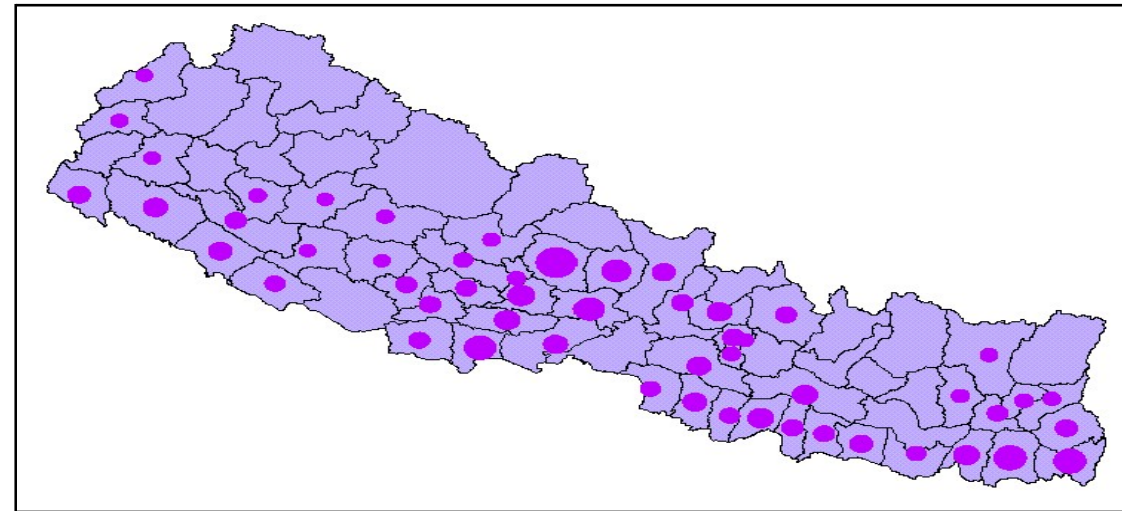
## *Nominal point data:*

Nominal data represented by symbols that are different in shape, orientation or colour.



## *Absolute proportional method:*

Discrete absolute values for point locations or areas are represented by proportional symbols.





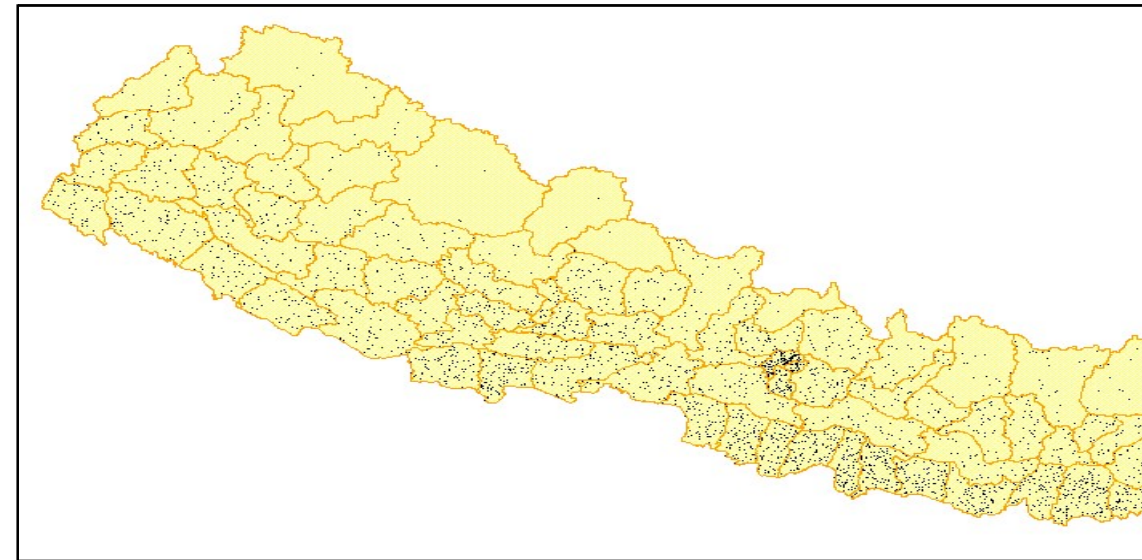
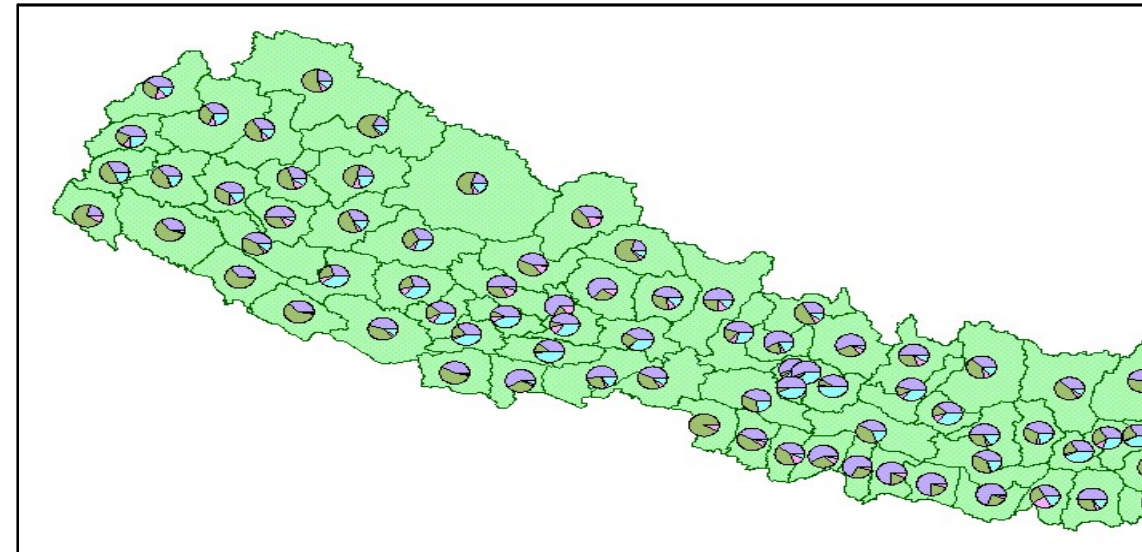
# Mapping Methods

## *Diagram maps:*

Diagrams are used in the maps to allow comparisons between figures or to visualize temporal trends.

## *Dot maps:*

Dot maps represent point data through symbols. Each dot denote the same quantity. Eg. One Dot = One thousand people.



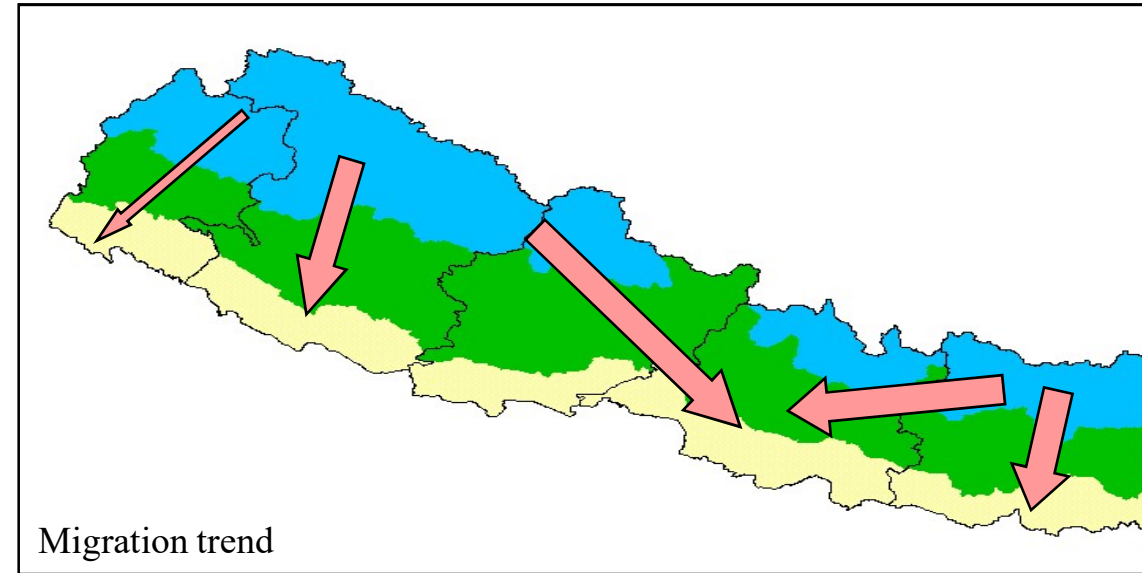
## Mapping Methods

### *Flowline maps:*

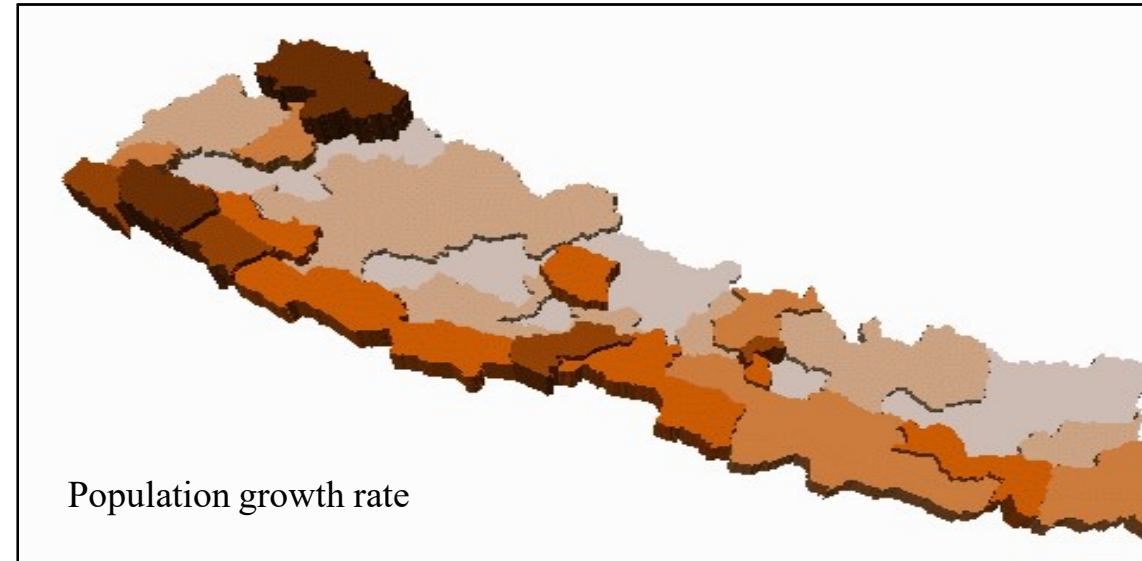
Simulate movement using arrow symbols. Arrows indicate route and direction of flows and volume is shown by the relative thickness of the arrow shaft.

### *Statistical surfaces:*

Three dimensional representation of qualitative data such as used in choropleth and isoline maps.



Migration trend



Population growth rate

## *New Map Output Types*

With the added potential of digital computers, new ways of visualization and using spatial information are being developed.

New products like **electronic atlases**, cartographic **animations** and are coming up in the field of spatial information.

These developments allow easy access through the GIS to text documents describing a parcel of land, photographs of the location, or a video clip of the landscape of the study area.

# Demonstration of Map Making

1. Define the process from Question to Map

2. Determine what type of Map best answers the Question

3. Perform the Classification of the data

4. Create Output Layout

5. Set the Legend, Scale, Title and Source

6. Output Map



# Summary

ing cartographic standards

e of graphic symbols

e of colour

e of different mapping methods

# QUESTION & ANSWERS