Geospatial Technologies

Day 3- QGIS Hands-on &
Remote sensing (Landuse/Landcover change)

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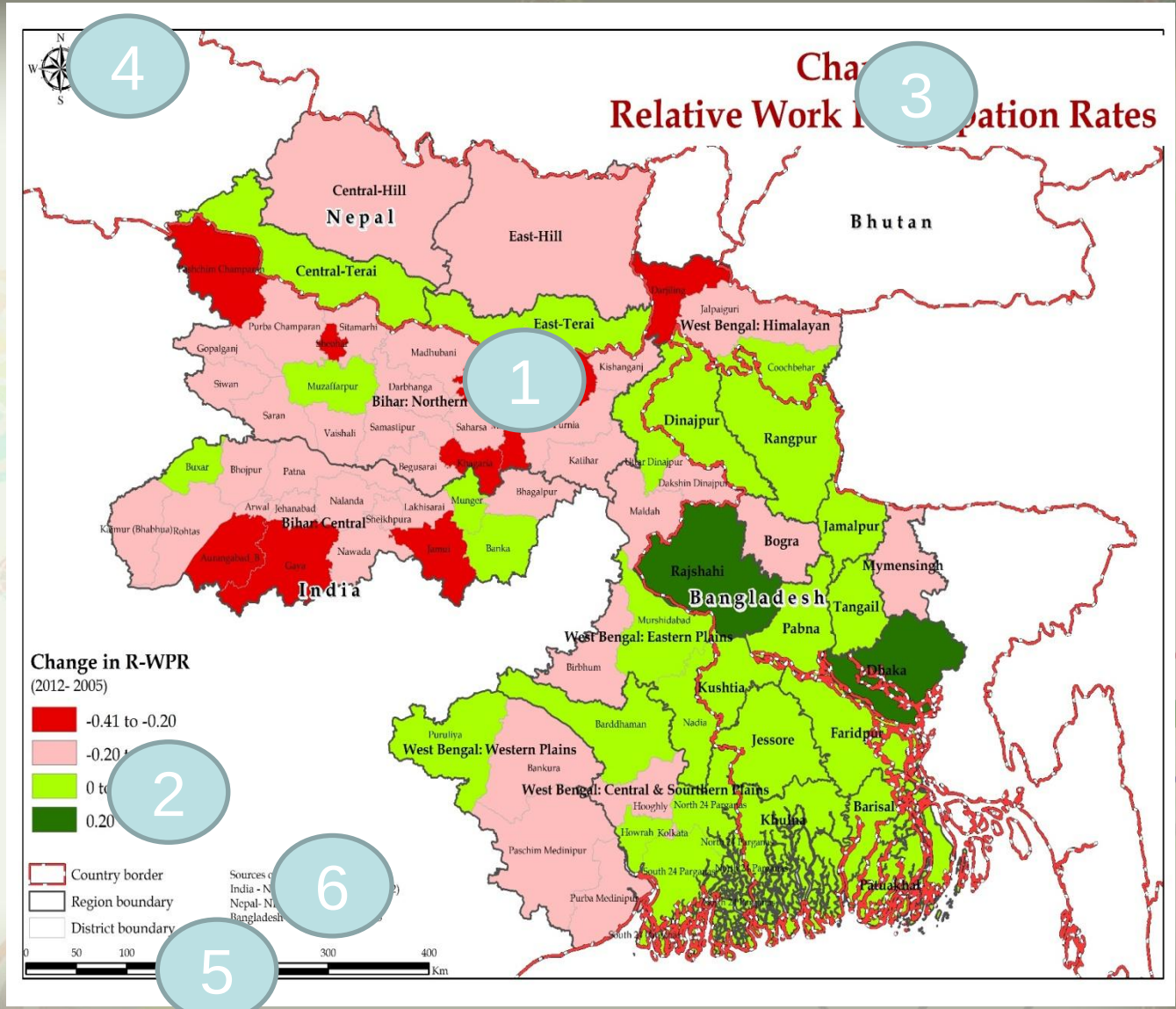
Map cosmetics

- Data frame
- Legend
- Title
- North Arrow
- Scale bar
- Citation
- Inset map



Landcover

Land cover data documents how much of a region is covered by forests, wetlands, Impervious surfaces, agriculture, and other land and water types. Water types include wetlands or open water.

Landuse

Land use shows how people use the landscape – whether for development, conservation, or mixed uses. The different types of land cover can be managed or used quite differently.

Landuse Landcover change (LULCC)

- The modification of Earth's terrestrial surface by human activities is known as Land use/land cover change (LULCC) around the globe.

- Technically, land use and land cover change mean quantitative changes in areal extent (increase or decrease) of a given type of landuse and land cover respectively.

- Land cover indicates the **physical land type** such as forest or open water whereas land use documents **how people are using the land.** The change or conversio

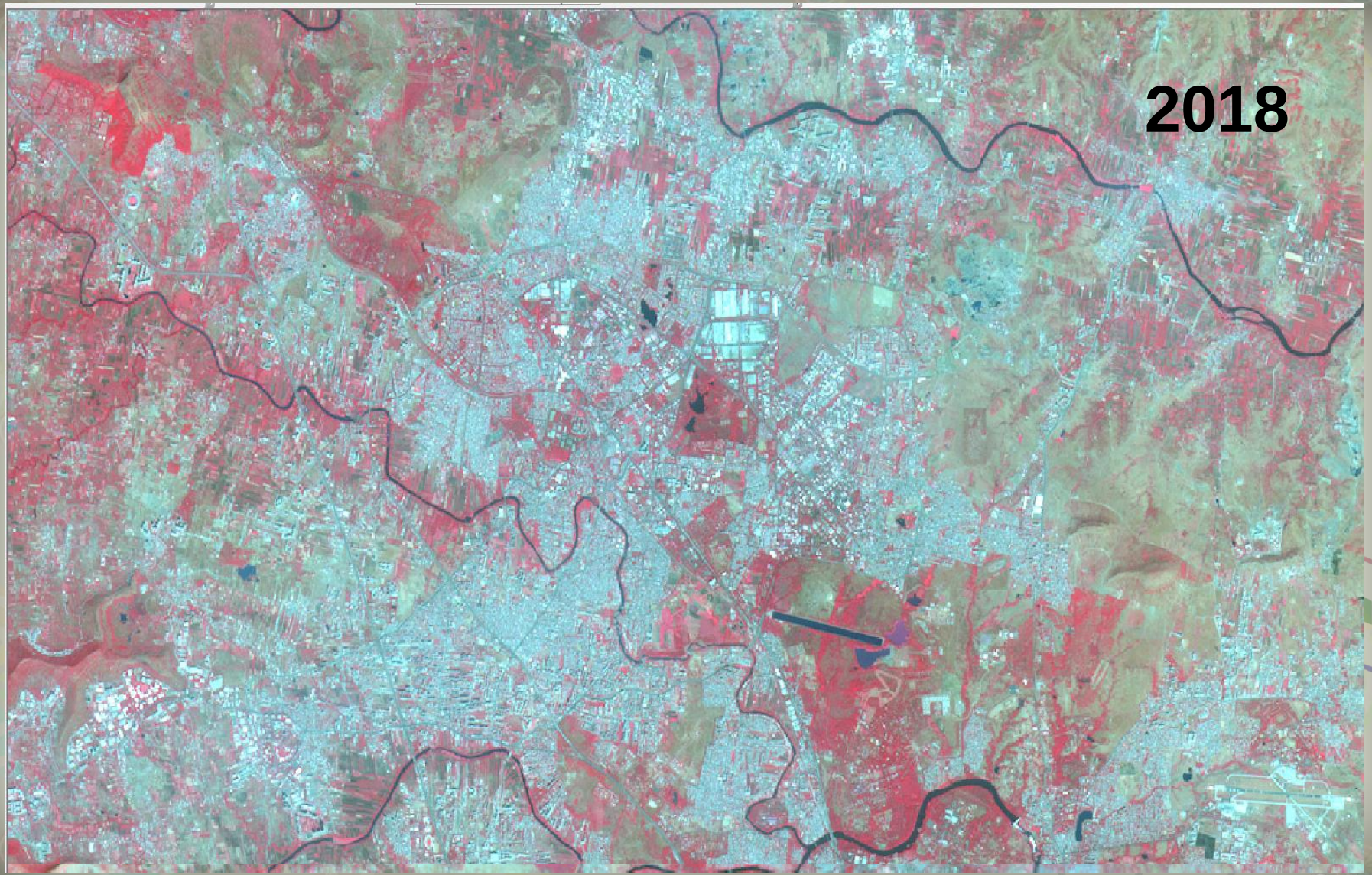
- n could be either environment driven (natural) or anthropogenic.

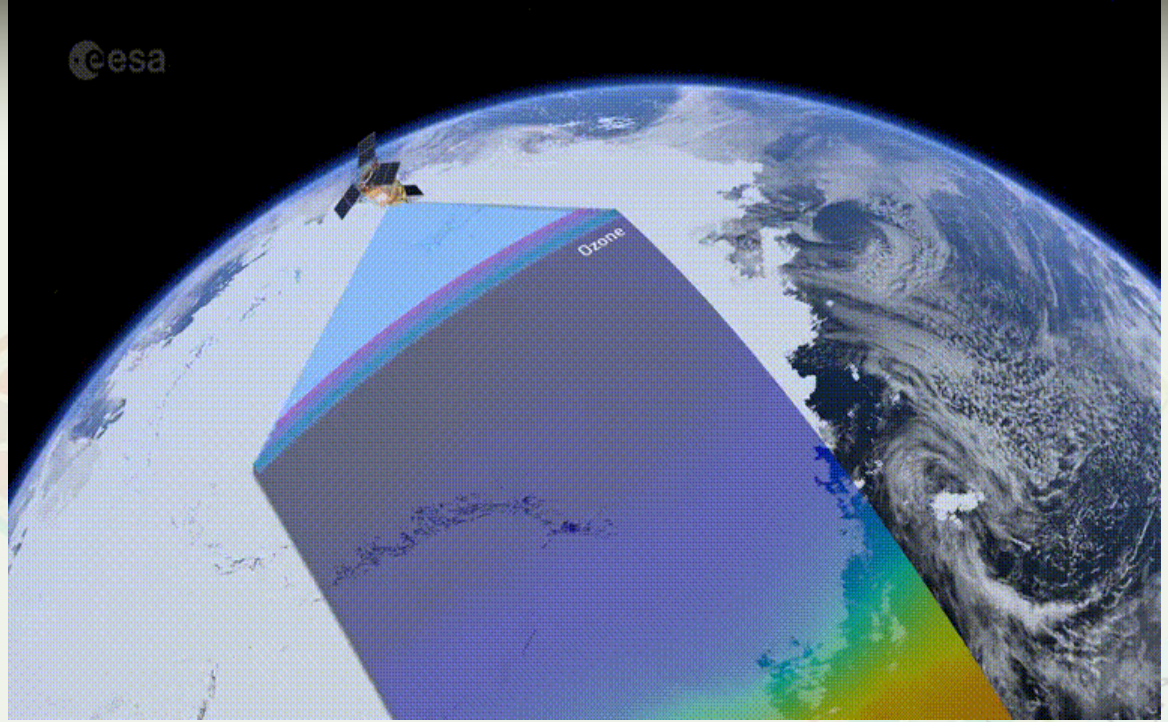
- Changes could be temporary/seasonal/permanent.

Why LULCC ??

Helps the policy makers to understand the environmental change dynamics to ensure sustainable development and helps answering questions such as

- What type of land is more severely under threat?
- Where do forests need protection?
- Which direction is an urban centre growing, and is that posing any dangers to the natural environment?
- How is the changing land use affecting the atmosphere and nearby water resources?
- Where do we have the best opportunity to exploit land as a natural resource?
- How is land use changes affecting natural ecosystems?





Why is remote sensing a better technique than other traditional methods?

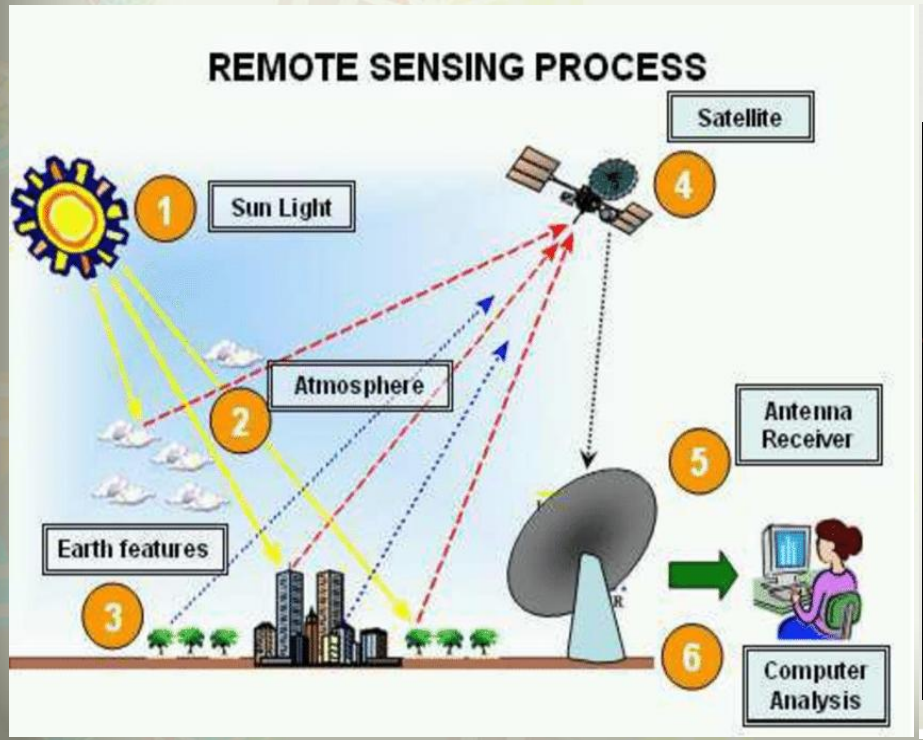
It presents the concise picture of a large area.
It provides real or nearly real pictures on time base line.
It is less expensive as compared to land survey and we can easily collect information by using it.
It converts energy received into photographic/digital form of data.
It is not affected by bad weather and inaccessible land.

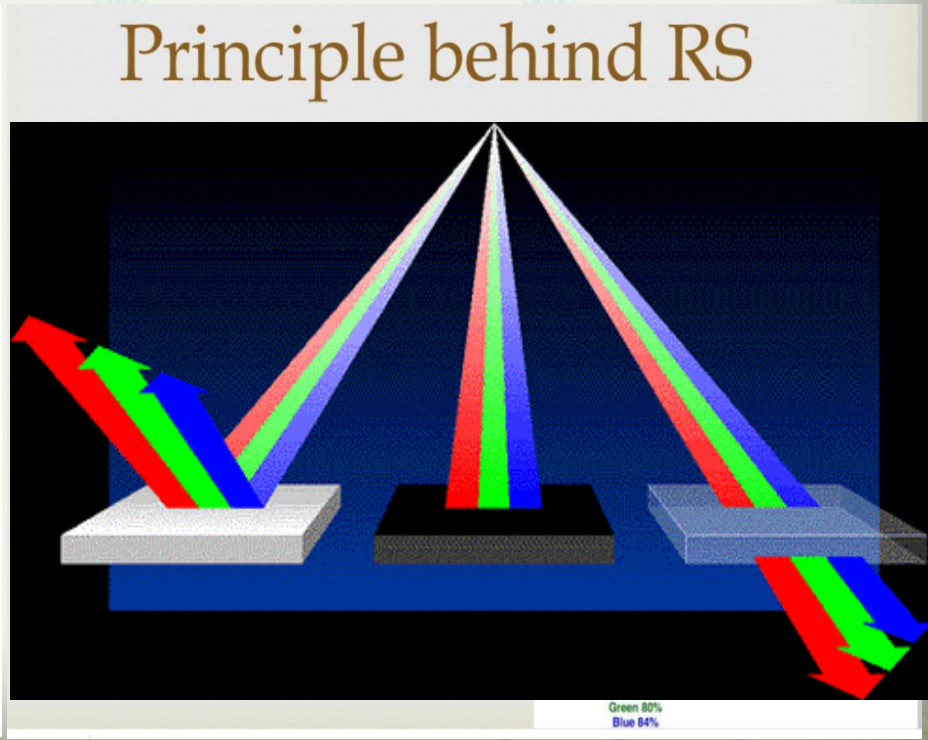
Remote Sensing

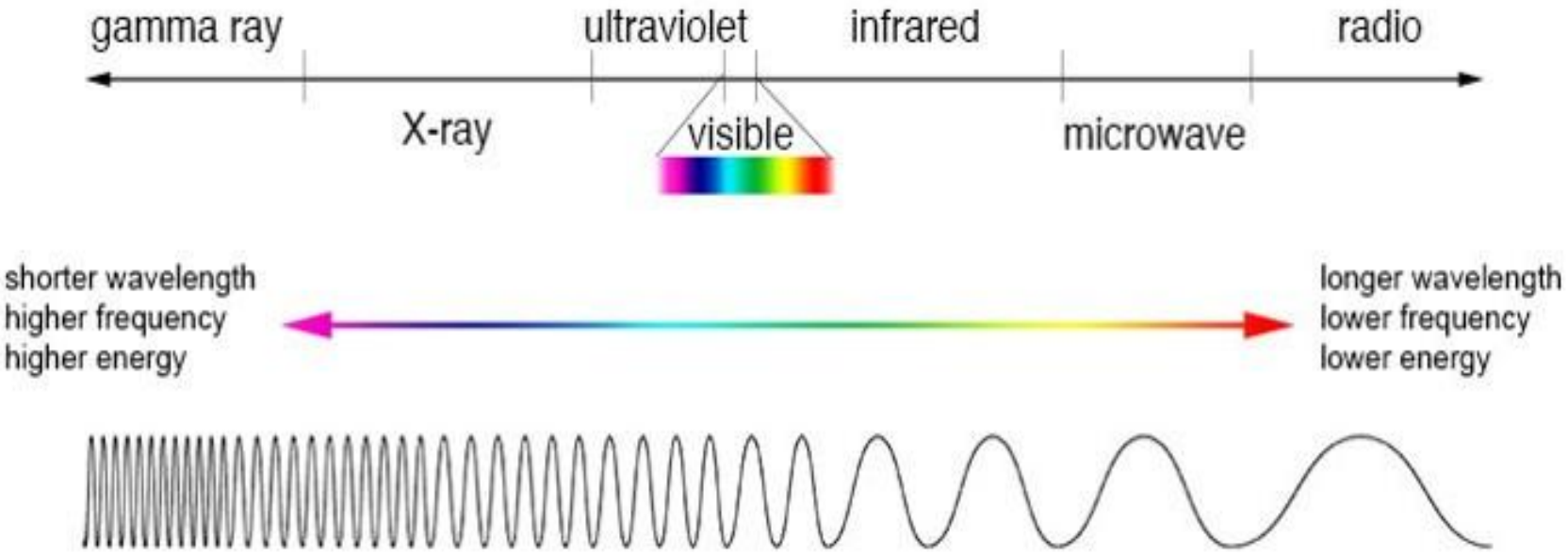
- Photography
- X-ray
- MRI- Magnetic Resonance Imaging
- Sonogram

Is a method of **obtaining characteristics** of an object without coming into physical contact with it.

This is done by sensing and recording reflected or emitted energy and processing, analysing, and applying that information







Which of the following regions of Electromagnetic spectrum is not used in satellite remote sensing.

- ❑ Microwave region
- ❑ Infrared region
- ❑ X - rays
- ❑ Visible region

Satellite/digital image

A digital image comprises of a two dimensional array of individual picture elements called pixels arranged in columns and rows

Each pixel represents an area on the Earth's surface.

A pixel has an intensity value (DN) and a location address in the two dimensional image.

Part of LISS III satellite image

Columns

Rows

52	36	23	56	33
25	10	255	96	98
18	0	200	10	65
45	46	52	89	35
20	0	55	65	23
51	75	22	84	44

Resolutions of Remote Sensing

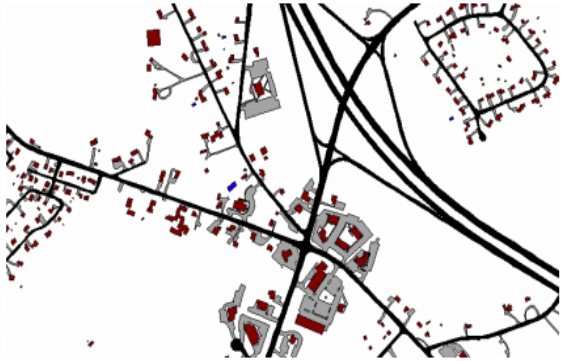
1. ***Spatial*** *(what area and how detailed)*
2. Spectral (what colors – bands)
3. Temporal (time of day/season/year)
4. Radiometric (color depth)

Spatial Resolution describes how much detail in a photographic image is visible to the human eye.

The ability to "resolve," or separate, small details is one way of describing what we call spatial resolution.

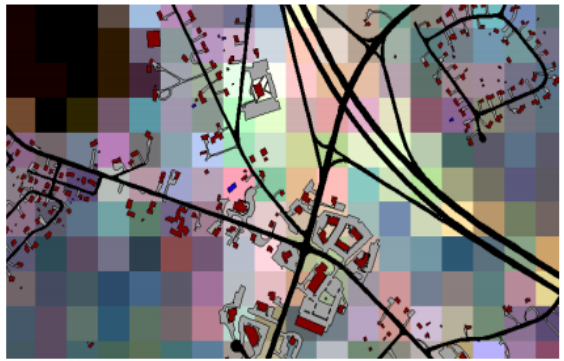
Spatial Resolution

Planimetric data – roads, buildings, driveways

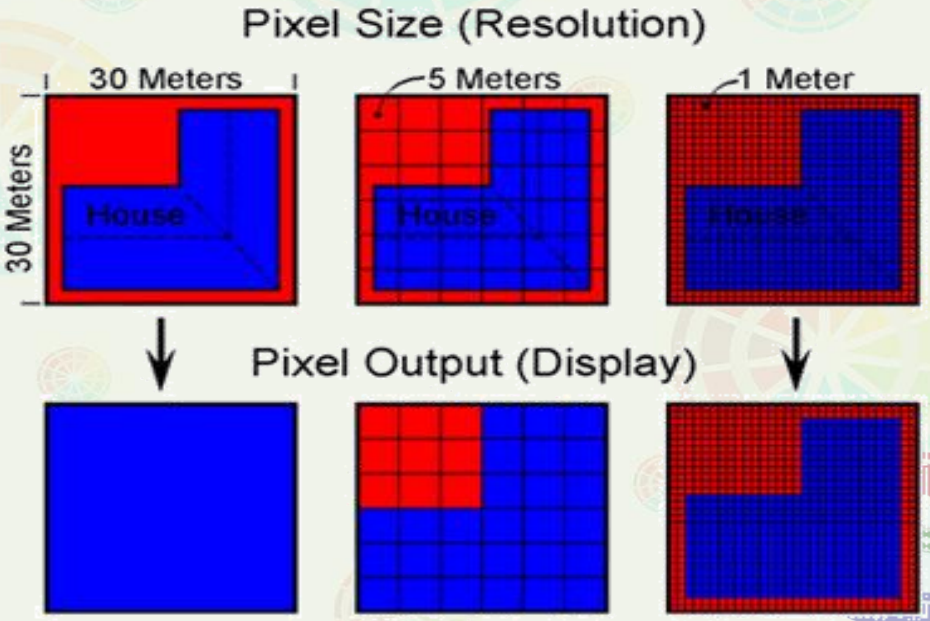


Spatial Resolution

80 meter MSS w/ planimetric overlay



Data resolution, minimum mapped size



Coarse resolution

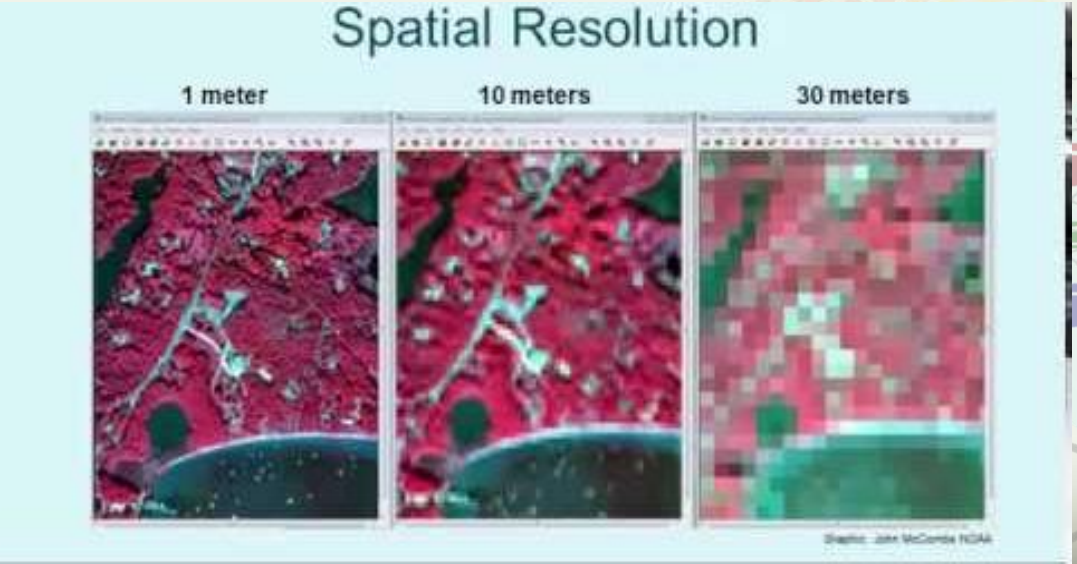
Fine resolution

Spatial Resolution

Spatial resolution refers to the amount of detail that can be detected by a sensor/ Smallest unit-area measured

Images where only large features are visible are said to be coarse or low resolution. In fine or high resolution images, small objects can be detected

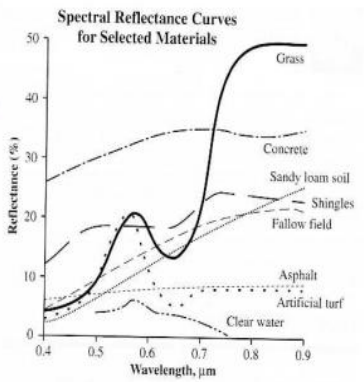
Detailed mapping of land use practices requires a much greater spatial resolution



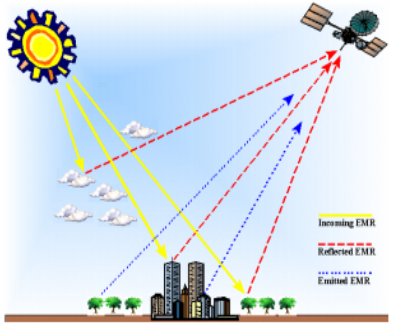
Resolutions of Remote Sensing

1. Spatial (what area and how detailed)
2. ***Spectral*** *(what colors – bands)*
3. Temporal (time of day/season/year)
4. Radiometric (color depth)

The spectral reflectance curves, or spectral signatures, of different types of ground targets provide the knowledge base for information extraction.



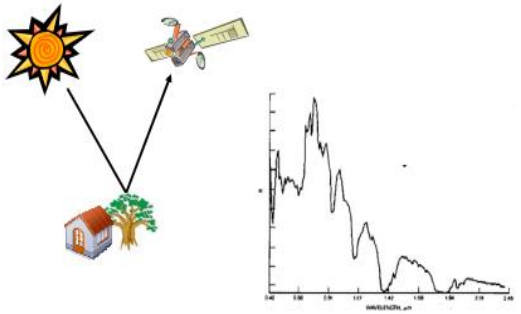
Spectral Response Curve



http://www.cas.sc.edu/geog/rslab/Rsco/mod1/emrpaths.gif

EMR patterns are recorded by sensors with separated spectral bands.

Spectral Response Curve



Resolutions of Remote Sensing

1. Spatial (what area and how detailed)
2. Spectral (what colors – bands)
3. ***Temporal*** (time of day/season/year)
4. Radiometric (color depth)

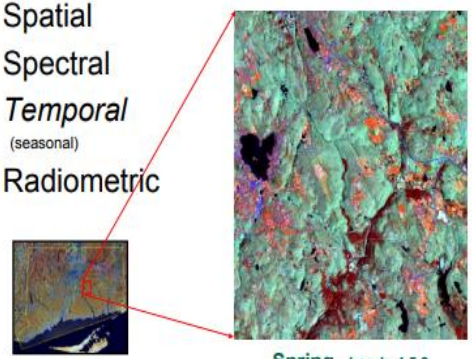
Temporal Considerations

Time of day/season image acquisition

- **Leaf on/leaf off**
- **Tidal stage**
- **Seasonal differences**
- **Shadows**
- **Phenological differences**
- **Relationship to field sampling**

Seasonal Considerations

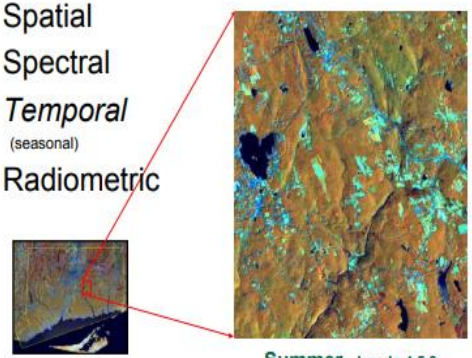
- Spatial
- Spectral
- *Temporal*
  (seasonal)
- Radiometric



Spring - bands 4,5,3

Seasonal Considerations

- Spatial
- Spectral
- *Temporal*
  (seasonal)
- Radiometric



Summer - bands 4,5,3

Radiometric Resolution

Every time an image is acquired by a sensor, its sensitivity to the magnitude of the electromagnetic energy determines the ***radiometric resolution***.

The finer the radiometric resolution of a sensor, the more sensitive it is to detecting small differences in reflected or emitted energy.

Imagery data are represented by positive digital numbers which vary from 0 to a selected power of 2. This range corresponds to the number of bits used for coding numbers in binary format. Each bit records an exponent of power 2.

The maximum number of brightness levels available depends on the number of bits used in representing the energy recorded. Thus, if a sensor used 8 bits to record the data, there would be $2^8=256$ digital values available, ranging from 0 to 255.

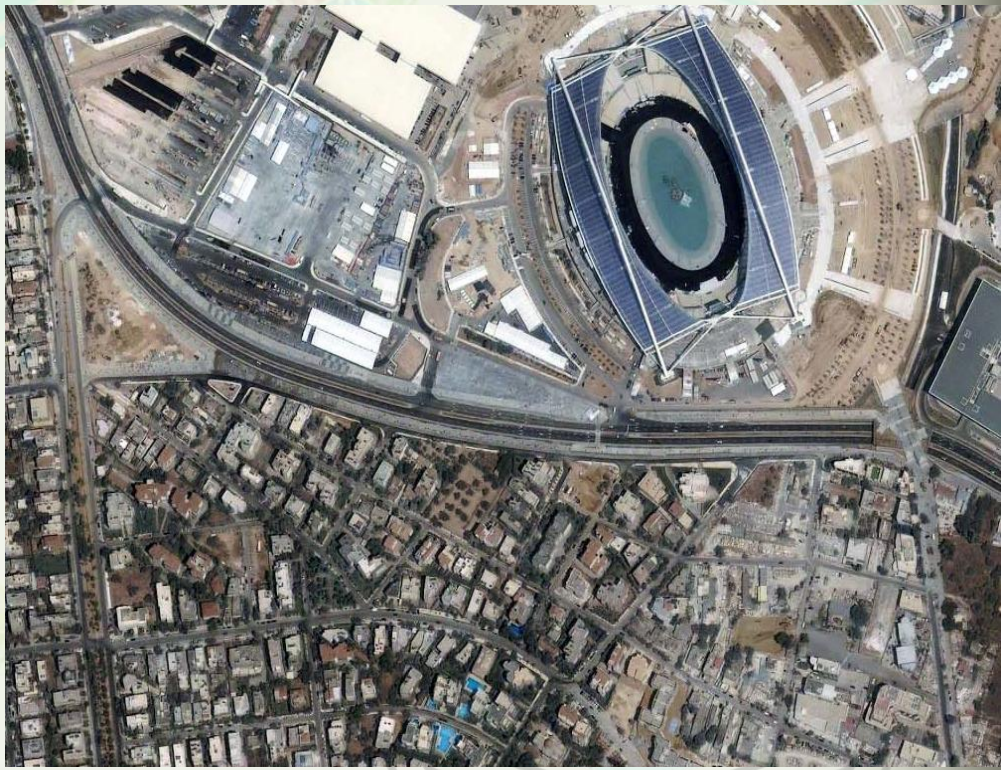
8 bits ↓ 11 bits ↓

1	2	3	4	5	6	7	8	9	10	11	Number of bits
2	4	8	16	32	64	128	256	512	1024	2048	Maximum Values

Data volume will increase as the radiometric resolution increases?

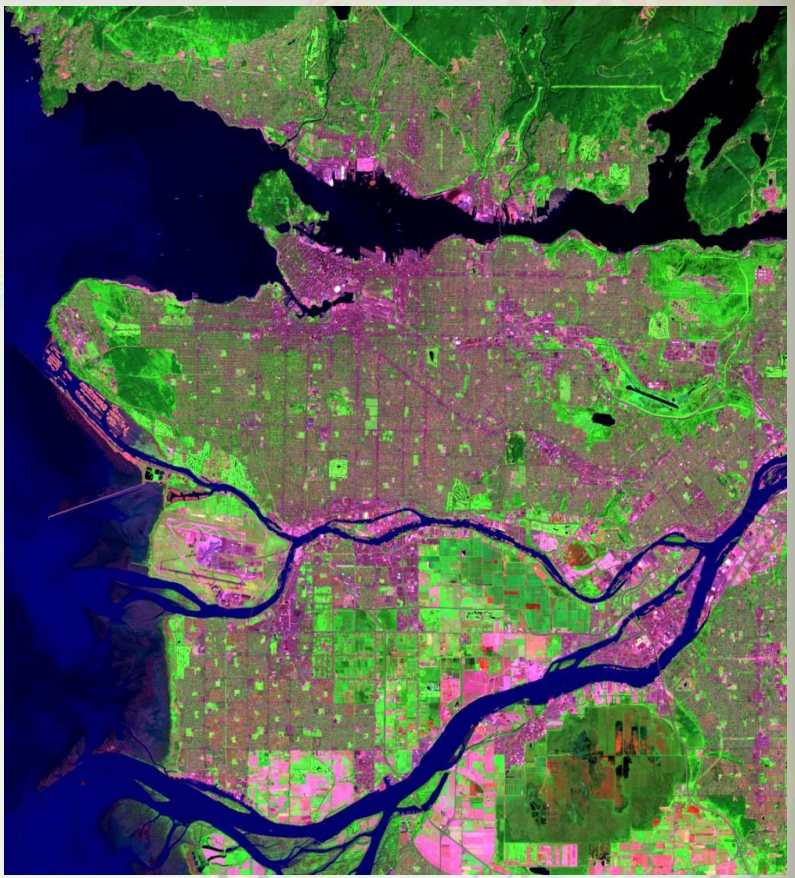
Ikonos

- High-resolution
- Launched September 1999
- 1-meter panchromatic infrared
- 4-meter visible/infrared
- 13 kilometer swath
- Revisit times 1-3 days



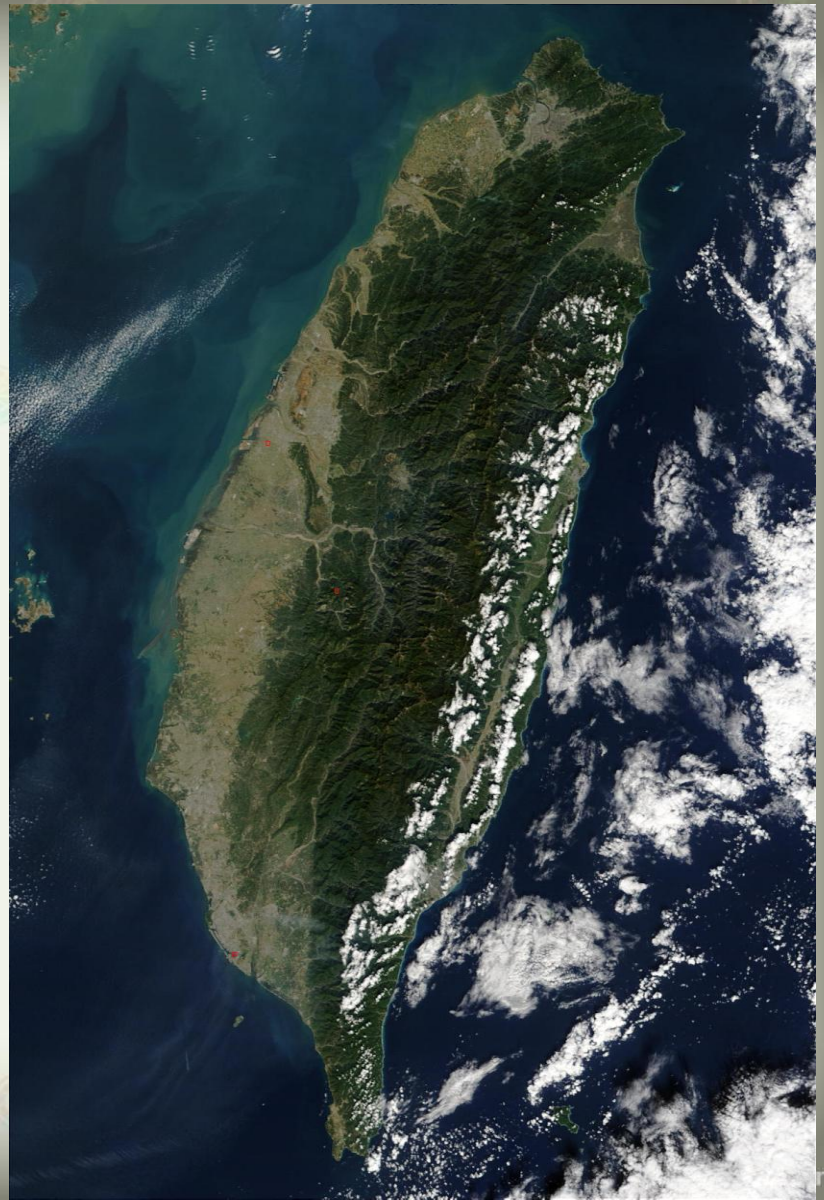
Landsat

- Launched July 1972
- First system designed to gather data about Earth's land surface
- Three imaging scanners onboard
  - Video camera
  - Multispectral scanner
  - Thematic Mapper
  - Enhanced Thematic Mapper
- Revisit time 16-18 days



MODIS

- Collects data at range of wavelengths from visible through thermal infrared
- Resolution between 250 meters and 1 kilometer
- Revisit time 1-2 days at 1 kilometer resolution

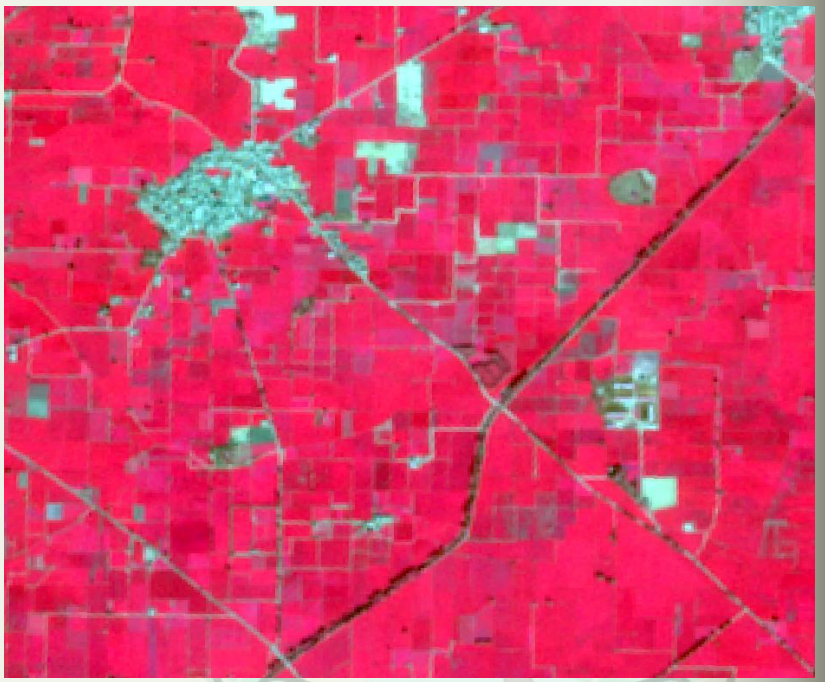


Sentinel -2

•Sentinel-2 carries an optical payload with visible, near infrared and shortwave infrared sensors

•comprising 13 spectral bands: 4 bands at 10 m, 6 bands at 20 m and 3 bands at 60 m spatial resolution

•with a swath width of 290 km.



Classification method

54 level-III classification system is used while mapping the land use / land cover classes.

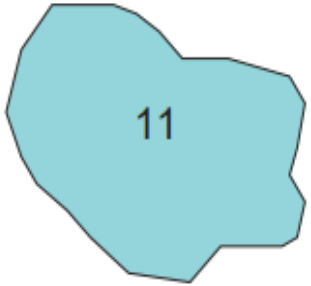
LU/LC categories are interpreted based on image parameters viz. tone, texture, pattern, size, shape and contextual association for delineating the Levels- I & II categories by Heads-on (onscreen) digitization methods.

Change mapping is carried out to depict the LULC change over 2005-06 to 2011-12 period. Land Use / Land Cover maps will undergo the possible changes:

• Decrease in areas • Increase in areas
• Change from One class to another class • No change

Table –2.1 Land Use / Land Cover Classification for 2nd cycle of NRC LULC mapping

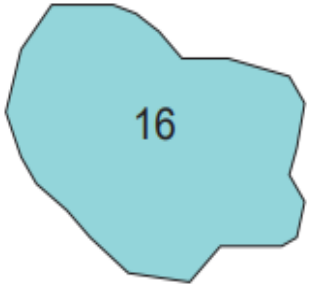
SI - I	L - I	SI - II	L - II	SI - III	L - III	LU11_12	LU_CODE
1	Built Up	1.1	Urban	1.1.1	Built up - Compact (Continuous)	1	010111
				1.1.2	Built up - Sparse (Discontinuous)	2	010112
				1.1.3	Vegetated / Open Area	3	010109
		1.2	Rural	1.2.1	Rural	4	010201
		1.3	Industrial	1.3.1	Industrial area	5	010301
				1.3.2	Ash / Cooling Pond / effluent and other waste	6	010304
		1.4	Mining / Quarry	1.4.1	Mining – Active	7	010401
				1.4.2	Mining - Abandoned	8	010402
				1.4.3	Quarry	9	010403
2	Agricultural land	2.1	Cropland	2.1.1	Kharif	10	020101
				2.1.2	Rabi	11	020102
				2.1.3	Zaid	12	020103
				2.1.4	Cropped in 2 seasons	13	020104
				2.1.5	Cropped in more than 2 seasons	14	020105
		2.2	Fallow land	2.2.1	Fallow land	15	020201
		2.3	Agriculture Plantation	2.3.2	Agriculture Plantation	16	020301
		2.4	Aquaculture	2.4.3	Aquaculture	17	020400
3	Forest	3.1	Evergreen / Semi evergreen	3.1.1	Dense / Closed	18	030101
				3.1.2	Open	19	030102
		3.2	Deciduous (Dry / Moist / Thorn)	3.2.1	Dense / Closed	20	030201
				3.2.2	Open	21	030202
		3.3	Forest Plantation	3.3.1	Forest Plantation	22	030300
		3.4	Scrub Forest	3.4.1	Scrub Forest	23	030400
		3.5	Swamp / Mangroves	3.5.1	Dense / Closed	24	030601
				3.5.2	Open	25	030602
		3.6	Tree Clad Area	3.6.1	Dense / Closed	26	030701
				3.6.2	Open	27	030702
4	rass/Grazing	4.1	Alpine / Sub-Alpine	4.1.1	Alpine / Sub-Alpine	28	040100
		4.2	Temperate / Sub Tropical	4.2.1	Temperate / Sub Tropical	29	040200
			Tropical /	4.2.2	Tropical / Desertic		



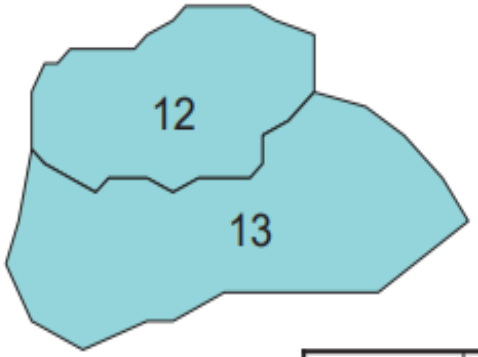
Change from One Class to another

Attribute table

OBJECT ID	Shape	LU_CODE	Description	Shape_ area	LU_0506	LU_1112
1	Polygon	020102	Agricultural land- Rabi Crop	36188.55	11	Null



OBJECT ID	Shape	LU_CODE	Description	Shape_ area	LU_0506	LU_1112	Change
1	Polygon	020301	Agricultural land- Agricultural Plantation	36188.55	11	16	CCIE



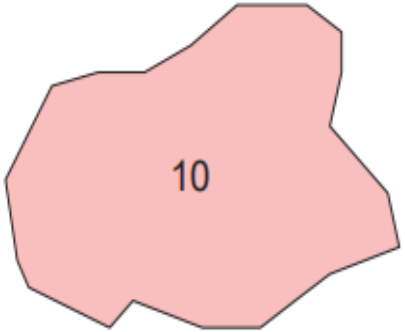
Increase in Area (Category Change)

Attribute table

OBJECTID	Shape	LU_CODE	Description	Shape_area	LU_0506	LU_1112
1	Polygon	020103	Agricultural land- Zaid Crop	55152.85	12	Null

CUT POLYGON

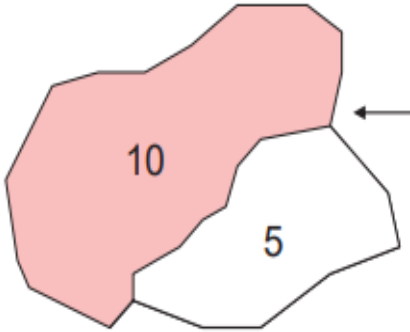
OBJECTID	Shape	LU_CODE	Description	Shape_area	LU_0506	LU_1112	Change
1	Polygon	020103	Agricultural land- Zaid Crop	55152.85	12	12	NO
2	Polygon	020103	Agricultural land- Zaid Crop	23636.91	13	12	CC
3	Polygon	020104	Agricultural land- Cropped in 2 seasons	35451.12	13	13	NO



Decrease in Area (Category Change)

Attribute table

OBJECTID	Shape	LU_CODE	Description	Shape_area	LU_0506	LU_1112
1	Polygon	020101	Agricultural land- Kharif Crop	78789.76	10	Null



CUT POLYGON

OBJECTID	Shape	LU_CODE	Description	Shape_area	LU_0506	LU_1112	Change
1	Polygon	020101	Agricultural land- Kharif Crop	55152.85	10	10	NO
2	Polygon	020105	Built-up - Industrial	23636.91	10	5	CC

References

https://www.researchgate.net/publication/235987981_Land_Use_and_Land_Cover_Change_A_Remote_Sensing_GIS_Perspective

https://ssdi.jk.gov.in/profiles/dkan/themes/nuboot_radix/templates/page/homepage/Technical%20Manual%20LULC%202nd%20Cycle.pdf