ADVANCED GEO INFORMATICS

-FINAL REPORT

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CONTENT

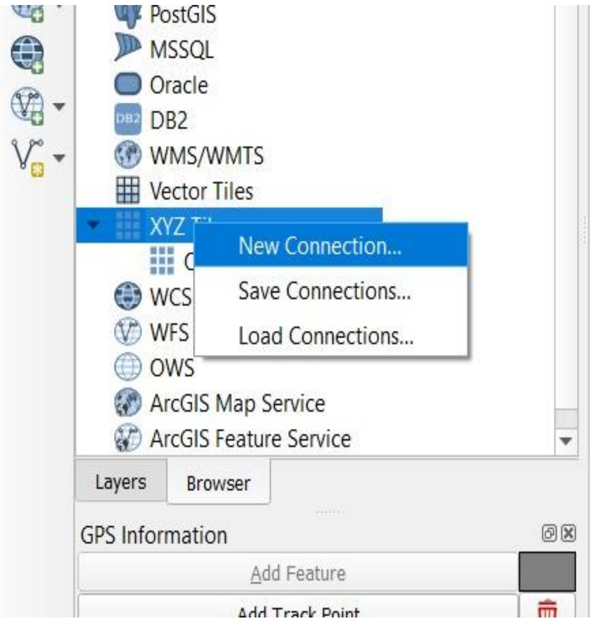
INTRODUCTION

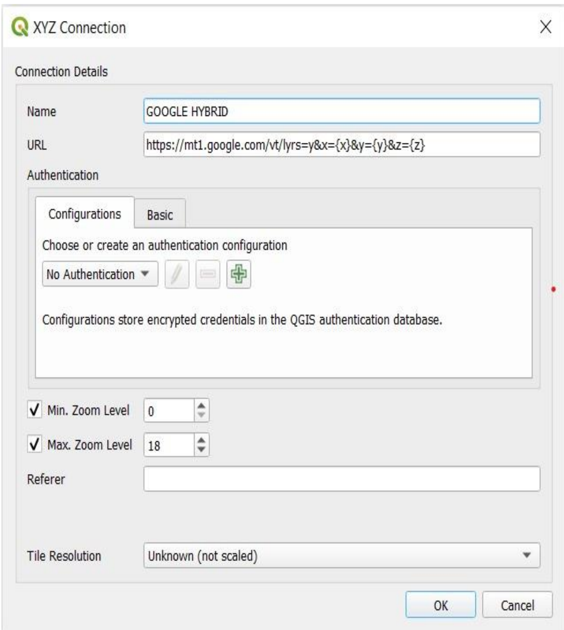
A geographic information system (GIS) is a framework for gathering, managing, and analysing data. GIS technology applies geographic science with tools for understanding and collaboration. It helps people reach a common goal: to gain actionable intelligence from all types of data. Advanced geoinformatics include a balanced mix of theoretical foundation and practical applications. The subject provides basics of data capturing (digitization, remote sensing), data correction, data processing and enhancement. This have also fostered improved mutual understanding, collaboration, and the effective exchange of geo-information between the different domains of geo-data acquisition, handling, analysing and/or visualization, and recognizing the need for a wider understanding and awareness of the entire geo-information production line to improve efficiency and productivity. Upon the completion of this subject, the capability to apply geo-spatial techniques and the related knowledge on concepts of geographic information systems are acquired. This report summarises the works that were performed during the entire semester for advanced geoinformatics which includes map preparation, analysis and application of gis techniques with related software (Qgis).

NEIGHBOURHOOD BASE MAP

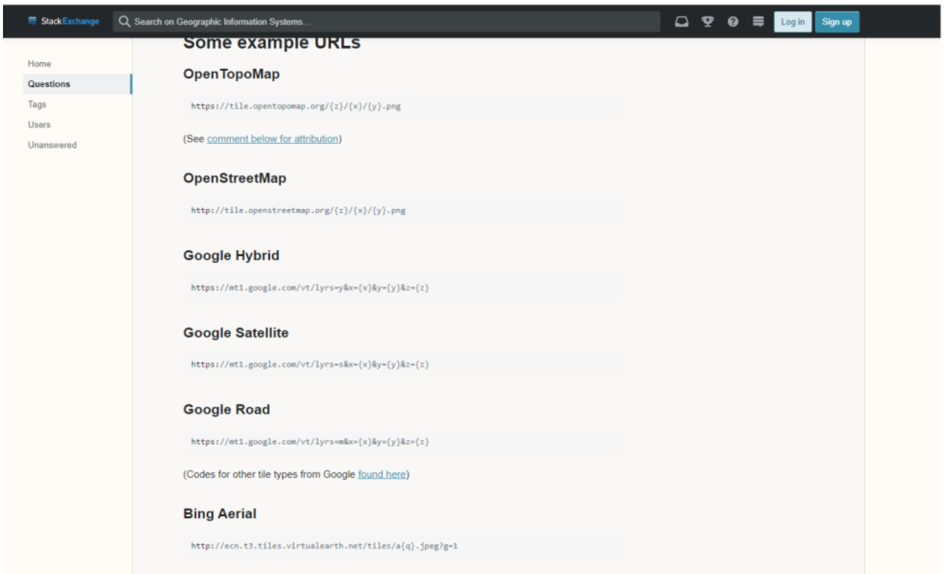
PROCEDURE

1. Open QGIS go to XYZ tiles in browser then open new connection.

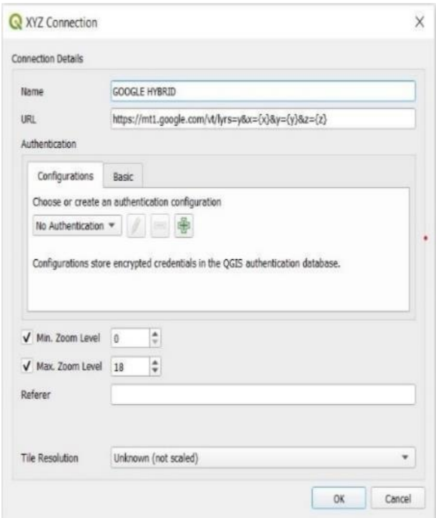


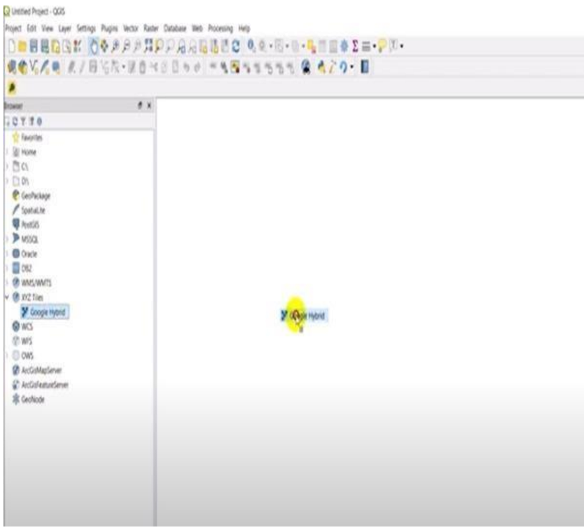


2. Openhttps://gis.stackexchange.com/questions/20191/adding-basemaps-from-google-or-bing-in-qgis and copy google hybrid URL link

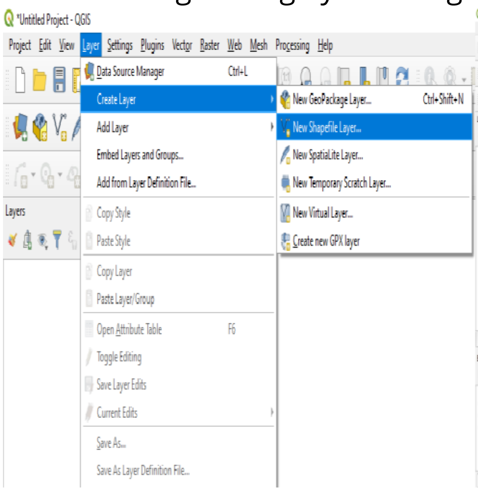


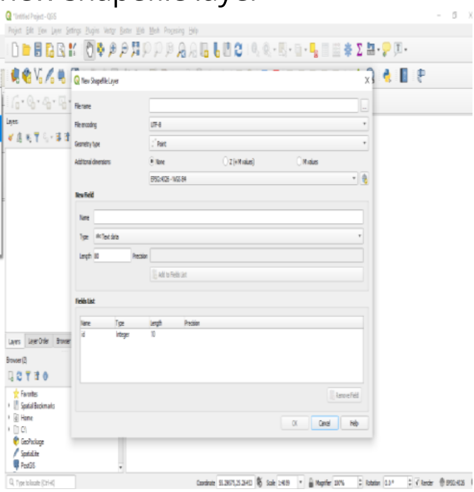
3. Give name as google hybrid and paste the URL link in Qgis and then OK. Then drag google hybrid on to thescreen to get google hybrid as layer





4. Then start digitalizing by inserting new shapefile layer

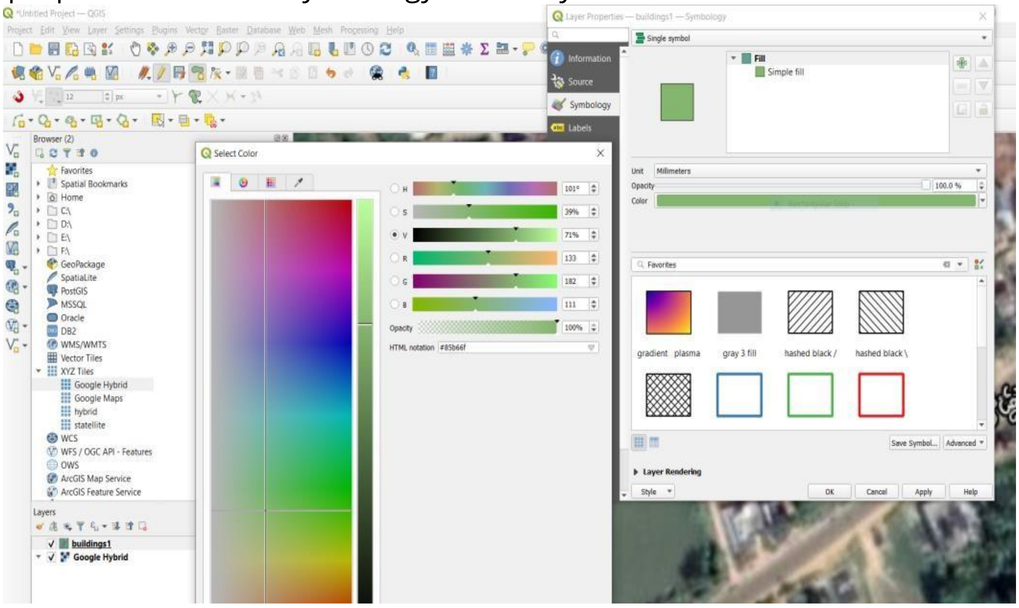




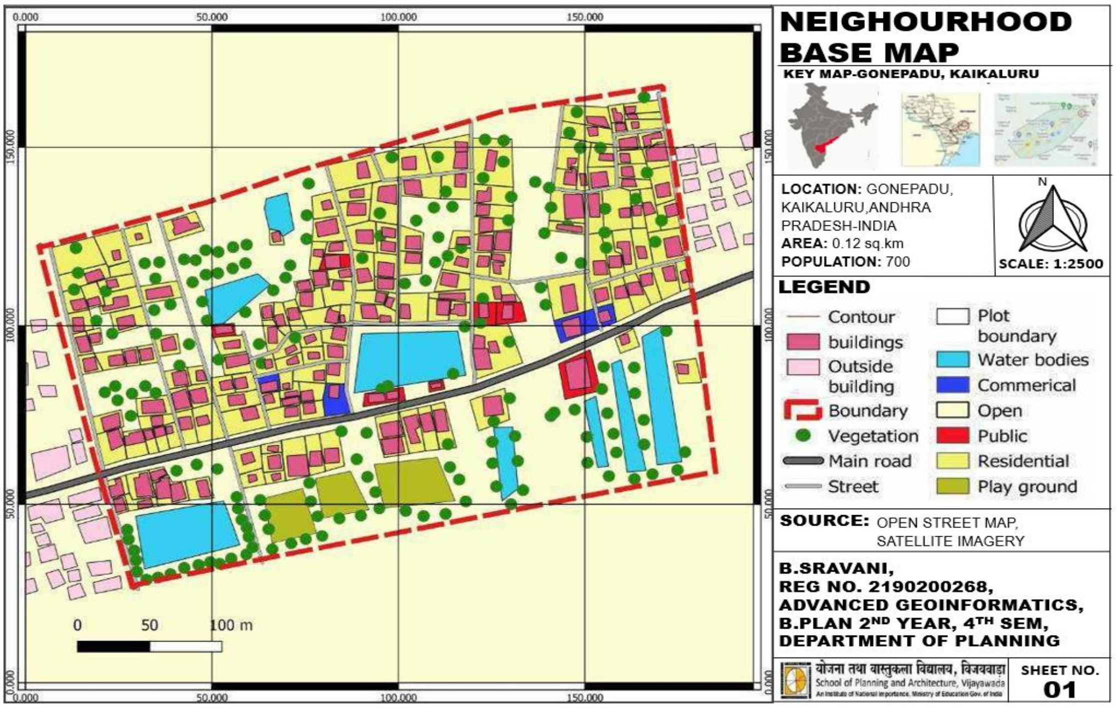
5. Then click the pencil icon to start editing the layer created thereby adding

shapes or polygon by tracing from a google hybrid and simultaneously adding id numbers for each shape created which will be stored inthe attribute table.

6. Then we can change colors and features of the shapes by going to properties and then symbology of thatlayer.



INFERENCE



The assignment was intended to develop an understanding of the basic tools used in the GIS application such as shapefile creation, map digitization tools, toggle editing, geo-referencing, and sheet composition.

LOCATION

The site area is gonepadu area located in kaikaluru city of Andhra Pradesh, Krishna district. It is situated at the outskirt of the city. The latitudes and longitudes are 81˚14′E and 16˚33′n and total area of my neighbourhood is 0.12sq.km with a population of 700. Number of households are 170 with an average household size 4. It comes under ward no. 2. Settlement and development are mainly towards northside than southside. The main language is telugu and most of the people here are Hindus and very few are Christians. Loam, sandy and slit soils are mainly found here.

LAND USE AND BUILDING USE

A large proportion of the land is used for constructing buildings of 74% and 22% of open spaces. 3% is usedfor waterbodies as people here are mainly dependent on aquaculture and 1% of playground used by children to play. 94% of the existing buildings are used for residential purpose and 2% for commercial and 4% for public and semi-public. In commercial we have small grocery shop which meet the daily needs and in public and semi-public we have panchayat office, anagawadi, small clinic and temples.

VEGETATION

Mostly we find greenery everywhere with lots of trees. They provide shade and give more air. So, we feel cool air in the evening especially because we have more trees and water bodies. Trees are divided into 4 types. First is tree height>5m and foliage 0-3m of 47% and second is tree height>5m and foliage>3m of 12% and third is tree height<5m and foliage 0-3m of 23% and finally tree height<5m and foliage>3m of 18%. In tree height >5m and foliage 0-3m we have palm and coconut tree etc and in tree height>5m and foliage>3m we have drumstick and neem tree etc and in tree height<5m and foliage 0-3m we have rose plant and hibiscus etc and in tree height<5m and foliage>3m we haveguava tree and subabul plant etc.



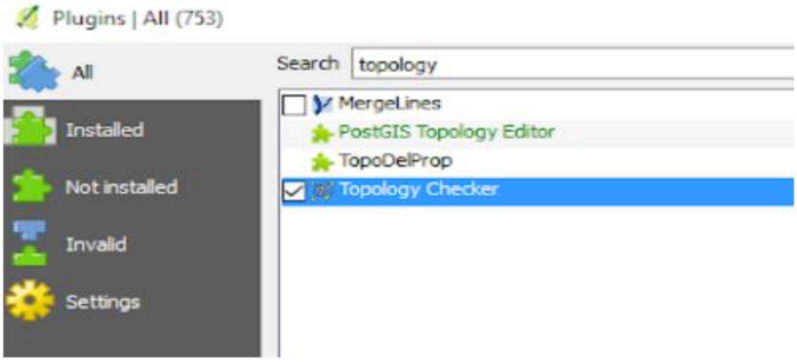

TRANSPORTATION

In transport we have one main road, metallic streets and unpaved streets. Unpaved streets have to develop. Peoplehere mostly prefers both private and public mode of transport. For travelling short distance, they prefer private mode of transport mostly we find 2wheelers like bike and in public mode of transport mostly we find intermediate mode of transport like auto. For travelling long distance more than 25km they prefer public transport like buses andprivate mode of transport 4wheelers like car.

TOPOLOGY CHECK-MAPPING

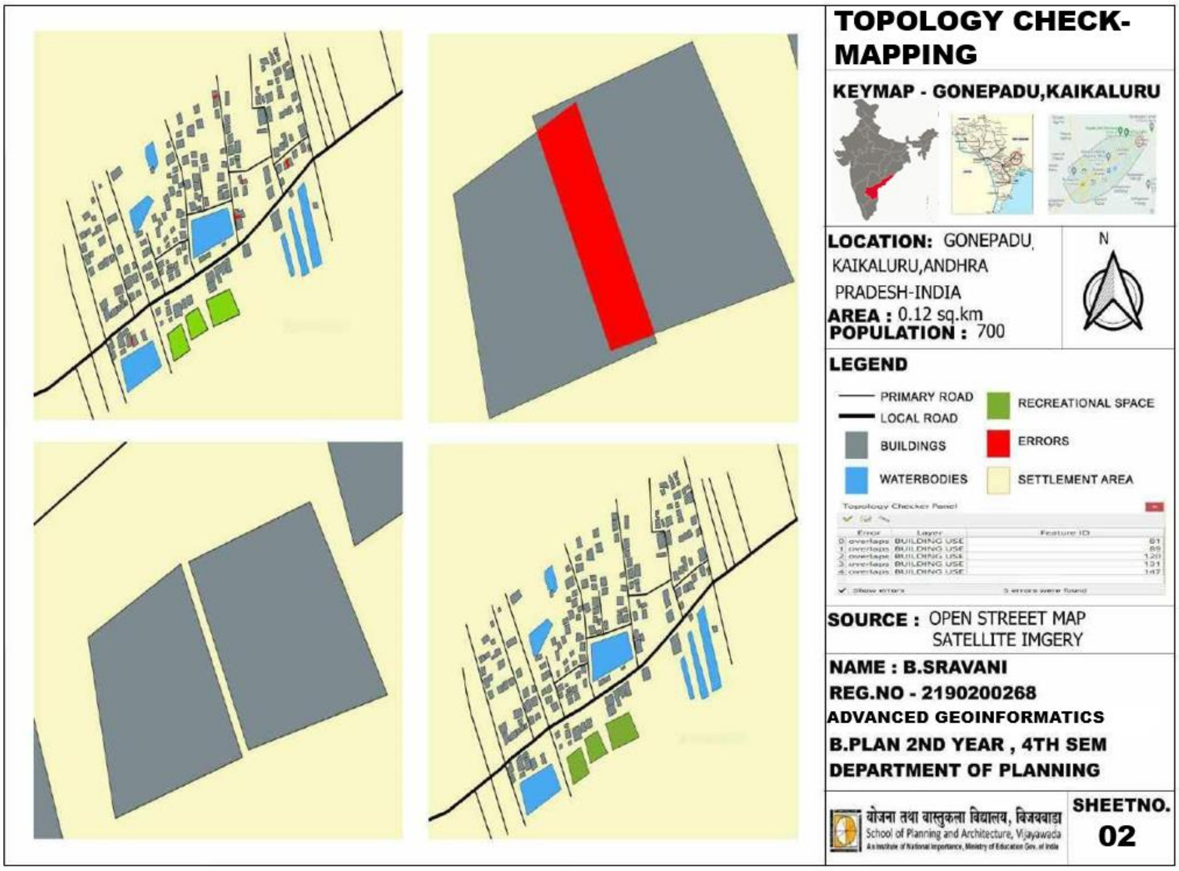
PROCEDURE

1. Install topology checker plugin
   a. Plugins→manage and install plugins



2. Insert the digitized map for which the errors have to be resolved into the qgis canvas.
3. 0pen topology checker toolbox from menu vector or from topology checkers icon
4. Click on the configure button in topology checker panel to set the topology rule
5. Click on the add rule icon to define the rules to configure the respective errors
   For example: to identify the errors caused due to overlapping of polygons, buildings must not overlap with plot boundary, the rule that have to be applied is “must not overlap”, the layer and the selected rule will be added to the list and click ok
6. After defining rule, click button validate all which will check the error for the defined area and will be shown in the topology checker panel list and also will be marked on the map view with red marker
7. Correct the errors manually using the advanced digitizing tool. Finally, repeat the same procedure in order to check whether the errors are resolved.

INFERENCE

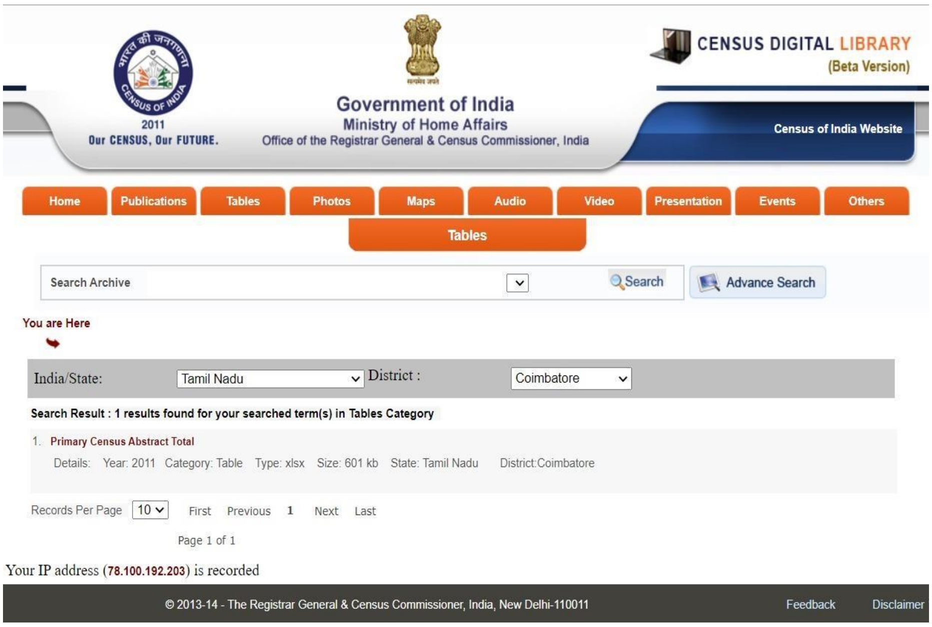


Topology defines mathematical relationships between features in geographic regions. It describes a spatial connection between objects like overlap, touches, cross, intersect, within, etc. the manual error caused due to digitizing is resolved with the topology checker plugin in qgis. For this exercise four predominant errors were identified for the digitized map of the neighbourhood i.e., errors caused due to overlapping. This error has occurred because the building polygon have occupied the same area of that of another building polygon and also due to the intersection of the building polygon with the plot boundary. This was identified through topology checker tool and was resolved manually through digitization.

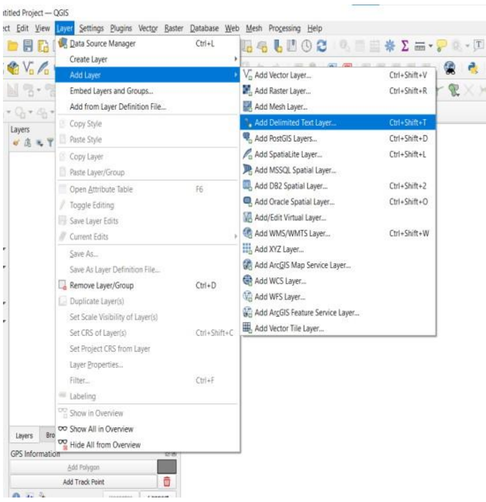
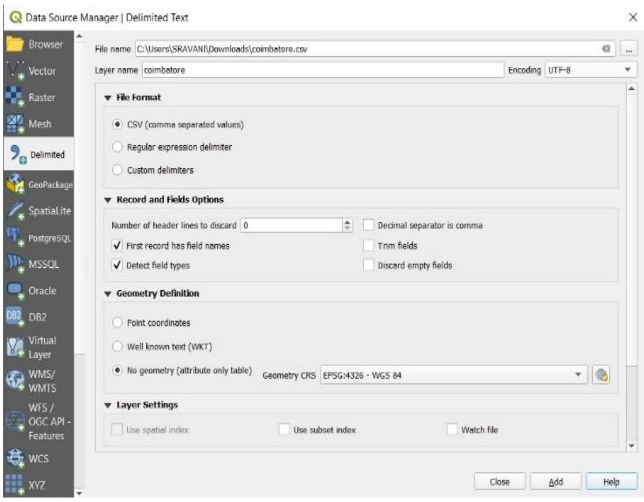
THEMATIC MAP

PROCEDURE

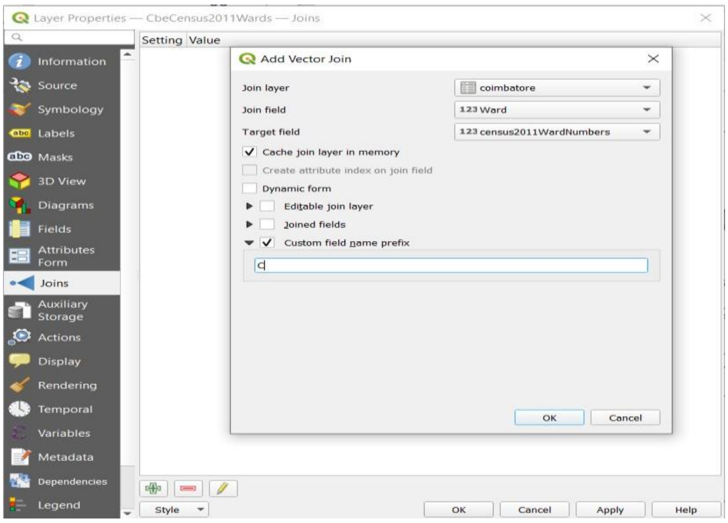
1. Census of India website provides the census data for the regions in India https://www.censusindia.gov.in/.
    a) Central digital library ---> tables ---> select census year as "2011"---> primary census abstract---> primary census abstract total ---> select state as "Tamil nadu" ---> select district as "Coimbatore".



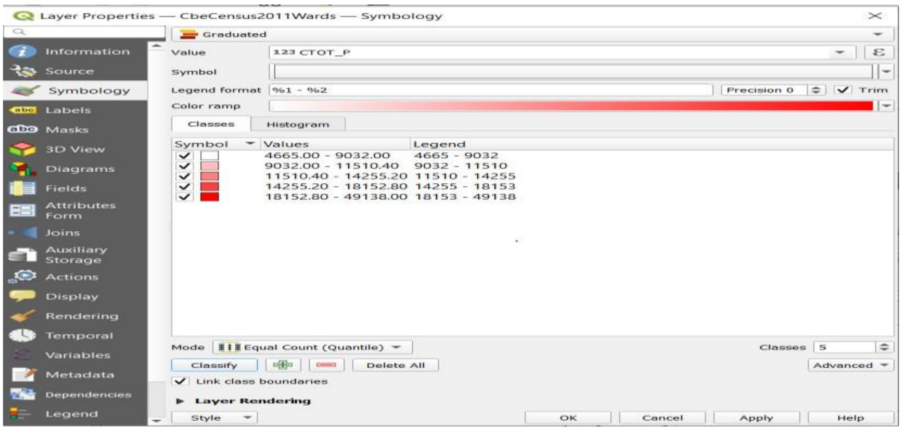
2. After downloading the excel file, open and save the file in .csv format.
3. Open qgis --->layer --->add layer --->add delimited text layer and insert the .csv file.

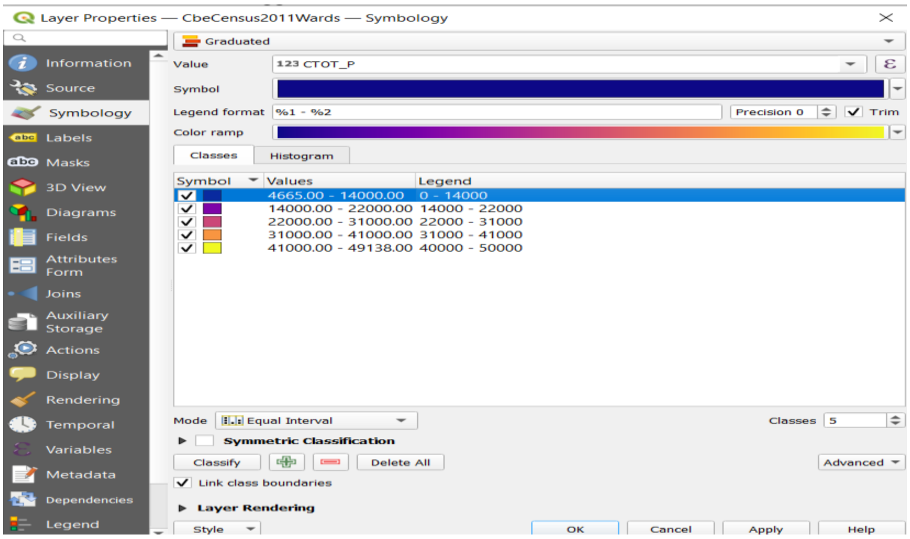
4. Insert the ward boundary shapefile on the Qgis canvas that was downloaded from online sources.
5. Now join the .csv file with the attribute table of the shapefile



6. In order to prepare the thematic maps, the symbology has to be changed to graduated andselect the value based on which map to be made and then classify.



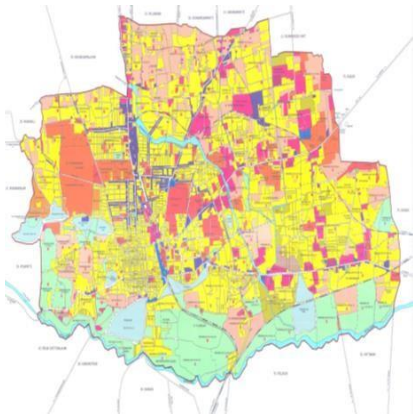
7. Then change value and legend values to nearest appriopate values with equal interval by changing themode to equal interval. We can change colour using color ramp.



INFERENCE

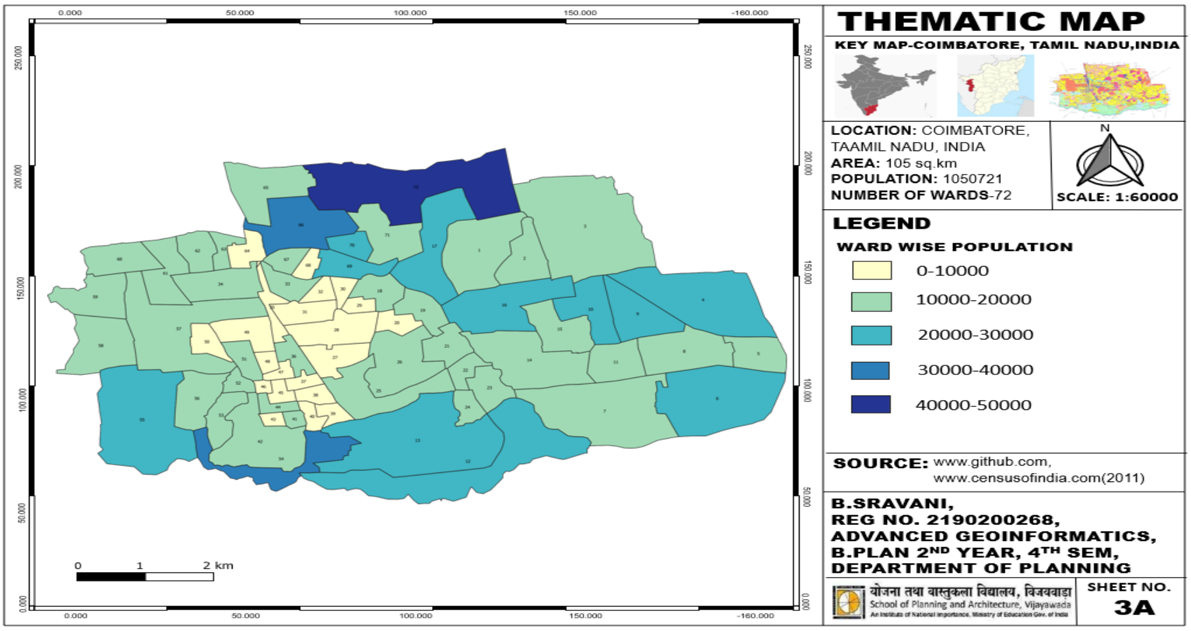
The mapping assignment was assigned to bring about comprehension and representation of various datarelated to a particular city of choice such as population composition, literacy, workforce participation through spatial maps.

LOCATION

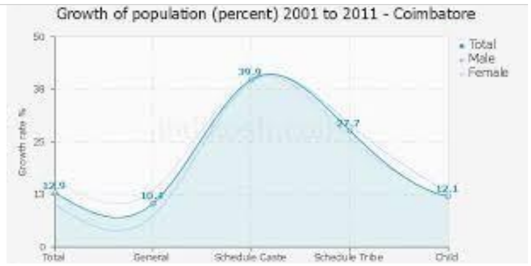



Coimbatore, often called 'the Manchester of South India', is the second largest city in Tamil Nadu of 246.8 sq.km area and the 16th largest urban agglomeration in India as per the census 2011. On the banks of the Noyyal River and surrounded by the scenic Western Ghats, the city is a major industrial center known for its factories, engineering firms, and automobile part manufacturers. Administered by the Coimbatore Municipal Corporation, the city is a district headquarters as well. Most of the urban development is outsidethe Municipal Corporation limits as the residential areas of the city have grown around existing industrial areas. The main industrial areas are at Peelamedu, Ganapathy, SITRA, Kurichi industrial estate (SIDCO), andVelandipalayam.

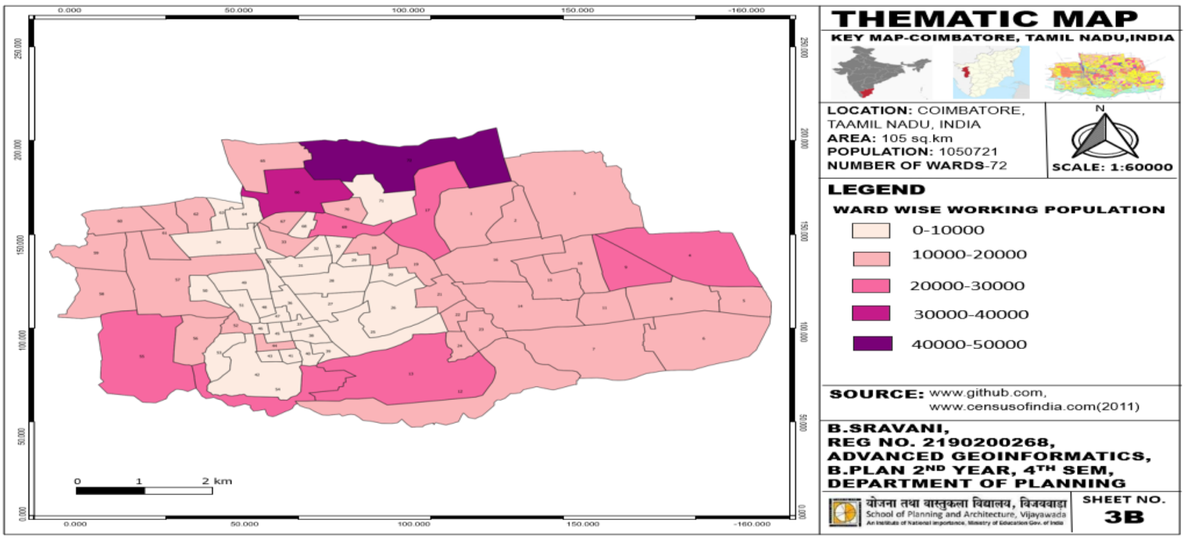
THEMATIC MAP1- WARD WISE POPULATION



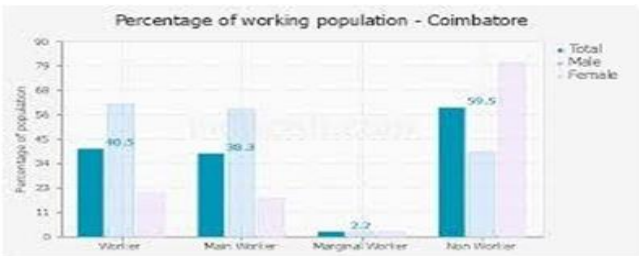
There are 72 wards in the city, among them Coimbatore Ward No 72 is the most populous ward with population of about 49 thousand and Coimbatore Ward No 39 is the least populous ward with population of 4665.



THEMATIC MAP2- WISE WARDS WORKING POPULATION



There are 72 wards in the city, among them Coimbatoreward no 61 is having a greater number of working people with population of about 13 thousand and Coimbatore ward no 39 is having a smaller number of working people with population of 1537



RASTER MOSAICING LIS III TILES

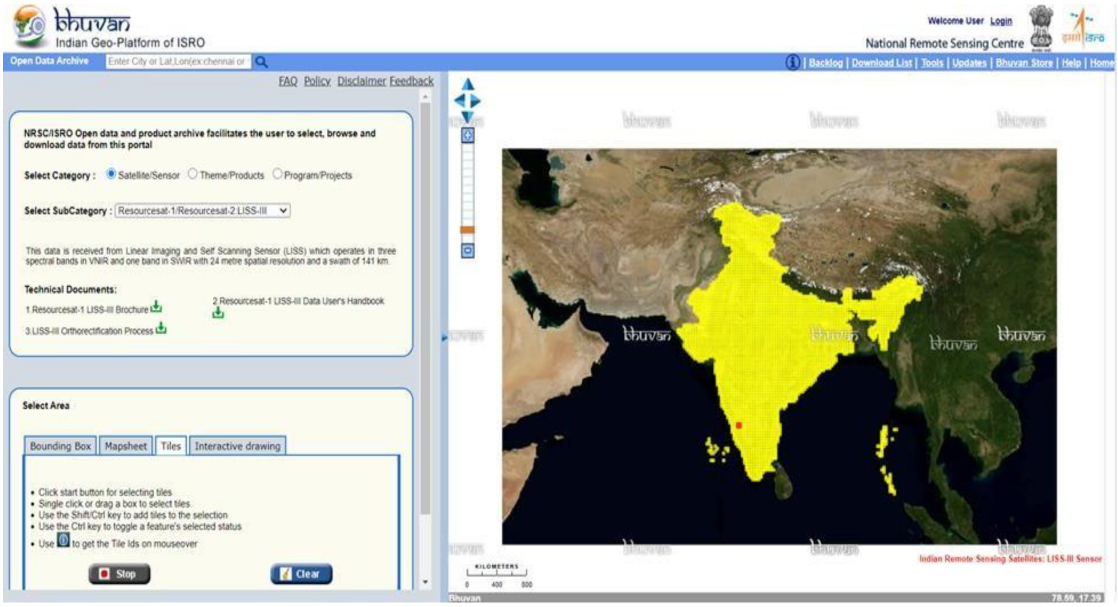
PROCEDURE

1. ACQUIRING DATA

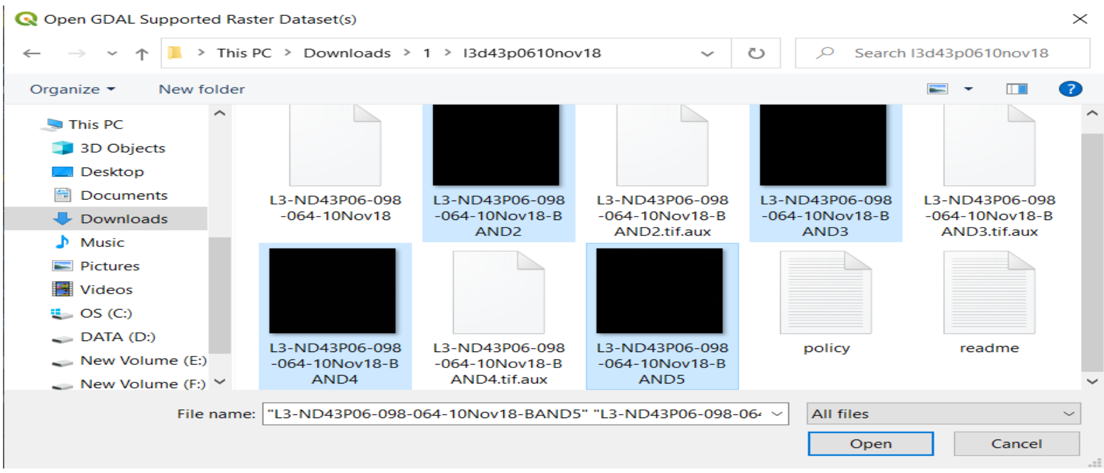
-An easy interface to download the tiles is https://bhuvan.nrsc.gov.in/

a. Open data archive ---> select category as "satellite/sensors" ---> select subcategory as "Resourcesat-1/resourcesat-2, LISS III". ---> select area as "tiles".

b. Download and extract the zip files.



2. Open QGIS and locate the downloaded files in the Browser panel. Expand individual zip files to show the .hgt files. Hold the Ctrl key and select all individual files. Once selected, drag them to the canvas.



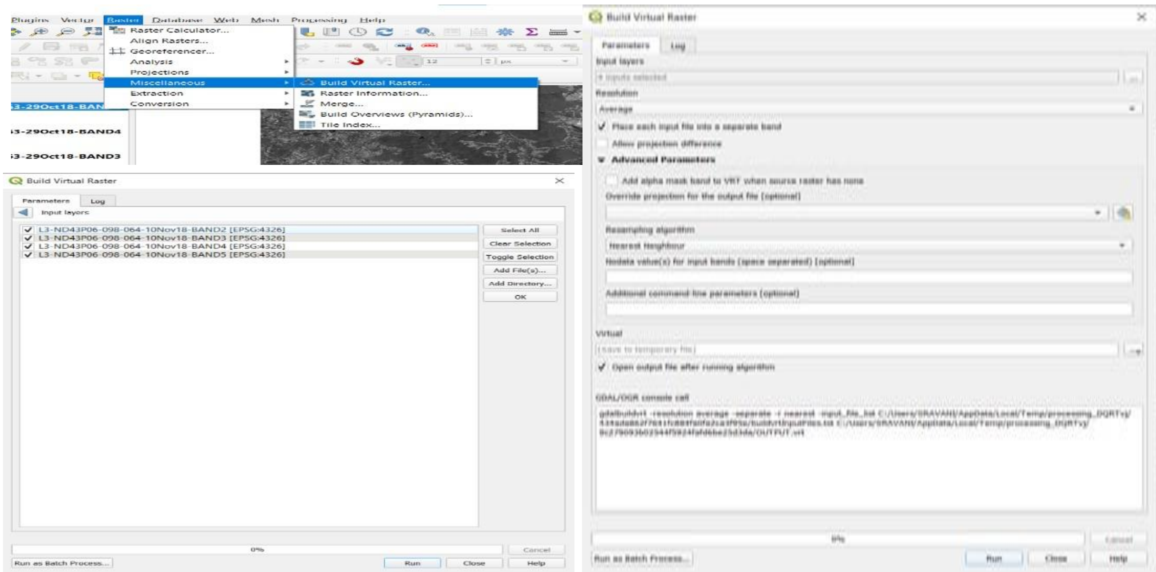
3. Virtual Raster (Catalog) will create a metadata file (.vrt) that QGIS treats like a merged multi-band raster without having to merge all the bands.

   a) Raster --> Miscellaneous --> Build Virtual Raster

   b) Select the bands you want to use as "Input files"

   c) Check "Separate" to put each input file into a single band (otherwise, they will be merged spatially and all put into a single band)

   d) Open the Virtual Raster (.vrt) in QGIS and treat it like a merged composite.

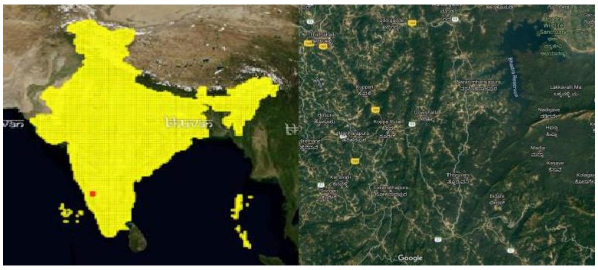


INFERENCE

This assignment helped to precisely understand the basic concepts of raster data bands, composite bands,and mosaicing of the colour composite bands obtained for the individual tile of a geographic location; alongside the application and interpretation of the images that were obtained through different colour composite bands. The data obtained from the sensors are used for information extraction related to the forms, and patterns of the objects and phenomena of the earth's surface.

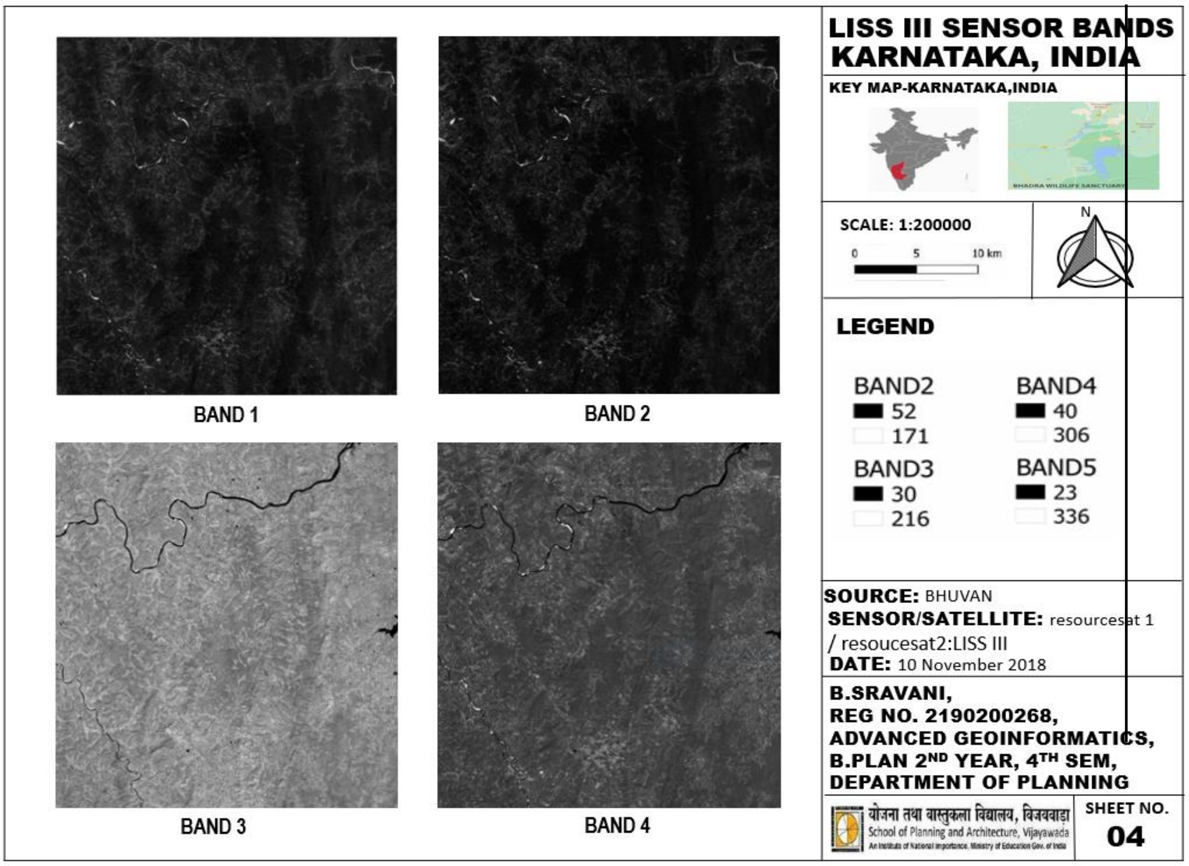
LOCATION

The selected tiles include settlements and Bhadra Wildlife Sanctuary which is the protected area and the tiger reserve as part of the Project Tiger, situated in Chikkamagaluru district, 23 km (14 mi) south of Bhadravathi city, northwest of Chikkamagaluru, and 283 km from Bengaluru city in Karnataka state, India. It accounts for lush tropical forests & meadows hosting a diverse range of wildlife,such as tigers & peacocks. It also includes Bhadra reservoir.



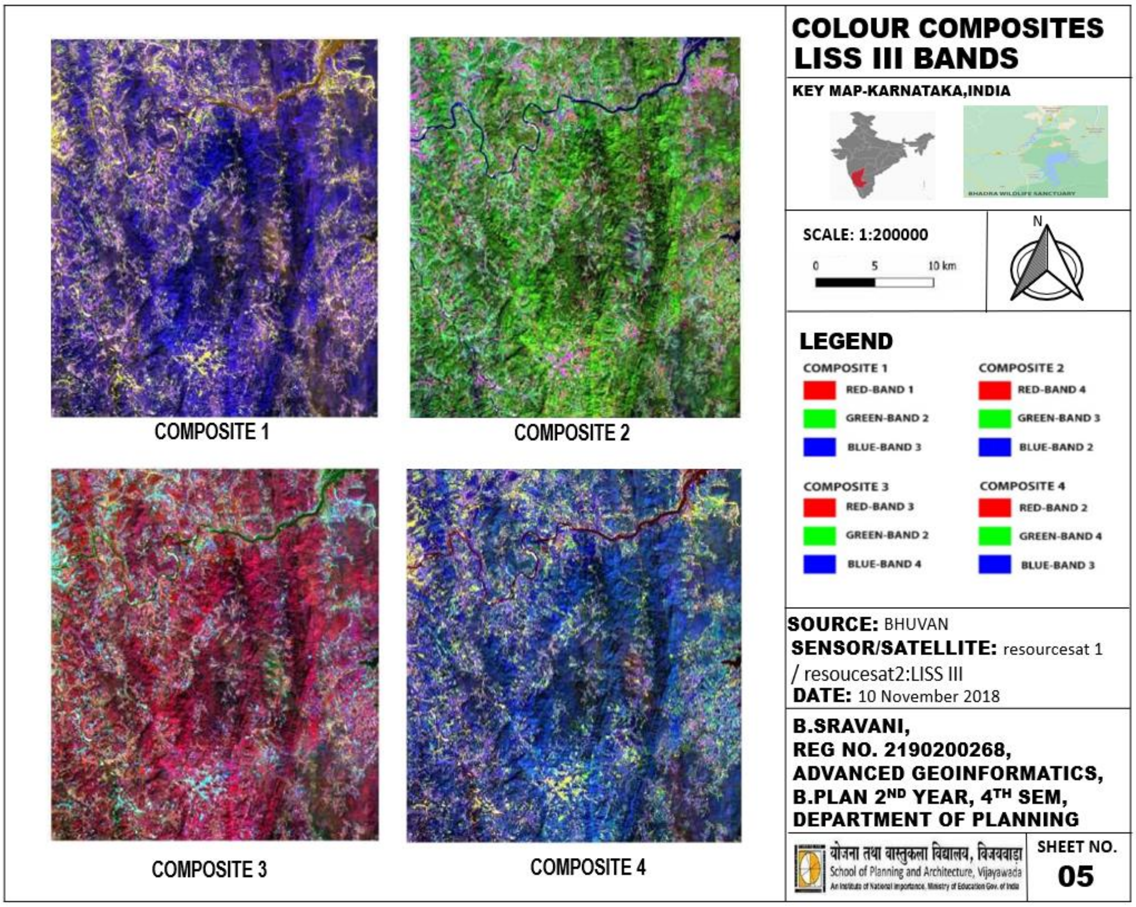
LISS-III SENSOR BANDS

The photographic and digital data products that were obtained from the LISS III sensor. The LISS – III camera provides multispectral data in 4 bands. The spatial resolution for visible (two bands) and near- infrared (one band) is 23.5 meters with a ground swath of 141 km. The fourth band (short wave infrared band) has a spatial resolution of 70.5 meters with a ground swath of 148 km. The repetition of LISS – III is24 days. The extraction of features for the site was carried out using visual interpretation methods in this assignment.



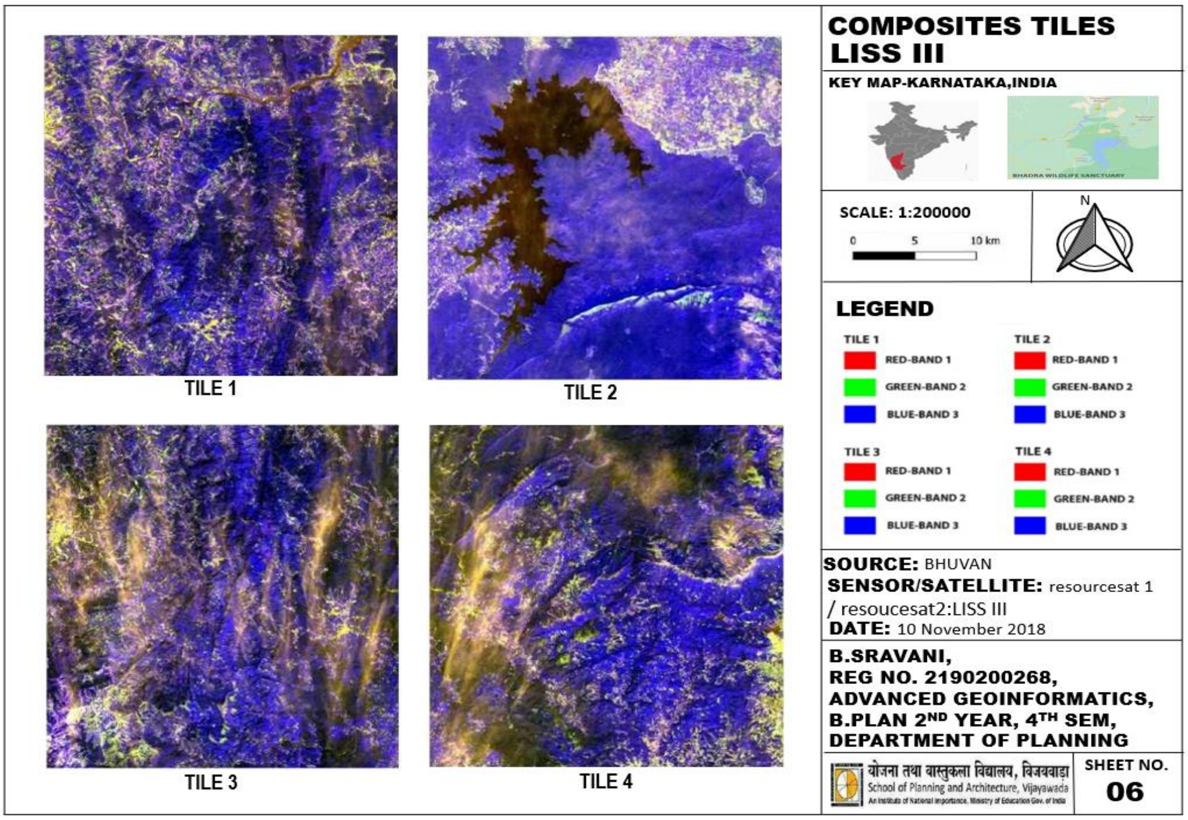
COLOUR COMPOSITE LISS-III BANDS

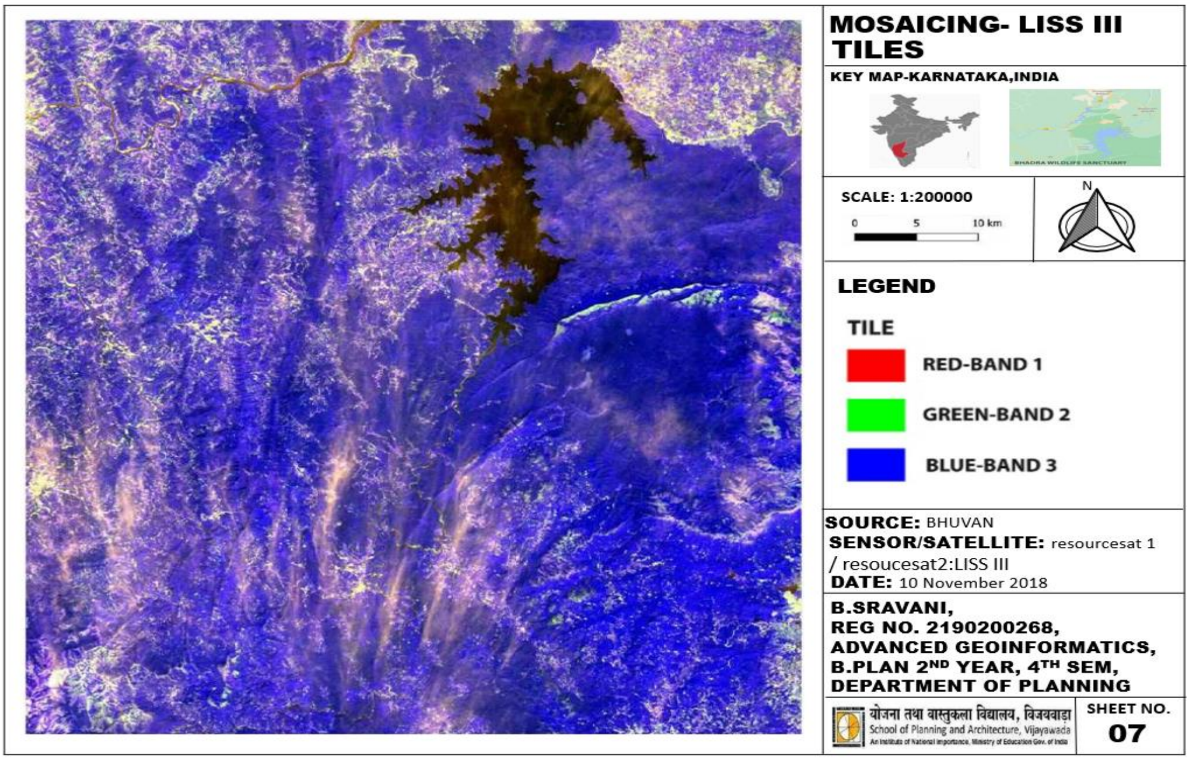
The reflected amount of the energy that is received and recorded by the sensor differs in tones of grey, orhues of colour in black and white, and colour images respectively. The variations in the tone or the colourdepend upon the orientation of incoming radiations, surface properties, and the composition of the objects. In other words, smooth and dry object surfaces reflect more energy in comparison to rough and moist surfaces. Besides, the response of the objects also varies in different regions of the spectrum. For example, in the composite bands shown above, healthy vegetation reflects strongly in the infrared region because of the multiple-layered leaf structure and appears in a light tone or bright red colour in standard false-colour composite and the scrubs appear in greyish red colour). Similarly, a freshwater body absorbs much of the radiations received by it and appears in dark tone or black colour, whereas the turbid water body appears in light tone or a light bluish colour in FCC due to mixed response shown by the water molecules as well as suspended sand particles. The texture refers to the minor variations in tones of grey or hues of colour. These variations are primarily caused by an aggregation of smaller unit features that failto be discerned individually the composite tiles depict a coarse texture which can be due to the dense canopy which is present in the selected site.



COMPOSITE TILES AND MOSAICING LIS III TILES

A mosaic is a combination or merging of two or more images. With this tool, a single raster dataset is obtained from multiple raster datasets by mosaicking them together. From the final mosaic tiles, we can interpret the presence of a very dense canopy with few settlements in the outskirts of the selected area. The shape and size of some of the objects are so distinctive that make them easy to identify. For example, the water body which is located in the site can be readily distinguished from its neighboring areas due toits long irregular shape with the gradual change in its course. The general form and configuration or an outline of an individual object provide important clues in the interpretation of remote sensing images. Thespatial arrangements of these features show the repetitive appearance of forms and relationships. A distinction can also be made between various types of drainage or settlements if their pattern is properly studied and recognized.





SURFACE ANALYSIS

PROCEDURE

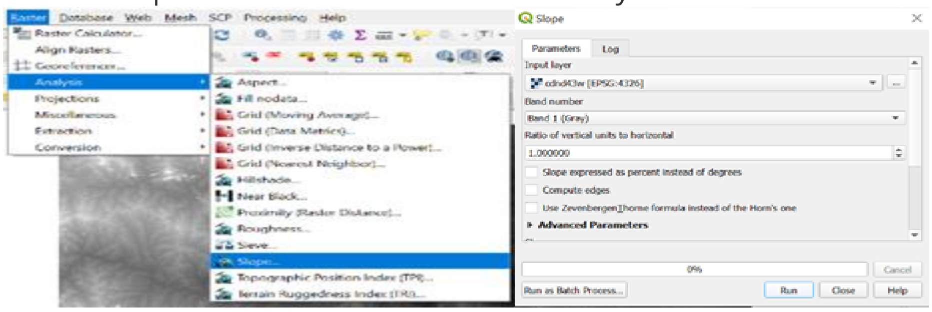
Download Dem file from Bhuvan.nrsc.gov.in:

-Open bhuvan.nrsc.gov.in in browser

open Data Archive--->Select Category (Satellite/Sensor) --->Select Sub Category (Carto sat -1) ---> Select Products (carto DEM version-3 R1) --->Select area--->Select tiles from the map --->Click on the download button of the respective file

SLOPE

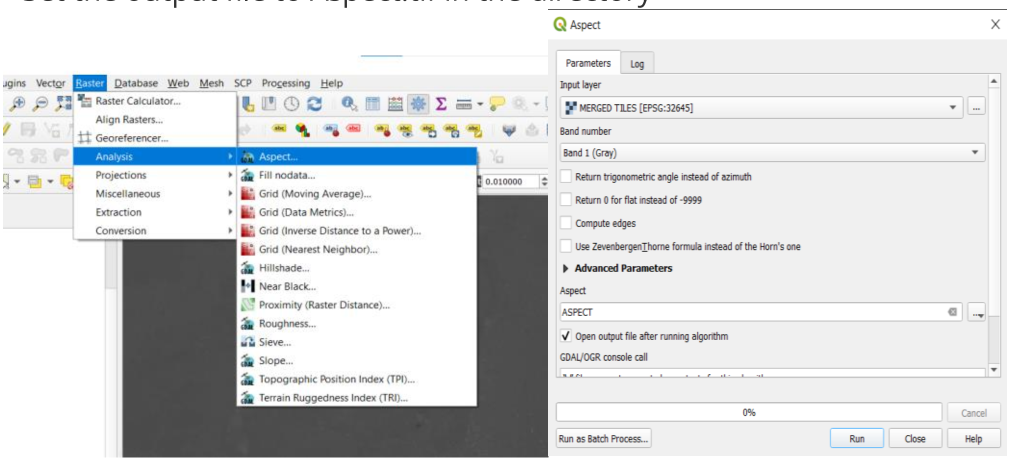
1. Click on the menu item Raster--->Analysis---> SLOPE
2. In the dialog that appears, Enter the input file as DEM layer.
3. Set the output file to SLOPE.tif in the directory



4. Also make sure that the mode option has slope selected.
5. You may leave all the other options unchanged.
6. Click RUN to generate the slope.

ASPECT

1. Click on the menu item Raster----> Analysis----->DEM (terrain models)
2. In the dialog that appears, ensure that the input file is the DEM layer.
3. Set the output file to Aspect.tif in the directory

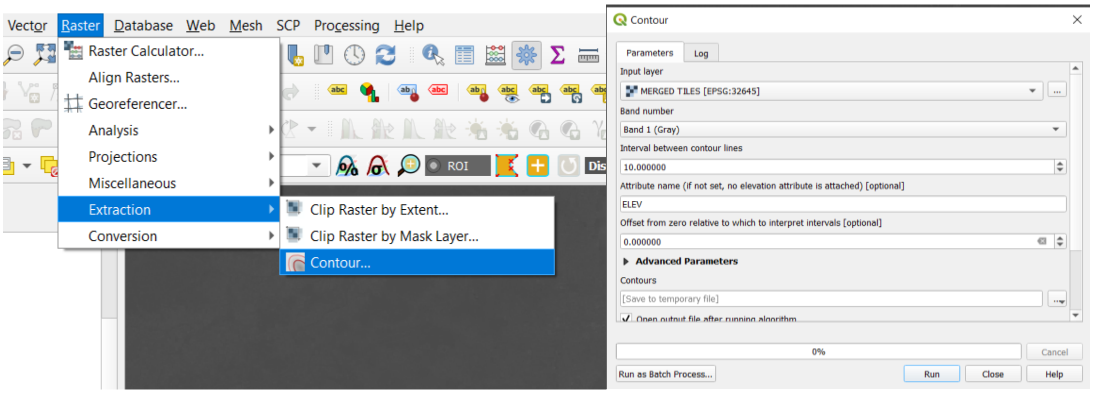


4. Also make sure that the mode option has Aspect selected.
5. You may leave all the other options unchanged.
6. Click **RUN** to generate the Aspect

7. Now go to properties --->symbology---> render type --->single band pseudo meter
8. Then interpolation into discrete--->mode equal interval--->then apply.

CONTOUR

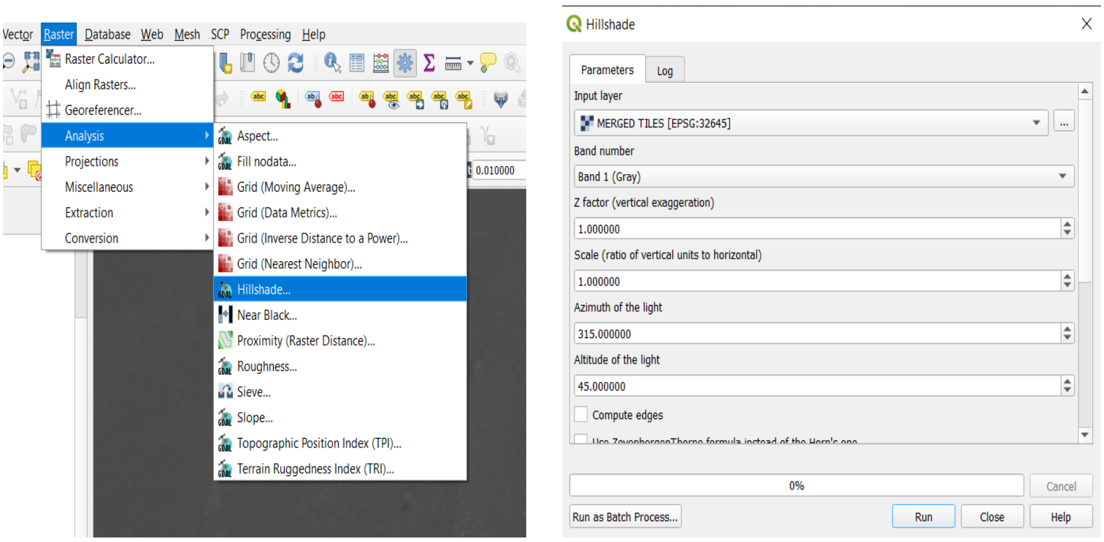
1. Click on the menu item Raster---->Extraction--->contour
2. In the dialog that appears, ensure that the input file is the SLOPE layer
3. Set the output file to CONTOUR.tif in the directory
4. Also make sure that the mode option has contour selected.
5. Stay leave all the other options unchanged and Click RUN to generate the contour.



6. Now go to properties--->symbology---> render type--->Graduated
7. Then change value into elevation--->mode equal interval and then apply.
8. Now go to properties--->labels--->value as elevation.

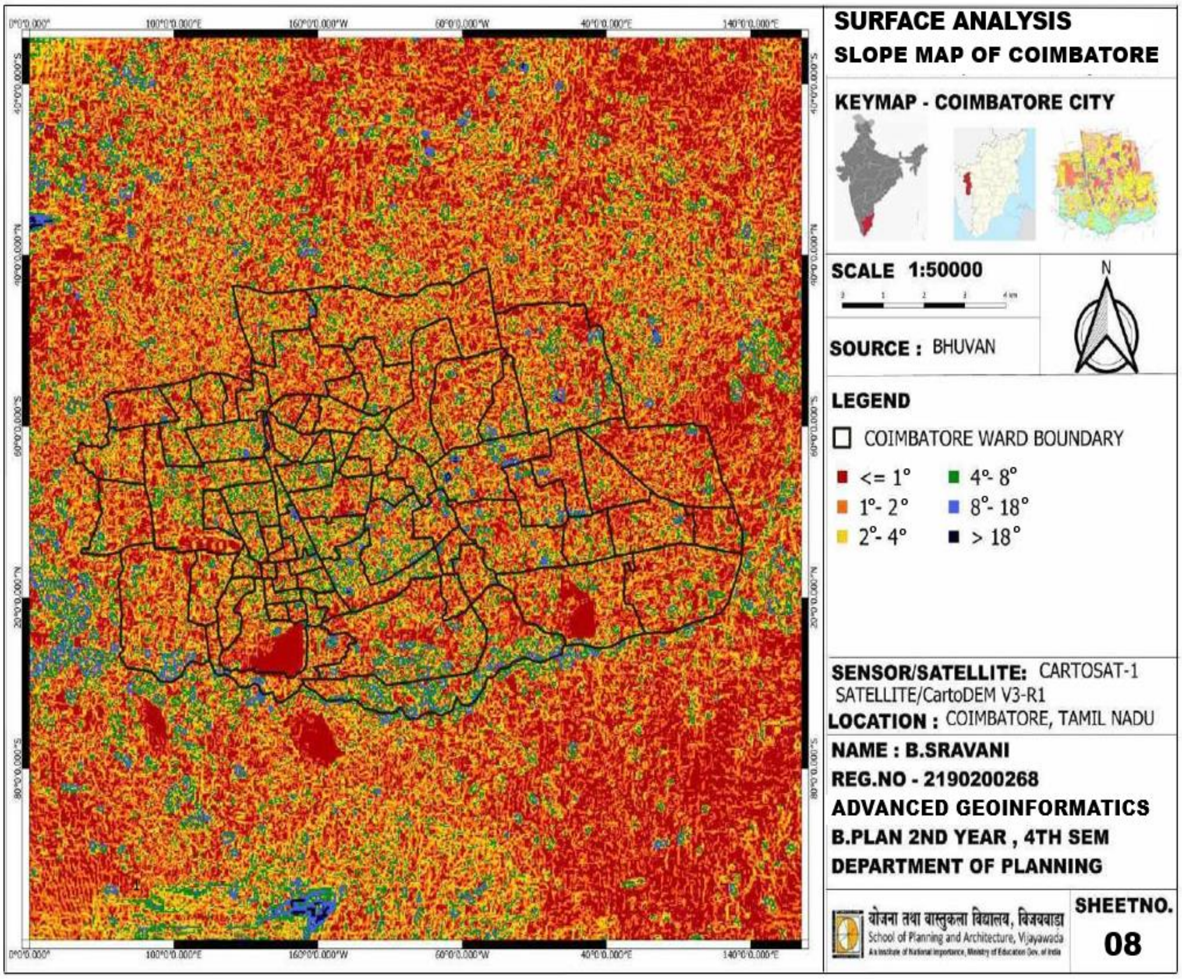
HILL SHADE

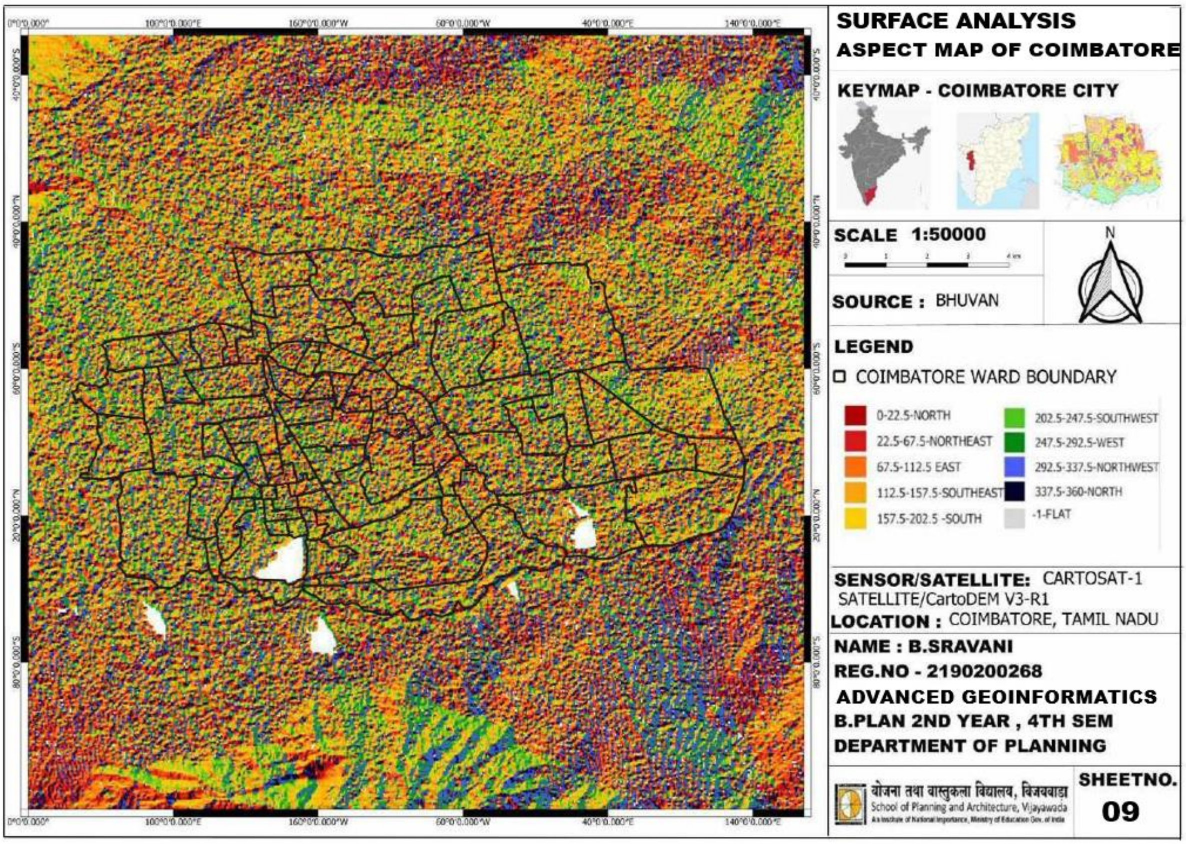
1. Click on the menu item Raster--->Analysis--->DEM (terrain models)
2. In the dialog that appears, ensure that the input file is the DEM layer.
3. Set the output file to hillshade.tif in the directory
4. Also make sure that the mode option has Hill shade selected.
5. You may leave all the other options unchanged click run to generate the hillshade layer.

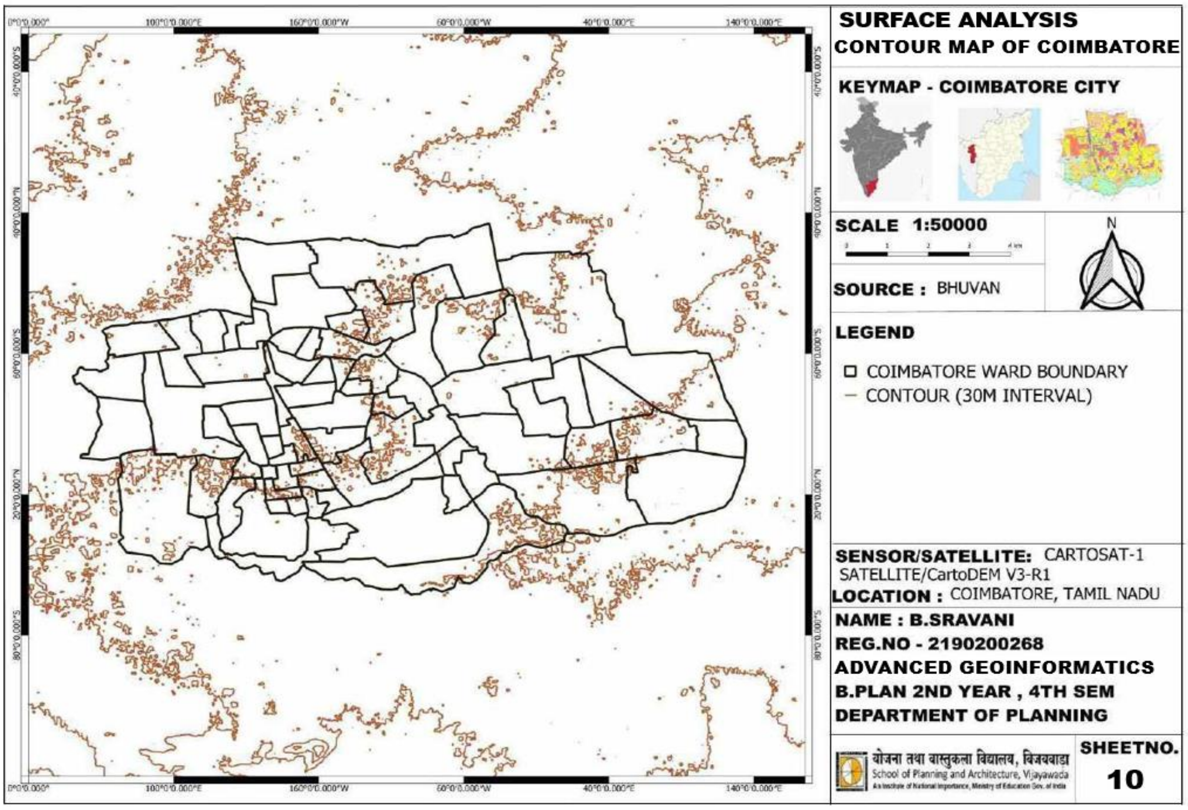


INFERENCE

Topographic maps show the three-dimensional shape of the landscape by representing equal elevation with lines on a two-dimensional map. Topographic maps are used to understand the shape of land, whether a slope will fail, how glaciers are changing and geologic history, among many other things. Individual contour lines on a topographical map are fixed interval of elevation. We can observe maximum slope of more than 18 and minimum of less than 1. Aspect helps to identify the direction of the slope.it helps to identify where to put which services on particular slopes. It also helps to identify where snow will meet faster, which slope is the best for eco diversity etc. The actual contour interval of a map depends upon the topography being represented as well as the scale of the map. Contour lines that are relatively close together indicate a slope that is fairly steep with interval of 30m. Hillshade shows the areas with light and shadow and it shows where light is coming and where shadow is falling analyse were make agriculture, greenhouse etc. we can see observe that the settlement is in an area with medium hillshade.




SURFACE ANALYSIS
ASPECT MAP OF COIMBATORE
KEYMAP - COIMBATORE CITY
SCALE 1:50000
N
SOURCE : BHUVAN
LEGEND
COIMBATORE WARD BOUNDARY
0-22.5-NORTH
22.5-67.5-NORTHEAST
67.5-112.5 EAST
112.5-157.5-SOUTHEAST
157.5-202.5 -SOUTH
202.5-247.5-SOUTHWEST
247.5-292.5-WEST
292.5-337.5-NORTHWEST
337.5-360-NORTH
-1-FLAT
SENSOR/SATELLITE: CARTOSAT-1 SATELLITE/CartoDEM V3-R1
LOCATION : COIMBATORE, TAMIL NADU
NAME : B.SRAVANI
REG.NO - 2190200268
ADVANCED GEOINFORMATICS
B.PLAN 2ND YEAR , 4TH SEM
DEPARTMENT OF PLANNING
योजना तथा वास्तुकला विद्यालय, विजयवाड़ा
School of Planning and Architecture, Vijayawada
SHEETNO.
09


SURFACE ANALYSIS
CONTOUR MAP OF COIMBATORE
KEYMAP - COIMBATORE CITY
SCALE 1:50000
N
SOURCE : BHUVAN
LEGEND
COIMBATORE WARD BOUNDARY
CONTOUR (30M INTERVAL)
SENSOR/SATELLITE: CARTOSAT-1 SATELLITE/CartoDEM V3-R1
LOCATION : COIMBATORE, TAMIL NADU
NAME : B.SRAVANI
REG.NO - 2190200268
ADVANCED GEOINFORMATICS
B.PLAN 2ND YEAR , 4TH SEM
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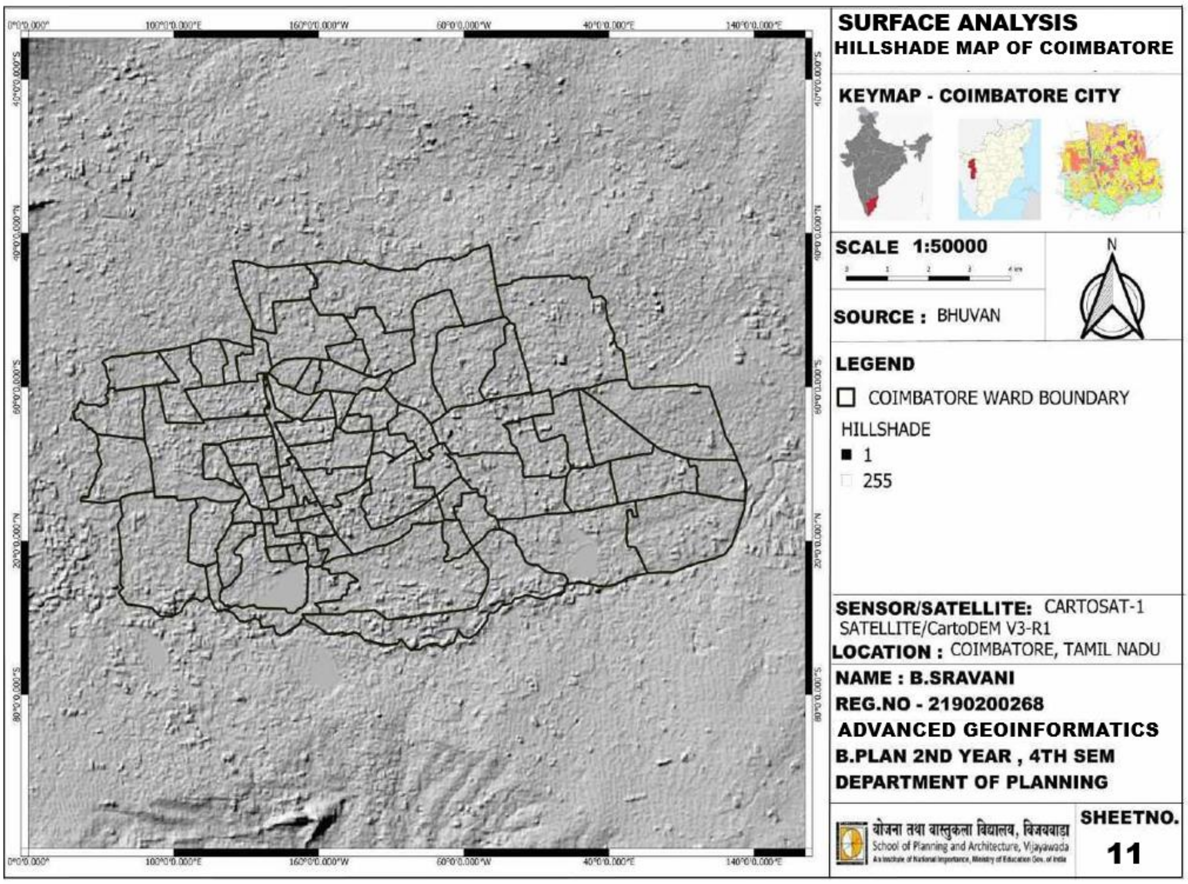


NDVI AND NDWI

PROCEDURE

1. Import the shape file of the city by Layer – Add layer – Add vector layer.
2. Import all bands Layer – Add layer – Add raster layer.
3. If your city lies in more than one tile, then we have to import all the bands of all tiles and combine all the bands together- Click on raster, miscellaneous, build virtual raster and select all bands of the same number and then run.
4. Then for a complete city, select raster
5. Click on raster calculator and then select the formula,
   NDVI = (BAND 4 – BAND 3) / (BAND 4 + BAND 3)
   NDWI = (BAND 2 – BAND 4) / (BAND 2 + BAND 4), Click on OK
6. Export the layer and save it by changing the CRS and UTM zone.
7. Click on this layer,

a. Right click--->properties--->symbology--->select render type as single band pseudocolor.
b. Select interpolation as discrete and mode as equal interval, class as 10-20 and then click on classify.
c. Now change color according to google hybrid or maps.

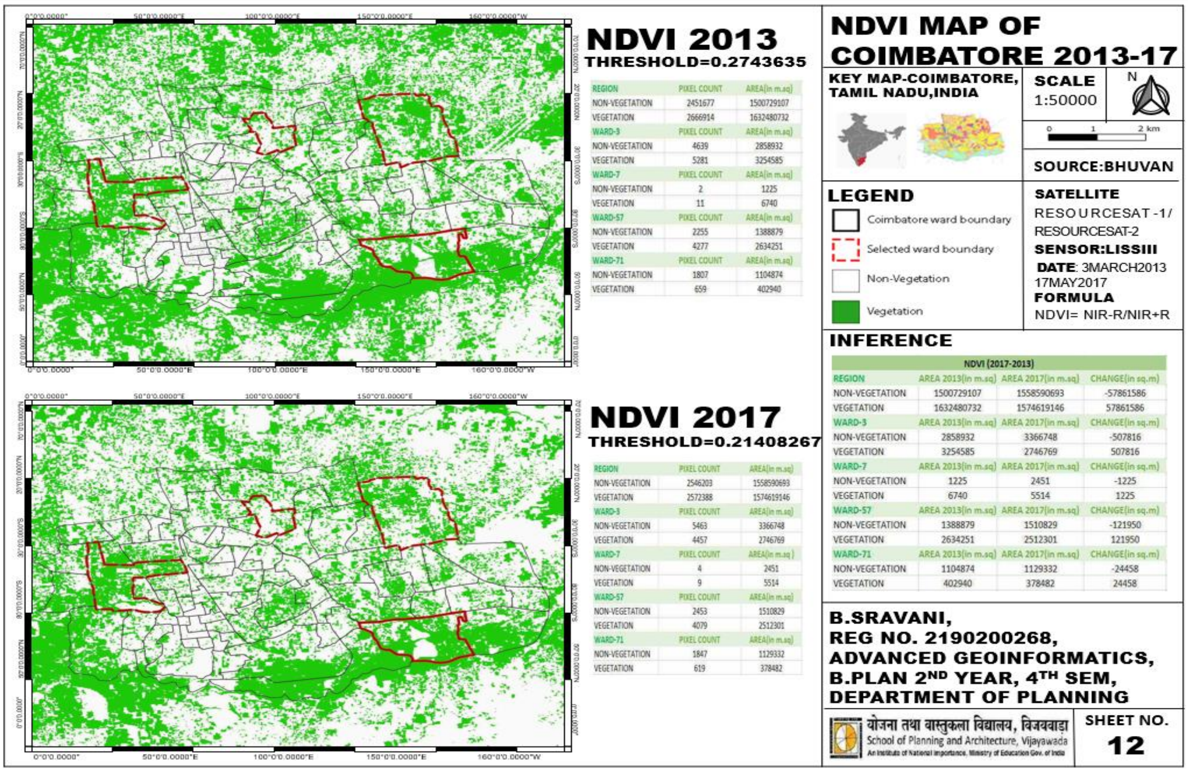
Note: The interval number where another color starts, that number will be your threshold.
(For example, if we are selecting the colour band as blues, then note the value at which the colour starts getting blue from white and consider it as u r threshold value)

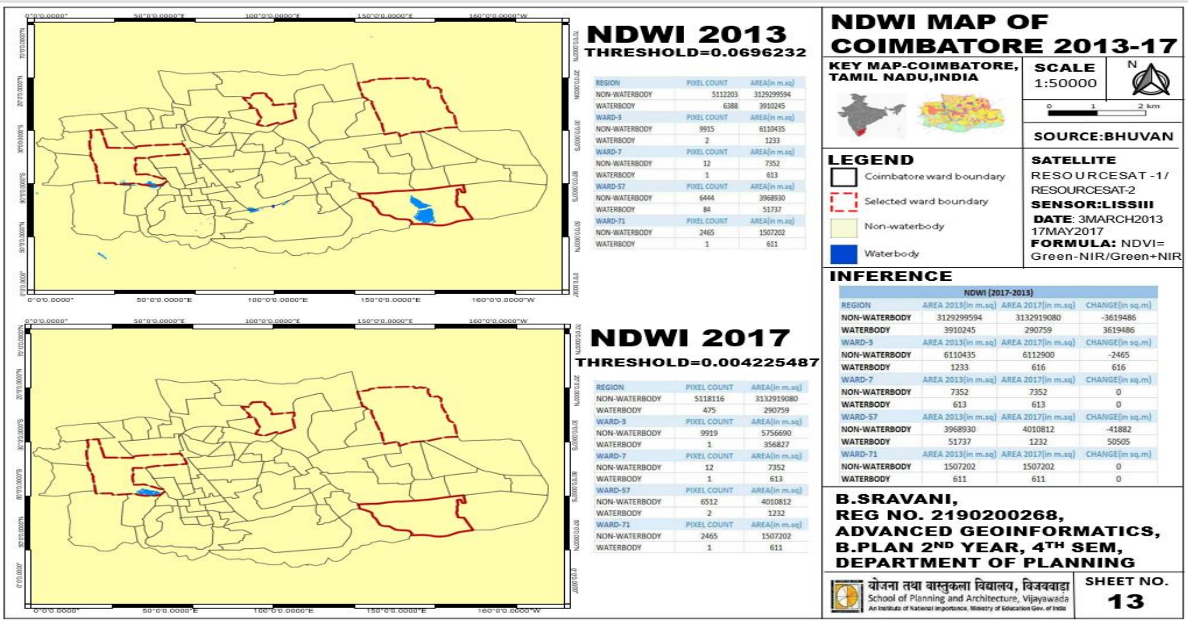
8. Click on projected layer--->processing--->toolbox.
   a. In the tool box, search for a raster layer unique values report.
   b. In the dialogue box that appears, select the projected layer as the input layer.
   c. In the unique values table, click on the 3 dots – save to file – and change type to XLXS and this is you excel file.
9. Open the excel file and in that, note the threshold we got in GIS and also pixel count that we got in GIS. Open properties-go to Information-the (x, y) values are our pixel size count.
10. In the excel file that we have got, check the threshold or nearest value to threshold and note that serial. No value. (So that we know the calculation will be easier)
    a. Let us assume that by calculating the count of non-water bodies for NDWI, its value is equal to the sum of all values in the count column till the threshold value or the value nearest to the threshold value that we have marked.
    b. The value of the count of the water body is equal to the sum of all the values in the count column starting from the threshold value or nearest threshold value we marked to the end of the table (i.e.; the values before the threshold or nearest threshold value should not be included)
    c. And area of the water bodies will be equal to the count value we have got *pixel size (x)*pixel size(y)
       a. AREA= TOTAL COUNT *X (PIXEL SIZE) *Y (PIXEL SIZE) [total count will be dependent on what area we want to find whether its water bodies or non-waterbodies]
    d. We can calculate area also by adding all the values from the threshold value serial .no to the end value in the m^2 column.
11. Same procedure goes for NDVI as well.
12. FOR WARD WISE COUNT:
    a. Create a new shapefile layer of the ward we want to calculate NDVI or NDWI.
    b. NOW, CLIP THE WARD LAYER: click on the ward layer – raster extraction- clip raster by mask layer
    c. Our input layer should be the NDVI or NDWI of the whole city, mask layer should be the ward layer.
    d. For assigning a specific value for no data value set value as '0'. And then run
    e. There will be a layer obtained, project it and extract the excel using it. the process will be same for the whole city and the count values will be directly obtained in the excel
    f. The procedure for NDVI and NDWI for calculating count values and area are the same.

INFERENCE

The city of coimbatore was selected to perform this assignment to analyse the changes precisely four wards within coimbatore was selected including wards3, 7, 57, 71.

NDVI aim is to assess the biomass quantity, while NDWI was developed to identify water bodies and saturated water. But NDWI, as a water index, was not appropriate to discriminate against water itself. The analysis was carried out to obtain the changes in vegetation and water index over the years from 2013-2017 for four wards in coimbatore. The NDVI threshold value obtained was 0.27(2013) and 0.214(2017) , the NDWI threshold value obtained was 0.06(2013) and 0.004(2017). It indicates that the value of ndvi have reduced in the proportion of vegetation in the study area, and ndwi represents the presence of water which can be observed from the map which show a few patches in the study area.





LULC IMAGE CLASSIFICATION

SUPERVISED

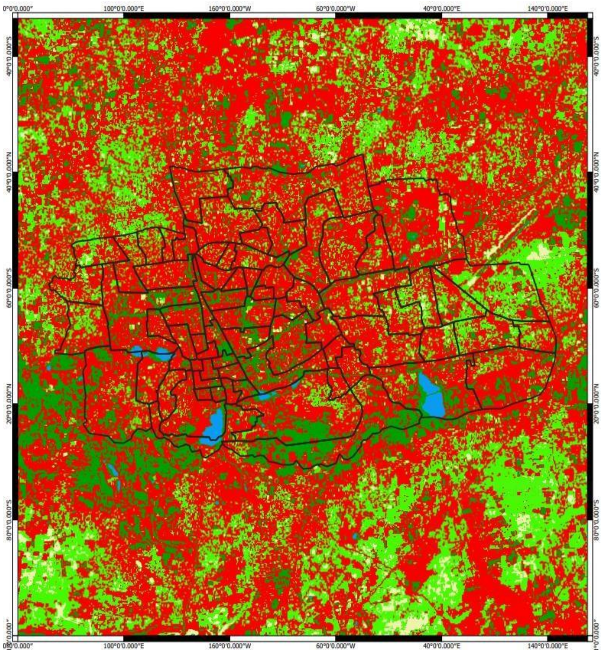
1. Open QGIS and install the SEMI-AUTOMATIC CLASSIFICATION plug-in from the plugin option.
2. Import the bands of the selected region downloaded from Bhuvan, mosaic the bands, and changethe properties to FCC.
3. Now click the toolbar and activate the SCP toolbar.
4. Now click on semi-automatic classification--->training input---> create training input layer andselect destination file where u want to save and save it as training input.
5. Now click on create an ROI polygon and draw a polygon and create the first ROI
6. Define the ROI with mouse clicks, to complete it, click right and change the MC ID (categorynumber) and C ID (sub-category number) and save
7. Repeat the same process for all land cover classifications and try to select at least four sub-classes for each individual category to get accuracy.
8. Now merge the same categories by selecting all the subcategories of the same category
   a. right-click---> select merge of highlighted list
   b. delete the individual sub-categories excluding merged layer by right click--->delete items
9. Select the band set icon from the SCP tool.
   i. Refresh the data and input the respective tile for the selected region as multi bandimages list
   ii. Select band processing--->classification from the left side panel of SCP toolbox tab
   iii. Tick the use as MC ID--->run---> select destination file where u want to save andsave it as supervised.
10. The output image directly displays on canvas.
11. In the layer panel, right-click on the output layer and select Properties --- > Symbology.
    i. a. Change Render Type.
    ii. b. Select the Colour Ramp
12. Click on OK. The output image is provided below. You can also classify according to discreteinterpolation if desired.
13. Save the supervised layer in the projected coordinate system and extract the excel file using theraster layer unique value report in processing toolbox.

UNSUPERVISED

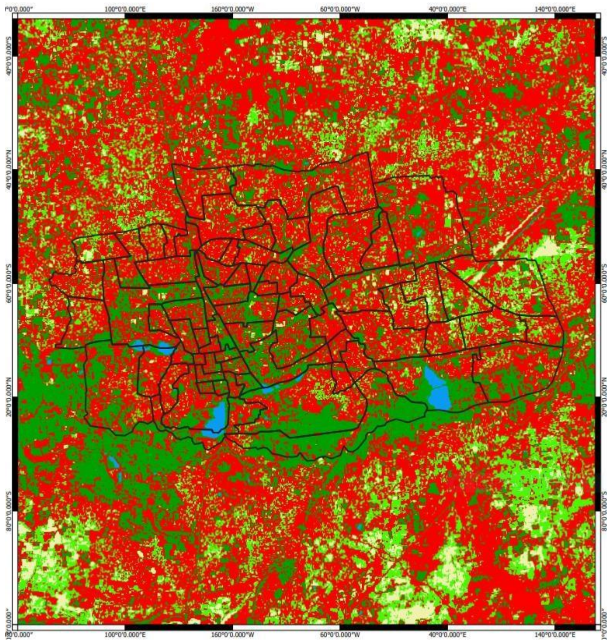
1. Open QGIS and install the SEMI-AUTOMATIC CLASSIFICATION plug-in from the plugin option.
2. Import the bands of the selected region downloaded from Bhuvan, mosaic the bands into tiles,and go to properties--->change band set to FCC.
3. Now click the toolbar and activate the SCP toolbar.

4. Select the band set icon from the SCP tool.
    i. Refresh the data and input the respective tile for the selected region as multi bandimages list
    ii. Select band processing---> clustering from the left side panel of SCP toolbox tab
    iii. Select the method as K-means--->increase the number of classes to 20-30--->change the iterations to 10
    iv. Run---> select destination file where u want to save and save it as unsupervised.
5. The output image directly displays on canvas.
6. In the layer panel, right-click on the output layer and select Properties>> Symbology.
    i. Change Render Type.
    ii. Select the Colour Ramp
    iii. Choose Mode Equal Interval
    i. Change the number of classes from 5 to 20.
7. Click on OK. The output image is provided below. You can also classify according to discreteinterpolation if desired.
8. Save the unsupervised layer in the projected coordinate system and extract the excel file usingthe raster layer unique value report in processing toolbox.

INFERENCE



SUPERVISED IMAGE CLASSIFICATION



UNSUPERVISED IMAGE CLASSIFICATION

After performing LULC classification using unsupervised and supervised techniques, supervised classification produced more accurate results with reference to the google satellite imagery of the site.

LCLU	PIXEL COUNT	AREA(SQ.M)	AREA (IN %)
BUILT UP	2544421	1557193221	50%
VEGETATION	1327396	812370300.8	25%
WATER BODIES	14751	9027655.882	1%
AGRICULTURAL	1087147	665337198.1	21%
BARREN LAND	144879	88666379	3%

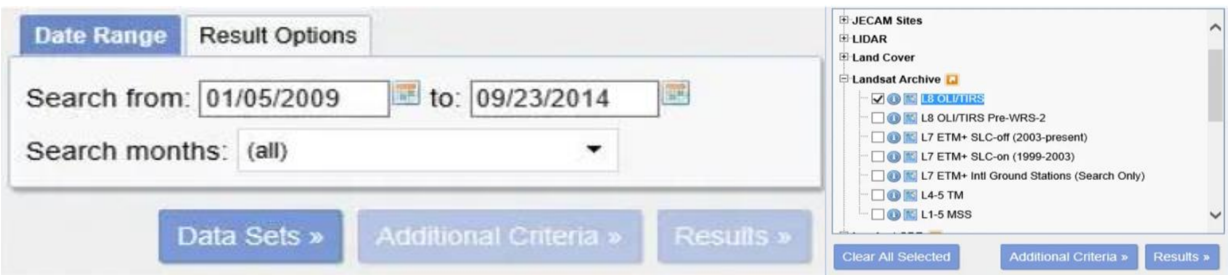
LCLU	PIXEL COUNT	AREA(SQ.M)	AREA (IN %)
BUILT UP	2437885	1491992872	48%
VEGETATION	1778594	1088504819	34%
WATER BODIES	16114	9861815.937	1%
AGRICULTURAL	673005	411881062.1	13%
BARREN LAND	212912	130302777.4	4%

We can interpret that vegetation and agricultural is more in unsupervised compared to supervised. Each of the features was classified according to its shape, size, colour, and texture through the visual interpretation method by overlaying google satellite imagery for LULC supervised image classification.For example, the water body which is located in the site was readily distinguished due to its shape andcolour similarly we distinguish vegetation, agricultural, barren land and built up. From the calculations,we can interpret that the built up predominates in the selected tile followed by vegetation, agricultural, barren lands and water bodies. The spatial arrangements of these features show the repetitive appearance of forms and relationships.

LAND SURFACE TEMPERATURE

PROCEDURE

1. Download Landsat 8 image from a particular location, unzip it, and check certain information needed (within the metadata) to execute this procedure.



2. Insert band 4, band 5, band 10, band 11 into the canvas from the unzipped file.

3. Calculate NDVI using raster calculator, it is important to find NDVI because, subsequently, the proportion of vegetation (Pv), which is highly related to the NDVI, and emissivity (ε), which is related to the Pv.

NDVI = (Band 5 – Band 4) / (Band 5 + Band 4)

4. Calculate the proportion of vegetation Pv in raster calculator, using the minimum and maximum values of the NDVI image which will be displayed directly in the image (layer panel)

Pv = Square ((NDVI – NDVImin) / (NDVImax – NDVImin))

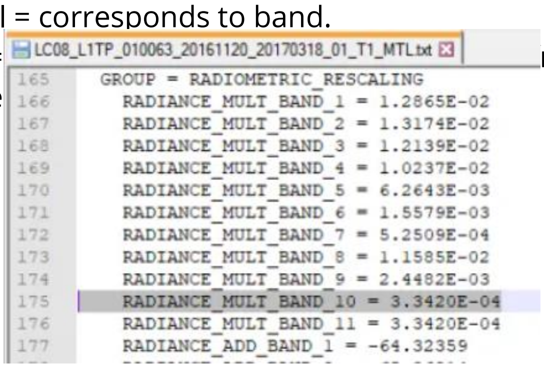
5. Calculate Emissivity ε, by applying the formula in the raster calculator, the value of 0.986 corresponds to a correction value of the equation

ε = 0.004 * Pv + 0.986

6. Calculation of TOA (Top of Atmospheric) spectral radiance for band 10 and 11 by obtaining the values from the metadata.

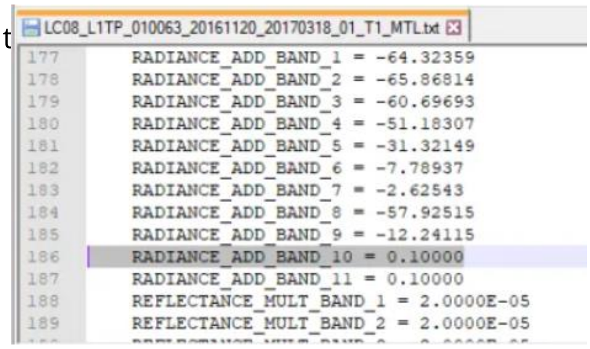
TOA (L) = ML * Qcal + AL

where:
ML = Band-specific multiplicative rescaling factor from the metadata (RADIANCE_MULT_BAND_x, where x is the band number).
Qcal = corresponds to band.
AL =


LC08_L1TP_010063_20161120_20170318_01_T1_MTL.txt

```
GROUP = RADIOMETRIC_RESCALING
  RADIANCE_MULT_BAND_1 = 1.2865E-02
  RADIANCE_MULT_BAND_2 = 1.3174E-02
  RADIANCE_MULT_BAND_3 = 1.2139E-02
  RADIANCE_MULT_BAND_4 = 1.0237E-02
  RADIANCE_MULT_BAND_5 = 6.2643E-03
  RADIANCE_MULT_BAND_6 = 1.5579E-03
  RADIANCE_MULT_BAND_7 = 5.2509E-04
  RADIANCE_MULT_BAND_8 = 1.1585E-02
  RADIANCE_MULT_BAND_9 = 2.4482E-03
  RADIANCE_MULT_BAND_10 = 3.3420E-04
  RADIANCE_MULT_BAND_11 = 3.3420E-04
  RADIANCE_ADD_BAND_1 = -64.32359
```

rom t


LC08_L1TP_010063_20161120_20170318_01_T1_MTL.txt

```
  RADIANCE_ADD_BAND_1 = -64.32359
  RADIANCE_ADD_BAND_2 = -65.86814
  RADIANCE_ADD_BAND_3 = -60.69693
  RADIANCE_ADD_BAND_4 = -51.18307
  RADIANCE_ADD_BAND_5 = -31.32149
  RADIANCE_ADD_BAND_6 = -7.78937
  RADIANCE_ADD_BAND_7 = -2.62543
  RADIANCE_ADD_BAND_8 = -57.92515
  RADIANCE_ADD_BAND_9 = -12.24115
  RADIANCE_ADD_BAND_10 = 0.10000
  RADIANCE_ADD_BAND_11 = 0.10000
  REFLECTANCE_MULT_BAND_1 = 2.0000E-05
  REFLECTANCE_MULT_BAND_2 = 2.0000E-05
```

whe

TOA = 0.0003342 * "Band 10" + 0.1,for band 10
TOA = 0.0003342 * "Band 11" + 0.1,for band 11

7. TOA to Brightness Temperature conversion, to obtain the results in Celsius, the radiant temperature is adjusted by adding the absolute zero (approx. -273.15°C). Corresponding constant for each band is obtained from the metadata.

BT = (K2 / (ln (K1 / TOA) + 1)) − 273.15

where:
K1 = Band-specific thermal conversion constant from the metadata (K1_CONSTANT_BAND_**x**, where x is the thermal band number).
K2 = Band-specific thermal conversion constant from the metadata (K2_CONSTANT_BAND_**x**, where x is the thermal band number).

LC08_L1TP_010063_20161120_20170318_01_T1_MTL.txt

```
    REFLECTANCE_ADD_BAND_8 = -0.100000
    REFLECTANCE_ADD_BAND_9 = -0.100000
  END_GROUP = RADIOMETRIC_RESCALING
  GROUP = TIRS_THERMAL_CONSTANTS
    K1_CONSTANT_BAND_10 = 774.8853
    K2_CONSTANT_BAND_10 = 1321.0789
    K1_CONSTANT_BAND_11 = 480.8883
    K2_CONSTANT_BAND_11 = 1201.1442
  END_GROUP = TIRS_THERMAL_CONSTANTS
  GROUP = PROJECTION_PARAMETERS
    MAP_PROJECTION = "UTM"
    DATUM = "WGS84"
    ELLIPSOID = "WGS84"
```

BT = (1321.0789 / Ln ((774.8853 / "%TOA 10%") + 1)) – 273.15, for band 10

BT = (1201.1442 / Ln ((480.8883 / "%TOA 11%") + 1)) – 273.15, for band 11

8. Finally apply the LST equation to obtain the surface temperature map.

LST = (BT band10 / (1 + (0.00115 * BT band 10 / 1.4388) * Ln(ε))), for band 10

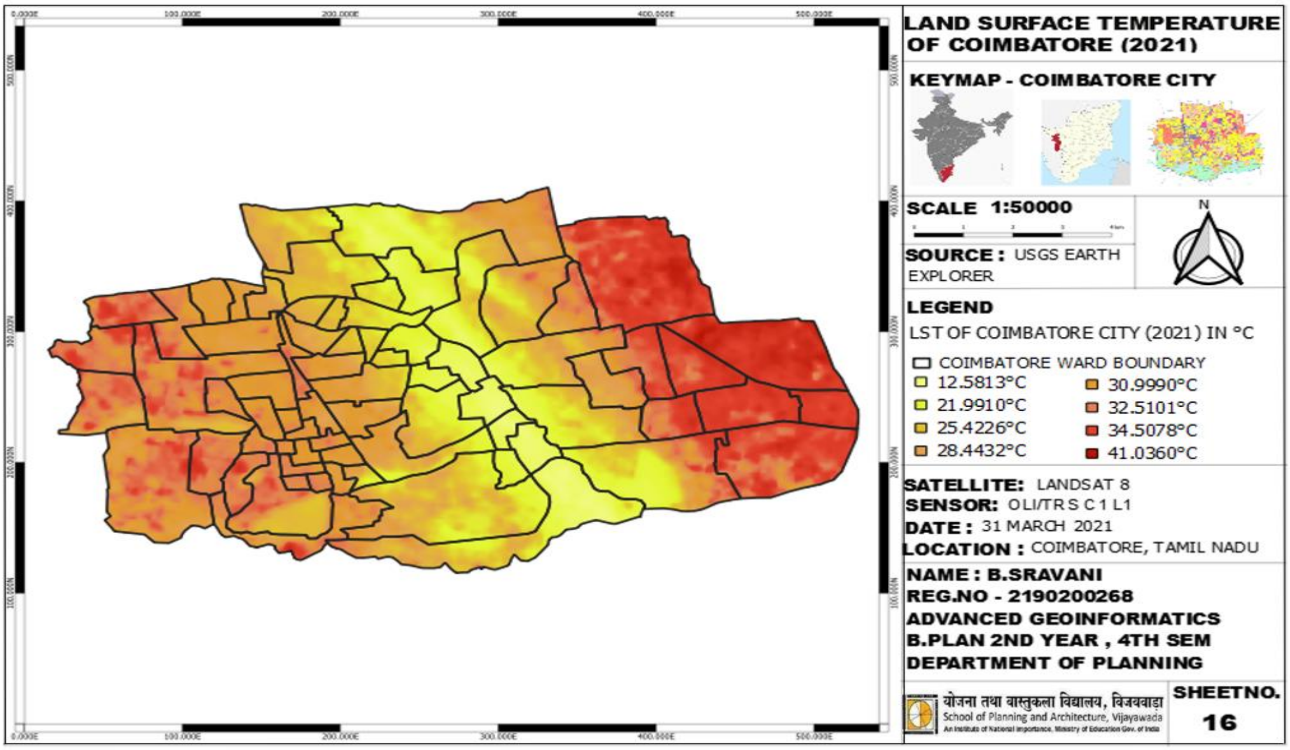
LST = (BT band11 / (1 + (0.00115 * BT band 11 / 1.4388) * Ln(ε))), for band 11

9. The obtained layer for LST using band 10 and band 11 is mosaiced using built virtual raster to obtain the final output
10. Import ward boundary shapefile and clip the LST final layer using clip raster with polygon and change the properties of the final output according to the requirements.

INFERENCE

The selected area is Coimbatore city which is located in southern part of India.

LST is a mixture of vegetation and bare soil temperatures. It is estimated from Top – Of – Atmosphere, Brightness temperatures from the infrared spectral channels of a constellation of geostationary satellites. Its estimation further depends on the vegetation cover and the soil moisture. The LST is observed in 2021 which shows the temperature range from 12-41˚C.



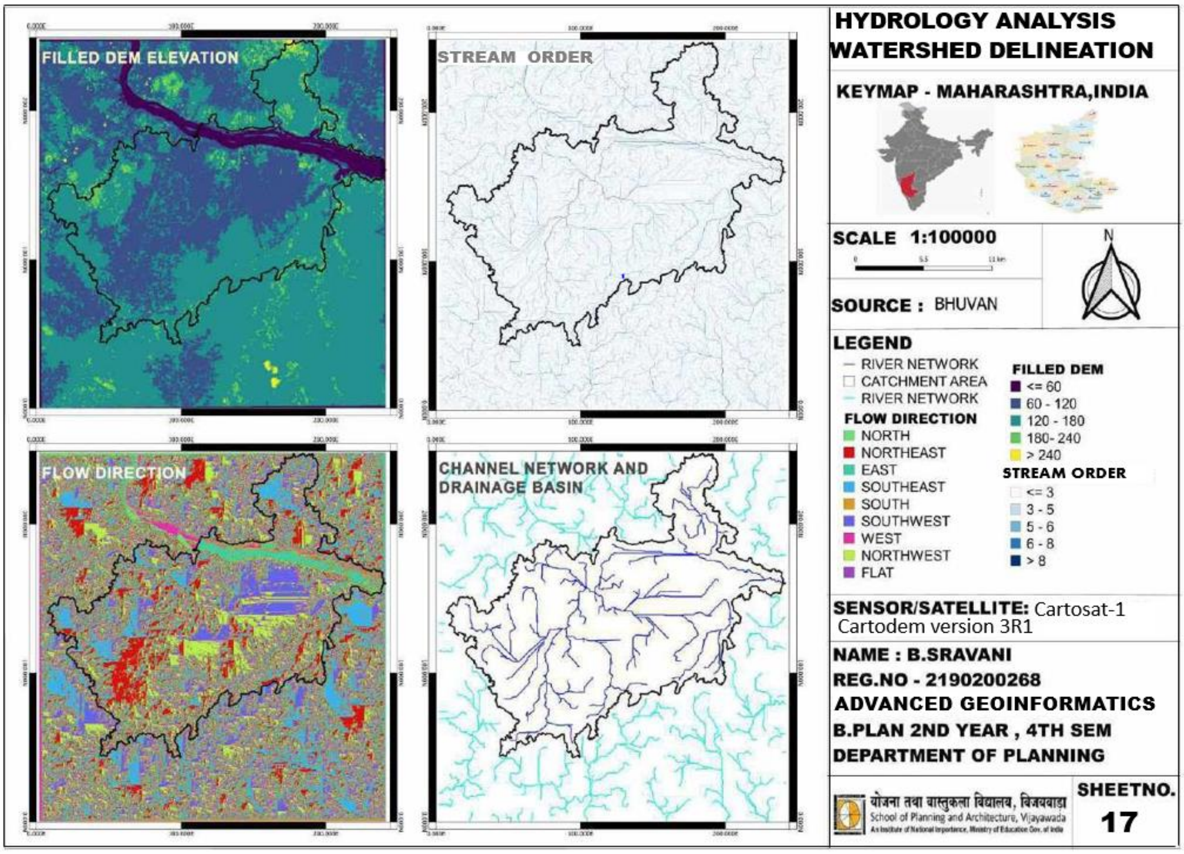
WATER SHED DELINEATION

PROCEDURE

1. First download carto sat dem from bhuvan and insert in GIS.
2. Install quick map services pulgins then open OSM--->OSM standard--->Open Street map.
3. SET PROJECTIONS FOR YOUR DEM
   a) Reproject the dem by changing CRS to projected coordination system using reproject in raster tool.
   b) And also set EPSG projections to projected coordination system.
4. Now the fill the voids or gap in the dem using SAGA GIS Fill sink(wang&liu) and name the file as filled dem.
5. Using the Strahler order toolbox import the stream order layer and divide the stream order by using expression “Strahler order>=6” in raster calculator.
6. Now obtain drainage basin, channel, and flow connection using channel network and drainage basin tool.
7. Select outlet point in Strahler order from drainage basin by creating new shapefile layer.
8. Now open attribute table of outlet point and create new field as X cord and Y cord and obtain values for Xcord and Ycord field by using field calculator.
9. Using this values and upslope tool we have to obtain catchment area.
10. And then convert catchment area from raster to vector using polygonise in raster conversion tool.
11. Delete the area which is outside the catchment area using attribute table of outlet
12. Clip the channel by using polygon clipping tool and also clip the filled dem for the boundary using clip raster with polygon.

INFERENCE

The area includes 43 drainage basins. The drainage basin obtained through watershed delineation occupies a catchment area of 288.09 $Km^{2.}$ The watershed is characterized by a vast stretch of undulating to moderately sloping lands with hilly patches. The stream order of watersheds is classified as ten order and the maximum stream frequency was obtained <=6 showing dendritic type drainage network which is assign of the homogeneity texture and lack of structural control of the watershed and helps understand various terrain parameters such as nature of the bedrock, infiltration capacity, runoff etc.



HYDROLOGY ANALYSIS
WATERSHED DELINEATION
KEYMAP - MAHARASHTRA,INDIA
SCALE 1:100000
SOURCE : BHUVAN
LEGEND
RIVER NETWORK
CATCHMENT AREA
RIVER NETWORK
FLOW DIRECTION
NORTH
NORTHEAST
EAST
SOUTHEAST
SOUTH
SOUTHWEST
WEST
NORTHWEST
FLAT
FILLED DEM
<= 60
60 - 120
120 - 180
180 - 240
> 240
STREAM ORDER
<= 3
3 - 5
5 - 6
6 - 8
> 8
FILLED DEM ELEVATION
STREAM ORDER
FLOW DIRECTION
CHANNEL NETWORK AND DRAINAGE BASIN
SENSOR/SATELLITE: Cartosat-1 Cartodem version 3R1
NAME : B.SRAVANI
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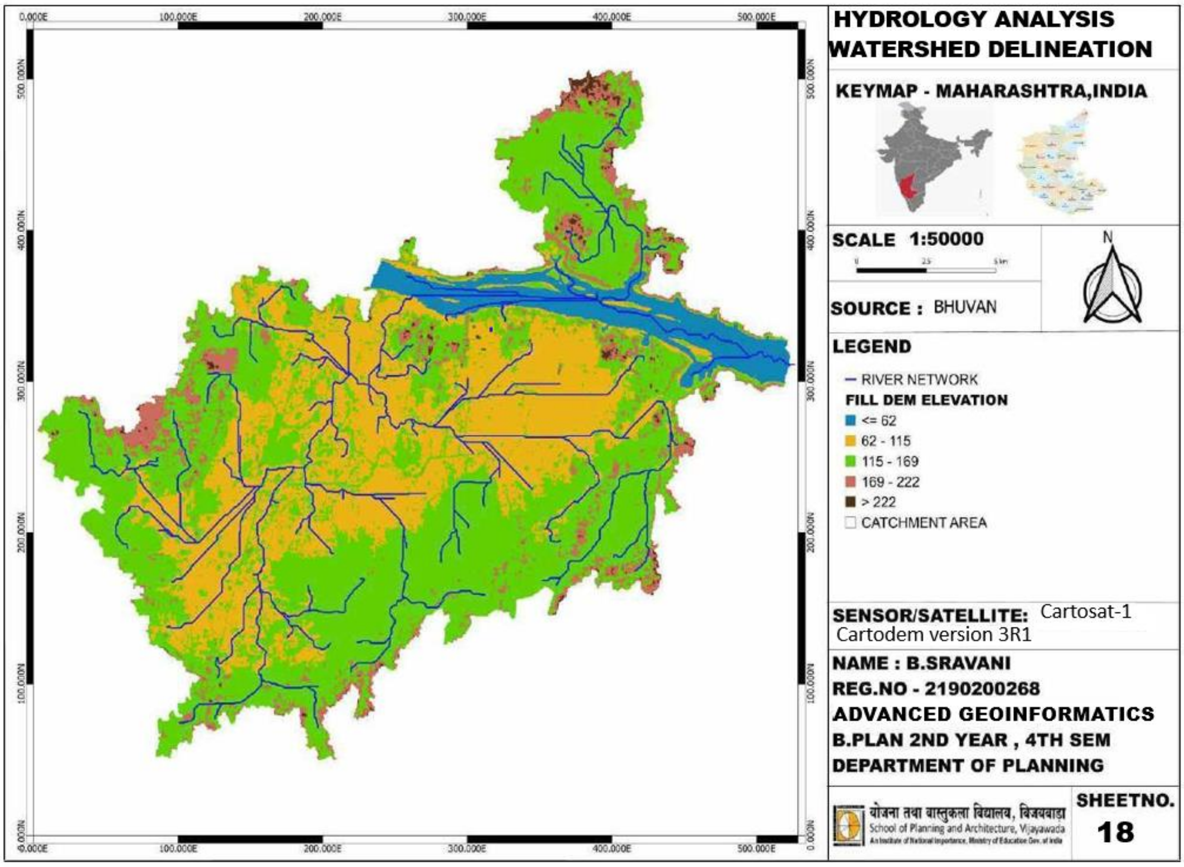

HYDROLOGY ANALYSIS
WATERSHED DELINEATION
KEYMAP - MAHARASHTRA,INDIA
SCALE 1:50000
SOURCE : BHUVAN
LEGEND
RIVER NETWORK
FILL DEM ELEVATION
<= 62
62 - 115
115 - 169
169 - 222
> 222
CATCHMENT AREA
SENSOR/SATELLITE: Cartosat-1 Cartodem version 3R1
NAME : B.SRAVANI
REG.NO - 2190200268
ADVANCED GEOINFORMATICS
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200.000E
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400.000E
500.000E

3D NEIGHOURHOOD BASE MAP

PROCEDURE

1. Import the projected base map of the neighbourhood
2. Go to view tool and open new 3d map view
3. Change the properties of the 3d view for the required layer that have to be elevated and enable the 3d render box.
   I. Check the elevated value under the object
   II. Enter the value as height in 3d view tab
   III. Under the extrusion enter the value that will determine the height of the buildings
   IV. Set altitude clamping to absolute
4. Finally, the 3d map view window will represent the extruded building footprints for the neighbourhood.

INFERENCE

Using the 3D view tool building footprints were extruded to analyse the height variations and orientations. Building heights 3m in the neighbourhood of which single storeyed covers 100% of the total building footprints. It represents the object in three dimensions to map the objects in real-world. So, it helps to virtual representations of environments, including buildings, terrain, land marks, infrastructure landscapes, and vegetation. They integrate geospatial data that culminates into a real-world, three-dimensional visualization of the city.