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CHAPTER I

GIS (GEOGRAPHIC INFORMATION SYSTEM)

A geographic information system (GIS) is a computer-based tool for mapping and analyzing things that exist and events that happen on Earth. GIS technology integrates common database operations such as query and statistical analysis with the unique visualization and geographic analysis benefits offered by maps. These abilities distinguish GIS from other information systems and make it valuable to a wide range of public and private enterprises for explaining events, predicting outcomes, and planning strategies.

Map making and geographic analysis are not new, but a GIS performs these tasks better and faster than do the old manual methods. And, before GIS technology, only a few people had the skills necessary to use geographic information to help with decision making and problem solving.

COMPONENTS OF GIS

A working GIS integrates five key components: hardware, software, data, people, and methods.

1. HARDWARE

Hardware is the computer on which a GIS operates. Today, GIS software runs on a wide range of hardware types, from centralized computer servers to desktop computers used in stand-alone or networked configurations.

2. SOFTWARE

GIS software provides the functions and tools needed to store, analyze, and display geographic information. Key software components are:

- Tools for the input and manipulation of geographic information
- A database management system (DBMS)
- Tools that support geographic query, analysis, and visualization
- A graphical user interface (GUI) for easy access to tools.

3. **DATA**

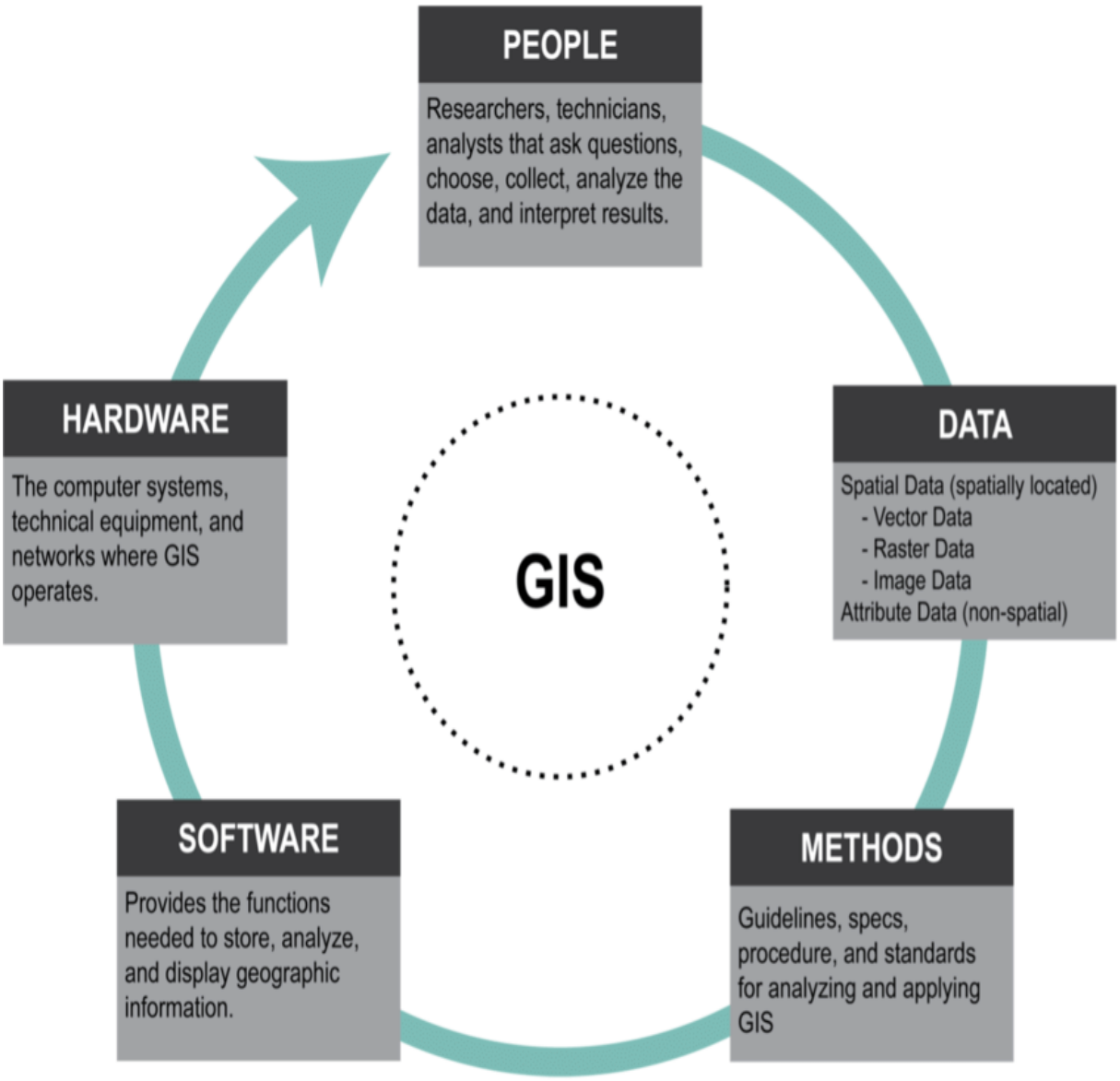
   Possibly the most important component of a GIS is the data. Geographic data and related tabular data can be collected in-house or purchased from a commercial data provider. A GIS will integrate spatial data with other data resources and can even use a DBMS, used by most organizations to organize and maintain their data, to manage spatial data.

4. **METHODS**

   A successful GIS operates according to a well-designed plan and business rules, which are the models and operating practices unique to each organization.

5. **PEOPLE**

   GIS technology is of limited value without the people who manage the system and develop plans for applying it to real world problems. GIS users range from technical specialists who design and maintain the system to those who use it to help them perform their everyday work.



APPLICATIONS OF GIS

1. Mapping and Cartography: -

GIS is widely used for creating maps and visualizing spatial data. It allows for the creation of detailed and accurate maps for various purposes, such as urban planning, environmental monitoring, and navigation.

2. Environmental Management:

GIS is used in environmental science and conservation for tasks such as monitoring land use changes, assessing environmental impact, and managing natural resources.

3. Urban Planning:

GIS helps urban planners analyze and manage spatial data related to land use, infrastructure, and population. It aids in making informed decisions about zoning, transportation, and city development.

4. Healthcare:

GIS is used in public health to map disease outbreaks, analyze the spread of diseases, and plan healthcare resource distribution.

5. Emergency Management:

GIS is crucial in disaster response and management. It helps in assessing vulnerabilities, planning evacuation routes, and coordinating emergency responses**.**

6. Business and Marketing:

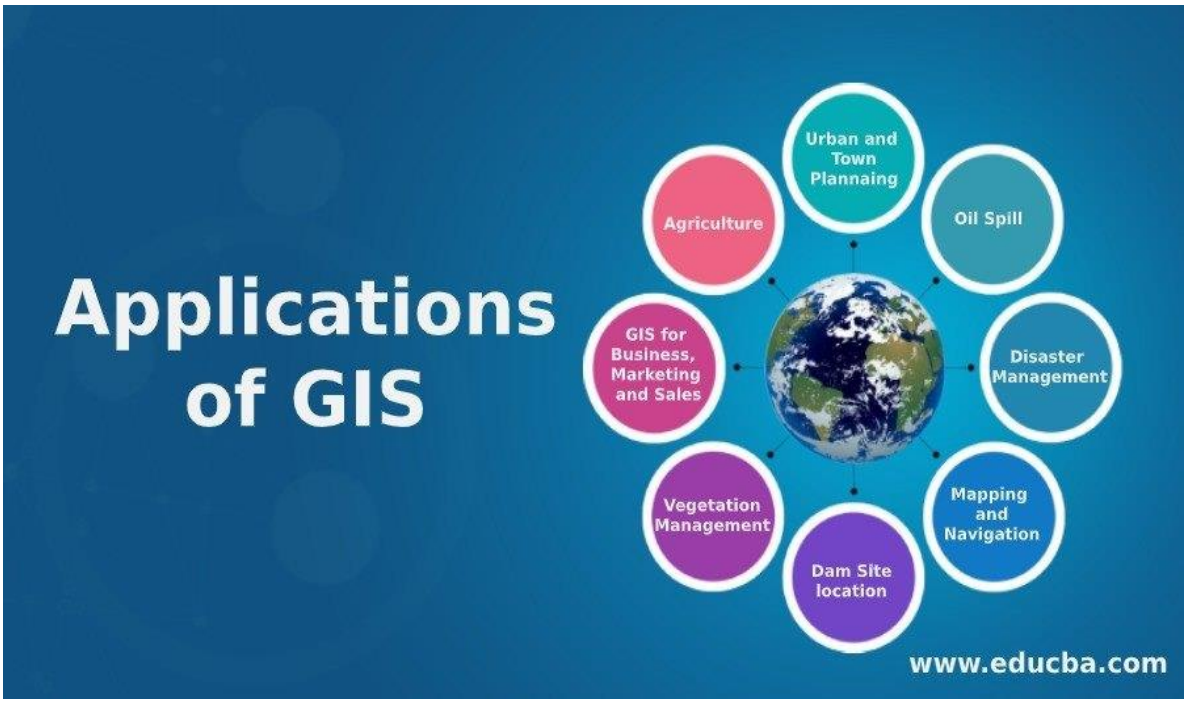
GIS is employed in business for location-based analysis, market research, and site selection. It helps businesses make informed decisions based on spatial data.

7. Natural Resource Management:

GIS is used in forestry, agriculture, and mining to manage and optimize the use of natural resources. It aids in monitoring land productivity, assessing soil quality, and planning resource extraction.

8. Transportation Planning:

GIS is utilized to optimize transportation networks, analyze traffic patterns, and plan efficient routes for logistics and transportation.




AGRICULTURE
BUSINESS
MAPPING
NAVIGATION
OIL AND GAS
URBAN PLANNING
TOURISM
INSURANCE
MARKETING
LANDUSE
APPLICATION OF GIS

CHAPTER II

GEOREFERENCING

WE ARE GOING TO STUDY THE AREA OF MAHARASHTRA AND ITS ADMINISTRATIVE DIVISIONS.

BEFORE STUDYING HERE IS SOME INTRODUCTION ON THE GEOGRAPHY OF THIS REGION ARE AS FOLLOWS: -

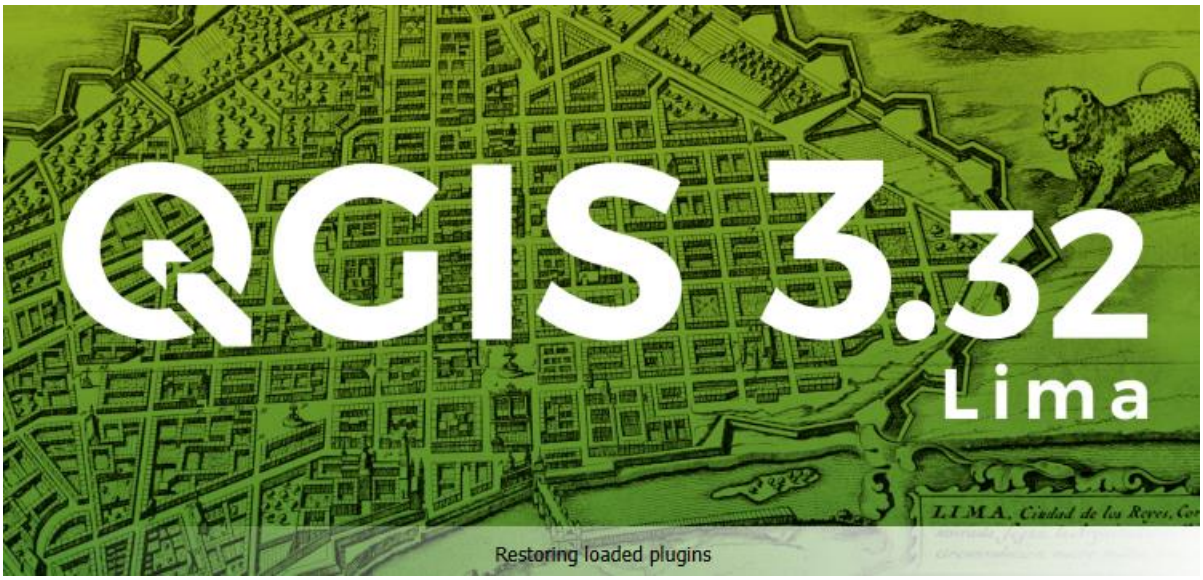
Maharashtra with a total area of 307,713 km^2 (118,809 sq mi), is the third-largest state by area in terms of land area and constitutes 9.36 per cent of India's total geographical area. The State lies between 15°35' N to 22°02' N latitude and 72°36' E to 80°54' E longitude. It occupies the western and central part of the country and has a coastline stretching 840 kilometers along the Arabian Sea.

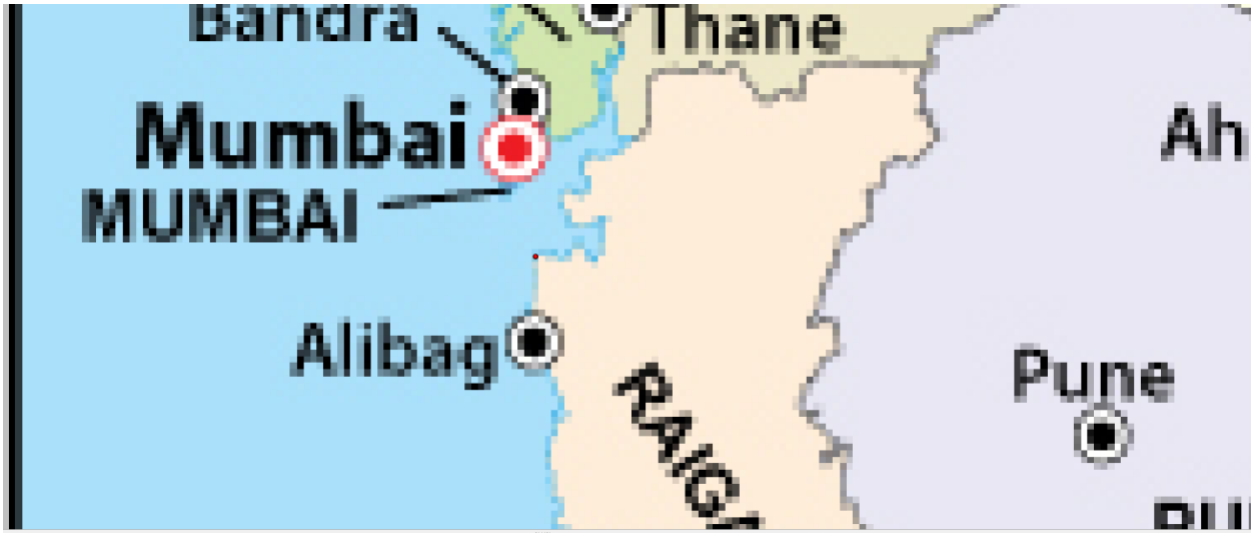
MAHARASHTRA is a state in the western peninsular region of India occupying a substantial portion of the Deccan Plateau. It is bordered by the Arabian Sea to the west, the Indian states of Karnataka and Goa to the south, Telangana to the southeast and Chhattisgarh to the east, Gujarat and Madhya Pradesh to the north, and the Indian union territory of Dadra and Nagar Haveli and Daman and Diu to the northwest. Maharashtra is the second-most populous state in India and the third-most populous country subdivision globally

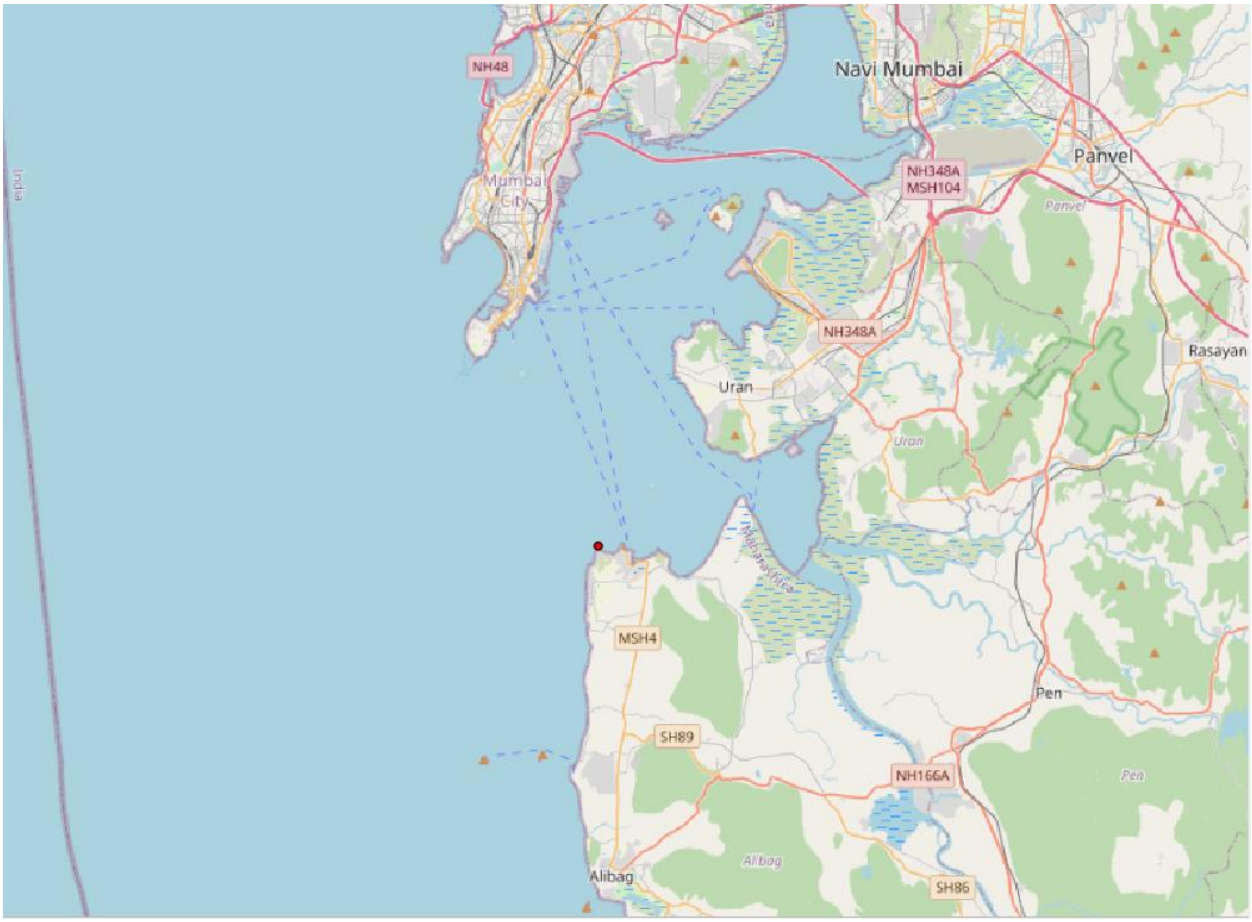
STEPS TO PERFORM GEOREFERENCING

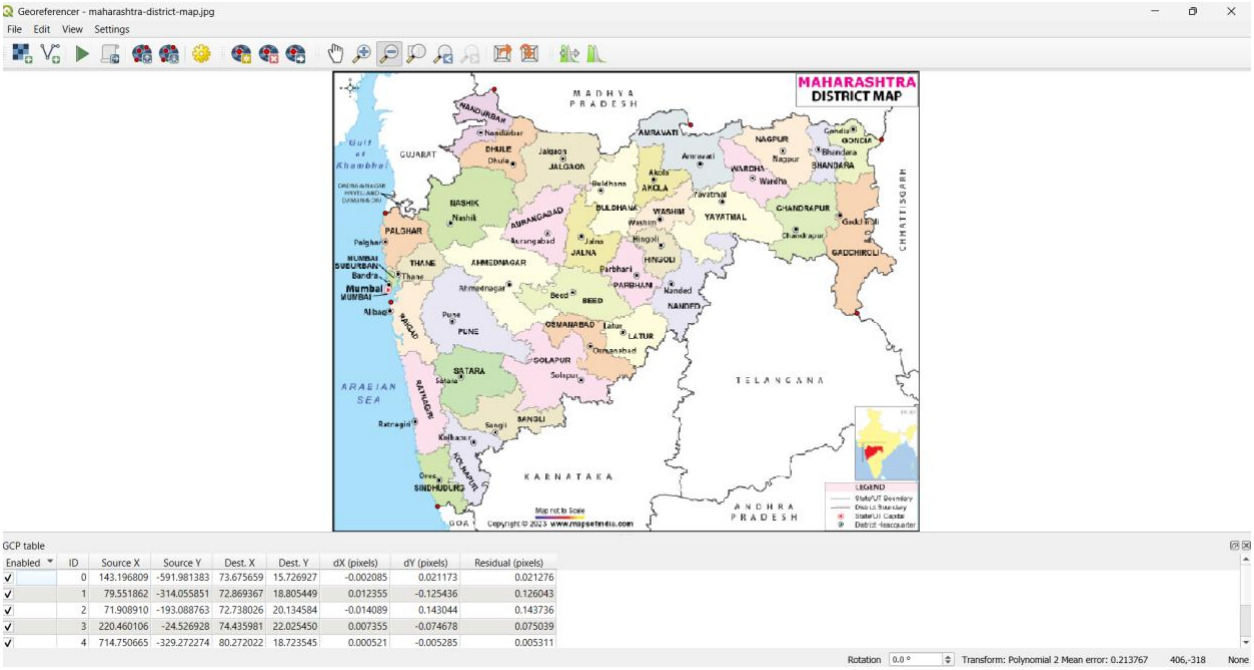
TO GEOREFERNCE THE MAP OF MAHARASHTRA WE USE CANVAS GEOREFERENCING IN WHICH WE HAVE TO ADD POINT ON

MAHARASHTRA MAP AND THEN ALSO ADD POINT ON THE SAME PLACE ON OPEN STREET MAP AND IT WILL AUTOMATICALLY TAKE THE COORDINATES AND OUR MAP WILL BE GEOREFERENCED BY FOLLOWING THESE STEPS: -

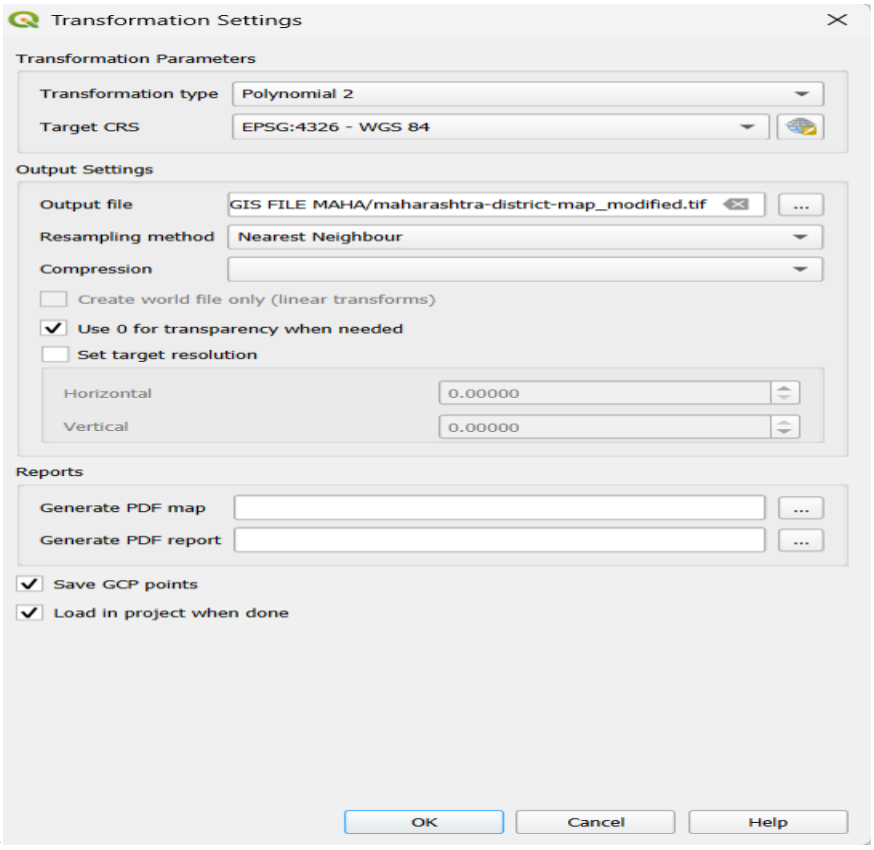
1. **OPEN QGIS SOFTWARE LATEST VERSION 3.32 LIMA**
2. 

3. **THEN OPEN THE GEO-REFERENCER AND OPEN MAP IN RASTER FORMAT AND SELECT THE MAP WHICH WE WANT TO GEO REFERENCE.**
4. **THEN ADD POINTS ON THE MAHARASHTRA DISTRICT BOUNDARY AND ONCE AGAIN ADD THE POINT IN OPEN STREET MAP ON THE EXACT SAME POSITION WHERE YOU HAVE POINTED IN THE MAP.**
5. 

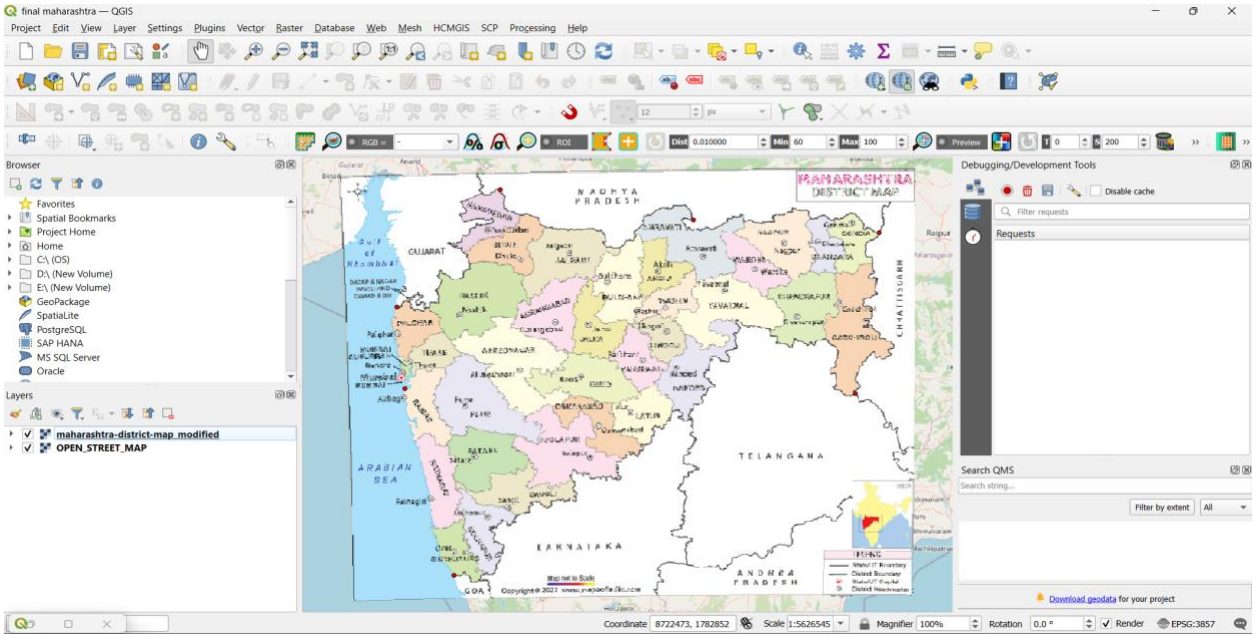
6. 

7. **IN THE SAME WAY ADD ALL THE 7 POINTS TO GEOREFERENCE THE MAP.**
8. 

9. **AFTER ADDING ALL THE POINTS CHECK THAT THE MEAN ERROR SHOULD BE LESS THAN ONE, AS IT WILL MAKE THE MAP MORE ACCURATE.**
10. **THEN SEE THE TRANSFORMATION SETTING AS BELOW**



11.
12. **THEN CLICK AND GEO REFERENCE THE MAP.**



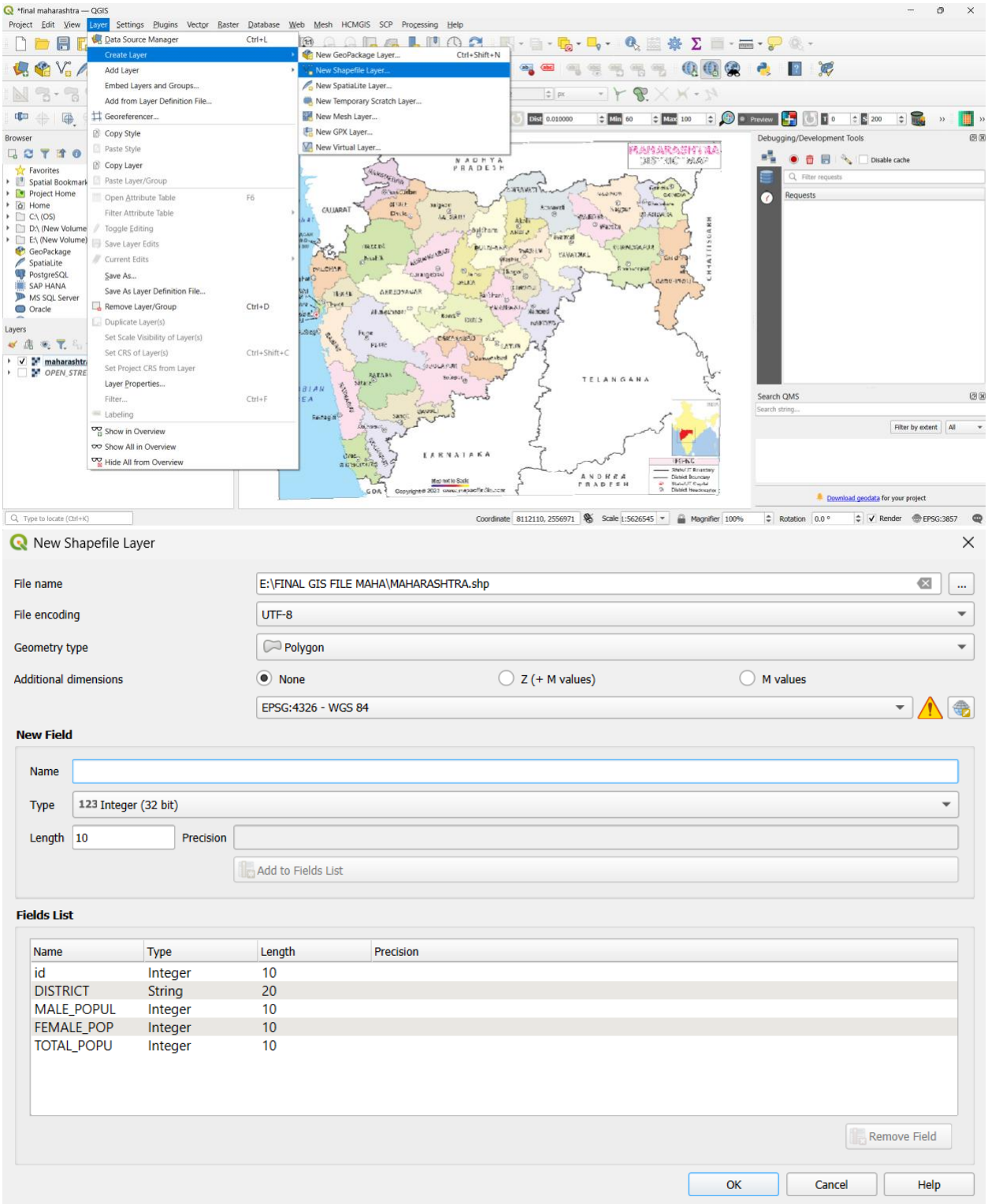
CHAPTER III

DIGITIZATION OF ADMINISTRATIVE DIVISIONS MAP MAKING

NOW DIGITIZE THE ADMINISTRATIVE DIVISION BY FOLLOWING THESE STEPS: -

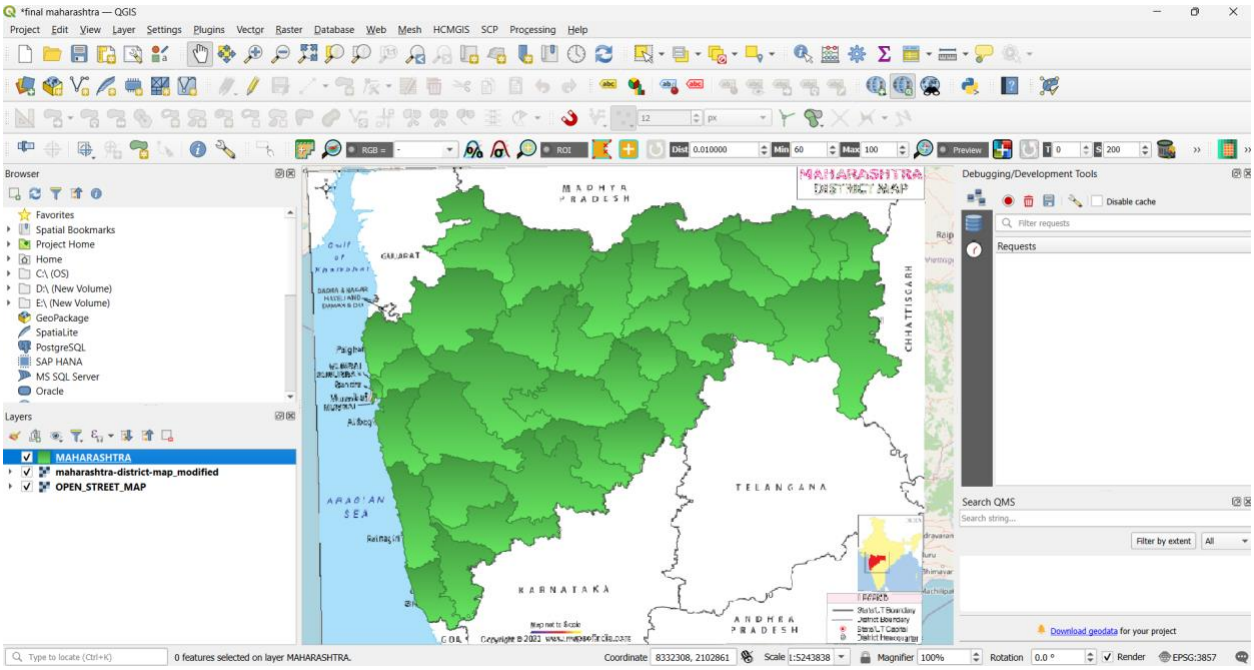
1. **CREATE A NEW SHAPEFILE LAYER (POLYGON) AND DIGITIZE THE DISTRICT BOUNDARIES OF THE MAHARASHTRA.**

2. **GO INTO LAYER, THEN CREATE LAYER, THEN CREATE NEW SHAPEFILE LAYER THEN A NEW WINDOW WILL OPEN.**



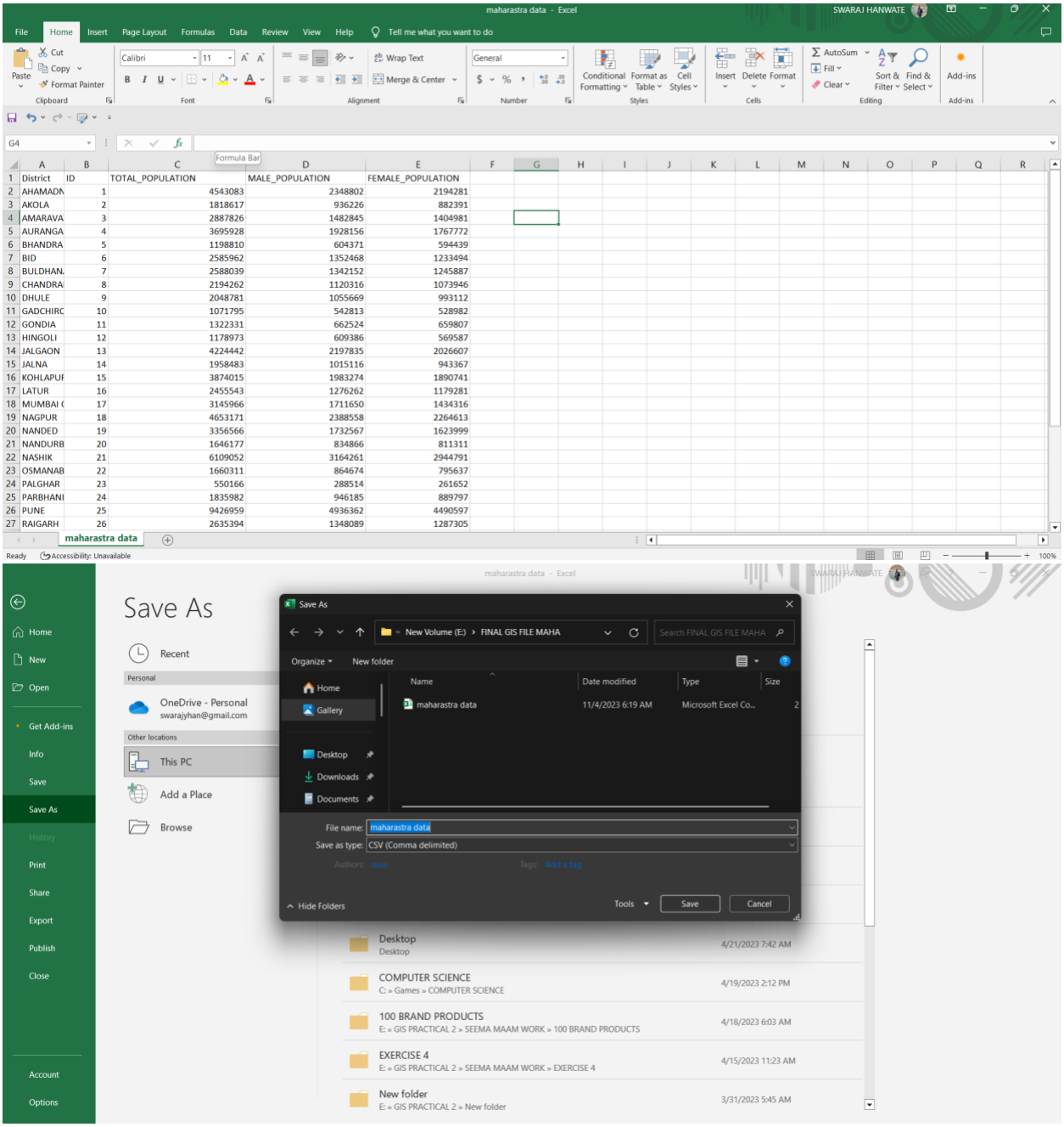
3.

4. **THEN TOGGLE EDITING AND START DIGITIZING THE DISTRICT BOUNDARIES.**



5.

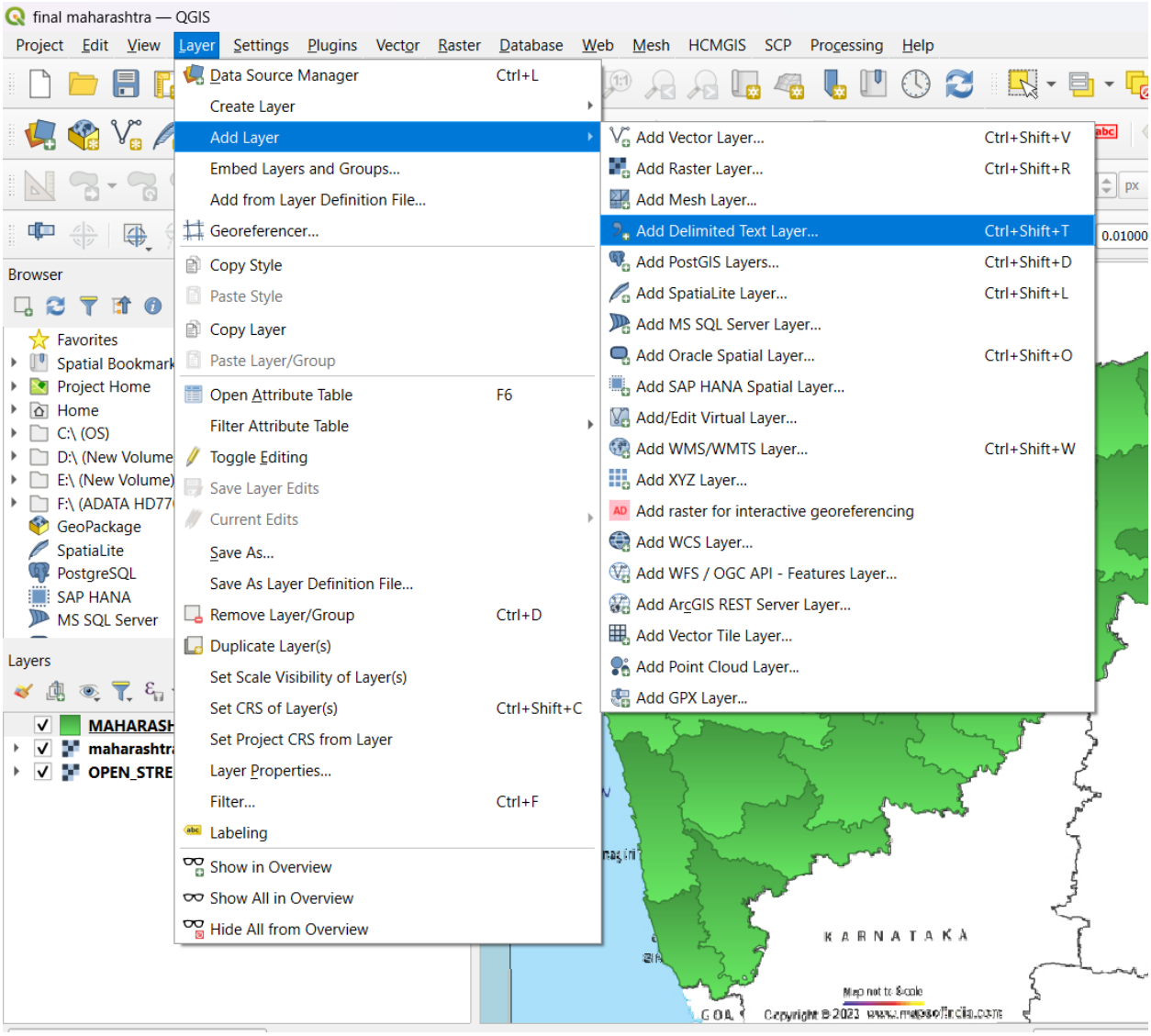
6. **After digitizing the district state boundaries, we have to add the district-wise population data from the excel sheet.**
7. **Create a excel sheet and add the population data of districts of Maharashtra and save it into (.csv) format in order to import it into Qgis software.**



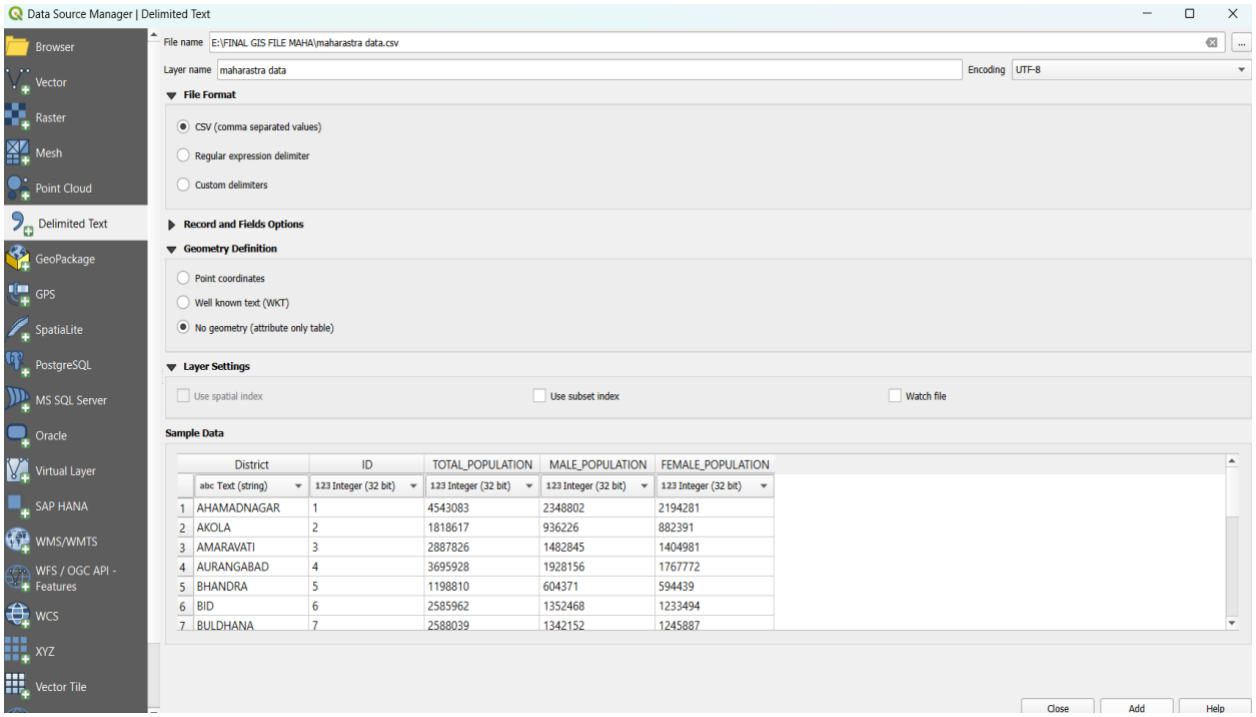
	District	ID	TOTAL_POPULATION	MALE_POPULATION	FEMALE_POPULATION
2	AHAMADN	1	4543083	2348802	2194281
3	AKOLA	2	1818617	936226	882391
4	AMARAVA	3	2887826	1482845	1404981
5	AURANGA	4	3695928	1928156	1767772
6	BHANDRA	5	1198810	604371	594439
7	BID	6	2585962	1352468	1233494
8	BULDHAN	7	2588039	1342152	1245887
9	CHANDRA	8	2194262	1120316	1073946
10	DHULE	9	2048781	1055669	993112
11	GADCHIRC	10	1071795	542813	528982
12	GONDIA	11	1322331	662524	659807
13	HINGOLI	12	1178973	609386	569587
14	JALGAON	13	4224442	2197835	2026607
15	JALNA	14	1958483	1015116	943367
16	KOHLAPUI	15	3874015	1983274	1890741
17	LATUR	16	2455543	1276262	1179281
18	MUMBAI (	17	3145966	1711650	1434316
19	NAGPUR	18	4653171	2388558	2264613
20	NANDED	19	3356566	1732567	1623999
21	NANDURB	20	1646177	834866	811311
22	NASHIK	21	6109052	3164261	2944791
23	OSMANAB	22	1660311	864674	795637
24	PALGHAR	23	550166	288514	261652
25	PARBHANI	24	1835982	946185	889797
26	PUNE	25	9426959	4936362	4490597
27	RAIGARH	26	2635394	1348089	1287305

8. **Open Qgis software then go to layer, then add layer then add delimited text layer then a new window will open to add the**

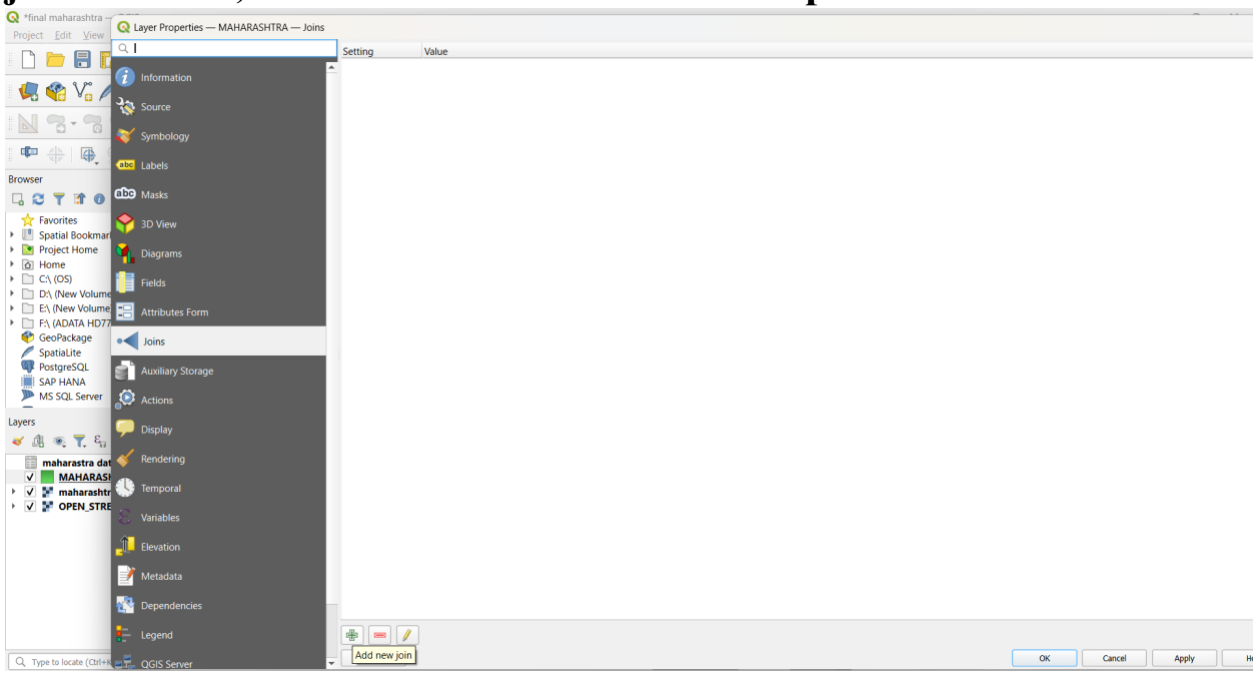
(.csv) data file.



9. **Then select the (.csv) data file and select format csv and as we want only its attribute table (data) we will select no geometry as shown below: -**

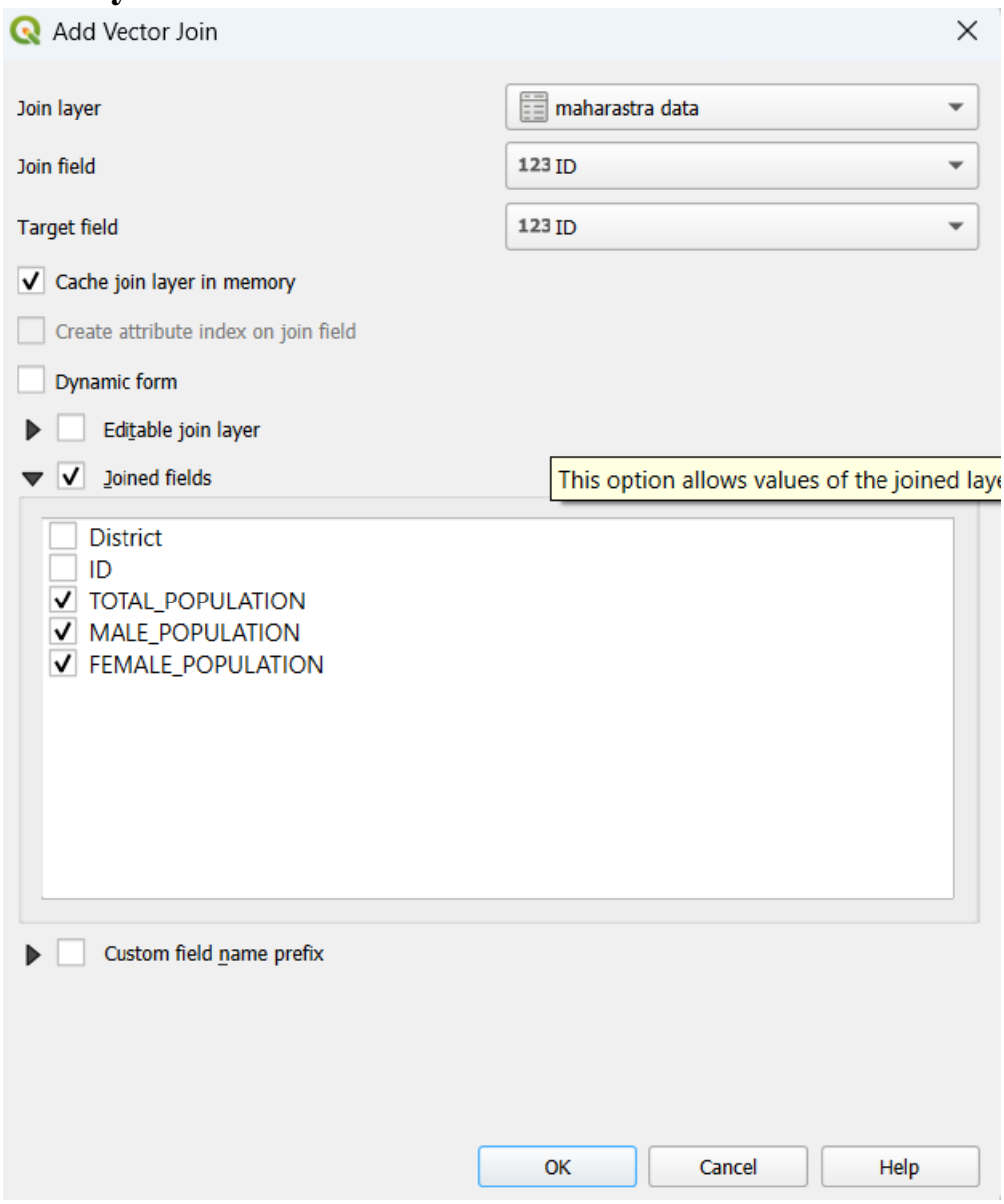


10. then add the file, after adding we have to go to properties of shapefile (Maharashtra) and then select (joins) as we want to join the data, after that a new window will open as shown here



11. then click on the plus sign and a new window will open then select the (.csv) file and the common attribute through which we will join the data to that specific attribute also select the

fields you want to add the data as shown here: -



12. **then click ok and we will see the data joined with our vector file name Maharashtra as shown below: -**

MAHARASHTRA — Features Total: 36, Filtered: 36, Selected: 0

	District	ID	maharastra data_TOTAL_POPULATION	maharastra data_MALE_POPULATION	maharastra data_FEMALE_POPULATION
1	AHAMADNAGAR	1	4543083	2348802	2194281
2	AKOLA	2	1818617	936226	882391
3	AMARAVATI	3	2887826	1482845	1404981
4	AURANGABAD	4	3695928	1928156	1767772
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20	NANDURBAR	20	1646177	834866	811311
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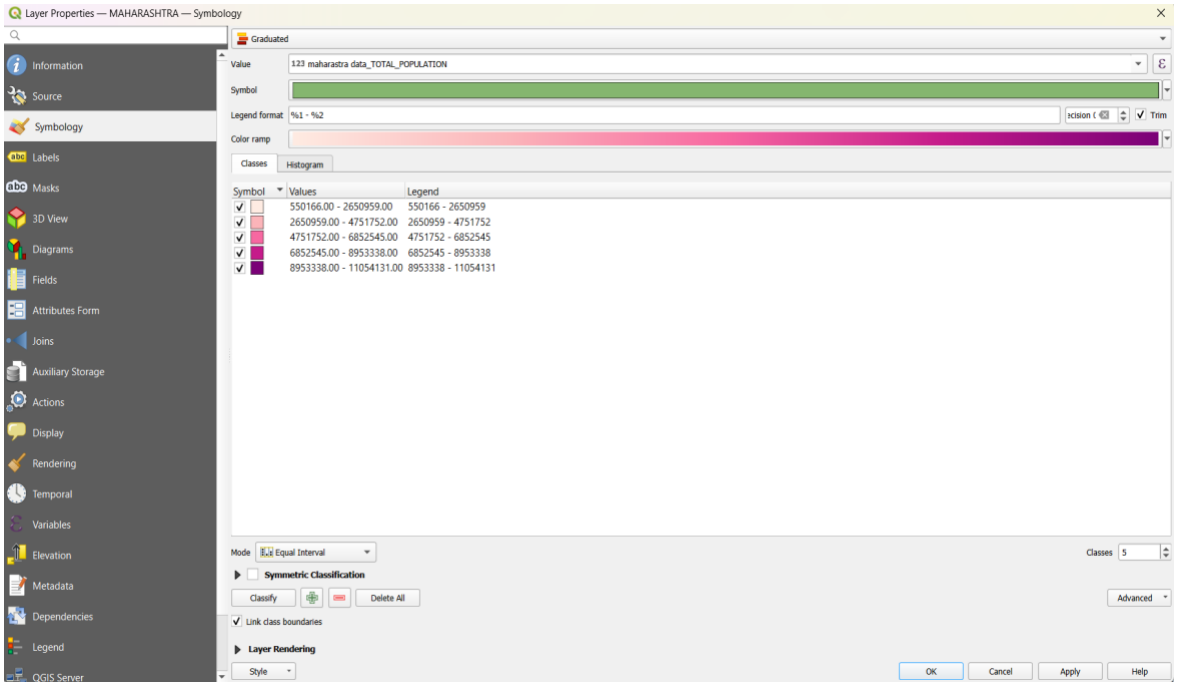
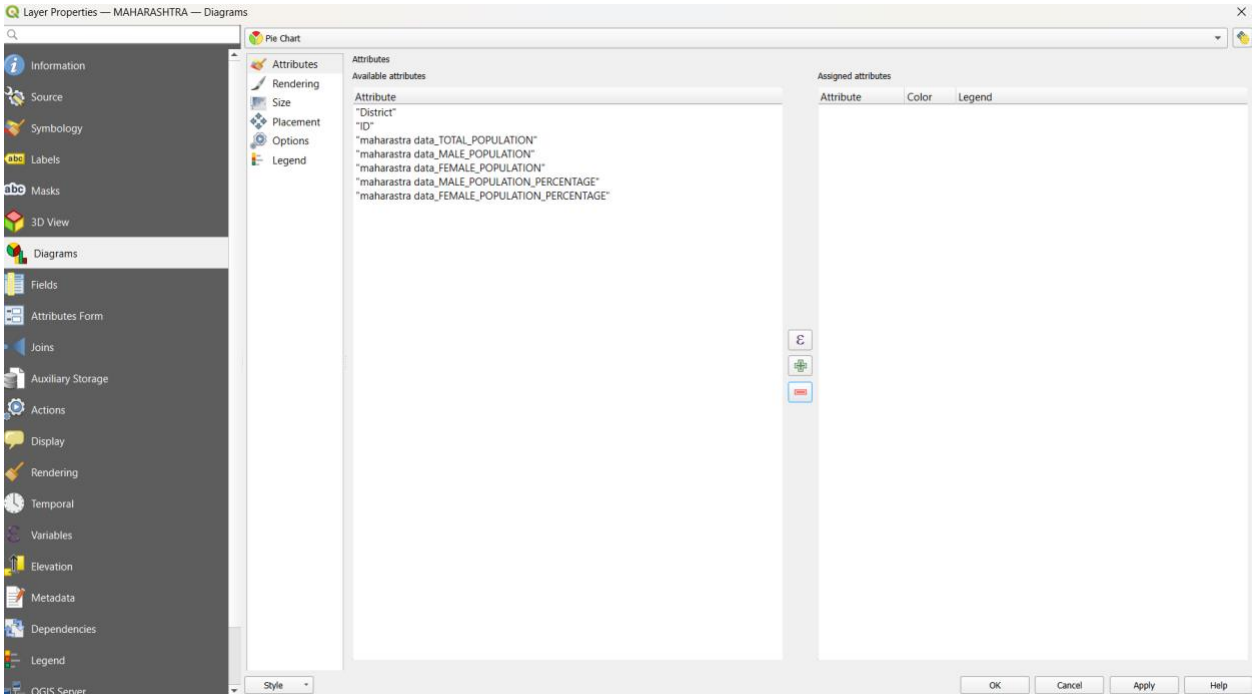
22	OSMANABAD	22	1660311	864674	795637
23	PALGHAR	23	550166	288514	261652
24	PARBHANI	24	1835982	946185	889797

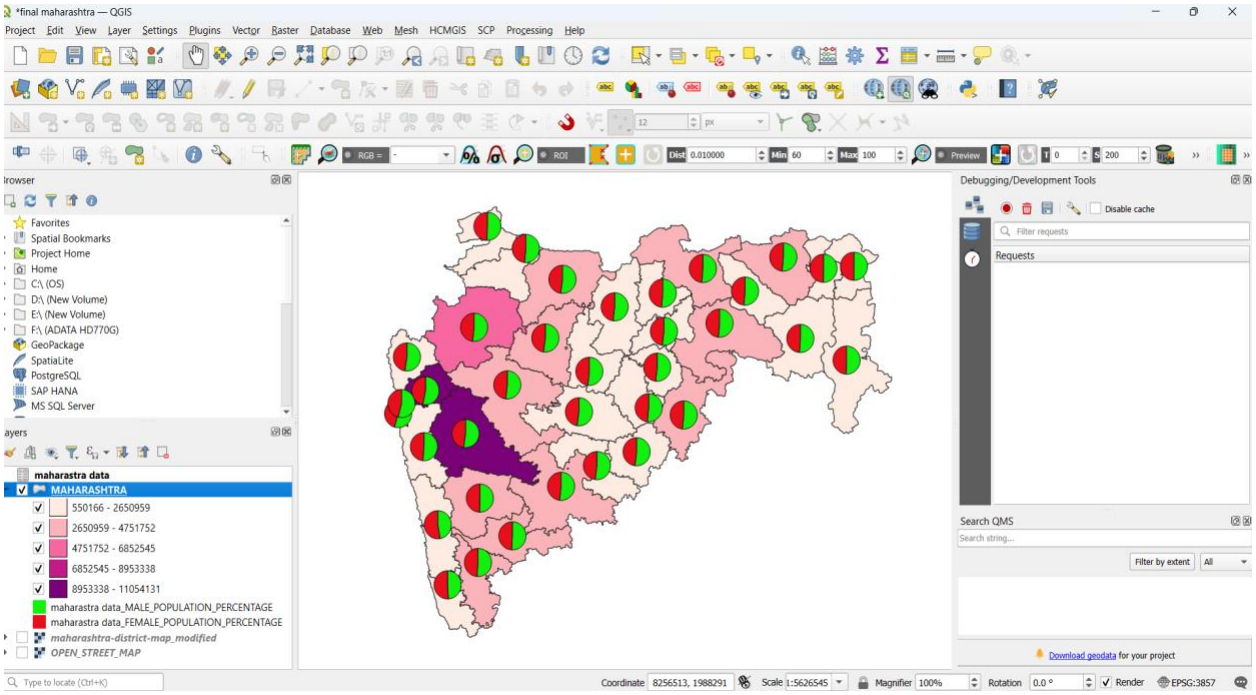
13. **after that we have to make a choropleth map on the basis of total population data district wise. go to properties and go to symbology and select graduated and select classify on equal interval and click ok as shown.**



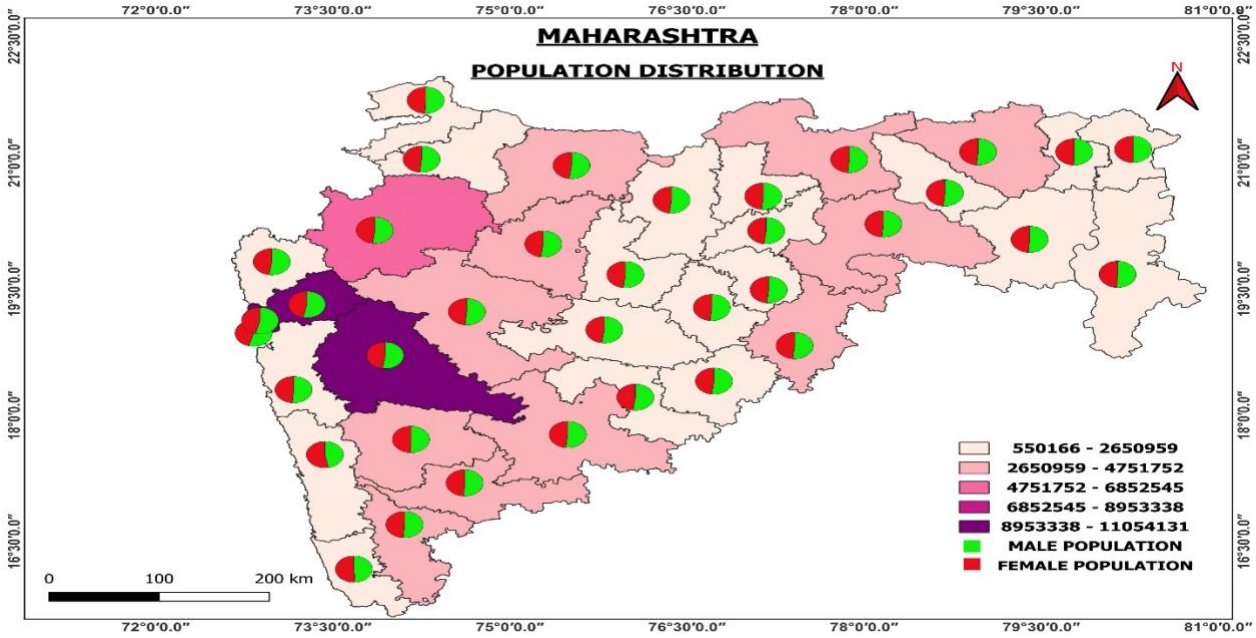
14. THEN AFTER THE CHOLOROPLETH, WE HAVE TO MAKE A PIE CHART ON BASIS OF MALE AND FEMALE POPULATION, TO DO THAT GO TO PROPERTIES, GO TO DIAGRAMS AND SELECT PIE CHART.



15. AFTER THAT SELECT THE ATTRIBUTES OF MALE AND FEMALE POPULATION AND SELECT THE SIZE ACCORDINGLY AND CLICK APPLY AN PIE DIAGRAM WILL BE CREATED.



16. AFTER THAT MAKE A LAYOUT AND ADD THE REQUIRED ELEMENTS OF MAP THAT HAS THESE FOLLOWING ELEMENTS (SCALE, DIRECTION, COORDINATES, LEGEND, BORDERS, TITLE ETC).



CHAPTER IV

BUFFERING: - POINT, LINE, AREA

Buffering is a fundamental and widely used spatial analysis technique in Geographic Information Systems (GIS). It involves creating a zone or area around a specific geographic feature or set of features. This zone is typically defined as a specified distance or a certain number of units (e.g., meters, feet) around the feature(s) of interest. The resulting area is known as a buffer zone or simply a buffer. Buffers are essential tools in GIS because they allow analysts and decision-makers to perform various spatial analyses and answer questions related to proximity, containment, accessibility, and more.

Purpose of Buffering in GIS:

1. Proximity Analysis: Buffers are commonly used to analyze proximity relationships between different geographic features. For example, they can help determine which residential properties are within a certain distance of a school, or they can identify areas at risk of flooding within a specified radius of a river. This information is crucial for making informed decisions related to land use planning, emergency response, and infrastructure development.

2. Containment Analysis: Buffers can be used to assess whether one geographic feature contains another. For instance, you can create a buffer around a protected nature reserve and then determine which parcels of land fall within that buffer zone, helping to identify potential areas for conservation or zoning restrictions.

3. Accessibility Analysis: Buffers are helpful in analyzing accessibility to specific locations or services. By creating buffers around public transportation stops, businesses, or healthcare facilities, you can identify areas within a certain distance that have convenient access to these services. This can be valuable for urban planning, retail site selection, and healthcare service allocation.

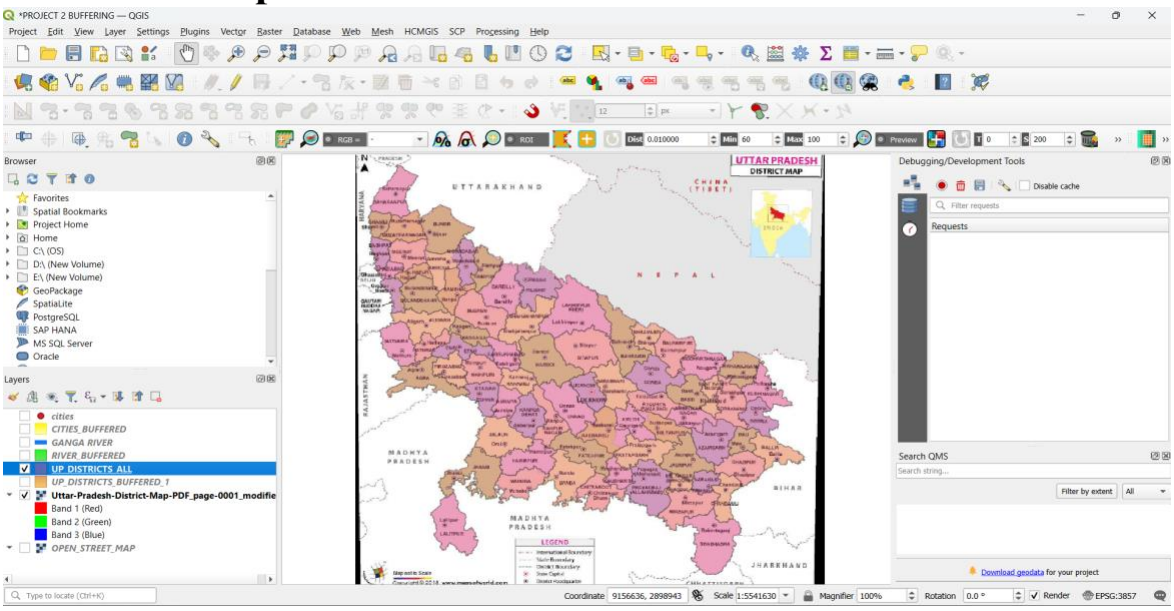
4. Environmental Analysis: Buffers are frequently used in environmental studies to evaluate the impact of developments on sensitive ecosystems. For example, they can be employed to assess the potential harm caused by

construction activities within a certain distance of wetlands, habitats of endangered species, or water bodies. This helps ensure compliance with environmental regulations and conservation efforts.

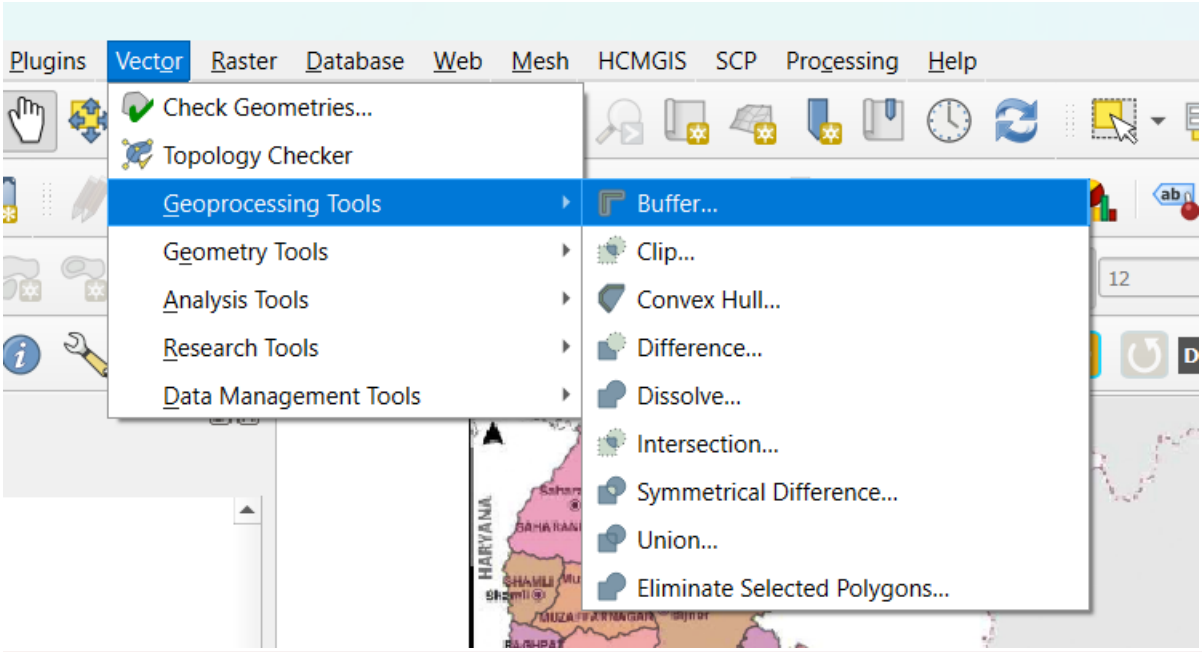
5. Network Analysis: In network analysis, buffers are used to analyze travel time and distance around transportation networks, such as road networks. By creating buffers around road segments, analysts can identify service areas for businesses or optimize route planning for delivery services. Problems in fields such as urban planning, environmental management, transportation, and public policy.

STEPS TO PERFORM BUFFERING: - POINT, LINE, AREA

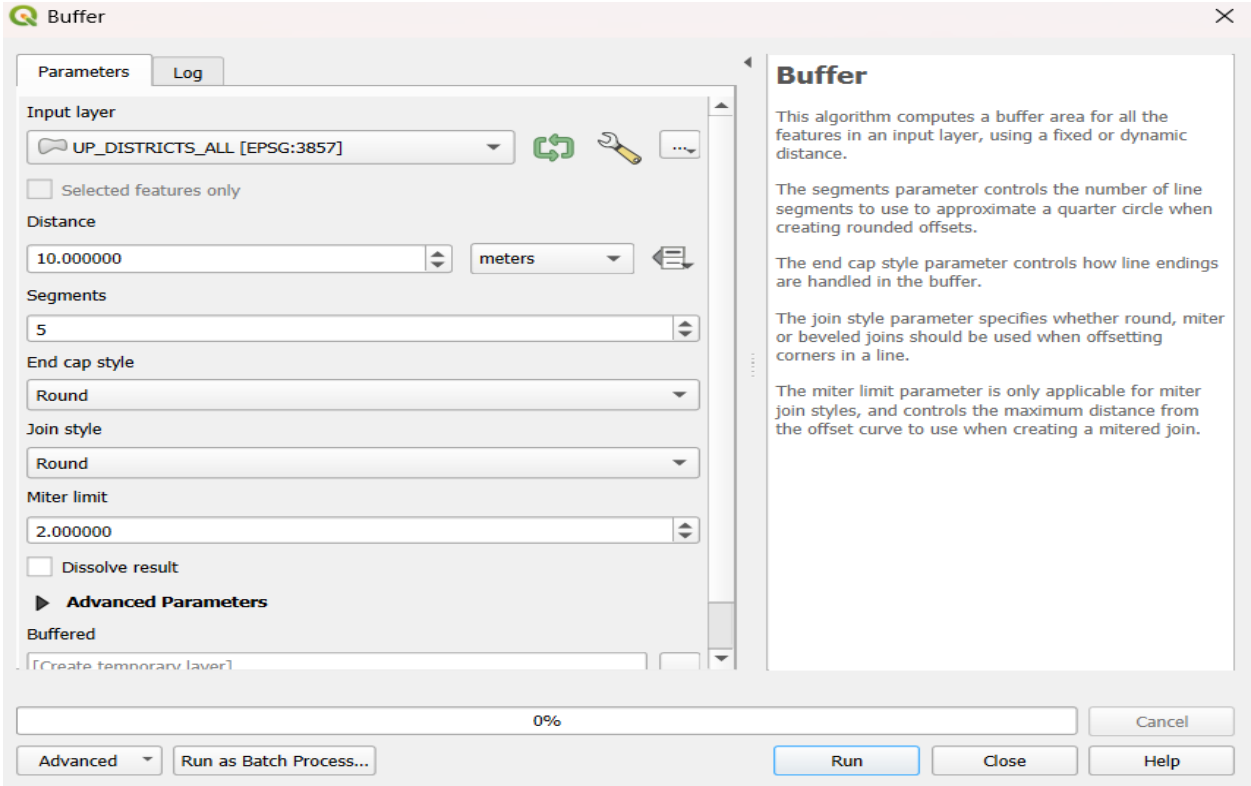
1. **Open Qgis and Georeference and digitize the Uttar Pradesh district administrative boundaries with the help of above-mentioned steps.**



2. **In order to buffer the districts, go to vector, then geoprocessing tools, and then select buffer and a new window will open.**

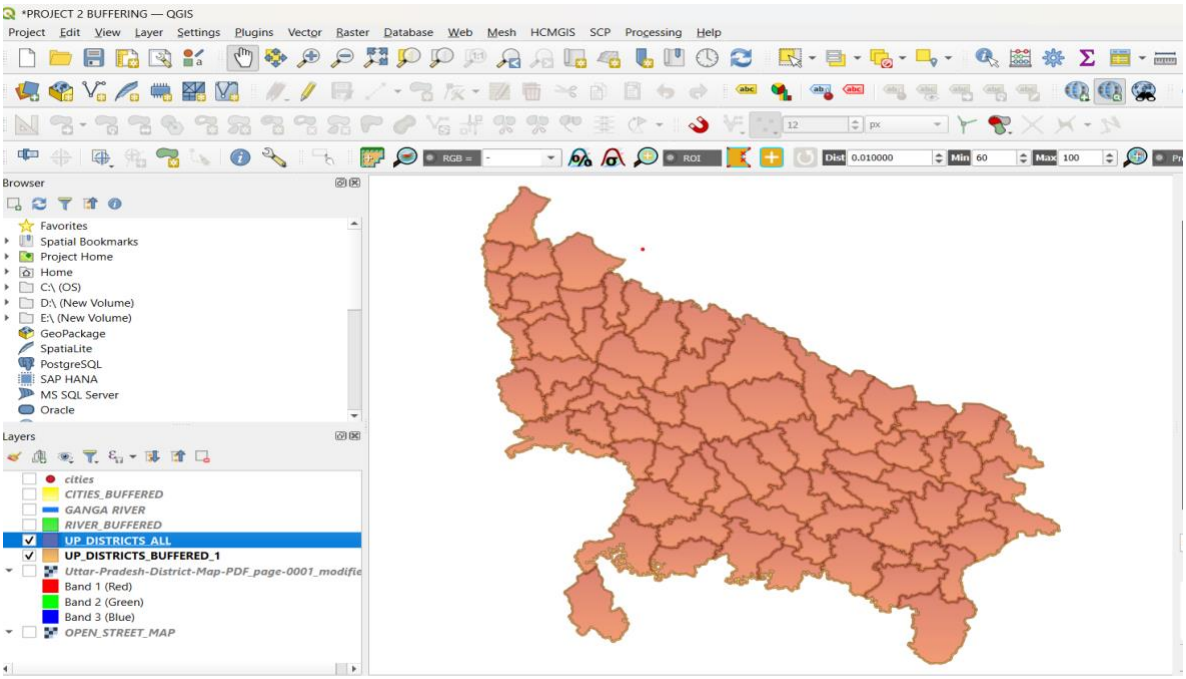


3.



4. **After that select the input layer (vector file of uttar Pradesh) and select the distance in kilometers and select the distance according to your study, in this case I am taking (9km), after**

that save the file in any folder and click on (run) to buffer the area.



5. **a new file will be added to your layer panel named (buffered) and we will observed the districts buffererred area.**

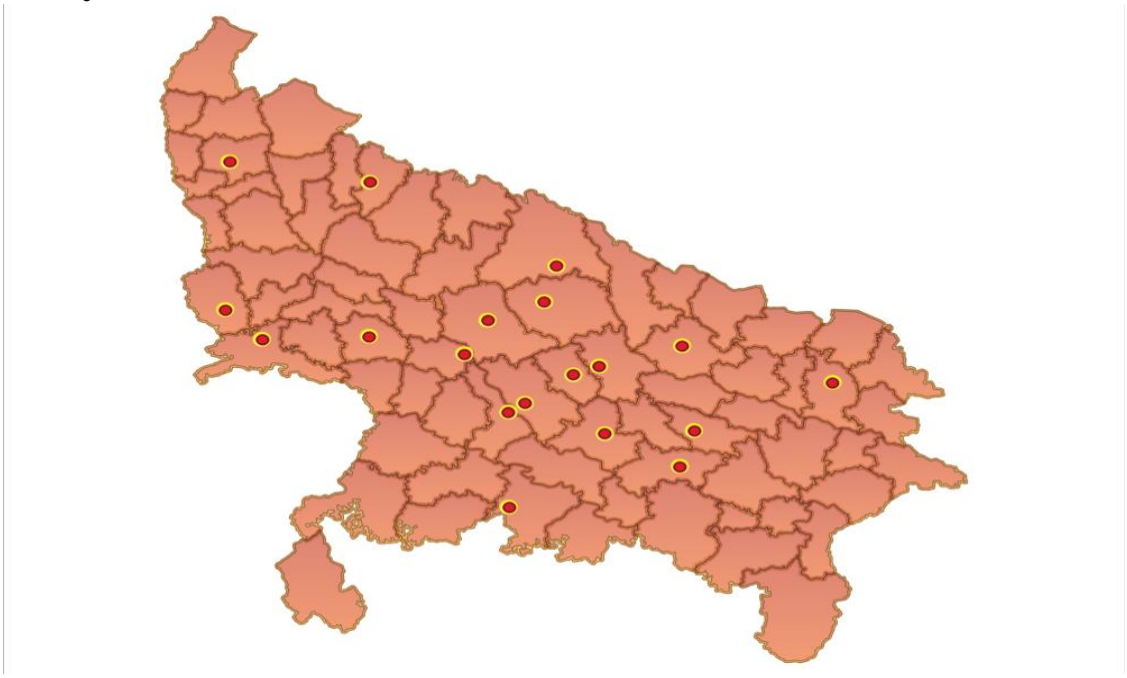
6. **In case of point we have to create a new shapefile layer and add points on the map according to our area of study.**

7. **To buffer the area on points we have to follow the same steps and go to buffer window and select the point (shapefile).**

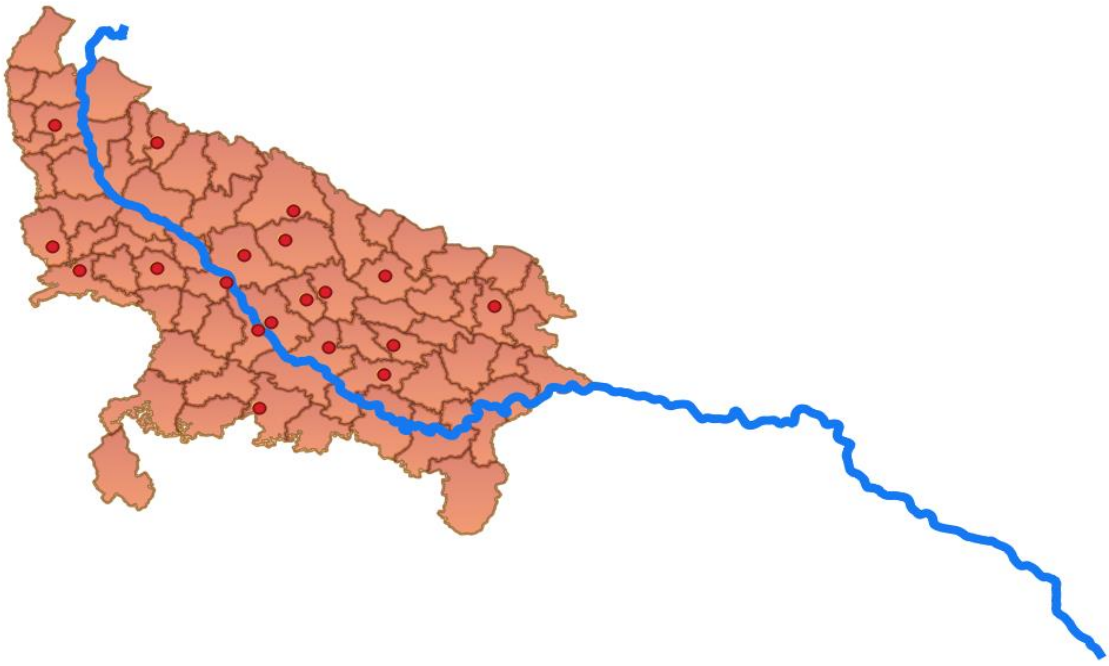
8. **Select the input layer and select the distance and save the file in a specified folder and run the program.**

9. **After that a new file will be added named (cities Buffered) and we can see the buffered area and do analysis according to our**

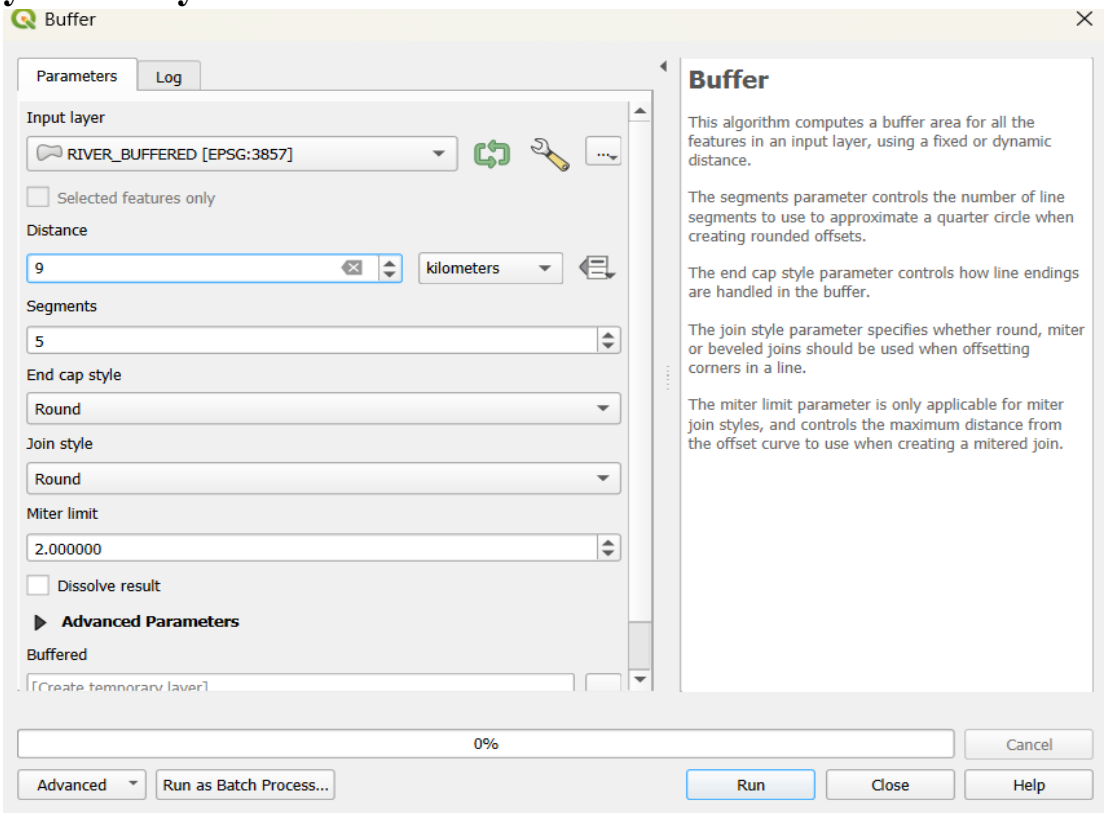
study.



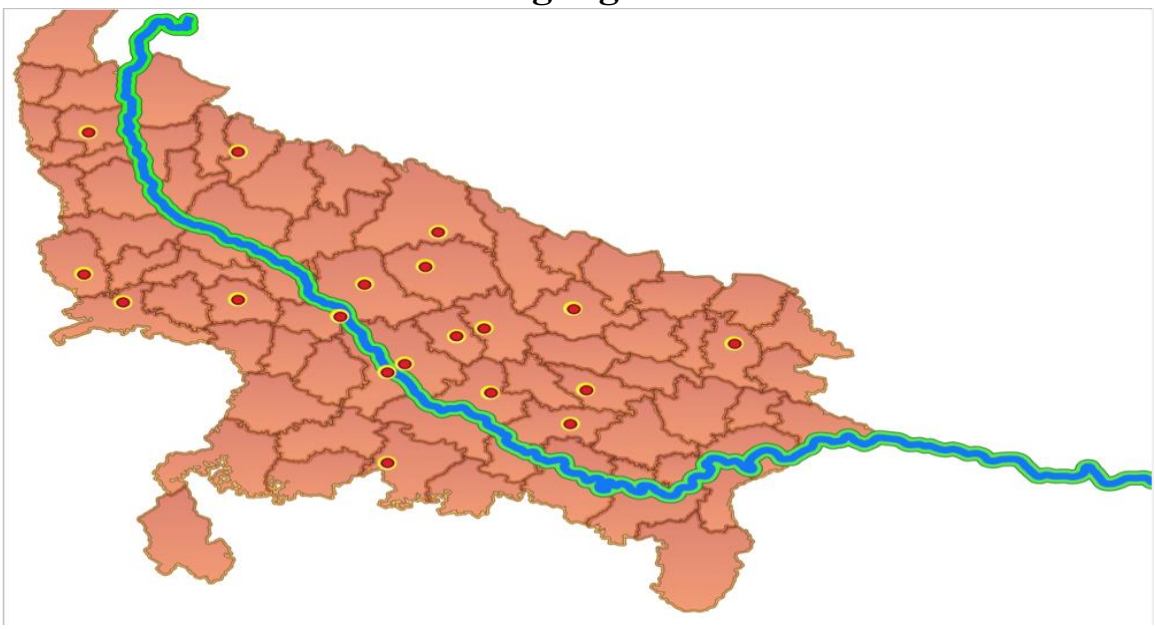
10. After that we will create a new shapefile layer of line in order to digitize the ganga river from dev Prayag till it flows into the Bay of Bengal.



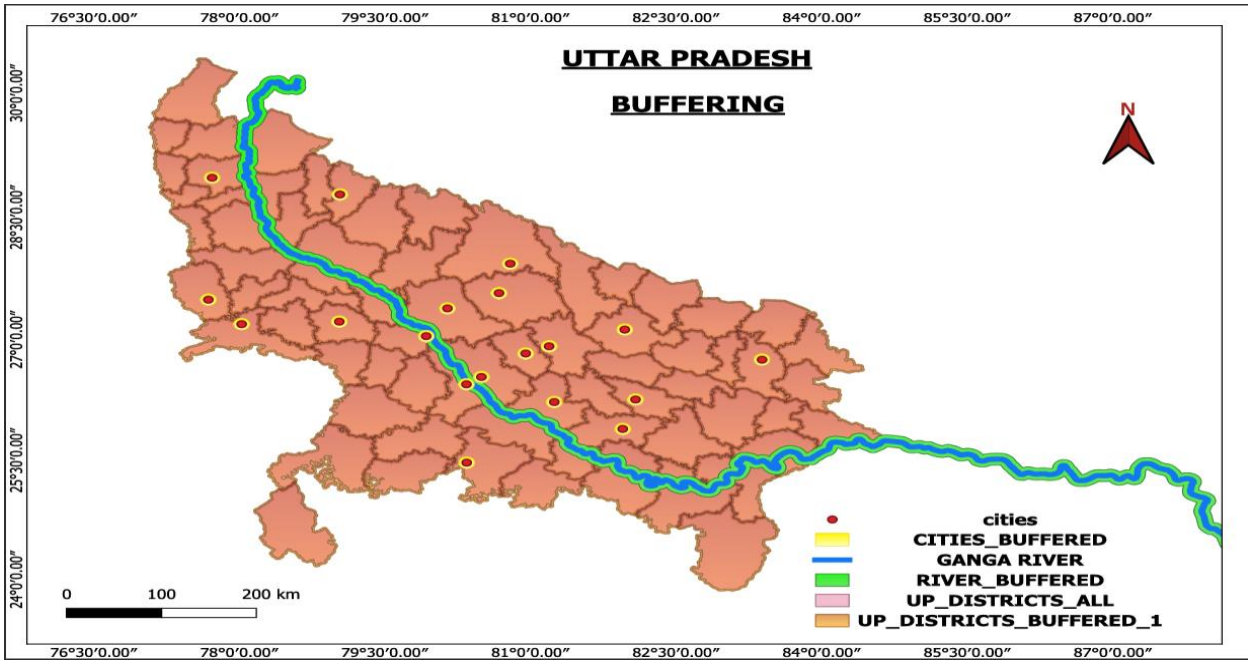
11. **After that we will follow the same procedure to buffer the river. Go to vector, and geoprocessing tools and select buffer and new window will open and select the new shapefile of ganga river and add the distance of buffered zone according to your study.**



12. After selecting these settings save the file and run the module and it will buffer the ganga river as shown below.



13. After that we have to make the layout of the map by following the previous mentioned steps and ADD THE REQUIRED ELEMENTS OF MAP THAT HAS THESE FOLLOWING ELEMENTS (SCALE, DIRECTION, COORDINATES, LEGEND, BORDERS, TITLE ETC).



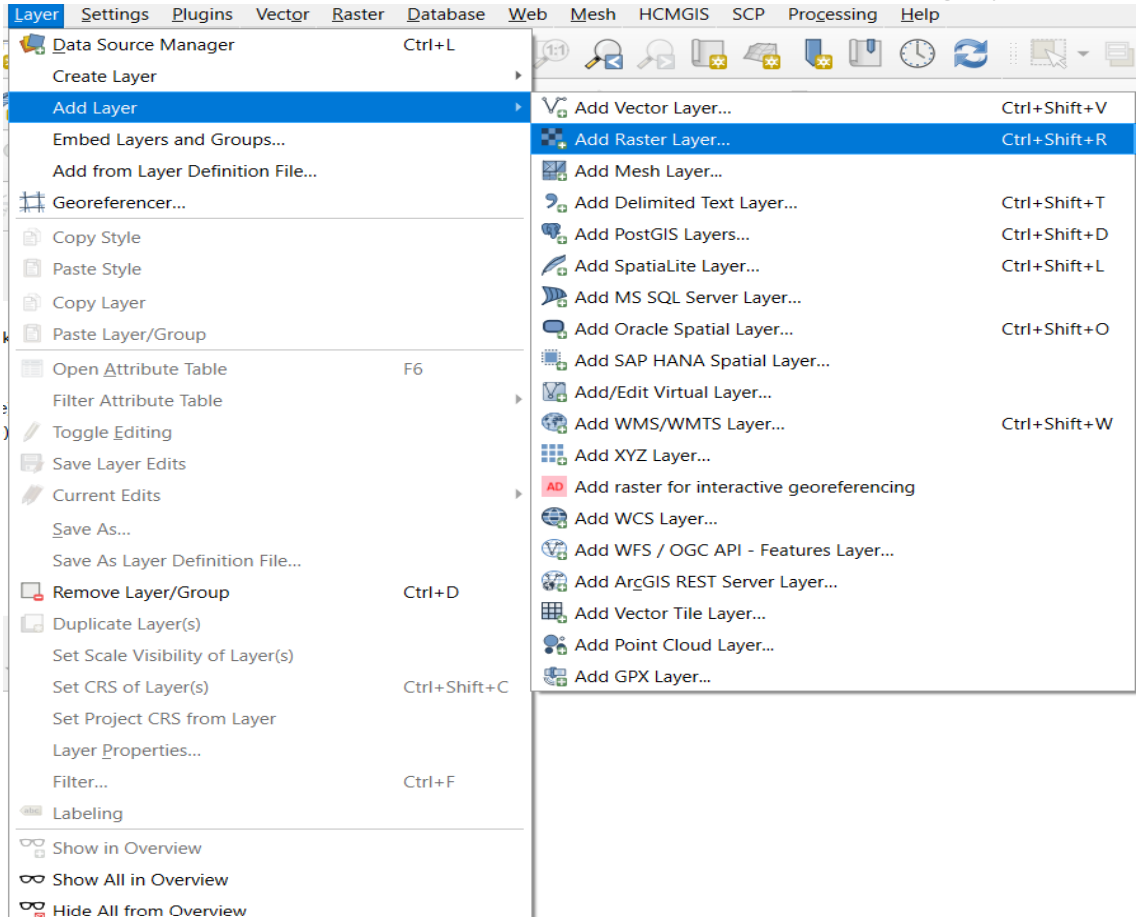
CHAPTER V

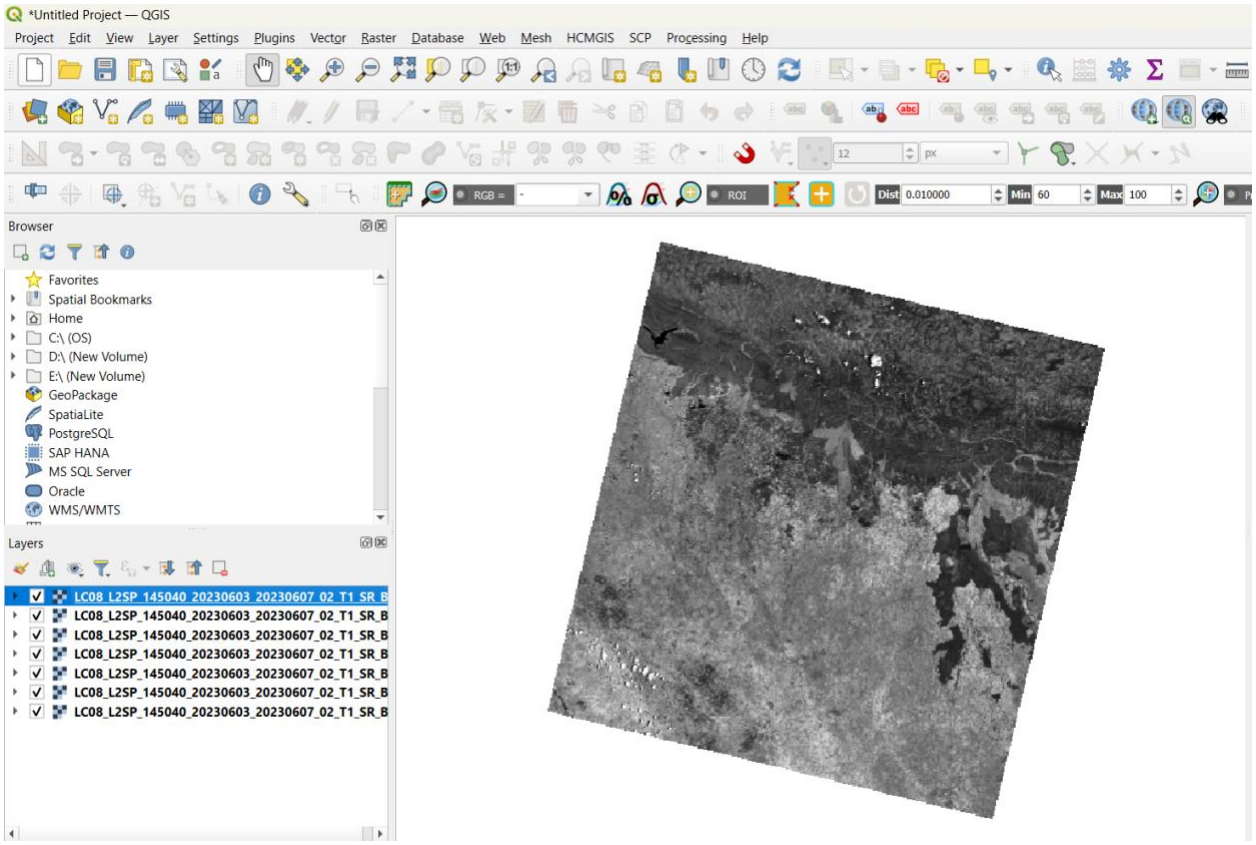
SUPERVISED CLASSIFICATION

Supervised classification in Geographic Information Systems (GIS) is a powerful technique that harnesses the principles of machine learning and remote sensing to assign land cover or land use categories to different geographic areas. This method relies on the utilization of labeled training data, where each sample is associated with a specific land cover class. GIS software, in conjunction with algorithms like Maximum Likelihood, Support Vector Machines, or Random Forest, then analyzes the spectral and spatial characteristics of remote sensing data, such as satellite imagery or aerial photographs, to differentiate and classify land cover types. The primary objective is to create accurate, high-resolution maps that provide valuable information for various applications, including urban planning, natural resource management, environmental monitoring, and disaster assessment. Supervised classification in GIS enhances our ability to understand and manage the Earth's surface, making it an indispensable tool in the field of geospatial analysis and decision-making.

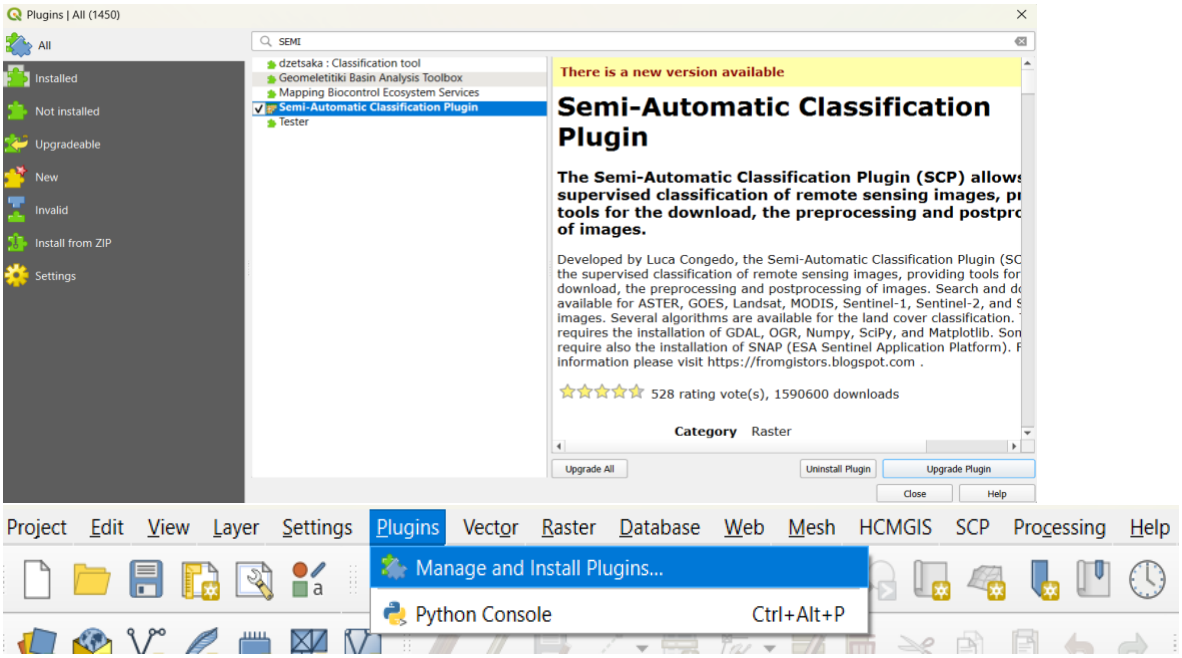
STEPS TO PERFORM SUPERVISED CLASSIFICATION ON A SATELLITE IMAGE (LANDSAT 8 & 9)

1. **OPEN QGIS SOFTWARE AND OPEN THE DOWNLOADED SATELLITE IMAGE FROM THE USGS (UNITED STATES GEOLOGICAL SURVEY) PORTAL BY GOING IN LAYER, ADD RASTER LAYER AND select the downloaded satellite imagery.**

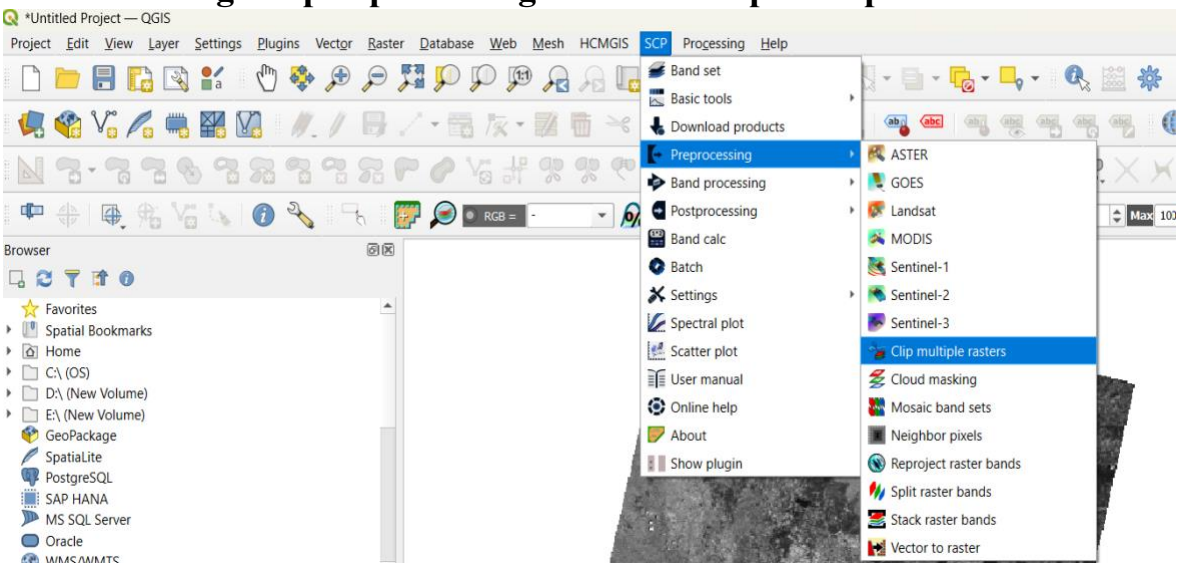


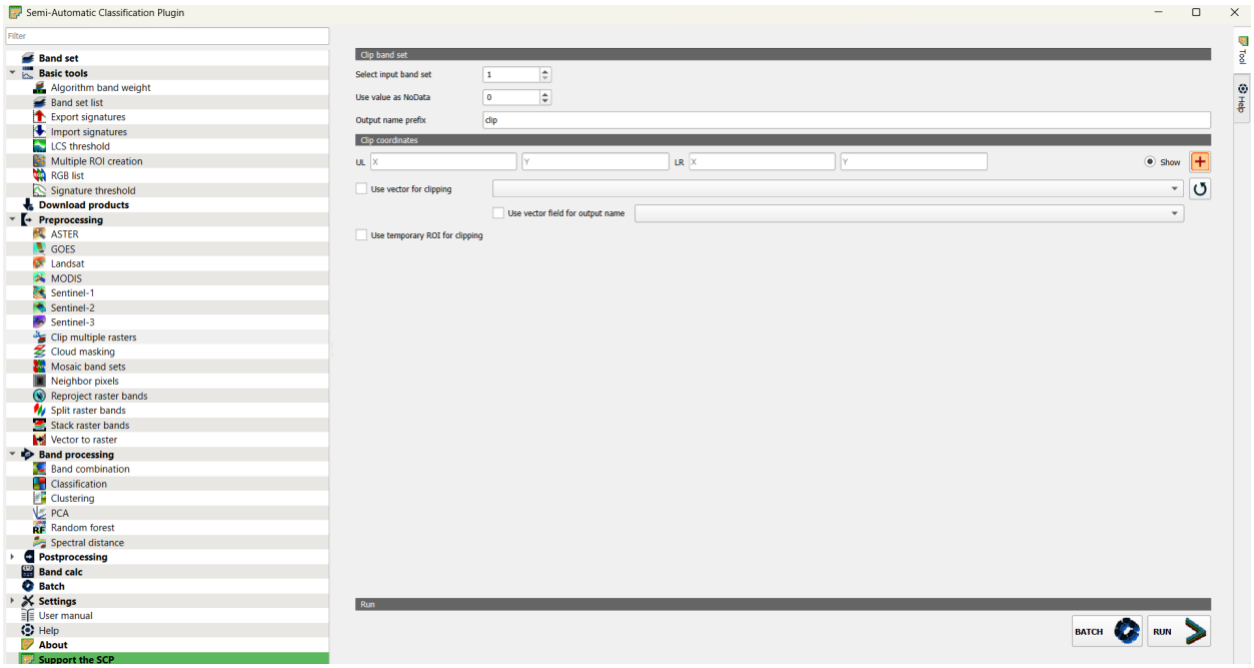


2. **WE NEED TO INSTALL NEW PLUGIN IN ORDER TO PERFORM THE CLASSIFICATION PROCESS.THAT IS PLUGIN:-(SEMI-AUTOMATIC CLASSIFICATION), IN ORDER TO DO THAT GO TO PLUGIN, THEN MANAGE PLUGIN AND TYPE NAME OF THE PLUGIN AND INSTALL IT.**

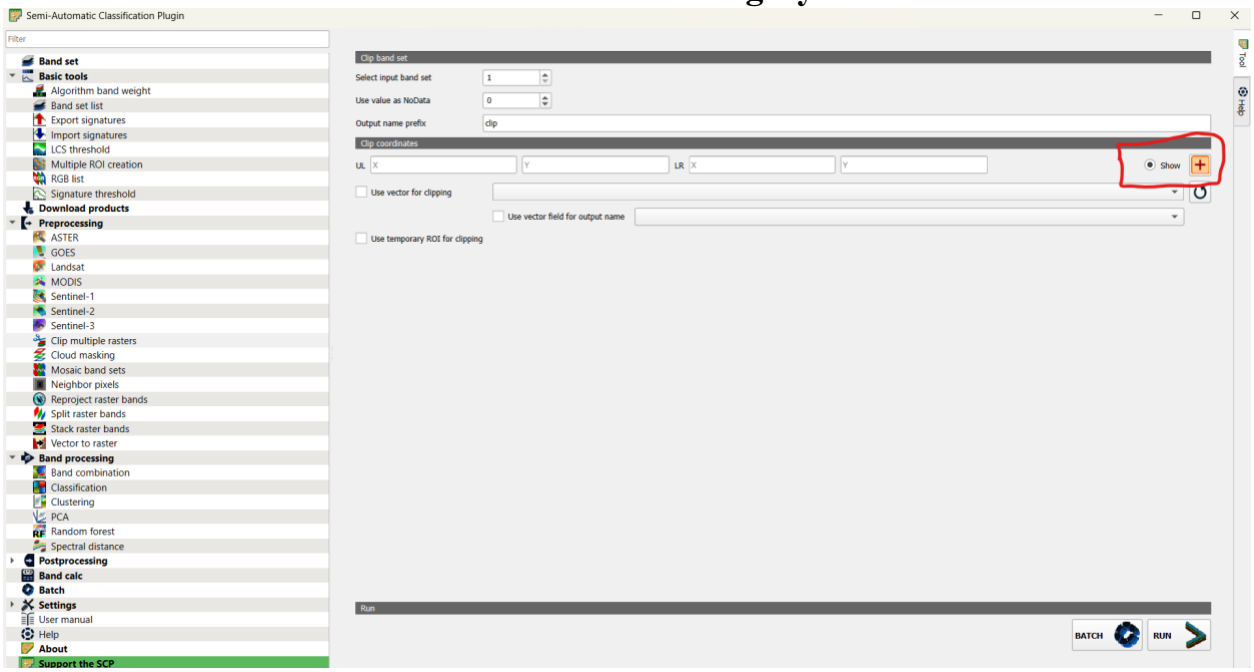


3. **AFTER THAT A NEW PANEL WILL OPEN NAMED (SCP DOCK) AND IT IS A CRUCIAL TOOL WHICH HELPS IN CLASSIFICATION AND MANY OTHER PROCESSES OF SATELLITE IMAGERY.**
4. **AFTER DOING SO, WE NEED TO CLIP THE AREA OF INTEREST on which we have to perform classification, to do so go to scp dock, then band set and go to pre-processing and select clip multiple rasters.**

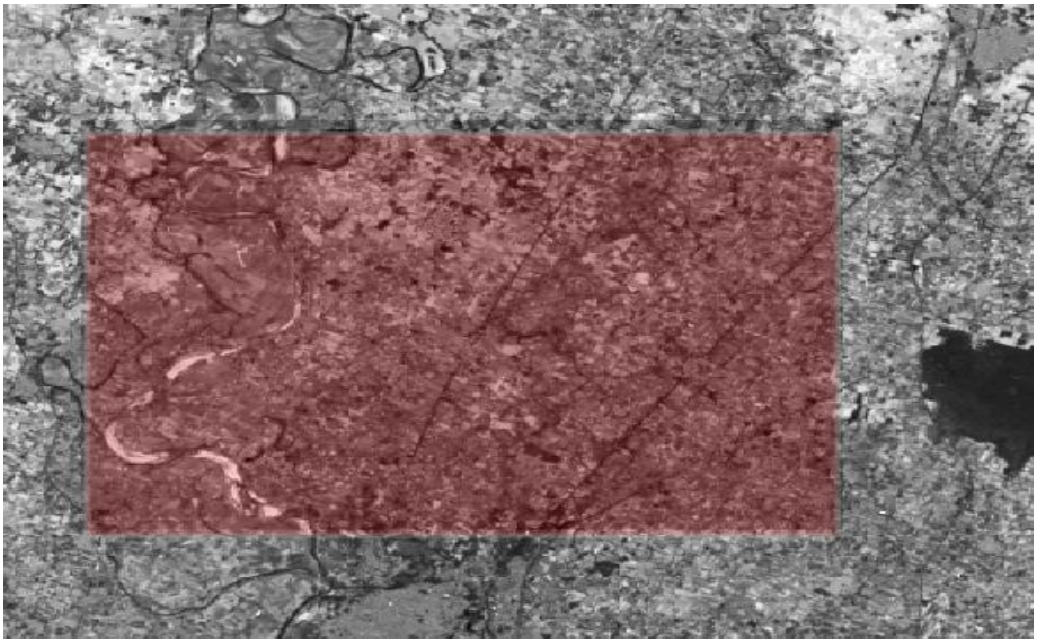




5. **A new window will open and select the show on the right in order to select the area of interest from the satellite imagery.**

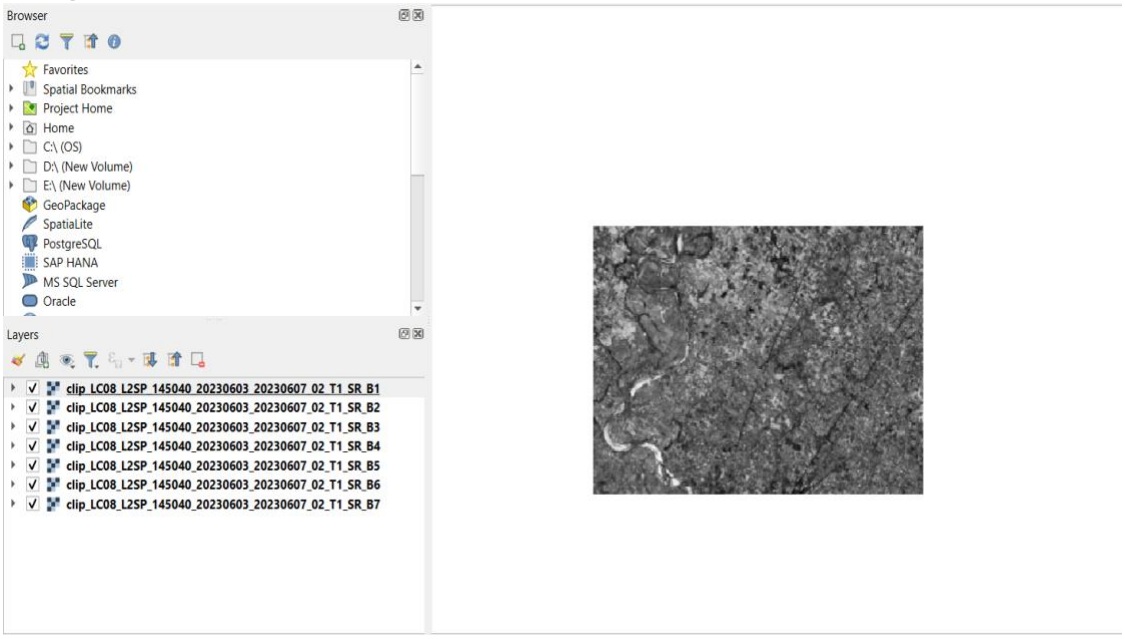


6. **then minimize the screen and select the area of interest by dragging and making a polygon.and click on run module and create a new folder to save clipped images and then you will observe the clipped images added to your layers section.**



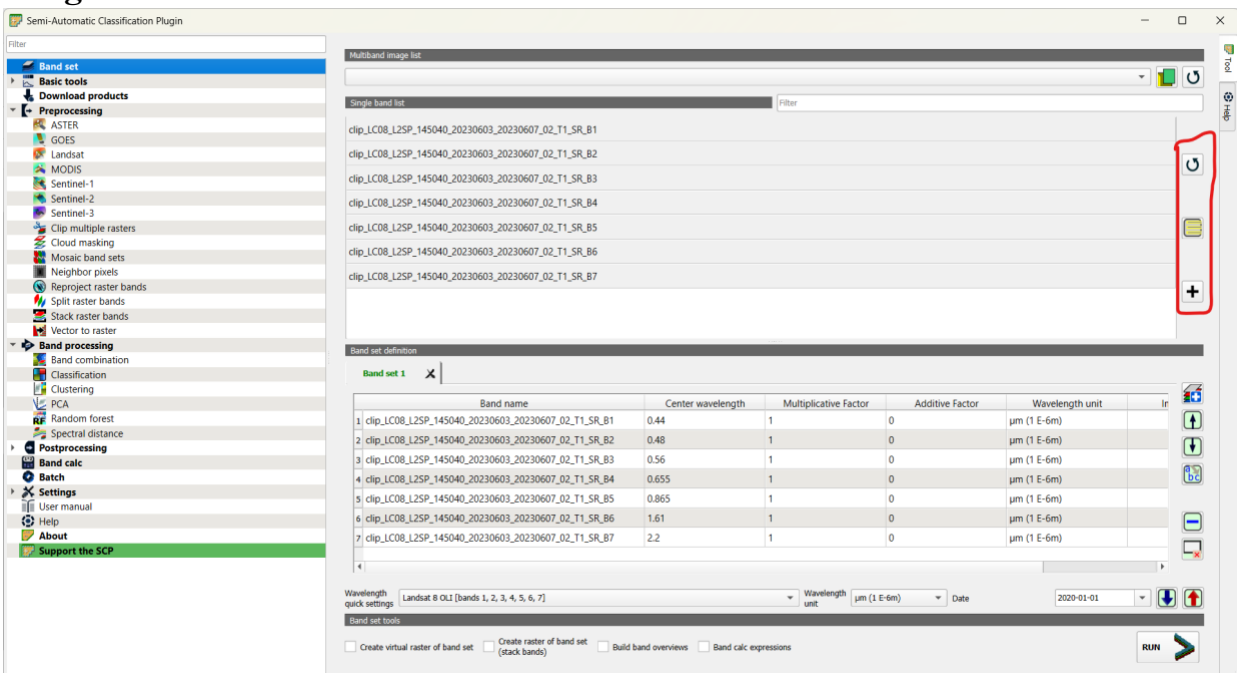
7.

8. **Then delete the previous added satellite images and not the clipped images and we will receive our area of interest.**

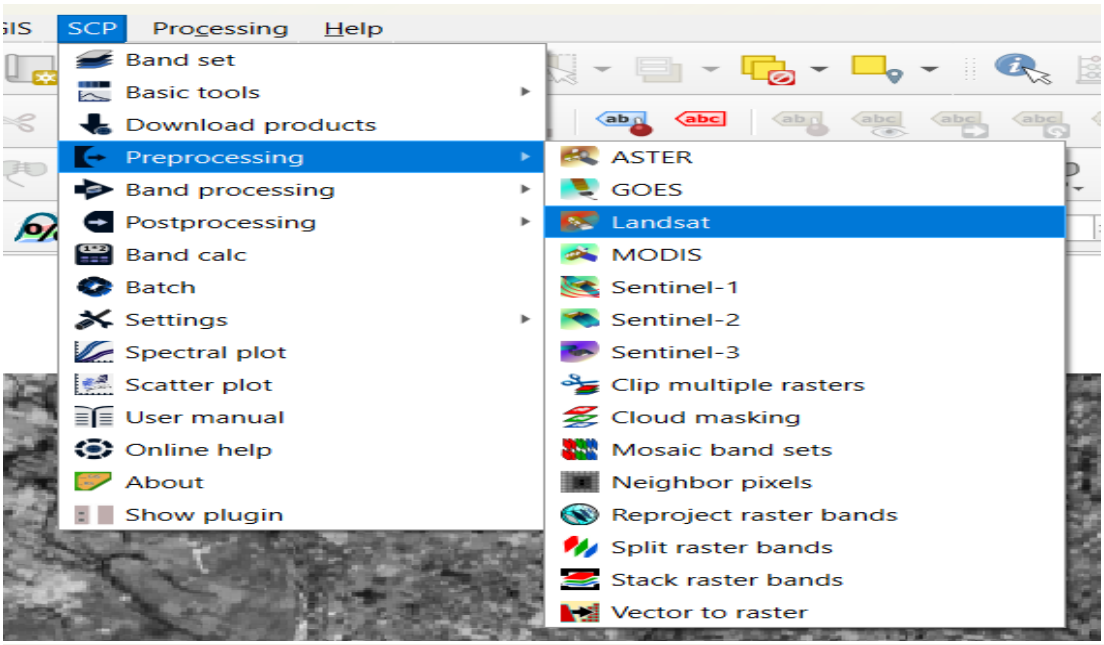


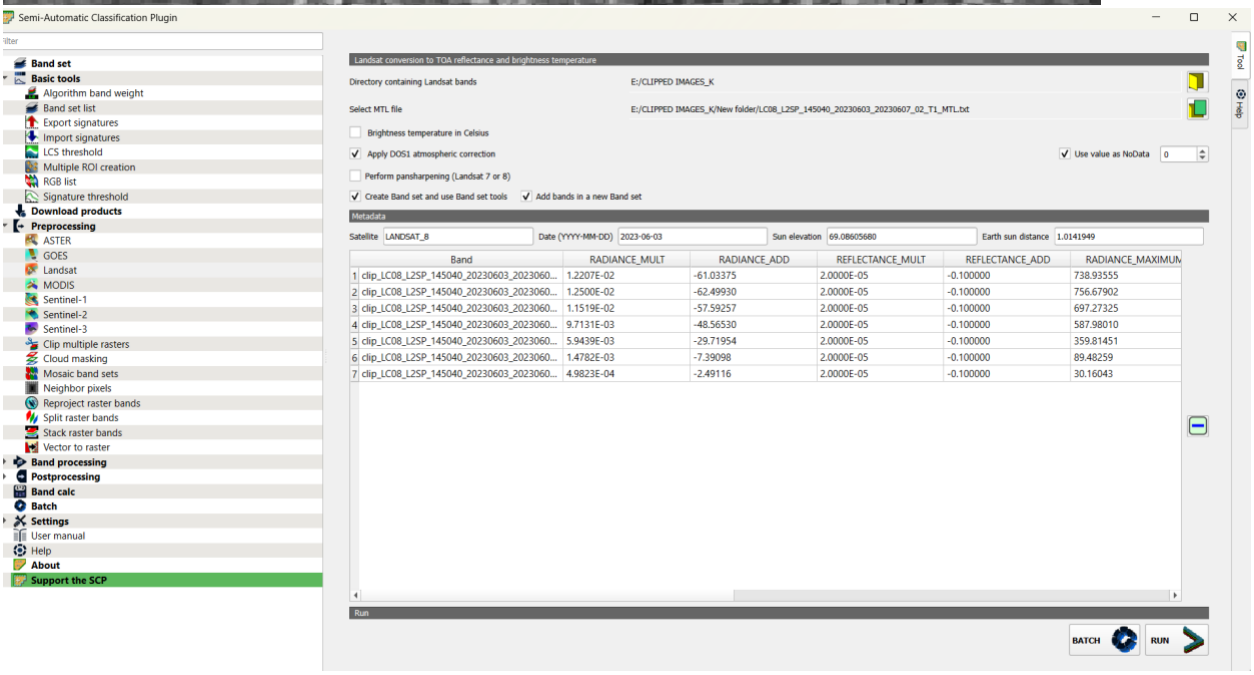
9. **Then we need to go to scp and then select band set and a new window will open and click on refresh icon and add the clipped images and also select (wavelength quick setting) and select landsat 8 as it is landsat 8**

image



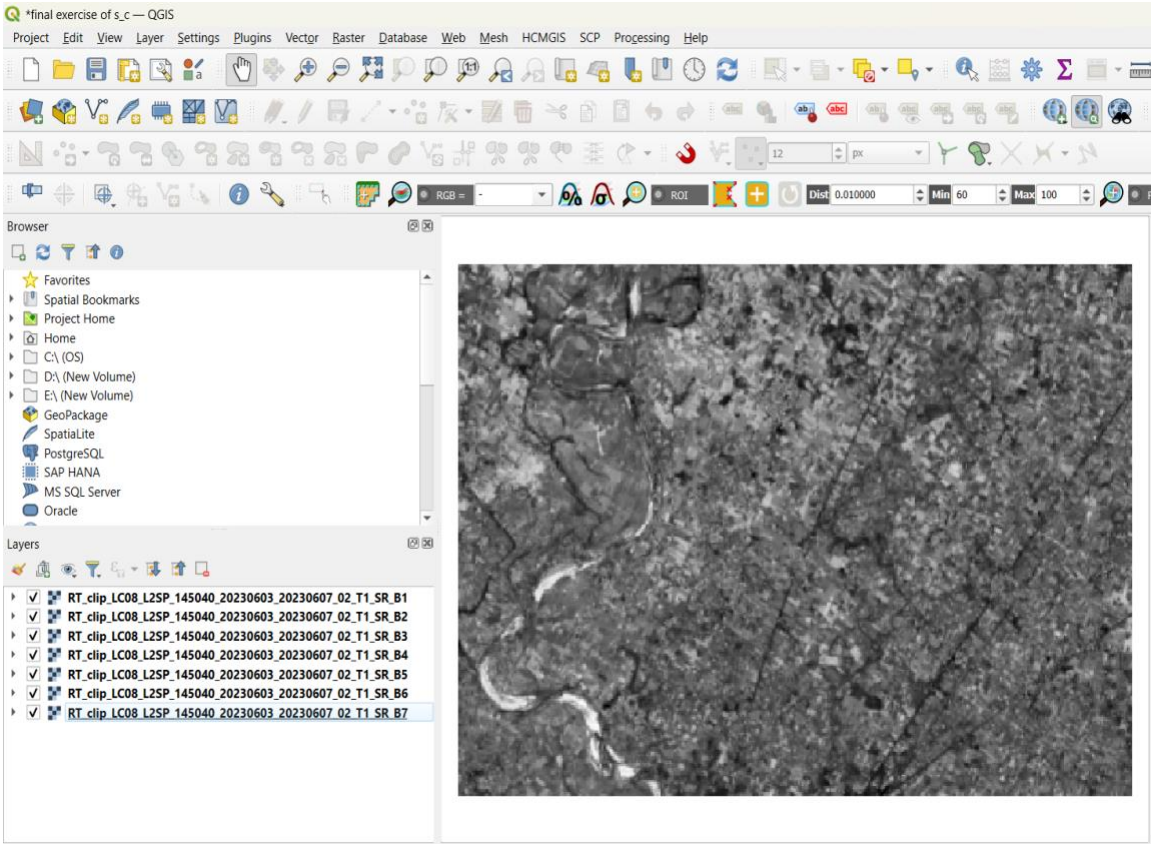
10. **Then we need to convert the clipped images into reflectance file which helps in storing the samples of classes and its digital value(dn value) .**
11. **In order to convert we need to go to scp , then to pre-processing and select landsat and a new window will open as shown below:-**



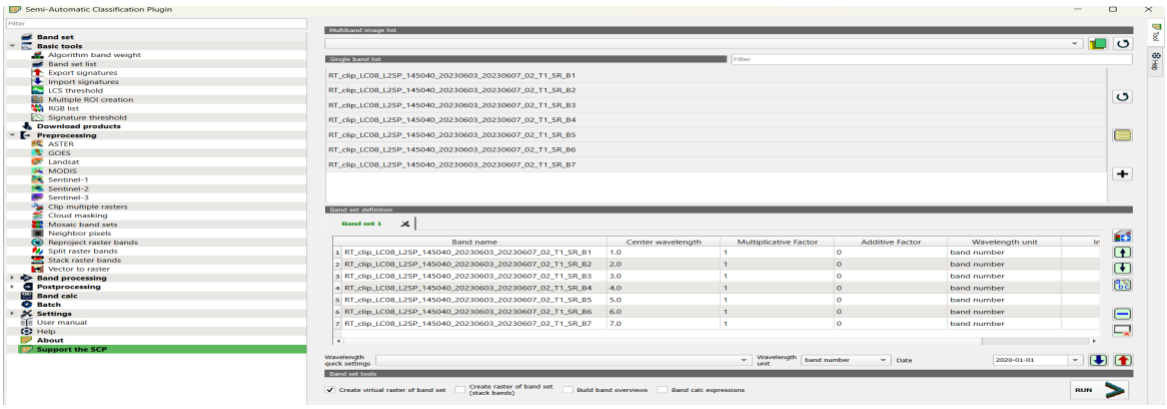


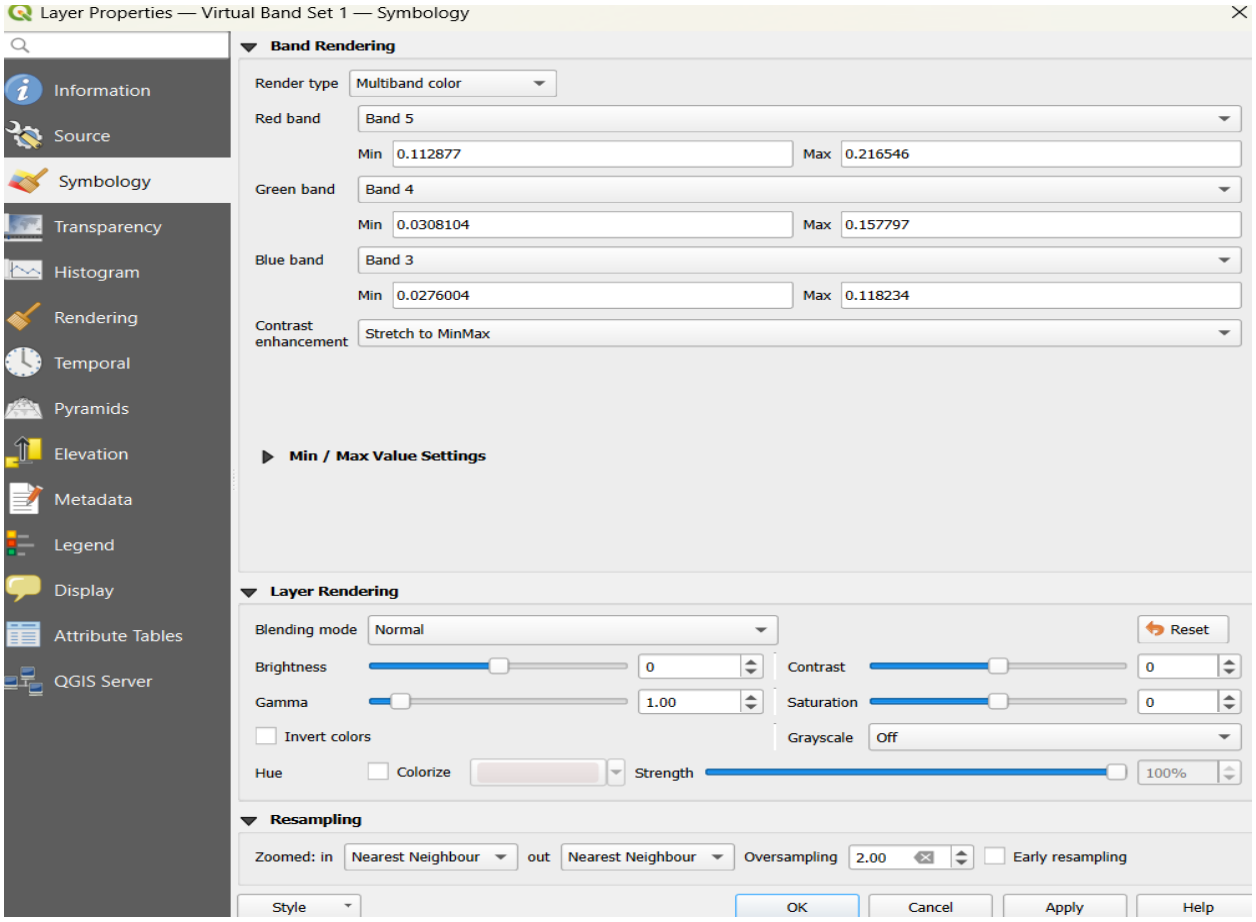
12. Select the clipped images and (.mtl file) and select the apply atmospheric correction and run the module and a new reflectance file will be added to layers panel, after that delete the clipped images from

layers panel.

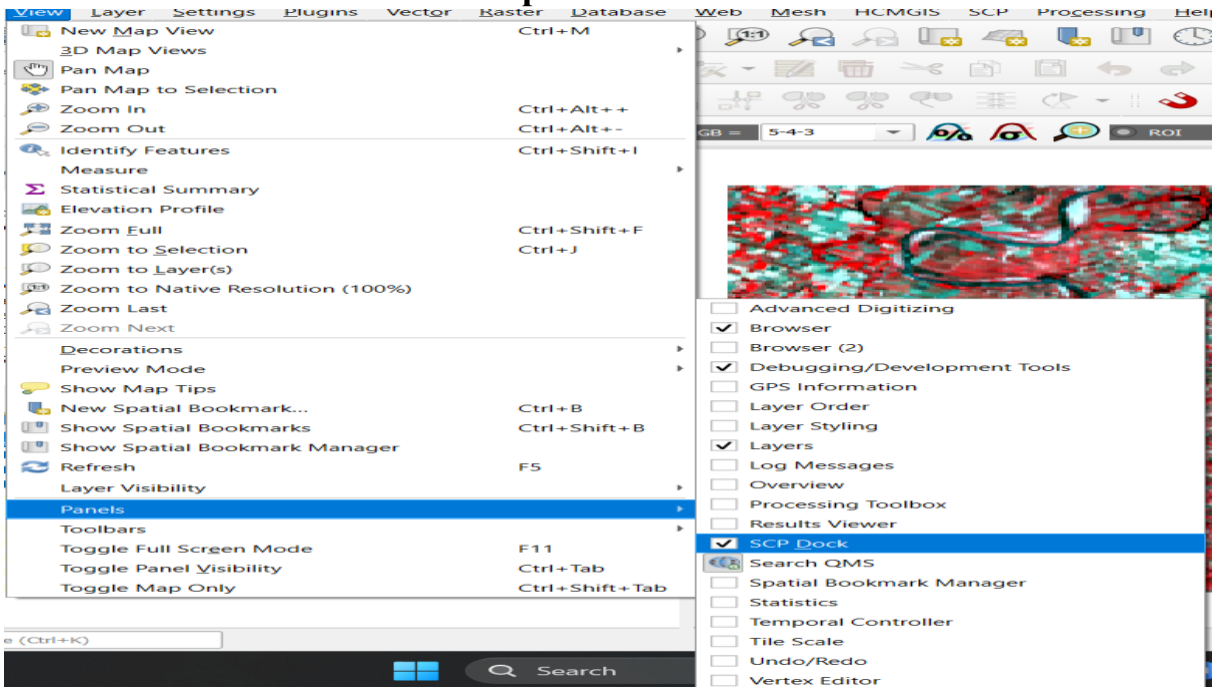


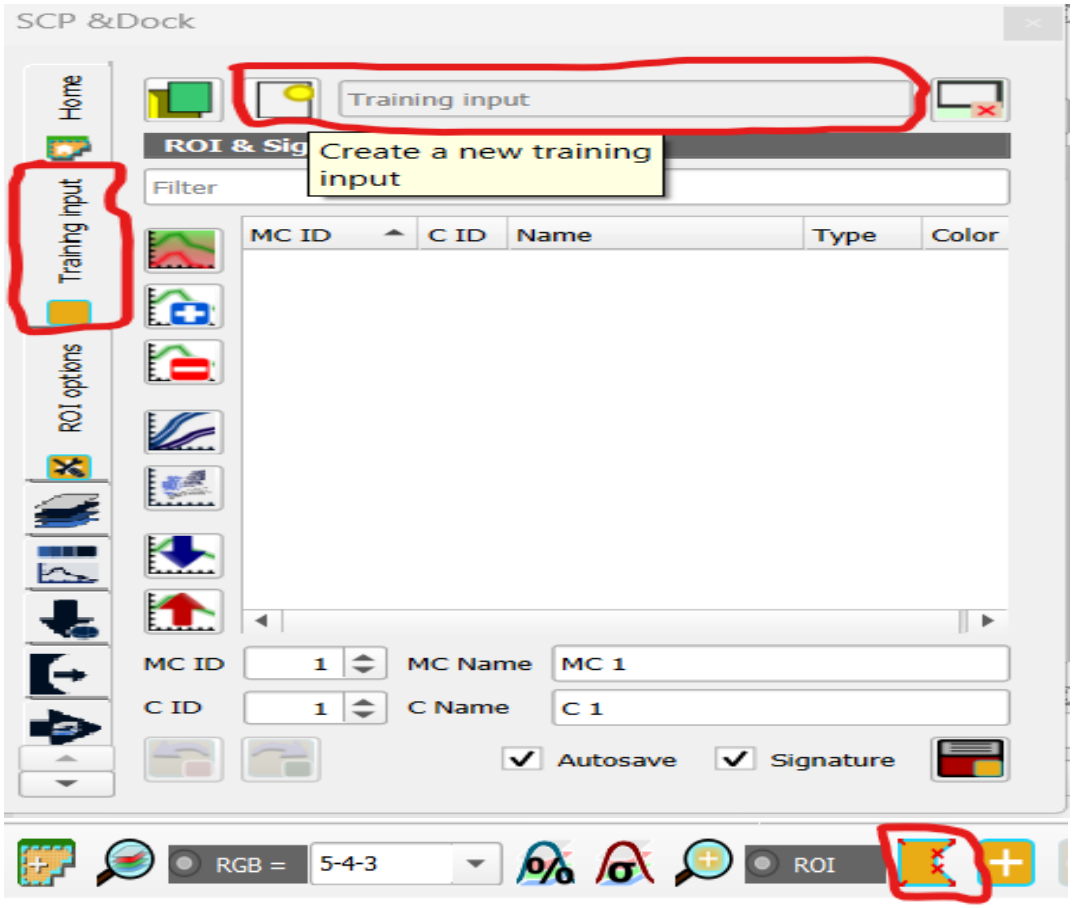
13. **Then we need to select the reflectance file in scp band set and create a virtual band set and select the (band 1- infrared, band 2 - red, band 3- green) cause it will help us to identify the land use/landcover of the area of interest.**



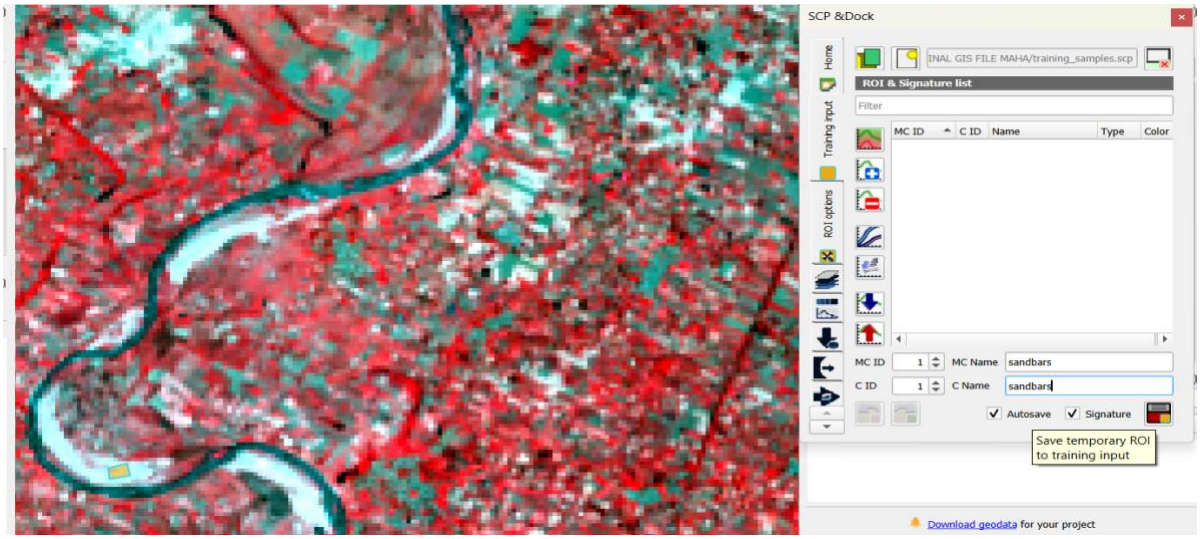


Then we need to open scp dock and create a training input and save it in a folder in order to collect the samples.

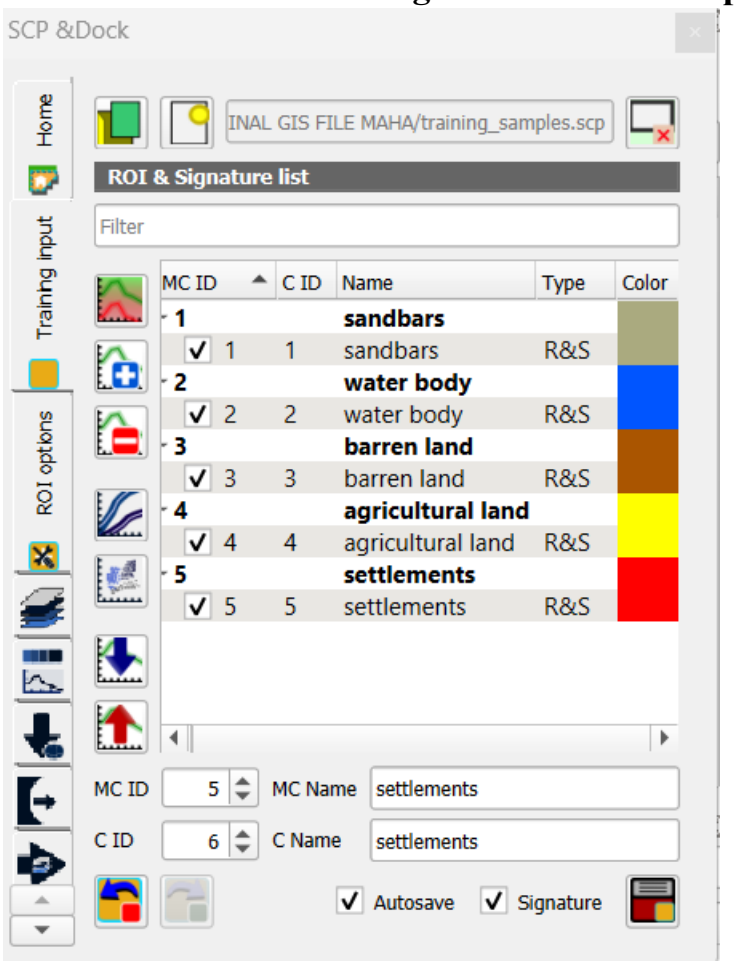




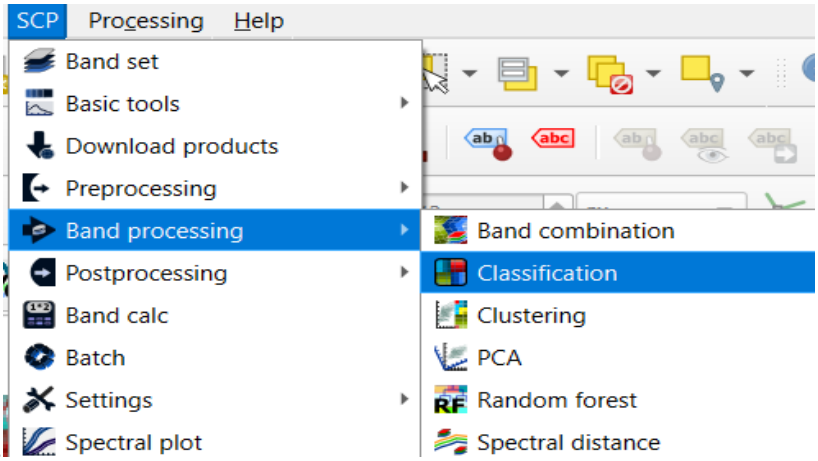
14. We need to make a polygon using the above highlighted icon and make a polygon by adding points and for right click to close the polygon and select the signature icon in order to save your sample of a particular class.



15. **Accordingly, we have to take samples of each class (at least 8 sample) and we have to save the signatures of the sample as shown below.**

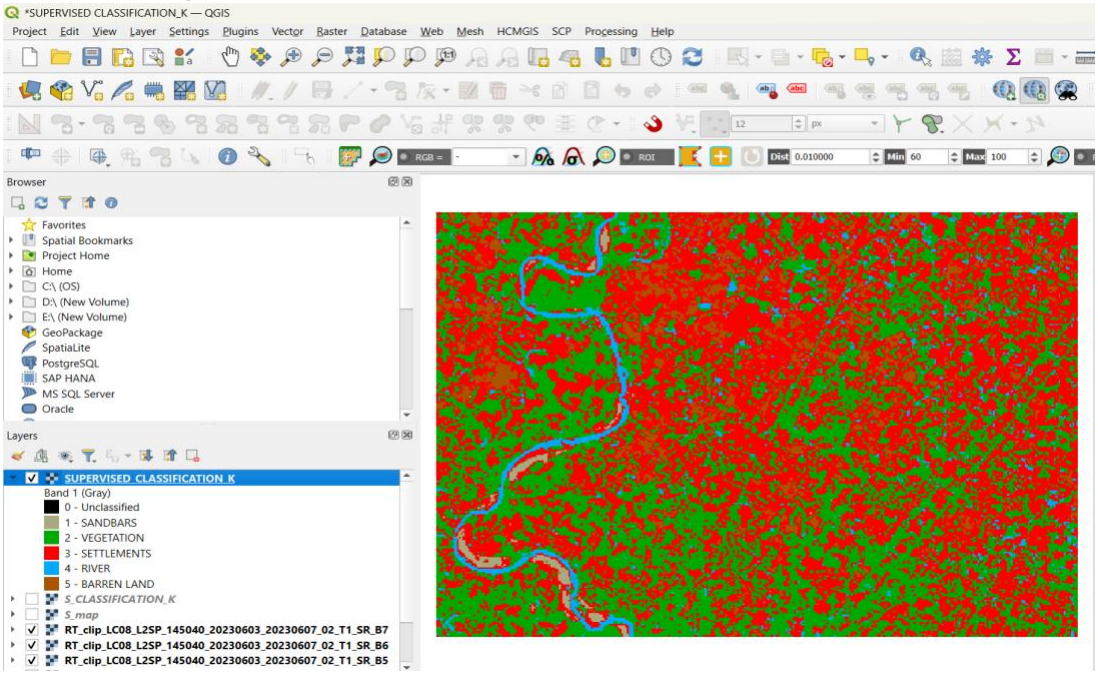


16. **After saving all the samples we need to classify the image, in order to do that we have to go to scp, then band processing and then select classification.**



17.

18. **Then a new window will open and we need to select the mc id /cid according to your classification. as in this case we have selected mcid and select maximum likelihood in order to automatically allocate the near digital values of each class. After that run the module and we will see the image has been classified.**



19. **After that we have to make the layout of the map**