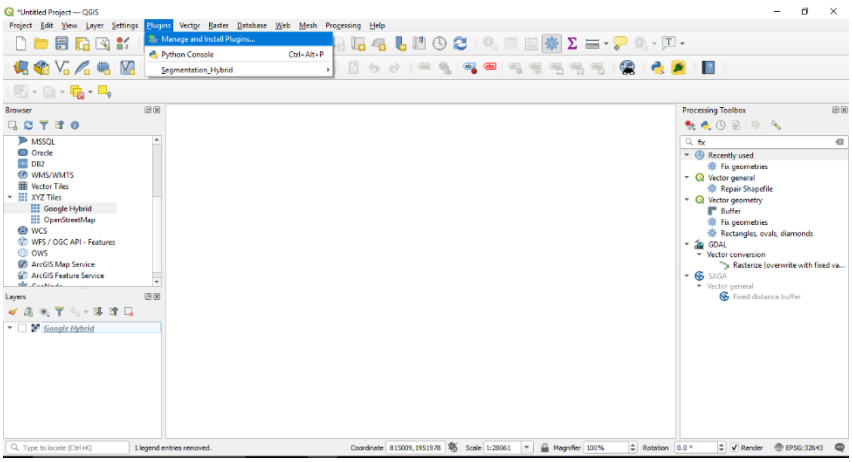
HS-FRAG: Plug-in

HS-FRAG (Hybrid Segmentation for FRAGmented croplands) is a hybrid segmentation plug-in, which uses the combination of region and edge-based algorithms in order to delineate the fragmented croplands. Performing the region and edge-based segmentations on a study area is long and complex procedure. If you are working on different time steps, this makes your work still more complex as it is a repetitive process. To reduce the long and repetitive work, a tool/plugin is introduced in order to perform all the tasks just in simple clicks.

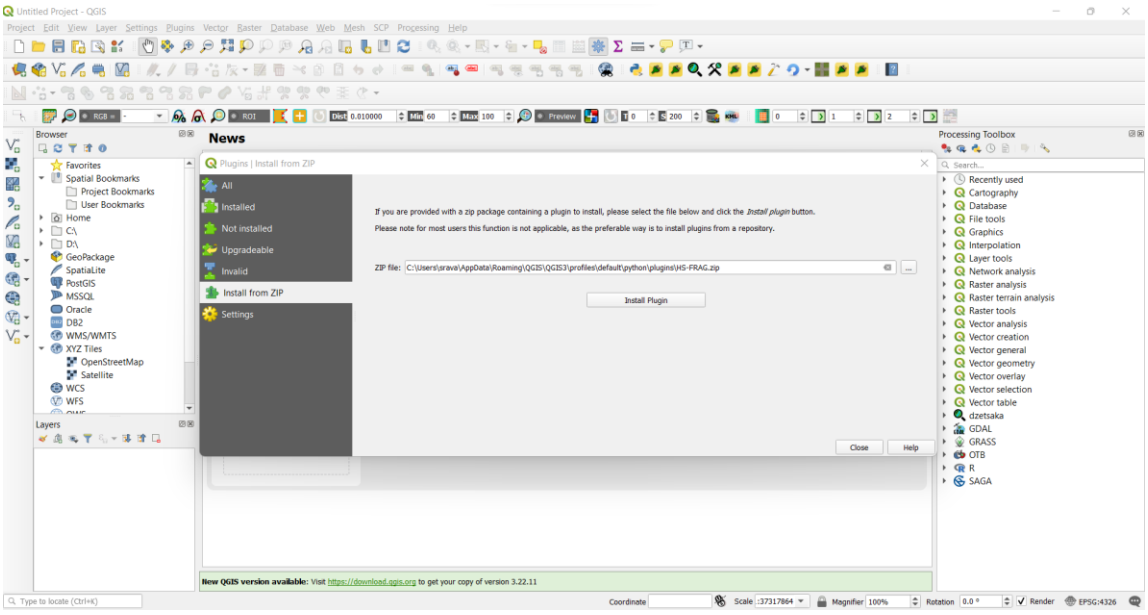
The developed Plugin named “HS-FRAG” directly gives the hybrid segmentation output with simple inputs as satellite data, overall region and threshold. The hybrid segmentation with this plugin performs Sobel edge detection and Watershed region technique under edge and region-based segmentation methods.

Installation of plugin

I. Open QGIS. Go to **Plugins** in the Menu bar →click on **Manage and Install Plugins**



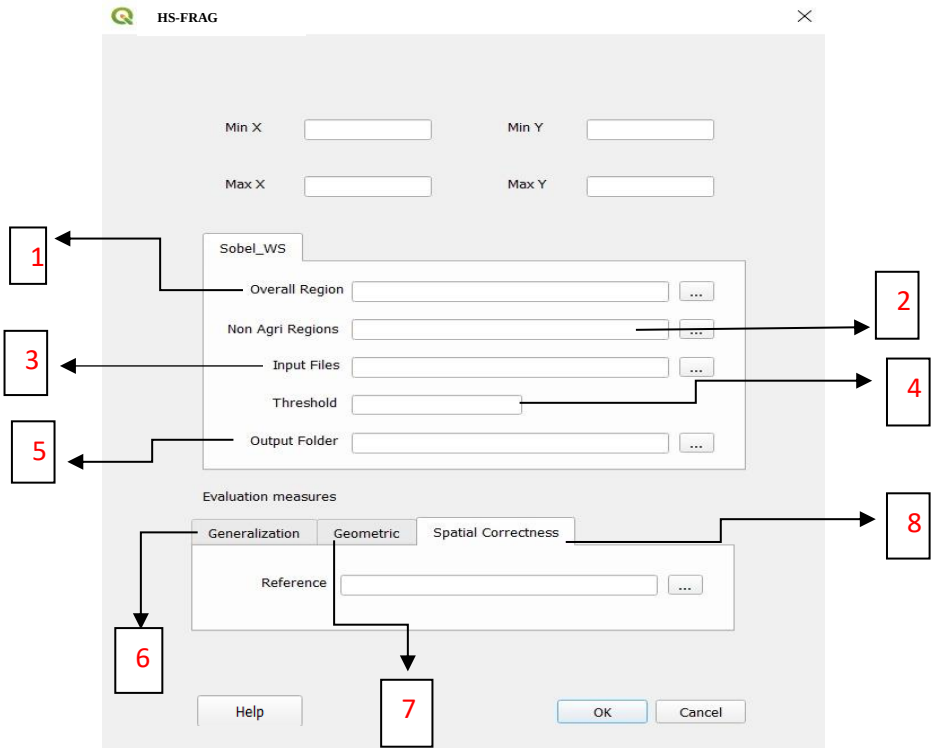
II. Click on **Install from ZIP** in the right panel → Load the ***HS-FRAG.zip*** (file provided)→ Now click on **Install Plugin.**



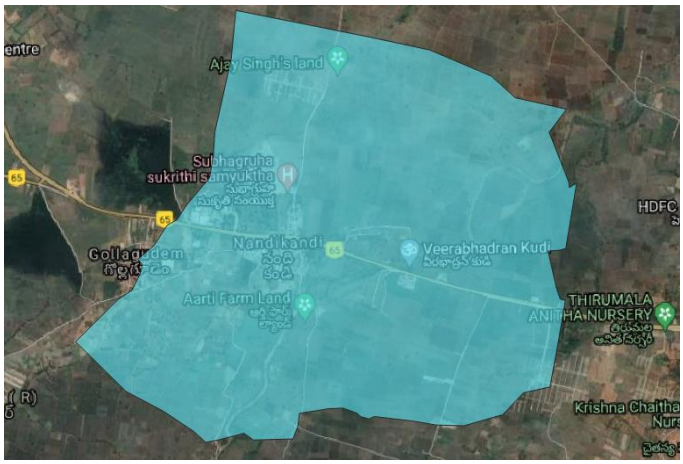
III. Finally, the plugin has installed and plugin icon appears on the top panel bar

IV. Click on that plugin icon and new dialog box named **HS-FRAG** will open (as shown below).

HS-FRAG Inputs

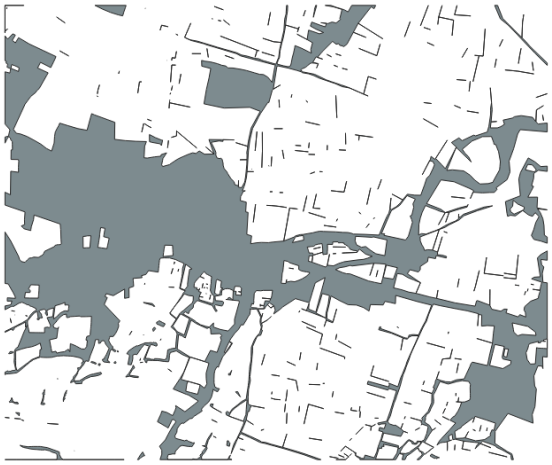


1. **Overall Region:**
   - It is the boundary of the region of interest you wanted to perform the hybrid segmentation in the overall study area. Shapefile/vector file of the boundary is taken as input.



2. **Non-Agri regions:**
   - As the segmentation is performed on the agricultural lands, presence of Non-agricultural regions like buildings, barren lands and roads etc., can produce wrong or incorrect segmentations.

- To avoid this issue, the Non-Agricultural regions are removed from the overall region. Shapefile/vector file of the Non-Agri regions is taken as input.



3. **Input files:**
   - The .TIF/raster images of the satellite data is taken as input. The satellite data may contain different bands that should be used to perform segmentation, input the bands each at a time.

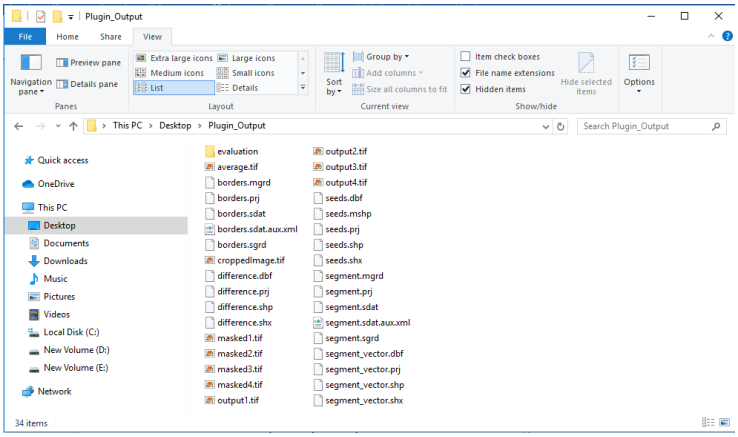
4. **Threshold**
   - In watershed segmentation threshold can be used to merge segments (basins) if the height difference (from seed to saddle) is less than the specified threshold.
   - The threshold technique is effective for dealing with the level of **over or under segmentation**, it is limited in the same value must be used for each segment, regardless of the homogeneity of its neighboring objects.
   - The following images shows the variations of different thresholds;

Threshold=15

Threshold=20

Threshold=25

5. **Output Folder:**
   - Select the output folder location where you want to save your hybrid segmentation files and evaluation measures files. All outputs and respective file names are shown below.
   - NOTE: All the required inputs are provided in the folder “SourceFiles”



a)Cropped image.tif

b)Difference.shp

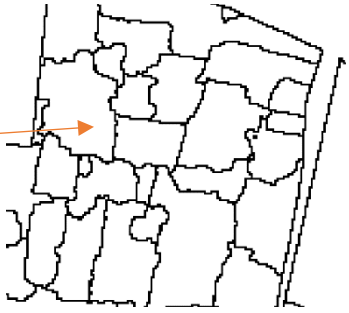
c)Masked.tif

d)output.tif (sobel edge image)

e)Average.tif

f)Segment.sdat

g)borders.tif



h)magnified image of borders.tif

i)Segment_vector.shp

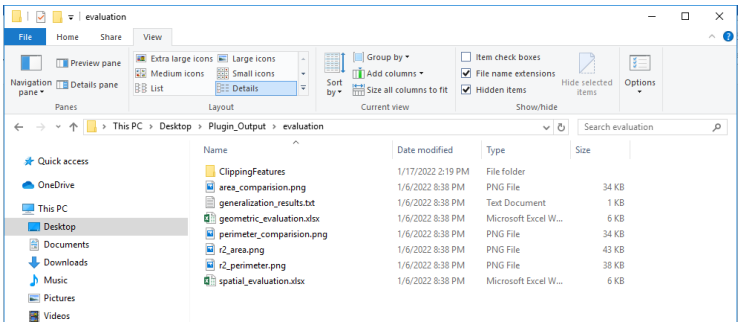
Evaluation measures

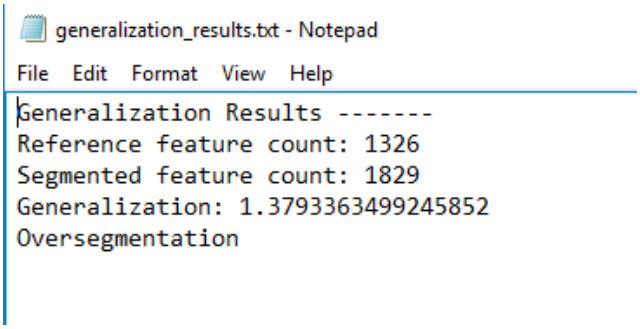
In any process, measures of evaluation are very crucial to numerically know how far our results coincide with respect to the reference data. The following 3 evaluation measures were considered for the hybrid segmentation process and in each measures segmentation results are compared with the reference.

6. **Generalization:**
   - It is simple ratio between the number of regions in the segmented image and the number of regions in the reference segmentation.
7. **Geometric:**
   - It is a simple ratio of area/perimeter of the resulted segments with respect to the area/perimeter of reference segments.
8. **Spatial correctness:**
   - Spatial correctness is simply the percentage of the segmented borders/pixels lying on and outside of the reference borders was calculated.

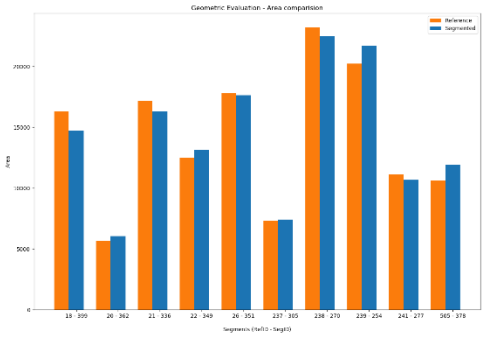
Outputs:

- Plugin_Output folder → evaluation →

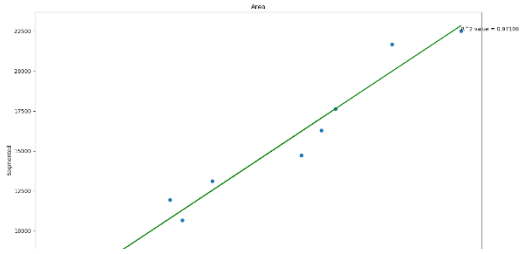




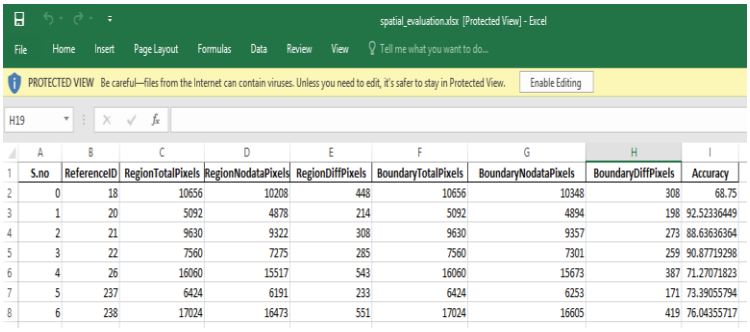
j) Generalization results were saved in .txt format



k) Histogram of area/perimeter comparisons (results also saved in excel format)



l) Graph plot of areas/perimeters along with R^2 value



	A	B	C	D	E	F	G	H	I
1	S.no	ReferenceID	RegionTotalPixels	RegionNodataPixels	RegionDiffPixels	BoundaryTotalPixels	BoundaryNodataPixels	BoundaryDiffPixels	Accuracy
2	0	18	10656	10208	448	10656	10348	308	68.75
3	1	20	5092	4878	214	5092	4894	198	92.52336449
4	2	21	9630	9322	308	9630	9357	273	88.63636364
5	3	22	7560	7275	285	7560	7301	259	90.87719298
6	4	26	16060	15517	543	16060	15673	387	71.27071823
7	5	237	6424	6191	233	6424	6253	171	73.39055794
8	6	238	17024	16473	551	17024	16605	419	76.04355717

m) Spatial evaluation results were saved in excel format