



# Unsupervised Classification

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## Using SAGA

Tutorial ID: IGET\_RS\_007



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## Unsupervised Classification using SAGA

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**Objective:** To create a land use and land cover map of a region by the unsupervised classification method using SAGA.

**Software:** SAGA GIS, Spread Sheet software (MS Excel)

**Level:** Intermediate

**Time required:** 4 Hours

### Prerequisites and Geospatial Skills

1. SAGA should be installed on the computer
2. Student must have completed the exercises IGET\_RS\_001, IGET\_RS\_002 and IGET\_RS\_003.

### Reading


1. Tempfli, K. (editor) , Huurneman, G.C. (editor) , Bakker, W.H. (editor) , Janssen, L.L.F. (editor) , Bakker, W.H., Feringa, W.F., Gieske, A.S.M., Grabmaier, K.A., Hecker, C.A., Horn, J.A., Huurneman, G.C., Kerle, N., van der Meer, F.D., Parodi, G.N., Pohl, C., Reeves, C.V., van Ruitenbeek, F.J.A., Schetselaar, E.M., Weir, M.J.C., Westinga, E. and Woldai, T. (2009) *Principles of remote sensing : an introductory textbook*. Enschede, ITC, 2009. ITC Educational Textbook Series 2, ISBN: 978-90-6164-270-1. pp. 280-312.  
[Full text](#)
2. Everitt, B. S., Landau, S., Leese, M., & Stahl, D. (2011). *Cluster Analysis*. John Wiley & Sons.

**Tutorial Data:** The LandSat TM image required for this exercise may be downloaded from this link:

## Introduction

To create a land use and land cover map of an area, we have to assign corresponding land use and land cover type to every pixel in the satellite imagery that exist at the time of acquisition. This is done based on the Digital Number (DN) values of the pixel which in turn represent the spectral properties of the ground surface. This assigning of classes to pixels in an image is called '*Image classification*'. More technically, it is an aspect of *image processing* in which quantitative decisions are made on the basis of the data present in the image, grouping *pixels* or regions of the image into classes representing different ground-cover types. The output of the classification stage may be regarded as a thematic map rather than an image (Rees, 1999). There are two broad types of image classification exists - '*Supervised classification*' and '*Unsupervised classification*'. In this tutorial we will learn how to classify an image using the unsupervised method.

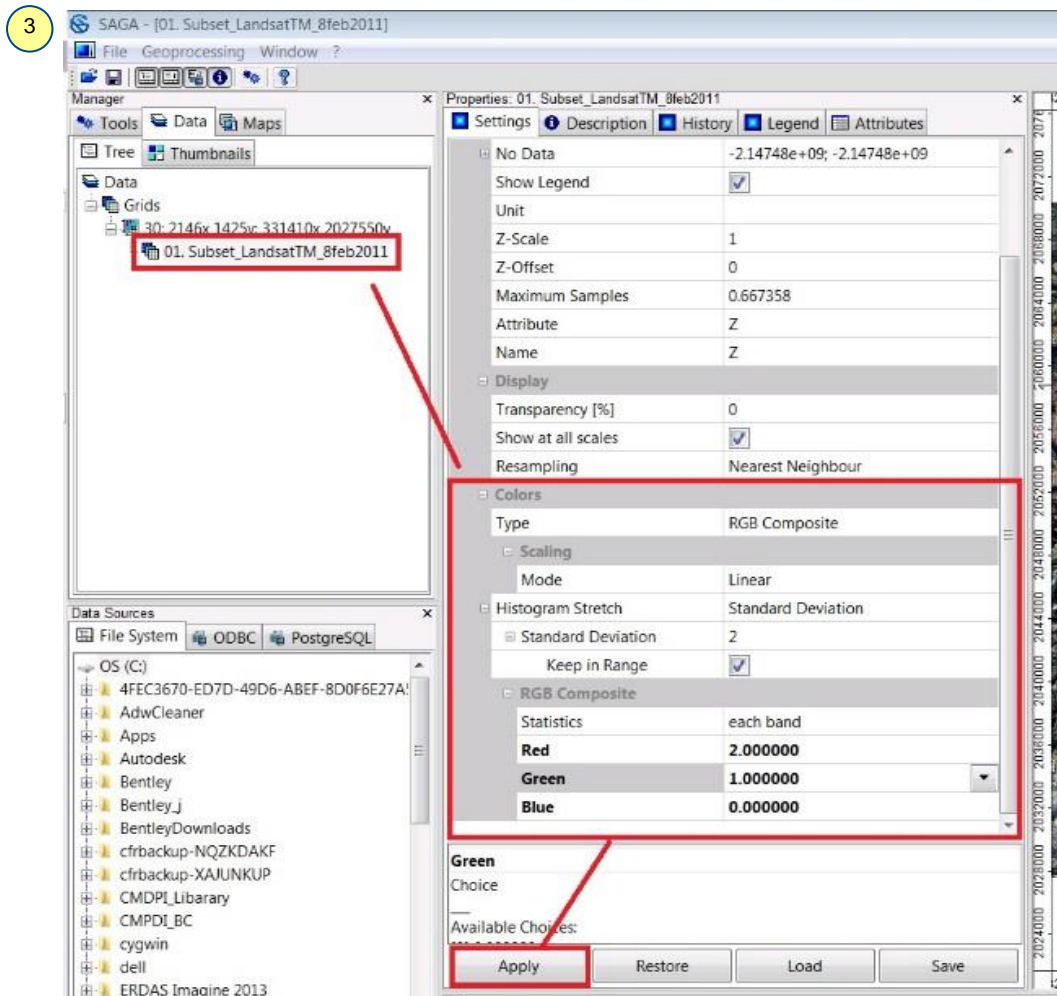
In unsupervised classification, the algorithm analyzes all the bands of the image and pick out the clusters of pixels having similar values without the user intervention. The clusters are then assigned to their classes at the user's discretion. Therefore, this method generally applied to the regions, where we don't have any knowledge and information about land cover type. In this tutorial, we will use a 7-band Landsat Thematic Mapper (TM) image to create a land cover map of Pune and its surrounding region. This Landsat TM imagery is downloaded from USGS earth explorer website: <http://earthexplorer.usgs.gov/>

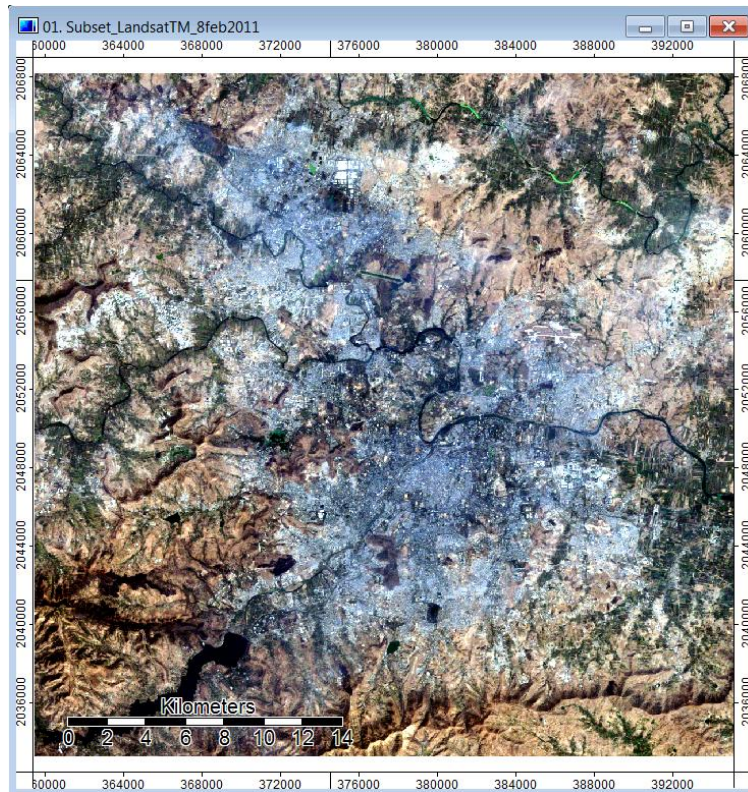
1. Load the Landsat images into SAGA by clicking on the  '**Load File**' button or via *File* → *Grid* → *Load*. Select the '*Subset\_LandsatTM\_8feb2011.tif*' image. This will import the image into SAGA.
2. The Landsat TM bands with their wavelengths and names are given below.

Band Number	Wavelength Range	Name
Band 1	0.45–0.52	Blue
Band 2	0.52–0.60	Green
Band 3	0.63–0.69	Red
Band 4	0.76–0.90	Near Infra-Red
Band 5	1.55–1.75	Short Wave Infra-Red
Band 6	10.40–12.50	Thermal Infra-Red
Band 7	2.08–2.35	Mid Infra-Red

3. We will change the composite band combination to True Color by using settings tab. Select '*Subset\_LandsatTM\_8feb2011.tif*' under Data tab. In settings, navigate to

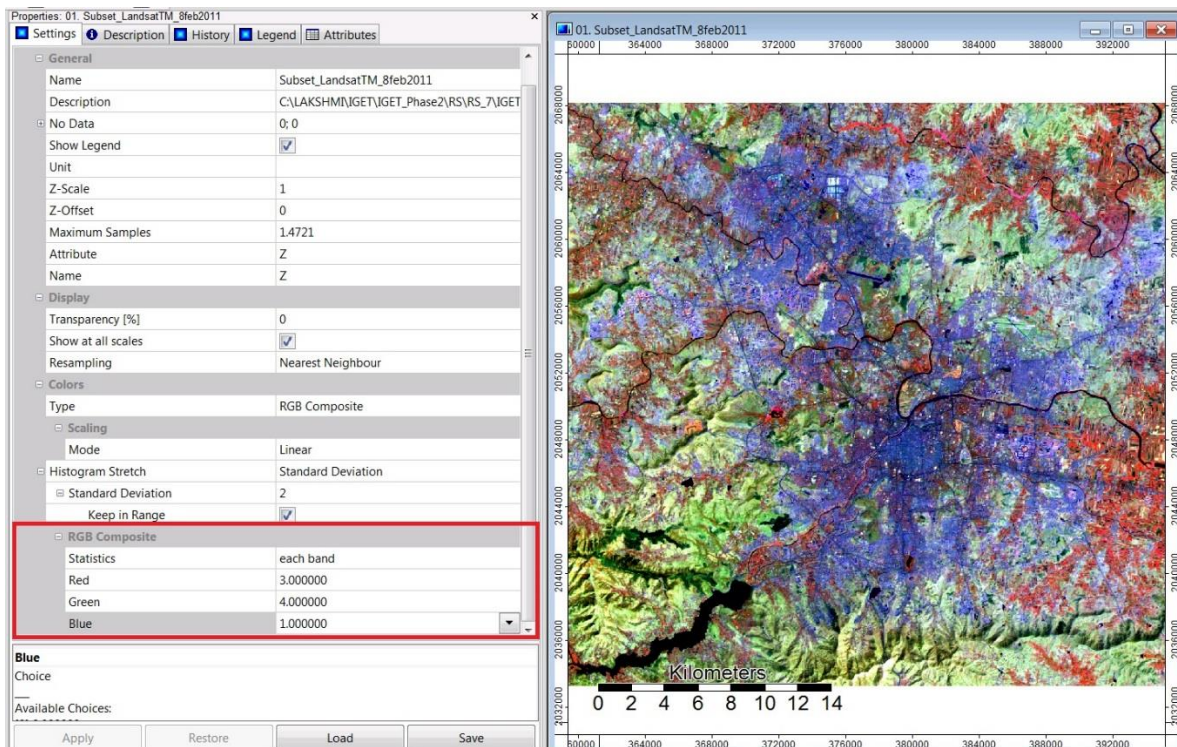
'Colors' section, select the band combinations as shown in below figure and Click on 'Apply' .







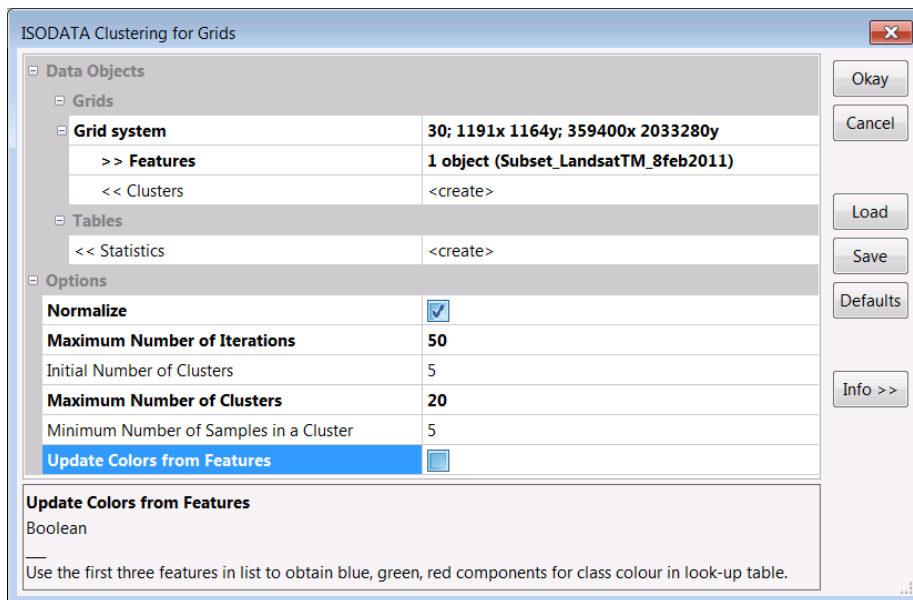
Task: Identify the land use and land cover in true color composite by using visual interpretation elements and make a note.

4. Similarly, visualize the study area by using following false color band combination and try to identify the land use and land cover in the false color composite by using visual interpretation elements and make a note.



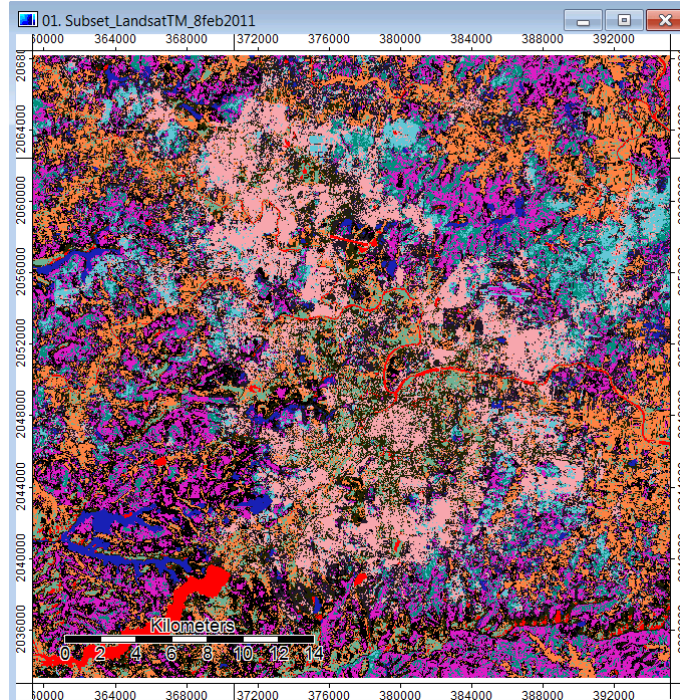
5. Now we will classify the image using *Geoprocessing* → *Imagery* → *Classification* → *Unsupervised* → *ISODATA Clustering for Grids*. The module window options are explained below.

- **Grid System:** This is grid system of the image to be classified. Select it from the drop down menu.
- **>>Features:** These are the input grid layers that will be used in the classification. Click on the  button and select the LandSat layer/s and click on the  button and click on 'Okay' .
- **<<Clusters:** This is the output option for the clustered image. To create a new image we keep it as '*[create]*' . If we are running the cluster analysis for the second time and want to overwrite an image then select the image to be overwritten from the dropdown menu.
- **<<Statistics:** This creates a table with the statistics of the band layers and the clusters. By default it is set as '*[create]*' but we can overwrite an existing table by selecting it from the dropdown menu.
- **Options:** Specify the options as shown below.



6. On clicking '*Okay*' , the ISODATA cluster analysis will start and will keep reiterating the search. You can see the progress on the left side of the status bar located at the bottom of SAGA GUI.

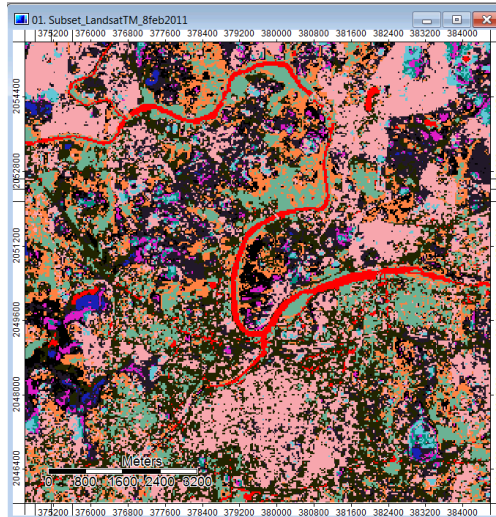
7. The classified image titled '*Clusters*' is placed in the Landsat image grid system. Double click on it to open in the '*True Colour Composite*' map list.
  
8. This newly created cluster map splits the image area into homogenous land cover segments. We now have to assign each cluster to its land cover class.

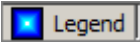
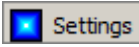




9. Before doing that we have to assign a unique number to each land cover class. We will use a simple 6 class classification. You may use the ones below or select your own.

Class	Number
Builtup	1
Agriculture	2
Jungle/Shrubs	3
Grass/Barren land	4
Water	5

10. Now turn on and off the cluster layer in the Map window. You will see that the clusters take the shape of some land features. This way we can identify the clusters based on their shape, location and image pixel values.



11. Select the '*Clusters*' layer from the data list and click on the  tab. This will display the different class numbers and their associated colour. To check which cluster a pixel belongs to, just mouse over the pixel and look at the *Status Bar* at the bottom of the SAGA window. This displays the '*Z value*' of the pixel. In this case the Z value is the class number.
  
12. We will start assigning class numbers to the clusters by selecting the layer and then accessing the  tab. Click the  button under '*Table*' to open the lookup table. This will give the clusters information with five fields: *COLOUR*, *NAME*, *DESCRIPTION*, *MINIMUM* and *MAXIMUM*.

Colors	
Type	Classified
Classified	
Table	(columns: 5, rows: 11) 
Histogram Stretch	Standard Deviation
Standard Deviation	2
Keep in Range	<input checked="" type="checkbox"/>

13. The color of a cluster can be changed by clicking on it and choosing a color from the palette. The *MINIMUM* and *MAXIMUM* fields indicate the cluster number and will have the same value in this table. The numbering of the clusters starts from 1. Therefore, *Class 1* would be numbered 1, *Class 2* would be numbered 2, and so on.

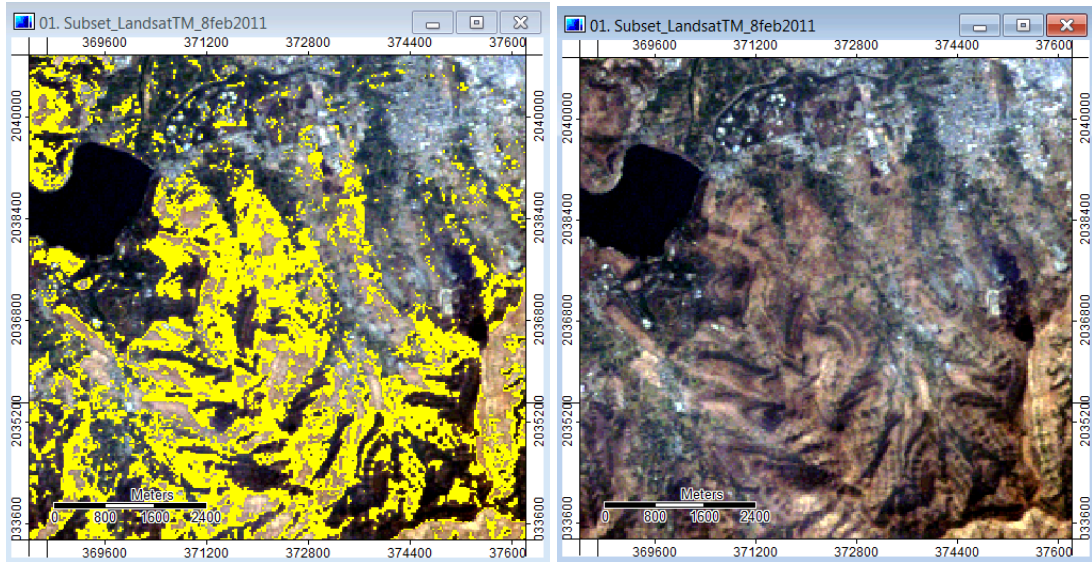


	COLOR	NAME	DESCRIPTION	MINIMUM	MAXIMUM
1	Black	Cluster 1		1.000000	1.000000
2	Red	Cluster 2		2.000000	2.000000
3	Dark Grey	Cluster 3		3.000000	3.000000
4	Pink	Cluster 4		4.000000	4.000000
5	Magenta	Cluster 5		5.000000	5.000000
6	Orange	Cluster 6		6.000000	6.000000
7	Dark Green	Cluster 7		7.000000	7.000000
8	Teal	Cluster 8		8.000000	8.000000
9	Light Green	Cluster 9		9.000000	9.000000
10	Blue	Cluster 10		10.000000	10.000000
11	Cyan	Cluster 11		11.000000	11.000000

- Identifying classes and the land cover they represent can become difficult when looking at the cluster map with all its classes. To make it easier, we will handle them one at a time.
- Change the *MINIMUM* and *MAXIMUM* field values of all the rows by clicking on the cells and replacing them with the value '-1'. Mark the first row *MINIMUM* and *MAXIMUM* value as '1' and change the color to 'Yellow or any other bright color' to click 'Okay'. Click on 'Apply' below. This will make the classes marked with '-1' invisible.

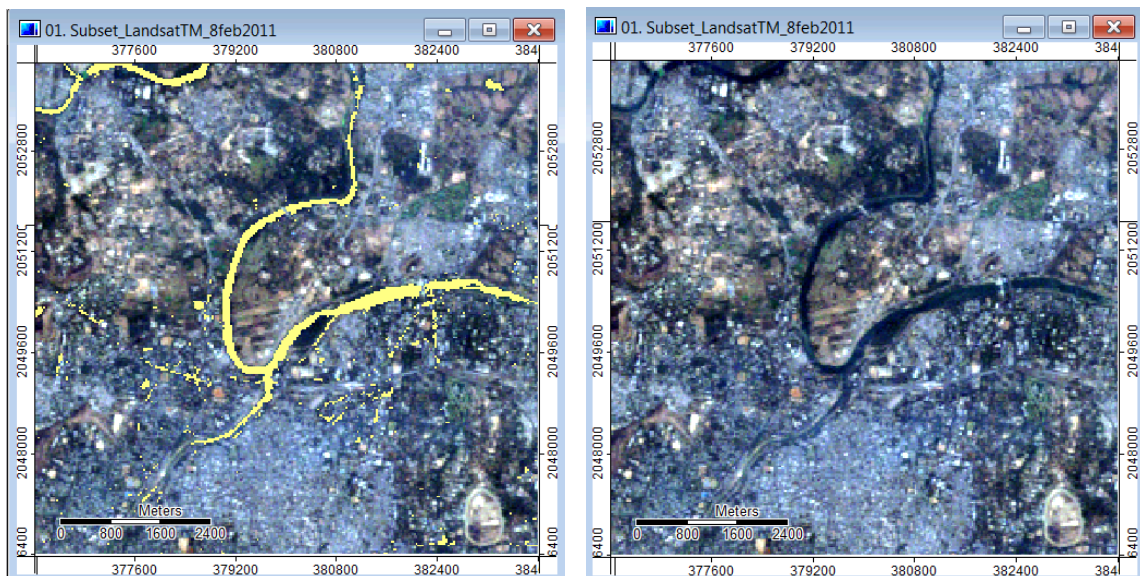
	COLOR	NAME	ESCRPTIO	MINIMUM	MAXIMUM
1	Yellow	Cluster 1		1.000000	1.000000
2	Red	Cluster 2		-1.000000	-1.000000
3	Dark Grey	Cluster 3		-1.000000	-1.000000
4	Pink	Cluster 4		-1.000000	-1.000000
5	Magenta	Cluster 5		-1.000000	-1.000000
6	Orange	Cluster 6		-1.000000	-1.000000
7	Dark Green	Cluster 7		-1.000000	-1.000000
8	Teal	Cluster 8		-1.000000	-1.000000
9	Light Green	Cluster 9		-1.000000	-1.000000
10	Blue	Cluster 10		-1.000000	-1.000000
11	Cyan	Cluster 11		-1.000000	-1.000000

- Turn the cluster layer off to view the satellite image below it. Identify the type of land covered by this cluster using the false color or true color composites. For example, let's look at the first cluster.



We see that the cluster covers 'Jungle/Shrubs' land cover. Considering the land cover type it would probably fall under the Scrub category. So we mark in the *NAME* column as 'Jungle/Shrubs' and color to 'dark green'.

- Let's take the *Class 2*. In 'Lookup Table' change the *MINIMUM* and *MAXIMUM* field values to its original value, i.e., '2', color to 'Yellow' and for *Class 1* to '-1'. This will make only *Class 2* visible. Now we zoom to more prominent details by keeping either false color or true color composites to identify the land cover.



From the above figure, it is clear that this cluster covers water landcover, so in its *NAME* column we'll write as 'Water' and color to 'Blue'. You may also note some pixels misclassified as water.

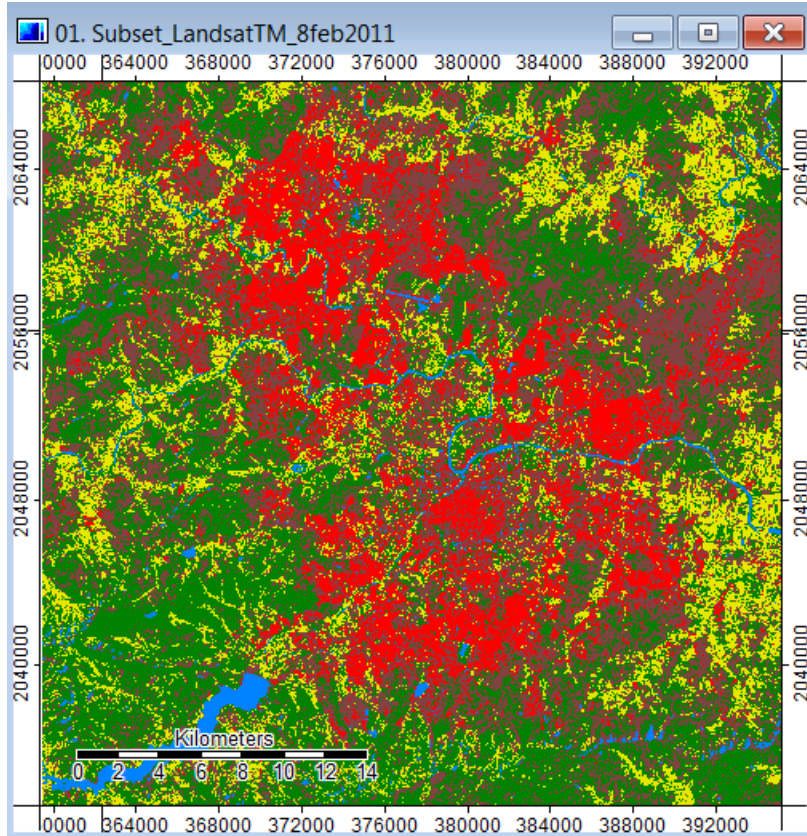
	COLOR	NAME	ESCRPTIO	MINIMUM	MAXIMUM
1	Green	Jungle/Shurb		1.000000	1.000000
2	Blue	Water		-1.000000	-1.000000
3	Black	Cluster 3		-1.000000	-1.000000
4	Red	Cluster 4		-1.000000	-1.000000

18. Go to the next cluster below and change its MINIMUM and MAXIMUM value to its original value (this will make it visible). Change its colour to 'Yellow or some other bright color'. Click 'Okay' and then 'Apply'. The next cluster will now be visible.

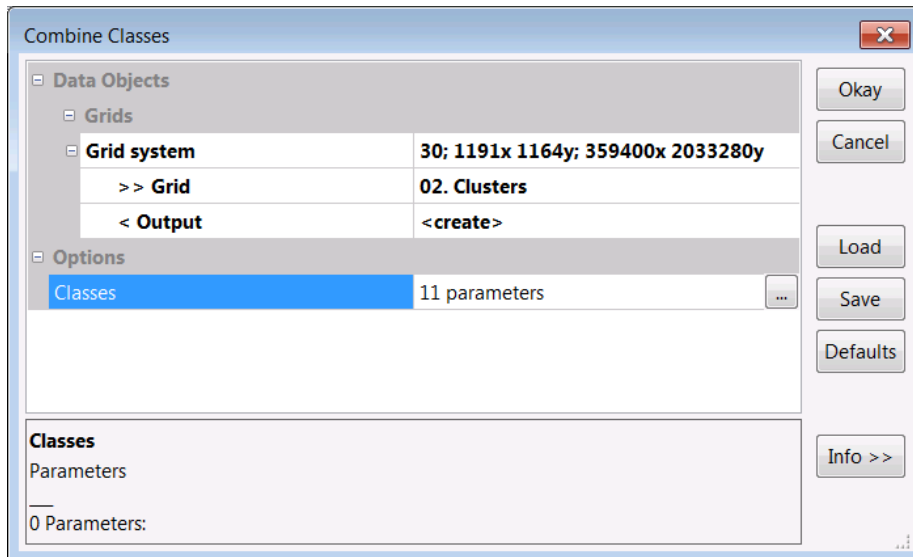
19. Repeat the steps 15 to 18 till all the clusters have been assigned a class number.


20. Once we are done with this, make sure that the MINIMUM and MAXIMUM columns have the original values instead of '-1'. Click on the 'Save' button in the lookup table and save this table as a text file in a convenient location. Use an explicit name like 'Lookup\_Table' which can be easily identified.

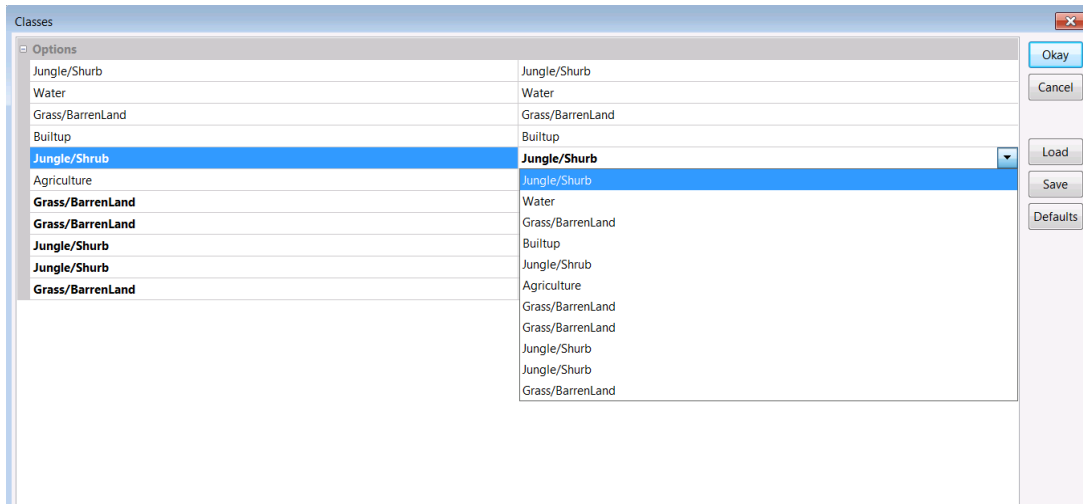
	COLOR	NAME	DESCRIPTION	MINIMUM	MAXIMUM
1	Green	Jungle/Shurb		1.000000	1.000000
2	Blue	Water		2.000000	2.000000
3	Brown	Grass/BarrenLand		3.000000	3.000000
4	Red	Builtup		4.000000	4.000000
5	Green	Jungle/Shurb		5.000000	5.000000
6	Yellow	Agriculture		6.000000	6.000000
7	Brown	Grass/BarrenLand		7.000000	7.000000
8	Brown	Grass/BarrenLand		8.000000	8.000000
9	Green	Jungle/Shurb		9.000000	9.000000
10	Green	Jungle/Shurb		10.000000	10.000000
11	Brown	Grass/BarrenLand		11.000000	11.000000



21. Open the 'Combine Classes' module via *Geoprocessing* → *Grid* → *Values* → *Combine Classes*. Select the grid system as per 'Cluster' grid system, 'Grid' as 'Clusters' and 'Output' as 'Create' .



22. Click the  button in the 'Classes' entry under 'Options' section. Now you can see class names under two columns. In the right column select the first entry of respective land use class in drop down menu as shown below. Click 'okay' in 'Classes' window and 'Okay' in 'Combine Classes' .



23. Now you can see the combine classes' grid under 'Data' tab in 'Manager'. Change the *Name* of 'Clusters [Combine Classes]' to '*Unsupervised\_Pune\_L5TM\_8feb2011*'. Open the unsupervised classification image on true color or false composite for comparison. 'Save As' the project with proper name and save other changed datasets before closing the SAGA GIS.

