

Using Farmer Field Schools Approaches to Overcome Land Degradation in Agro-Pastoral Areas of Kenya

Land degradation assessment – Baseline survey on spatial analysis of land cover / degradation trends and Toolkit Development.

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LESSON 2 – SYMBOLIZATION

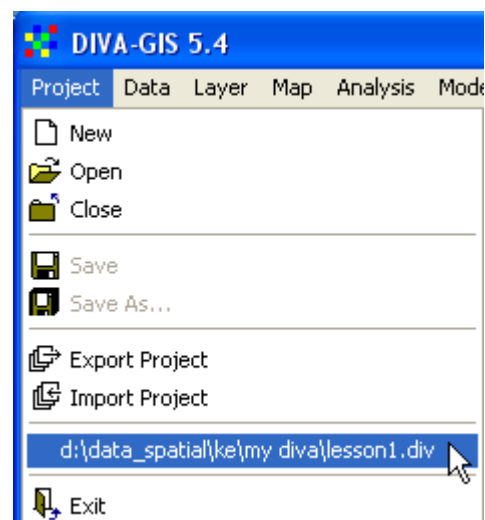
Lesson overview

In this lesson you will learn about different types of attribute data; nominal data like names, ordinal data that gives an order without numbers, interval data where a number denotes a difference but the difference is not absolute, and ratio data which is data with absolute numerical values. The symbolization of attributes vary dependent on which type of data the attribute represents, and the lesson introduces symbolization of GIS data in DIVA-GIS.

Add and remove layer

Open project

Start DIVA-GIS by clicking the icon for DIVA-GIS on the desktop (see [lesson 0](#) to create an icon on the desktop if you do not have one). Open the project from lesson 1 (...:\data_spatial\ke\my diva\lesson1.div) by either clicking the Open Project tool, , or via the menu: Project – Open. Dependent on your installation of DIVA-GIS there should also be a short cut indicating previous projects, and you can select your project from there as indicated below.




With the project opened, save it as a new project (e.g. with the name lesson2) via the menu: Project – Save As.


Remove layer

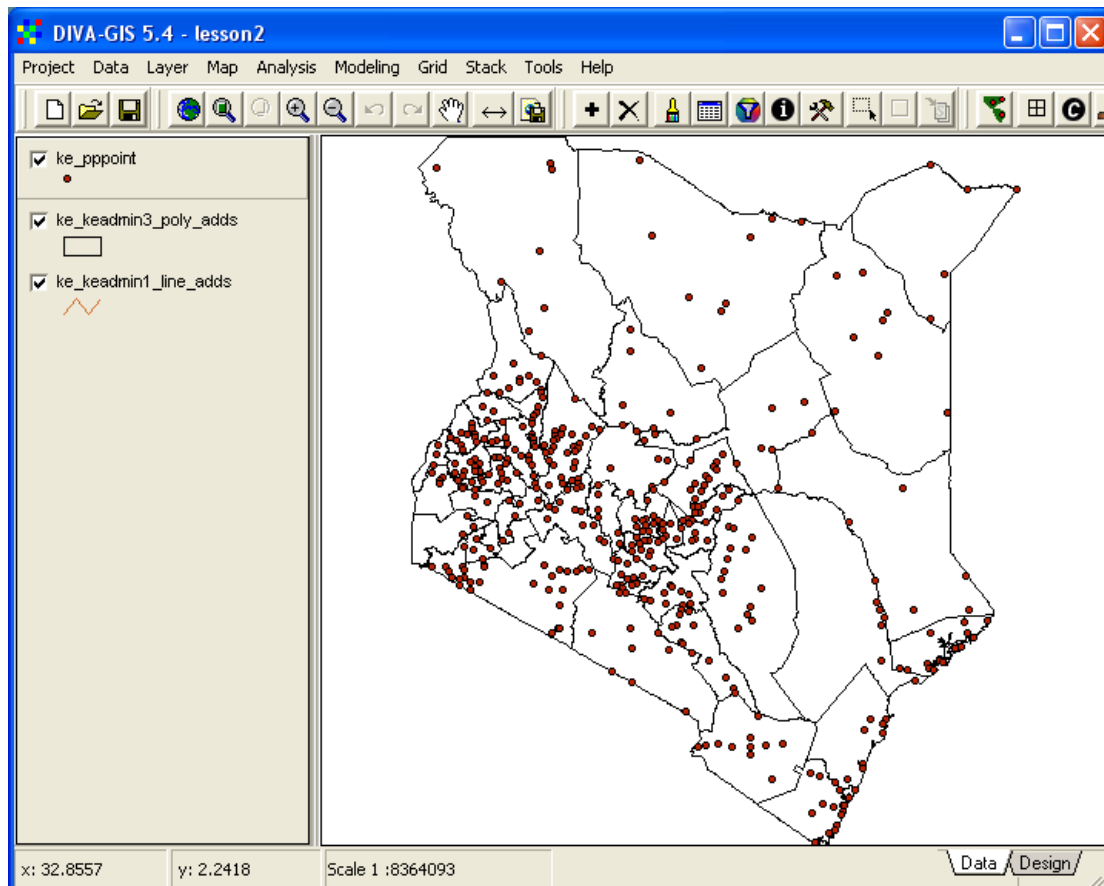
In this lesson we will use a national index for land degradation rather than the original GLASOD (Global Assessment of Land Degradation) map used in [lesson 1](#). Start by making both the vector and image layers for ke_glasod_geo active – by first clicking on one layer in the Legend, then hold down both the Ctrl and Shift keys and click the other.



With both layers active, click the Remove Layer tool, , or go via the menu: Layer – Remove Layer, and remove the GLASOD layers. Diva-GIS will prompt you and ask if you really want to remove the layers, but do not worry the layers will only be removed from the project document, not from the hard drive.

Attribute data

In [lesson 1](#) we used the Identify tool, , to see information about single features in a map layer. [Lesson 1](#) also introduced vectors as the most common format for representing GIS map data, and you now know vector data can represent points, lines or polygons. The project you are working with should also contain three layers, one point layer (ke_dnpoint), one line layer (ke_rdline), and one polygon layer (ke_country-index). If you do not have these layers in your project, use the Add layer to add them.




A vector layer is actually composed of several separate files stored on the computer; one file for the geographic data (coordinates), one file that contains information on how the features relate to each other (called topology), and one file with *attributes*. Attributes are characteristics that describe the geographic feature. The attributes will vary dependent on if the geographic feature is a point, line or polygon, and what kind of phenomena the layer represents. Here are some examples:

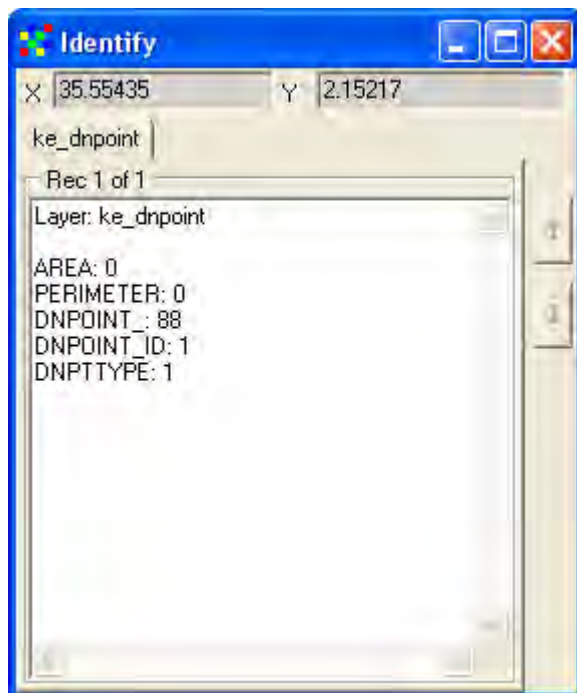
Vector type	Example	Nominal attribute	Ordinal or interval attribute	Ratio attribute
Point	Well	Type (dug-drilled-spring etc)	Temperature (hot- warm-cold)	Capacity (m3/s)
Line	Road	Surface (dirt-tar etc)	Condition (good-bad)	Length, Width (m)
Polygon	Country	Name	Land degradation (low - high etc)	Population (nr)

A well can be described as a point with a specific geographic position. But a well also has other characteristics, called attributes in GIS-jargon. The well can be dug or drilled, or a spring etc. The well type is a typical attribute that can be stored in a database and linked to geographic feature. This is how it is done in GIS. Furthermore, the attribute well type as used here is a description without any rank or order (a dug

well is not better or worse than a drilled well in general). Such an attribute, without any rank or numerical value, is called a *nominal* attribute. The water temperature of a well is another typical attribute, but the temperature can be ranked. If the ranking is loosely done, like for instance hot – warm – cold, then the attribute is called ordinal. If it has an order (hotter is more warm than cold) but we do not know *how much* warmer – hence ordinal. If we know the exact temperature the attribute is called *interval*. The difference between 20 degrees and 15 degrees is the same as the difference between 15 degrees and 10 degrees, but 20 degrees is not double 10 degrees in absolute terms. A well also has a capacity (the amount of water it gives over time –measured as cubic meters per second for instance). Also the wells capacity is a typical attribute of the well. If we know the exact amount of water several wells can produce, we can also say that one well gives double as much water as another – this is a *ratio*, and hence the attribute is called ratio. If we had known the capacity of the well only as rich-moderate-poor, the attribute would have been ordinal instead.

Attribute data - points

Now make the point theme ke_dnpoint the active layer by clicking on it in the legend. Choose the Identify Feature tool, , and click on one of the points for ke_dnpoint.



In the Identify window the information about this particular point is displayed. There are 5 attributes for the theme ke_dnpoint (area, perimeter, dnpoint_, dnpoint_id and dnptype). Obviously the attributes for area and perimeter are zero as a point has no extension. The other attributes are coded, so you need to know what they stand for. The layer ke_dnpoint comes from Digital Chart of the World (DCW), the largest scale consistent map of the world (1: 1 000 000), originally prepared by Environmental Systems Research Institute, Inc. ([ESRI](http://www.esri.com) – that also produces e.g. ArcView and ArcGIS) for the US Defense Mapping Agency. DCW can be downloaded for all the worlds' countries from www.maproom.psu.edu/dcw.

Metadata

Ideally geographic data posted on the internet (or delivered on a CD like this project) should come with a full description of how the dataset was created, when it was done, how accurate it is, who did it etc. Such information is usually called *metadata*, and most layers on the project CD come with metadata. You can access all the metadata via the [web-catalogue](#) on the project CD. The link to the DCW metadata is [here](#). But for simplicity the coding of the drainage point data is given here as well:

DNPTTYPE

Drainage point type.

Code Definition

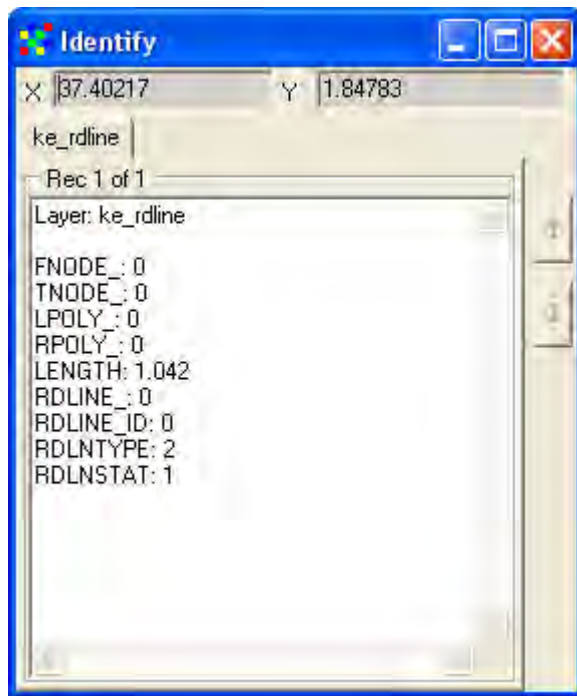
1. = Spring, well, waterhole, or bore
2. = Small reservoir
3. = Falls
4. = Rapids
5. = Lock
6. = Dam
7. = Sluice gate

The attribute data for ke_dnpoint only contains nominal data, The global dataset is not detailed enough to hold any ordinal or ratio data.

Attribute data - lines

A road is represented as a line in GIS. In the data file with the geographical data it is represented as a series of connected points. A road also has some typical attributes. The type of surface of the road is a typical nominal attribute. A tar road might in general be preferred over a dirt road, unless it has lots of potholes for instance. Hence the road surface is nominal. Road condition on the other hand is typically ordinal – good – mediocre – bad. It is difficult to put numbers on road conditions, but you can often rank road conditions. The length and width of a road is an absolute attribute, a road that is 9 meters wide is 50% wider than a road that is 6 meters wide – hence length and width are ratio attributes.

Click on the theme ke_rdlines in the Legend to make this theme the active theme (it becomes lifted up). Turn it on by clicking the checkbox if it is not already on. Again select the Identify Feature tool and click on one of the roads.



In the Identify window you see that roads have 9 attributes, most coded. Also the road theme is from DCW, and is not absolutely accurate. But we can see that the length of the road is given as an attribute. As length is an absolute numerical value, the attribute length is of the type ratio (a road that is 8 km in length is twice as long as a road that is 4 km in length). Here is the coding for some of the attributes in the ke_rdlne theme from DCW (you will use this attribute later for symbolizing the roads):

RDLNTYPE

Road line type

Code Definition

1. = Dual lane (divided) highway
2. = Primary and secondary road
3. = Track, trail, or footpath
8. = Added road connector within urbanized area polygons

RDLNSTAT

Road line status

Code Definition

1. = Functioning
2. = Under construction
3. = Existence doubtful or "reported" to exist
4. = Compile road connector (used for arcs added from other source materials in order to provide cartographically correct connectivity within urbanized area polygons)

5. = Compiled from adjacent, more recent sheet (used for arcs added for edgematch or network connectivity in the ONC sheet overlap areas)
6. = Compiled, under construction (used for arcs added for edgematch or network connectivity in the ONC sheet overlap areas)
9. = Schematic road (used for arcs added within the urbanized area polygons for network connectivity only)

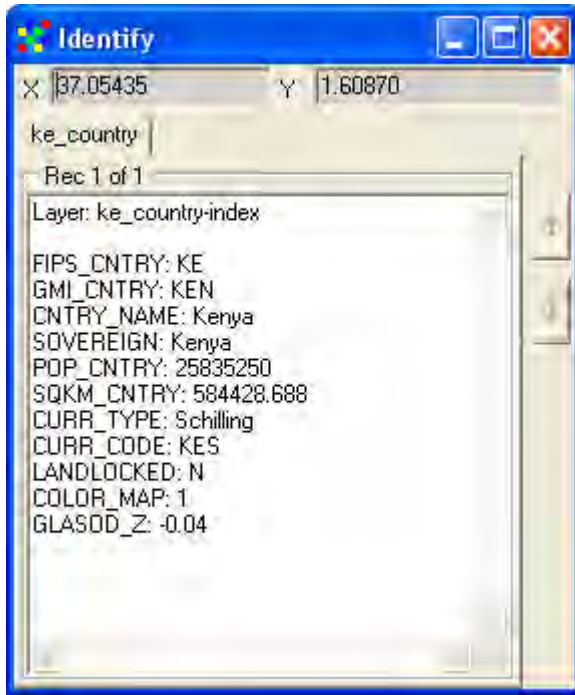
From the coding table you can see that there are three classes in rdlnType (Dual lane, primary and secondary road, and track, trail or footpath). This is a graded scale, albeit without any numerical value, hence the attribute rdlnType is ordinal. The attribute rdlnStat on the other hand carries information on the status of the road (how it was captured into the dataset, if under construction or functioning). This is a nominal attribute of the theme ke_rdline.

Click on some road segments in the road theme using the Identify Feature tool, and note how all features represent rather short road segments. If you look carefully you will see that each feature represents the road between road crossings. You can see it when you click, as the segment is shortly highlighted before the Identify window pops up. Lines must be done in this way in order for the GIS to interpret how roads are connected – that is how the topology of the roads works. With the help of the topology, more advanced GIS programs can calculate the shortest path between two points. If there are breaks in the lines, or if road crossings were not included, this could not be done. Having a correct topology is hence important.

Attribute data - polygons


A country is a typical polygon when represented as a vector in GIS. It has a boundary (line) that closes upon itself and hence forms a polygon. The country name is perhaps the most typical nominal attribute. Human induced land degradation is a widespread phenomenon, and several attempts have been made to map it out globally. The Global Assessment of Land Degradation (GLASOD) was the first such attempt. Experts around the world tried to estimate the extent and severity of land degradation, and compiled the data into a global dataset. From this dataset a statistical ranking was done to assign a soil degradation index to each country. Most indexes are interval attributes, where the interval between numbers denotes the same difference, but where the ratio between numbers has no meaning. The most common ratio attributes for countries are area and population. Not only is for example Kenya larger than Uganda, but we can also calculate that Kenya is 2.5 times larger than Uganda, which is a ratio.

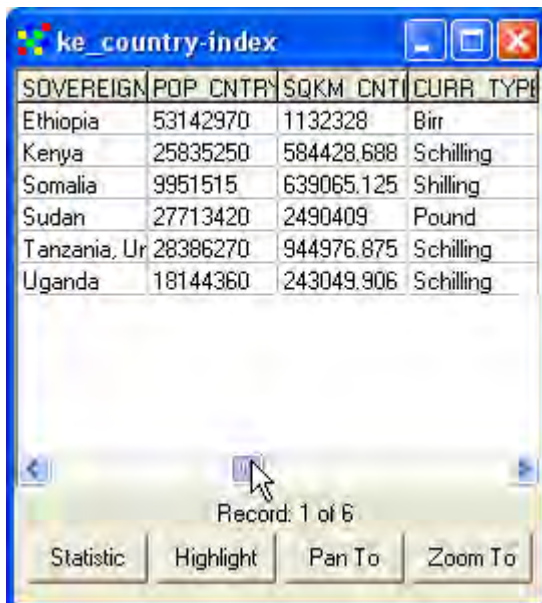
Make the theme ke_country_index the active theme and click inside Kenya in the Data View.



The attributes for Kenya include all types of attributes: country name (CNTY_NAME) and currency type (CURR_TYPE) are nominal attributes; GLASOD land degradation (GLASOD_Z) is an interval attribute; and population (POP_CNTRY) and square kilometers (SQKM_CNTRY) are ratio attributes.


Attribute table


Instead of using the Identify Feature tool to look at the database connected to a layer, you can use DIVA-GIS to view the full database (or attribute table). Make sure that ke_country-index is the active theme, and open the table using the Table tool, , or via the menu: Layer – Table. A window showing the content of the database that comes with ke_country-index pops up.



You can make the popup window larger by sliding the mouse over the blue frame, clicking the mouse to grab the frame and then drag the mouse to change the size. You can also scroll in the database by clicking the slide button and dragging it, as indicated in the figure above. In the attribute table shown above you can see the database values for population (POPS_CNTRY) and country area in square kilometers (SQKM_CNTRY), and the currency used in the included countries (CURR_TYPE).

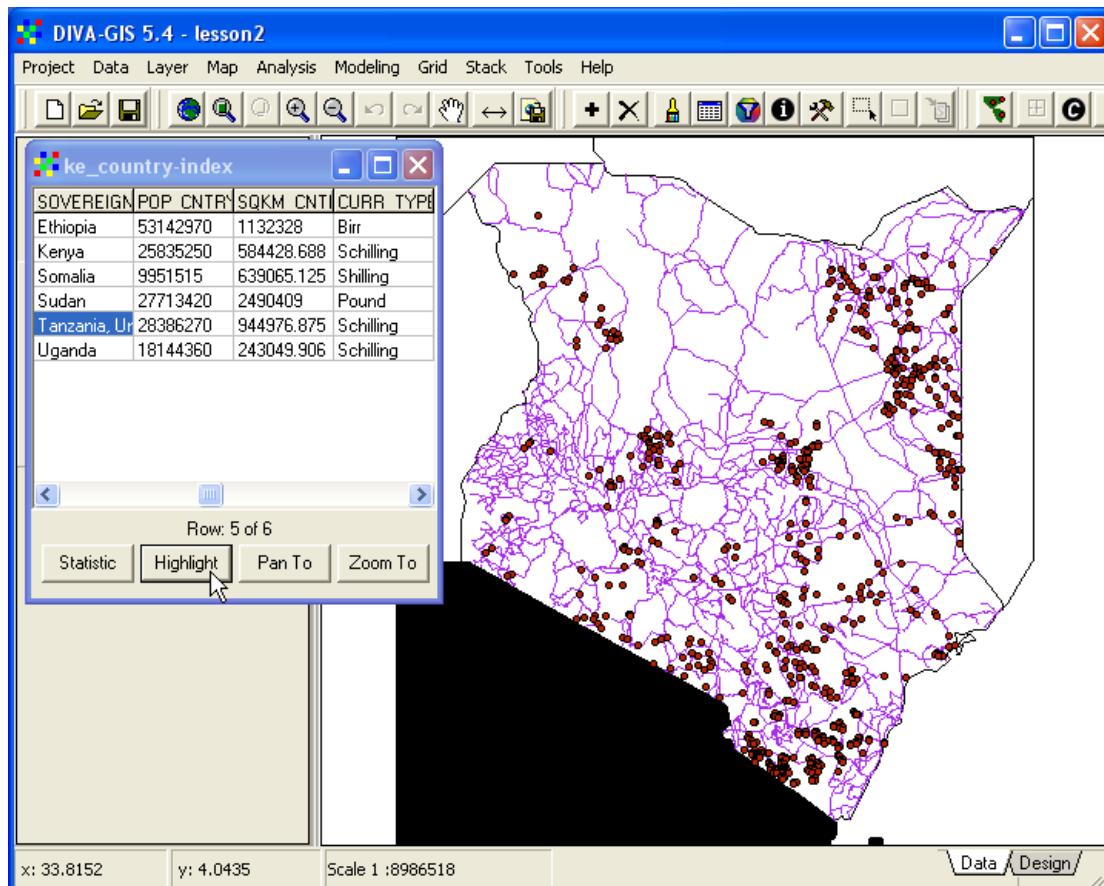
Highlight feature

From the attribute table you can interactively do some simple statistical analysis, and highlight, pan and zoom to selected features. Click the Statistic button, , from the drop down menu for Field, select POP_CNTRY, and you will get basic statistics about the population in the countries in the database.




Field	POP_CNTRY
Count	6
Min	9951515
Max	53142970
Mean	27195630.8333333
StdDev	14533312.1322004
Sum	163173785

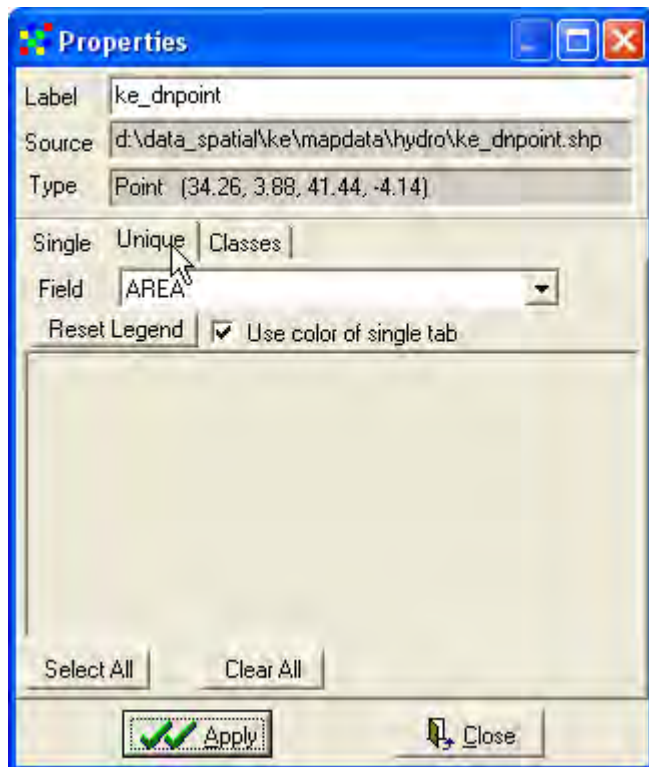
Click on any cell in the database to select the record (row) that that cell belongs to (Tanzania in the example below). Then click the Highlight button and blinking will highlight the feature you selected.



If you click the buttons for Pan To and Zoom To, DIVA-GIS will pan/zoom to the geographic feature represented by the selected record.

Symbolizing features

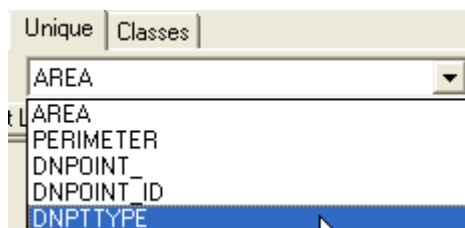
A large part of GIS is to symbolize geographic features so they can be easily understood and interpreted, by yourself or by others. Symbolizing includes putting colors, patterns, texture, icons and text on the map. Make the point theme (ke_dnpnt) the active theme by clicking it in the Legend. Symbolizing in DIVA-GIS is done from the Properties window, and you can open the dialogue window for properties in three ways, by double clicking in the Legend, by clicking the Properties tool, , or via the menu: Layer – Properties.



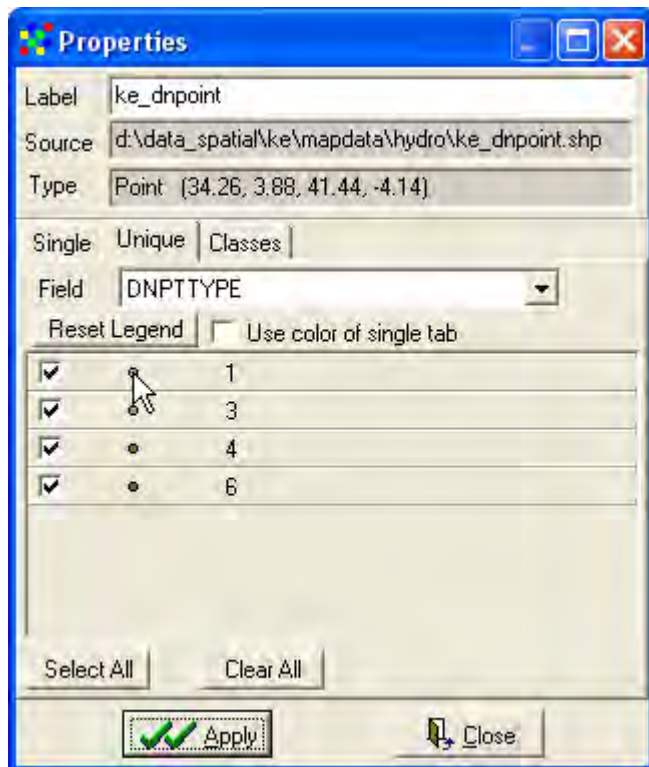
There are three alternatives, each under its own tab, for symbolizing a layer: Single, Unique and Classes. Single puts a single symbol on all features in a layer, and is what DIVA-GIS uses as default when you add a layer (all layers in the Data View are symbolized using the Single alternative).

Symbolizing nominal data (points)

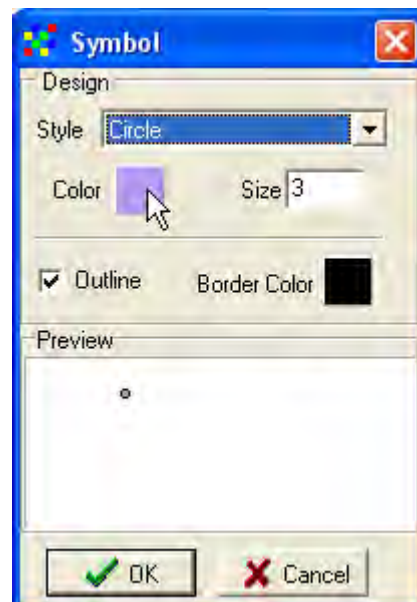
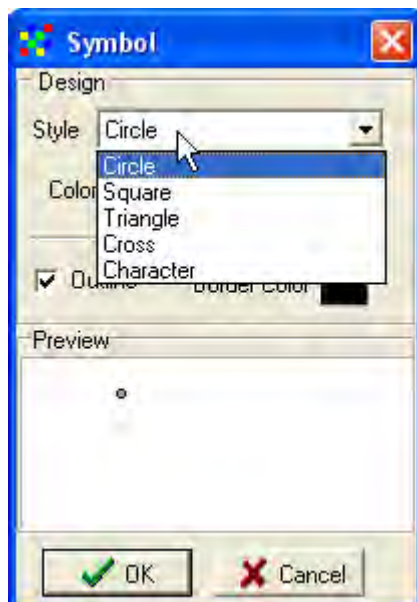
For the drainage points the attribute data included in the attribute table is only nominal, and you should choose Unique to symbolize nominal data. Hence click the tab for Unique as indicated in the figure above. Then you have to choose which field (column) in the attribute table you want to use for the symbolization. As you saw above, the field dnptype contains nominal data about what type of water feature the point represents. Hence choose the field dnptype from the Field drop down menu.



With dnptype selected as field, click the Reset Legend button, **Reset Legend**, and the legend is reset. If, as in the example below, the checkbox for Use color of single tab was checked all symbols will be the same, if unchecked DIVA-GIS will generate a color scheme for you (just uncheck and click the Reset Legend button again to try it out).

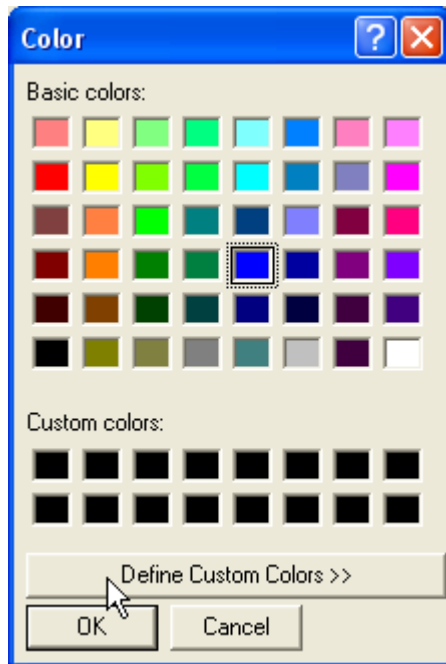




The Properties window should now show all Unique entries found in the field dnpttype, as shown above. You can change the individual symbols for each Unique value, just click the little symbol icon as indicated above. The Symbol window will popup, and here you can choose the Style, Color, Outline and Border. If you remember from earlier in this lesson, code value 1 represents Spring, well, waterhole, or bore.




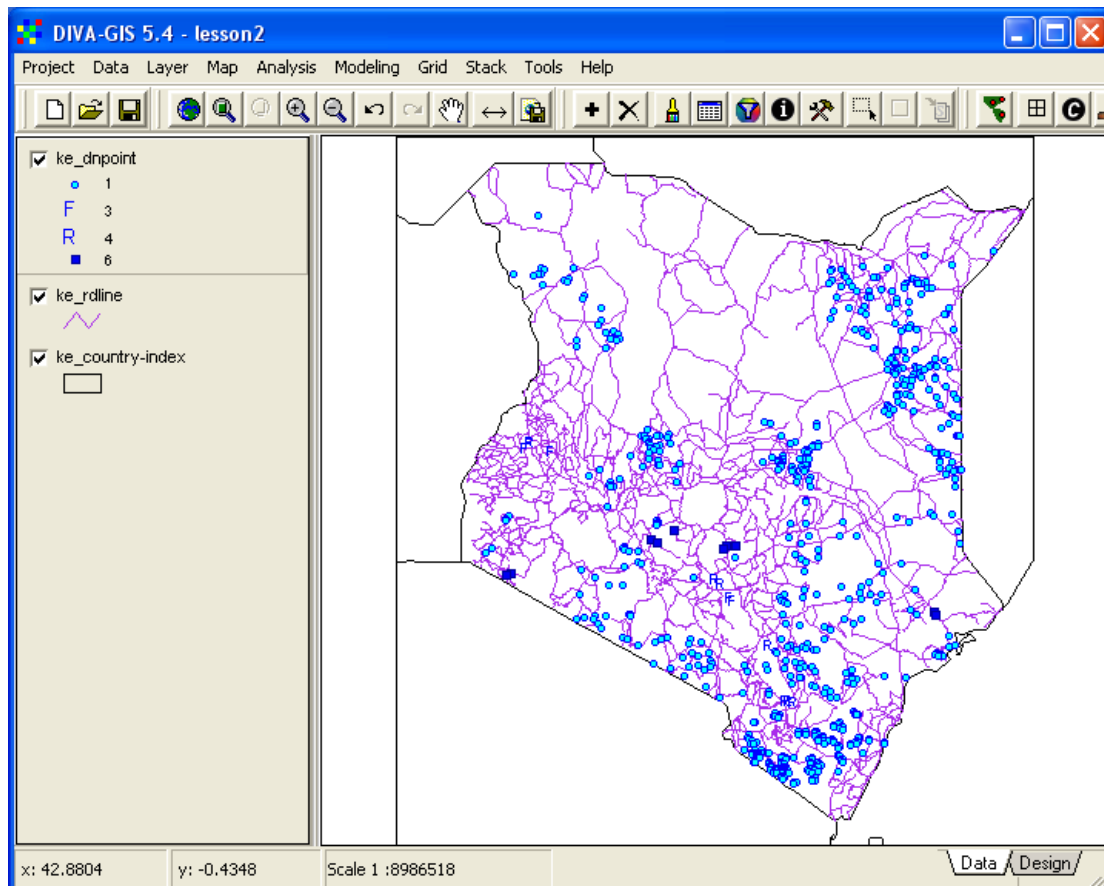
Select the Style of the symbol by clicking the drop down menu for Style (to the left above). To change the fill color of the symbol, double click the squared icon for color (to the right above). The Color window for selecting (or creating) colors will pop up.

You can either select a predefined color or click the Define Custom Colors >> button to expand the window to allow your own definition of colors.




You must click the OK button, , in the Color window for the change to apply. To change the border color you instead double click the squared icon for Border Color (black as default), and the same Color window will open again. Once your symbolizing is ready you must also click the OK button, , in the Symbol window.

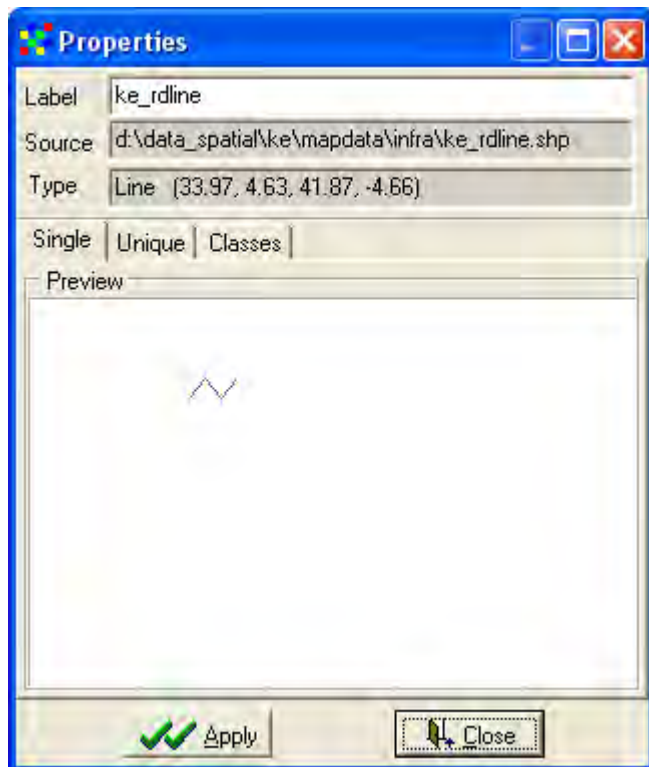
Repeat the symbolizing steps for all Unique values in the Properties window, and when all are changed, click the Apply button, , in the Symbol window.



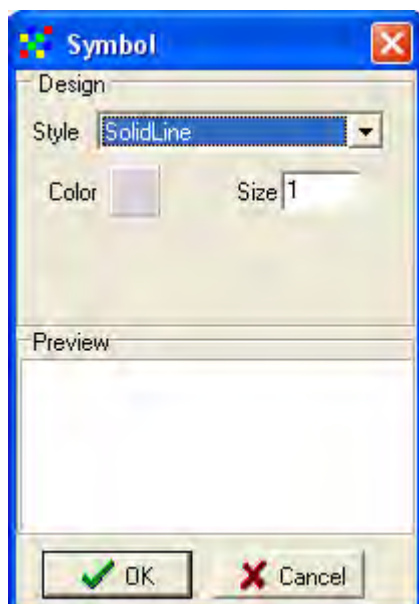
In the example above, Falls and Rapids were symbolized using characters (F and R as blue capital letters), and dams were symbolized with medium blue squares of size 5 and dark blue border color.

Symbolizing ordinal data (lines)

The road theme (ke_rdlne) contains both nominal, ordinal and ratio data, and you should use the ordinal data to symbolize the roads. Open the Properties window for ke_rdlne, by first making ke_rdlne the active theme and then click the Properties tool, .

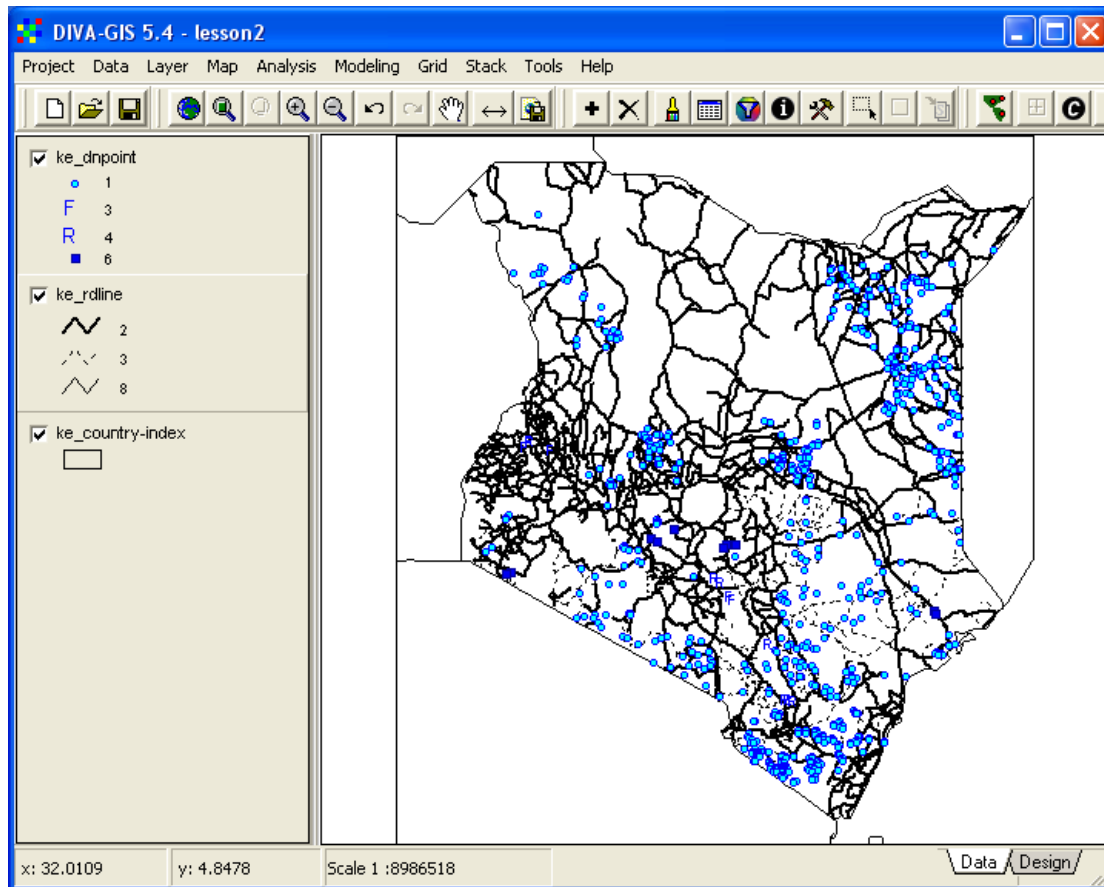


The Properties window for lines looks similar to the one for points, and works much in the same way. If you remember from earlier in this lesson, the ordinal data for roads is in the field rdIntype. Ordinal attribute data can be symbolized using either Unique or Classes. As there are only a few classes of roads (rdIntype) it is probably easier to use Unique again. Click the Unique tab, and the Symbol window for lines will popup.



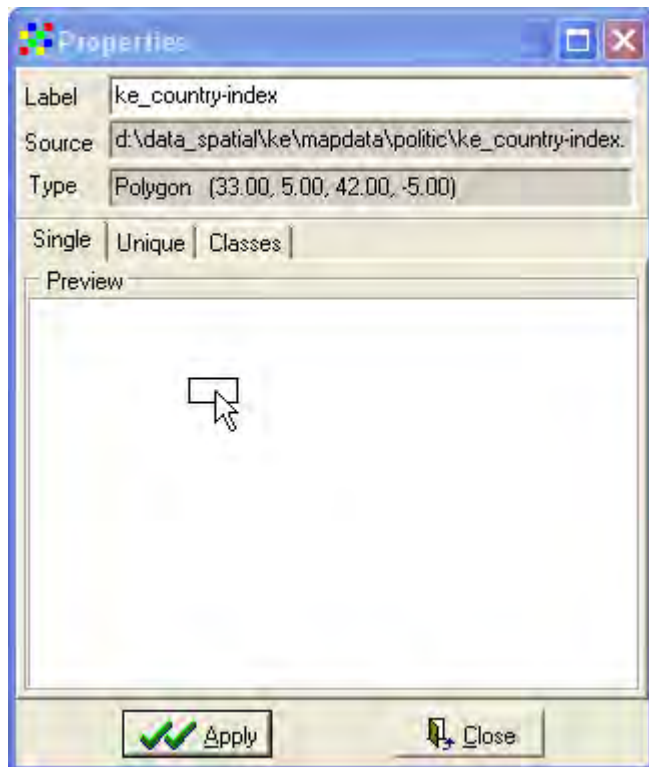
In the Symbol window for lines you can set the Style of the line, the Color and the Width. Look above in this lesson to interpret the coding of the attributes for ke_rdlne, and symbolize the roads. In the example below the ordinal scale of the road types (as

given in the field rdlnType) are visualized using both texture (e.g. solid – dashed – dotted for lines) and line width. The color is, however the same for all roads.

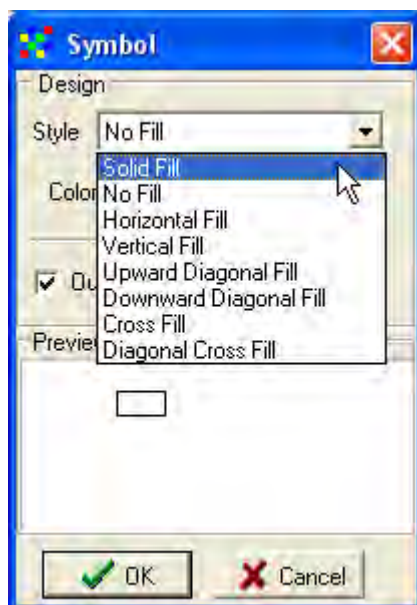


Symbolizing ratio data (polygons)

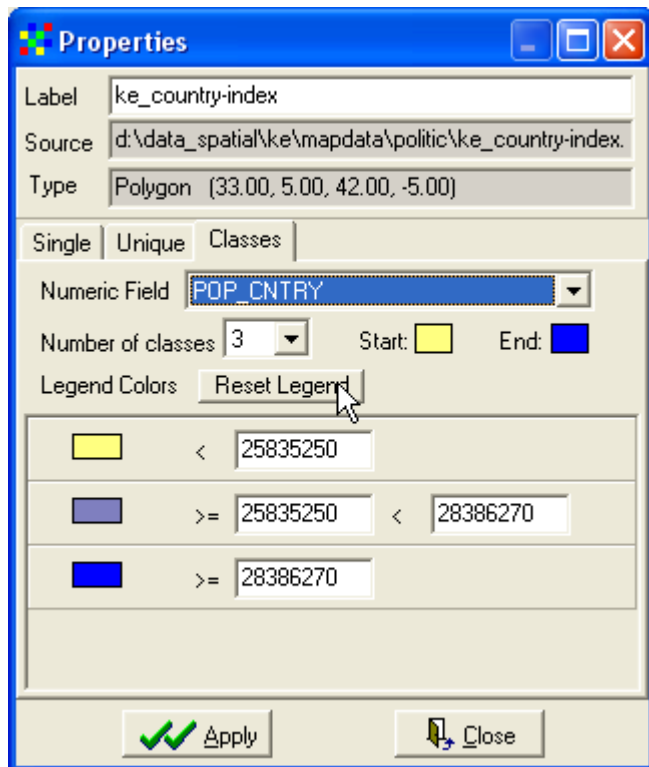
Make the polygon layer (ke_country-index) the active theme by clicking it in the Legend. Open the Properties window (e.g. double click the layer in the Legend). The attribute table for ke_country-index contains nominal, ordinal and ratio data, and you should symbolize the layer using the GLASOD land degradation index (the field GLASOD_Z in the attribute table), which is an interval attribute. First you must set the fill type using the Single tab. In the Properties window, select the Single tab, and click on the rectangular icon for polygon symbolization, as indicated below.



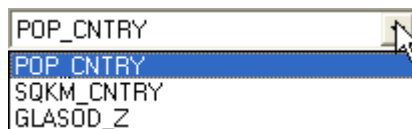
The Symbol window for polygons will then popup. Change the Style to Solid Fill (default when a polygon layer is added in DIVA-GIS is No Fill), as shown below. You do not need to worry about the other options, as they will be set using a classification scheme.



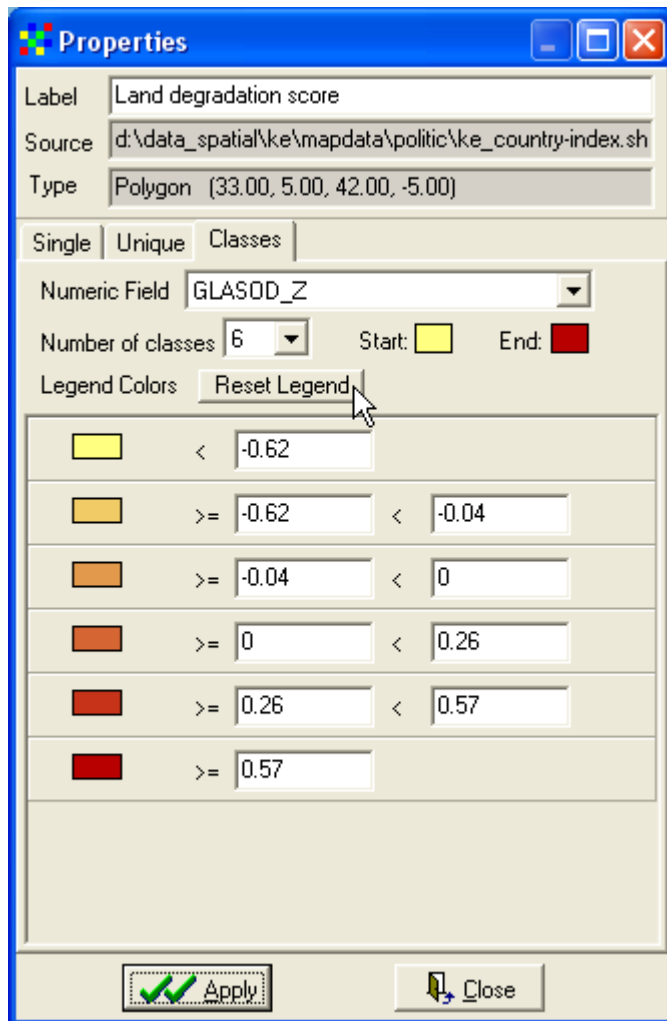
Remember to click the OK button in the Symbol window, and the Apply button in the Properties window. Then click the Classes tab in the Properties window.



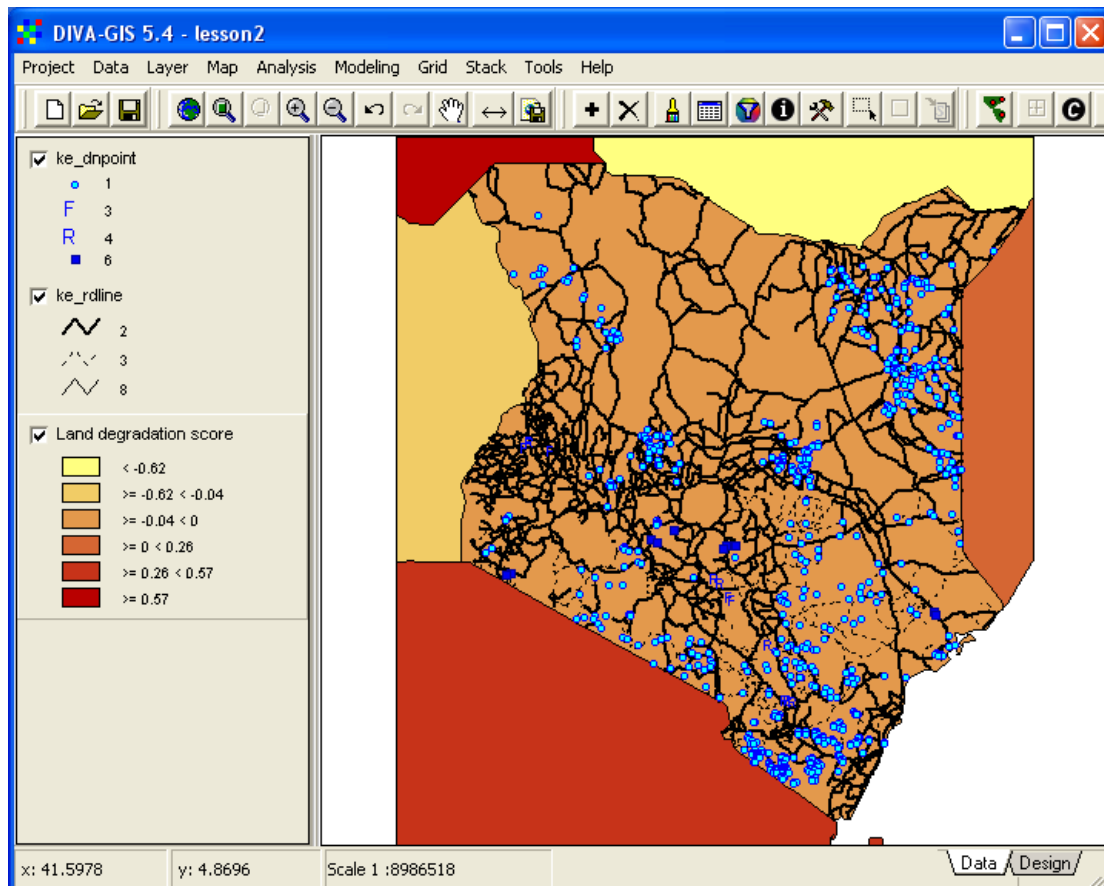
By default DIVA-GIS suggests 3 classes and a predefined color scheme that starts with light yellow and ends with medium blue. From the attribute table DIVA-GIS also calculates class breaks and puts them in the Properties window. If you just click the Reset Legend button, DIVA-GIS will symbolize the countries in the databases using these default settings. Click the Apply button to see the result in the Data View. The Classes alternative for symbolization can only be used for symbolizing numerical data, i.e. data that represent interval or ratio attributes. You can check that out by clicking the drop down menu for Numeric Field, only those fields in the database that contain attributes with numerical value will show up.




Select the field GLASOD_Z, representing interval data on countrywide land degradation for symbolizing the countries included in the database. The higher the value of GLASOD_Z, the higher the land degradation. In the example below the symbolization is set to six classes, and DIVA-GIS automatically finds the natural breaks in the field to set the classes – as there are only six countries in the database, each country gets its own symbol (you can only choose, 1, 2, 3 or 6 classes, as DIVA-GIS otherwise fails to find breaks). The color scheme is set to start with light yellow and end with dark red. Then also the Label was changed to reflect the symbolization (at the top of the Properties window). You must press the Reset Legend to apply the changes in the Properties window and the Data View.

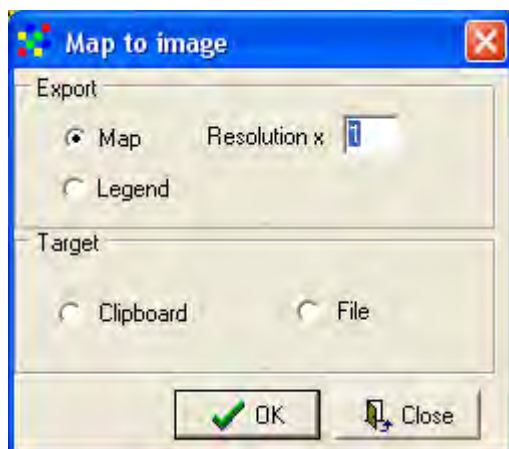


The resulting map then looks like the example below. Note how the Legend label for the country layer also changed – in the example to Land degradation score.



Map to image

If you want to save a Data View and its symbolization for use in a another document (e.g. word or powerpoint) you can easily create an image file, either by clicking the Map to Image button, , or via the menu: Map – Map to Image. A pop up window will allow you to set the output resolution, and then you can export both your Data View and your legend. You can also choose to export to a file, or directly to the windows clipboard. With the latter alternative you can directly paste the image into an open word document by using the paste function in word (or Ctrl-v).



Remember to save the project before finishing the lecture.