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**Precision Agriculture.
(Part 2)**

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Precision Agriculture
Map making and Analysis using SMS Advanced Software
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Task 1: IMPORTING SHAPEFILE INTO SMS Advanced

1. In this lab we will be importing a yield data file. This file is saved under the name YieldN7.shp in your storage folder named “Data”. Please note that the *.shp extension is ESRI (Educational Systems Research Institute, Inc.- a leading GIS software maker) shapefile format. The other file that we will use is saved under the name veris.shp, again a shapefile format.
2. The steps outlined below may be followed to import both the shapefiles and for creating a map:
 - i) Go to the File menu and select Import and then Spatial File...
 - ii) Set the file type to ESRI Shape and then select the desired files one by one starting with YieldN7.shp followed by veris.shp in the Open dialog. Click Open once you make your selection.
 - iii) A preview map of the data contained in the selected file will now be displayed. Click the Next> button to continue.
 - iv) Now select a Data Type for the imported data. Under Import Data Type selection, accept the default option of Generic Attribute Data. Click the Next> button to continue.
 - v) A new window, Select Column Attributes will be open now. You can select specific attributes that you want to map in SMS, if desired. For the YieldN7.shp file, attributes such as ALT, YIELD_KG_H and MOISTURE will be selected for mapping. Click on the desired column. A new window named Column Settings will open. Check the box ‘Use this column’. Accept default option of Use attributes. Select ‘General’ under attribute group and ‘Elevation’ under attribute group. Take a look at the Description statement of the selected item. Now, Click OK. Repeat the same step for the two other attributes. For describing yield attributes, select ‘Grain Harvest’ group and create a new attribute named ‘Yield’. Other options to be selected for this new attribute on Attribute Editor are, Attribute Group: Grain Harvest, Data Type- Decimal Number, Dimension- Small Mass Yield, Display Units- Kg/h, and Total Units – kg. Similarly for defining MOISTURE attributes, select ‘Grain Harvest’ group and ‘Moisture’ attribute from the displayed option. Once the desired attributes have been selected, the Save Template button can be used to save the column settings as a custom template for future use. Click Next> when done.
 - vi) Under the Management Selection window, Add Grower, Farm and Field name according to your own choice. Year option should be changed to 2002, Operation type

selected should be 'Grain Harvest' and crop type should be 'Soybeans'. Click next and then Finish. Click on YieldN7.shp and Create New Map. Indicate the answer for each of the following:

Min yield:

Max yield:

Mean yield:

Median yield:

- vii) Follow the same steps, 1 to 3(i)-(iv), for importing the veris.shp file. Attribute named LOWEREC_MM will be used for mapping purposes. Using 'Crop Production' attribute group, select the attribute 'EC Shallow'. Click OK and then next. Select the same options as used for the YieldN7 layer in the Management Selection window for Veris layer too except that 'Soil Sampling' should be selected under select operation. After selecting product type as 'Soybeans', click next and Finish. Add this layer to the current map using the appropriate steps as learned in previous labs. Indicate the answer about EC values for each of the following:

Min EC value:

Max EC value:

Mean EC value:

Median EC value:

Task 2: Manually creating Field Boundary

Often, point yield data is supplied without boundary information. SMS Advanced allows you to create the boundary manually. Thus, this operation enables you to digitally measure total area of field(s) under cultivation. A boundary can be created using the following steps:

- a) You will be creating a boundary for the field for which you already have created the yield map in the previous task. Keep yield map as active layer.
- b) From the File Menu, select New then Boundary Layer or click on the New Boundary icon on the Map Toolbar.
- c) The Boundary Editor dialog will now appear with a copy of the layer(s) that was in the Map window.(Hint: Use yield layer for boundary creation)
- d) Use the tools in the toolbar to obtain the desired boundary. Click the Set Field Boundary button and fill in the grower info. This will save the boundary info as part of the field info. Click close. Add boundary layer to the current map document. What is the field size? _____.
- e) Adjust the transparency level in order to see other layers below the boundary layer.

Task 3: Using Layer/Attribute Property Options

You will explore the changes that can be made on the map by using the Layer and Attribute property command.

- a) Make Yield layer active.
- b) From the Edit Menu, select Layer Options or click the Edit Options button located below transparency scale on the right of the map.
- c) Under the Layer Options, click on Label Selection button and then check the box beside Show Area statement.
- d) Click on the Attribute (Yield) Options button. Click on the Grid/Contour/Clip button. Under the Clipping Options box, select option “Clip to Field” by clicking.
- e) Now, change the default grid size values of x and y to 10 m * 10 m. Also change the maximum distance value under Inverse Weighted Distance to 15 m without changing the Distance Ratio. Click Apply and then Ok.
- f) Generate contour map of the yield layer. Notice yield values have changed. Again make a note of the values:
 Min yield:
 Max yield:
 Mean yield:
 Median yield:
- g) Repeat the same procedure by changing grid size to 5m * 5 m, maximum distance value to 10 and click Apply followed by Ok.
- h) What happens to the yield values?
- i) Why have these values changed?
- j) What did you learn from changing grid size values?
- k) Adjust legend properties and reduce yield ranges to four values. You will notice that area values under each yield range are showing up on the map. It is because in step c) above, you checked show area box under Label Selection button. Area values won't show up if you uncheck the box.
- l) What other method you can use to find the area under each yield range if the Label Selection button is not used? (Hint: You did a similar kind of exercise in previous labs)

Task 4: Querying Data Layers

SMS Advanced also allows you to query data layers to get the information you might be looking for.

- a) You already have a Veris layer and a boundary layer in the map window.
- b) Create a contour map of Veris EC layer by clipping it to the field boundary.
- c) From the Map menu, select ‘Select Intersection’ option under Select Type .
- d) Now select a selection tool from the Map menu by selection Select Tool and then choosing one of the tools or click on the Select Tools icon in the Map toolbar and choose one of the options.
- e) Based on the selected type and tool make a selection on the active layer/map.
- f) Once the selection is made go to the Map menu, select Query Tools and then Query Current Layer or click on the Query Current Layer icon on the Map Toolbar.

- g) A numbered query result will now be displayed in a window that appears inside the Map window, labeled Query Results. These results can be printed by going to the File Menu and selecting Print and then Query Results.
- h) Click the Reset Cursor icon on the Map Toolbar or select a different tool to clear any selections and deactivate the selection tool. To clear the contents of the Query Results window go to the Map menu and select Query Tools and then Clear Query Results or select the Clear Query Results icon from the Map Window Toolbar.
- i) Note down the results of one of the query in the format given below:
 Total area:
 Minimum EC:
 Maximum EC:
 Average EC:

Task 5: Creating a Variable Rate Prescription Map

Follow these steps to create a variable rate prescription data set:

- i) Use the contoured yield map for creating a fertilizer prescription map.
- j) Once the reference layer to be used for the prescription has been made active, go to the File menu and select New and then Prescription Layer or select the New Prescription icon from the Map Toolbar.
- k) The Prescription Reference Layer Selection dialog should now appear. Accept the default layer and click Next.
- l) The Prescription Attribute Type and Units Selection will now appear. Select Fertilizing Prescription(Dry) as an Operation type. Now select a rate attribute type for the prescription data, i.e. Target rate (Mass). Finally, select rate units for the selected rate attribute, i.e. kg/ha.
- m) Click Next> once all the required information has been set for the new prescription dataset.
- n) The Edit Prescription Legend dialog will now appear. Select the number of ranges equal to the number 3. It means we shall be applying fertilizer at three rates in the whole field. Enter individual values of 100, 80 and 60 for each range corresponding to fertilizer rates of 100 kg/ha, 80 kg/ha and 60 kg/ha respectively. The range values will be automatically sorted as values are entered, from high to low at the bottom. Click the Next> button once the prescription legend is complete.
- o) The Assign Legend Ranges dialog will now appear. Click on one of the ranges under Prescription Legend Values and it will become highlighted. Now click on the first three ranges under Reference Layer Values and Map and the selections will all become highlighted. Click the Add>> button to assign the selected Reference Layer value(s) to the Prescription Legend value that was selected. This assignment of values is displayed under Legend Assignment View.
- p) Repeat the steps above, selecting two ranges under Reference Layer Values until all the reference layer values have been assigned to values from the prescription legend. Click the Finish button after all the desired assignments have been made.

- q) The Prescription Editor dialog will now appear. The new prescription dataset will be displayed in it and the Prescription Legend that was used to create it. The prescription dataset that has been created is a vector dataset by default. Convert the map into raster, by selecting the Convert Prescription tool. Select grid size of 3 m each and click at Grid All button and then Ok. A gridded layer will be shown.
- r) Measure the area of the polygon under each prescription. Note, area values appear in the information bar below the map window. Note down these values in the table given below and answer questions based on this information:

Fertilizer Rate (kg/ha)	Area under each rate (ha)-from raster map	Cost of applying fertilizer *
100		
80		
60		
Total Area=		

* (Hint: assume cost of per kg of fertilizer as \$ 0.60).

What will be the total cost of fertilizer requirement for the whole field considering a uniform application rate of 100 kg/ha?

How much is the cost saving by variable rate fertilizer application by creating prescription map zones vis-à-vis on uniform basis?