Dynamic Image Processing for Landuse Analysis & Precision Agriculture

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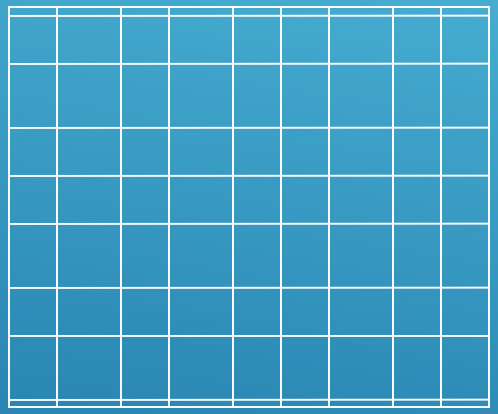
CONCEPT OF PRECISION AGRICULTURE

"Farming by the Square Foot"

Traditional Mgt.

1-10+ Acres

Precision Mgt.

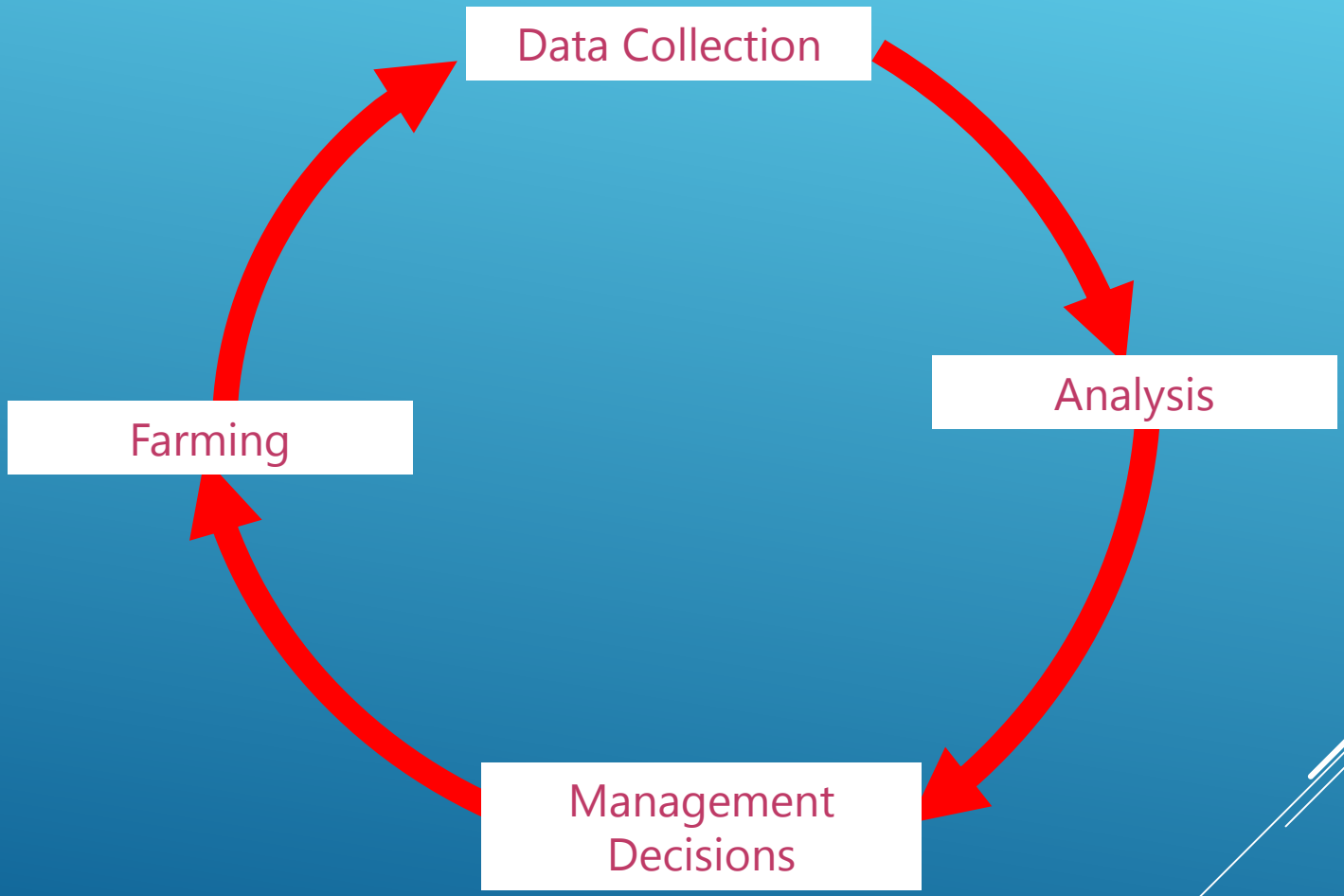


0.1-0.001 Acre

COMPONENTS OF PRECISION AGRICULTURE

- Remote Sensing
- Spatial Decision Support System (IDSS)
- Differential Global Positioning System (DGPS)
- Variable Rate Applicator (VRA)

PRECISION FARMING CYCLE



BACKGROUND

- Implementation of Precision Agriculture helps in optimizing the use of agricultural inputs to reduce the negative environmental impact and to maximize profitability by using geospatial information to better understand the soil properties, crop performance and the spatial variability in the soil.
- Geographic Information Systems (GIS) have been used in Precision Agriculture to better understand, Measure, Visualize, Analyze and interpret the spatial heterogeneity and yield variability of the soil. The aim of this project is to develop an Extension for ArcGIS Desktop which provides the various tools to process geospatial data for any agricultural field.
- The Integrated Spatial Decision Support System for Precision Agriculture extension developed is specifically customized for processing of agricultural data and to meet the key requirements.

OBJECTIVES

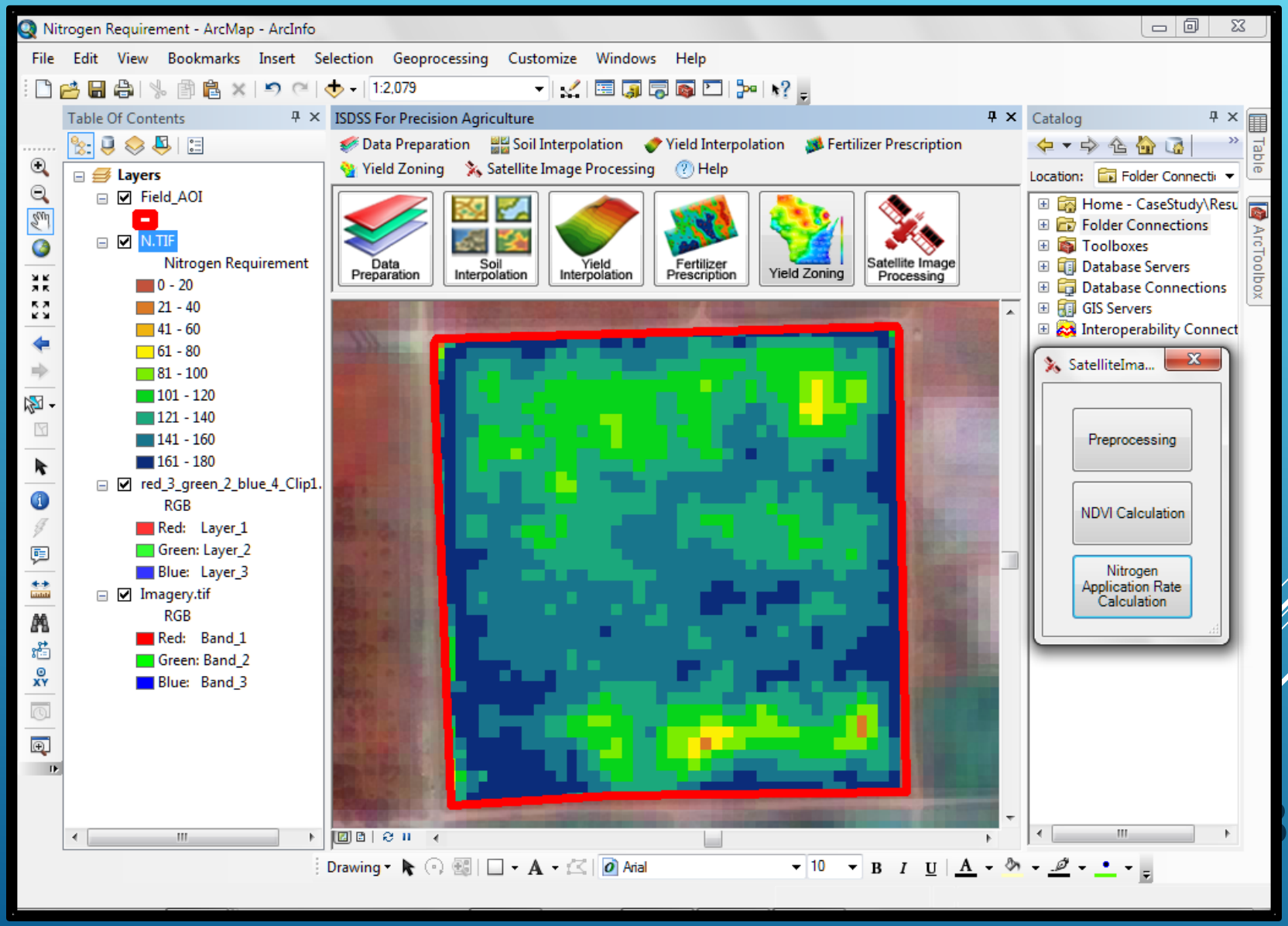
The specific functionality of the Application can be summarized as follows:

1. To Work as an Integrated Spatial Decision Support System for Precision Agriculture.
2. To Interpolate Soil Parameters like Potassium (K),Organic Matter(OM),pH, Phosphorous to Aluminum Ratio(P/Al) using Spatial Modelling techniques.
3. To perform Yield Interpolation for Crops such as Corn.
4. To develop Fertilizer Application rate Maps for Phosphorous (P_2O_5), Potassium(K_2O),Lime (CaO),Nitrate (NO_3^-)
5. To develop Yield Zoning Maps for Nitrate(NO_3^-)
6. To perform Certain Satellite Image Processing functions.

Designing the Application:

- Precision Agriculture Extension for ArcGIS Desktop 10.x has been developed using C#. A Customized extension for Precision Agriculture was created and integrated in a customized Dockable window user Interface.
- The Graphical User Interface for the customized Models, Tools, Menu strip, Forms and Customized Icons for the Models and Tools were created.
- Models were created for the tools.
- Python scripting was used as the general-purpose programming language for geoprocessing.
- Application extensions such as buttons, Dockable windows and tools are used to coordinate activities between other components

Calculating Nitrogen Requirement :



ISSSPA Modules

(a) Data Preparation module :

Creating a Soil Sample Grid and Points for collection of samples.

(b) Soil Interpolation module :

Creating Soil Interpolation Maps using Geostatistical Analysis.

(c) Yield Interpolation module :

Calculating the yield for various crops.

(d) Fertilizer Prescription module :

Generating the prescriptions for various fertilizers.

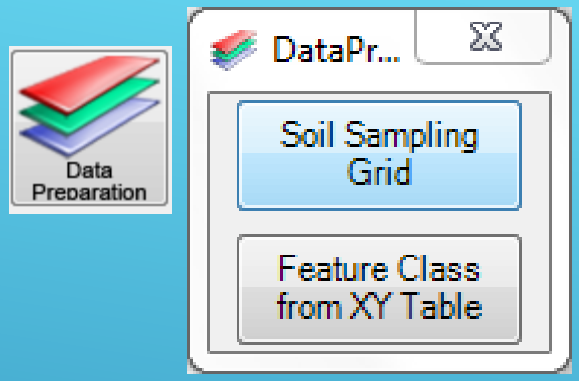
(e) Yield Zoning module :

Creating the Yield management zones.

(f) Satellite Image Processing

Used for NDVI and Nitrogen Application Rate Calculations.

(a) Data Preparation module.



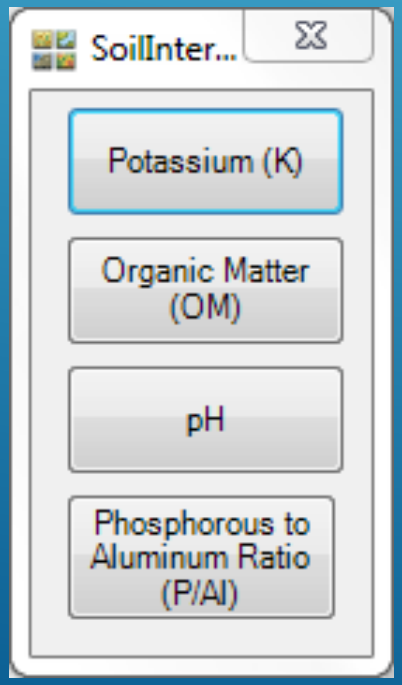
Soil Sampling Grid

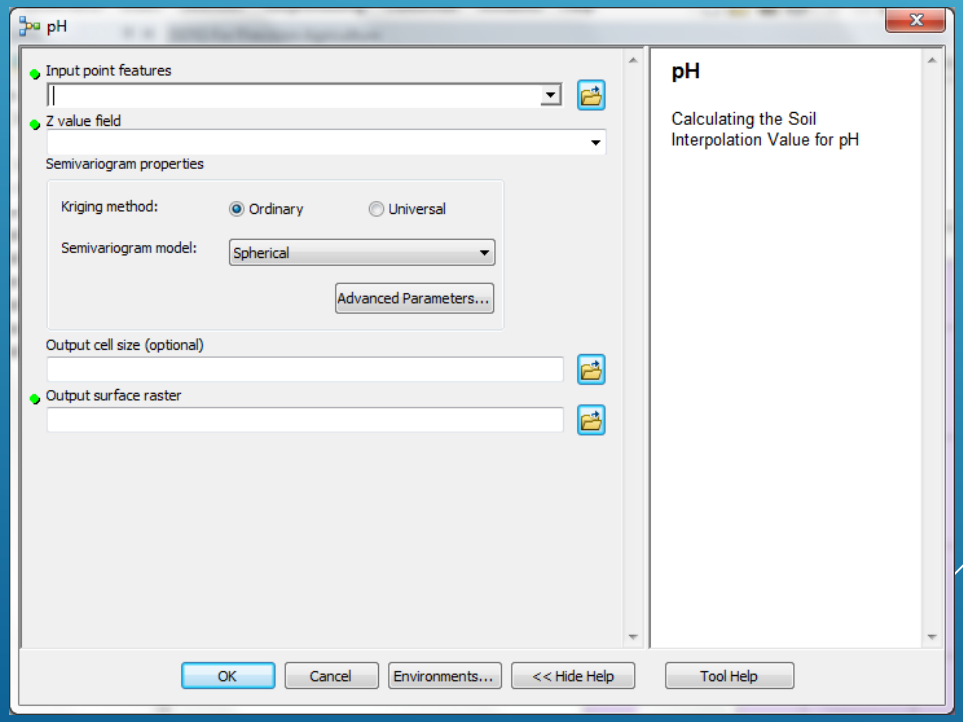
The Soil Sampling Grid creates a feature class containing a net of rectangular cells. This tool requires three basic pieces of information: the spatial extent of the Agricultural Field, the number of rows and columns, and the angle of rotation.

X, Y coordinates describe points on the earth's surface such as the location of Soil samples in a Agriculture Field or the points where water samples were collected. The X,Y Coordinates can be easily collected using a GPS.

(b) Soil Interpolation module

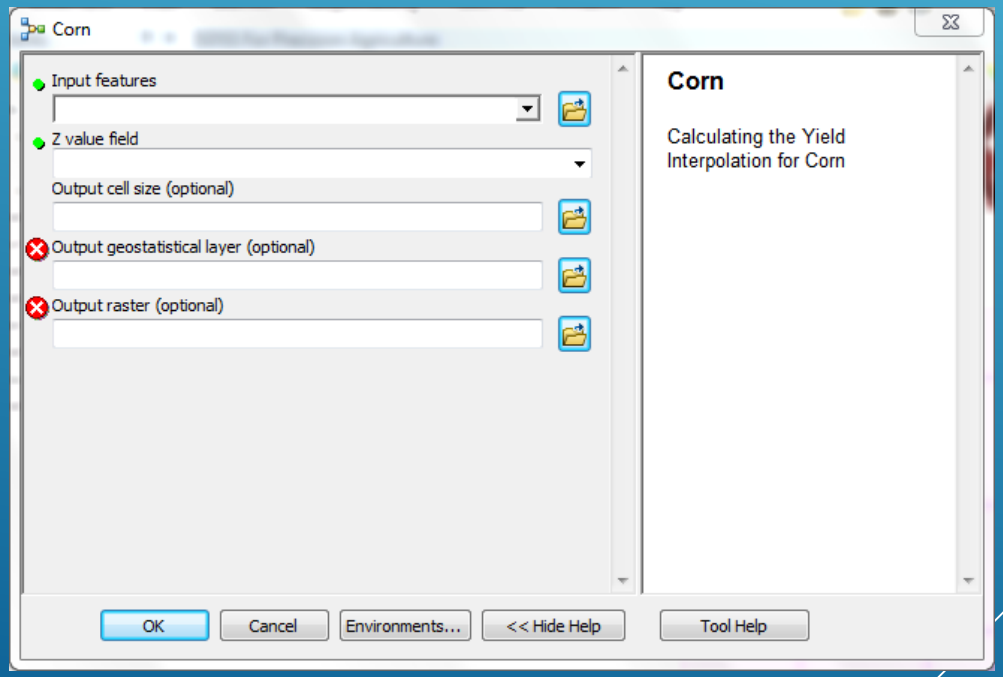
- Detailed soil sampling has become possible by the integration of GPS and GIS tools available to precision agriculture.
- As part of this development work, tools for generating the soil properties variability maps for Potassium (K), Organic Matter (OM), pH, Phosphorous to Aluminum Ratio (P/Al) have been developed.





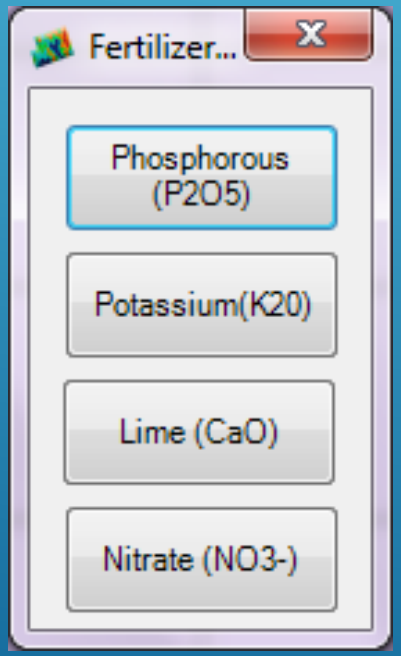
(c) YIELD INTERPOLATION MODULE

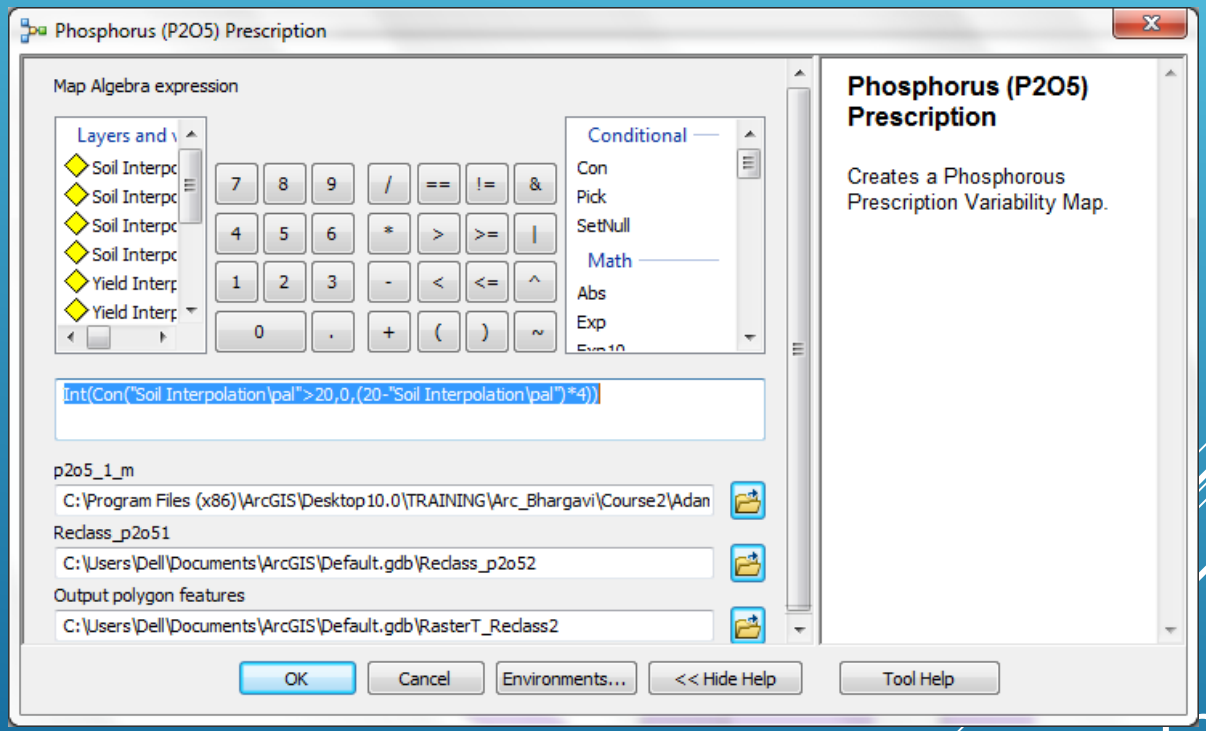
- Yield monitoring and mapping is one step in precision agriculture which is often recommended as a first step to carry out in precision agriculture (Krill 1996).
- Tools for generation of the Various Yield variability maps have been developed for Corn, Soybean, and Wheat by using spatial analysis of point samples from various years.



(d) FERTILIZER PRESCRIPTION MODULE.

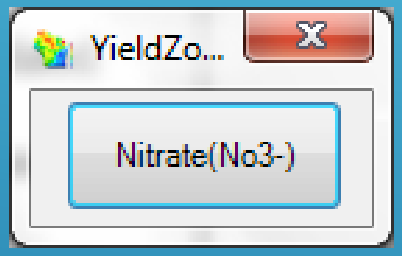
- Prescription variability maps for Phosphorous (P2O5), Potassium (K2O), Lime (CaO), Nitrate (NO3-) have been created.

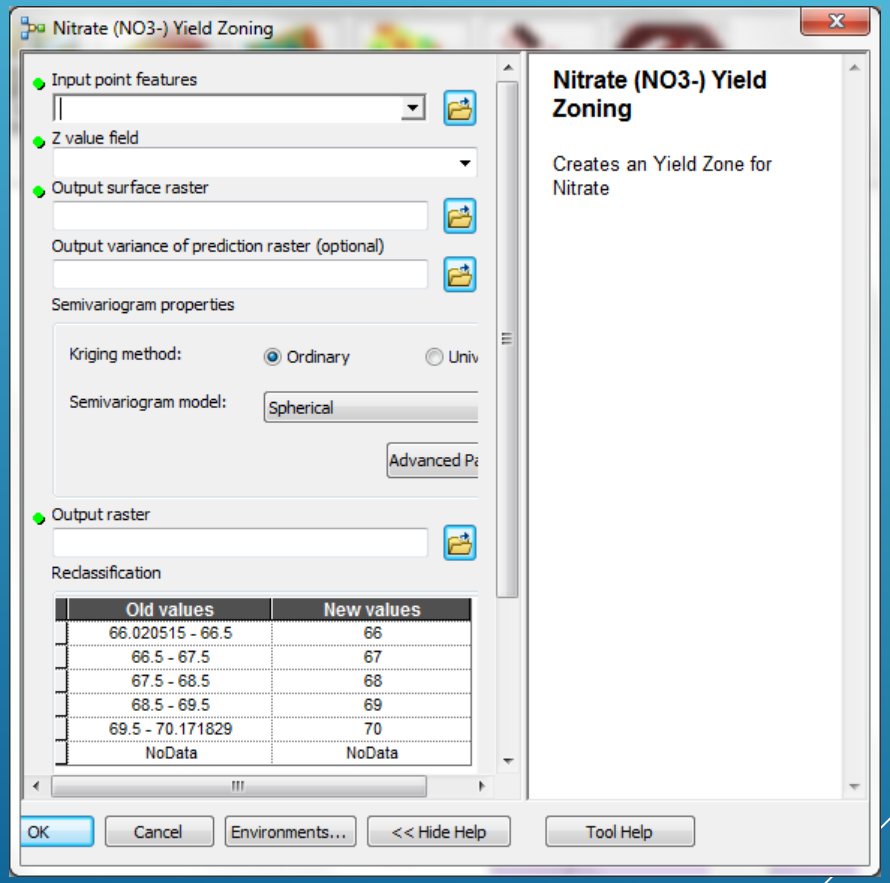




(e) YIELD ZONING MODULE.

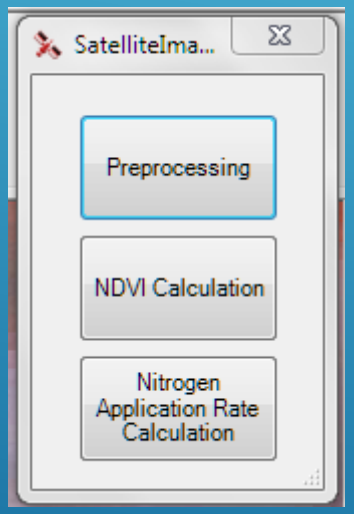
- Yield-based management zones based on multiple years historical yield data can be generated.

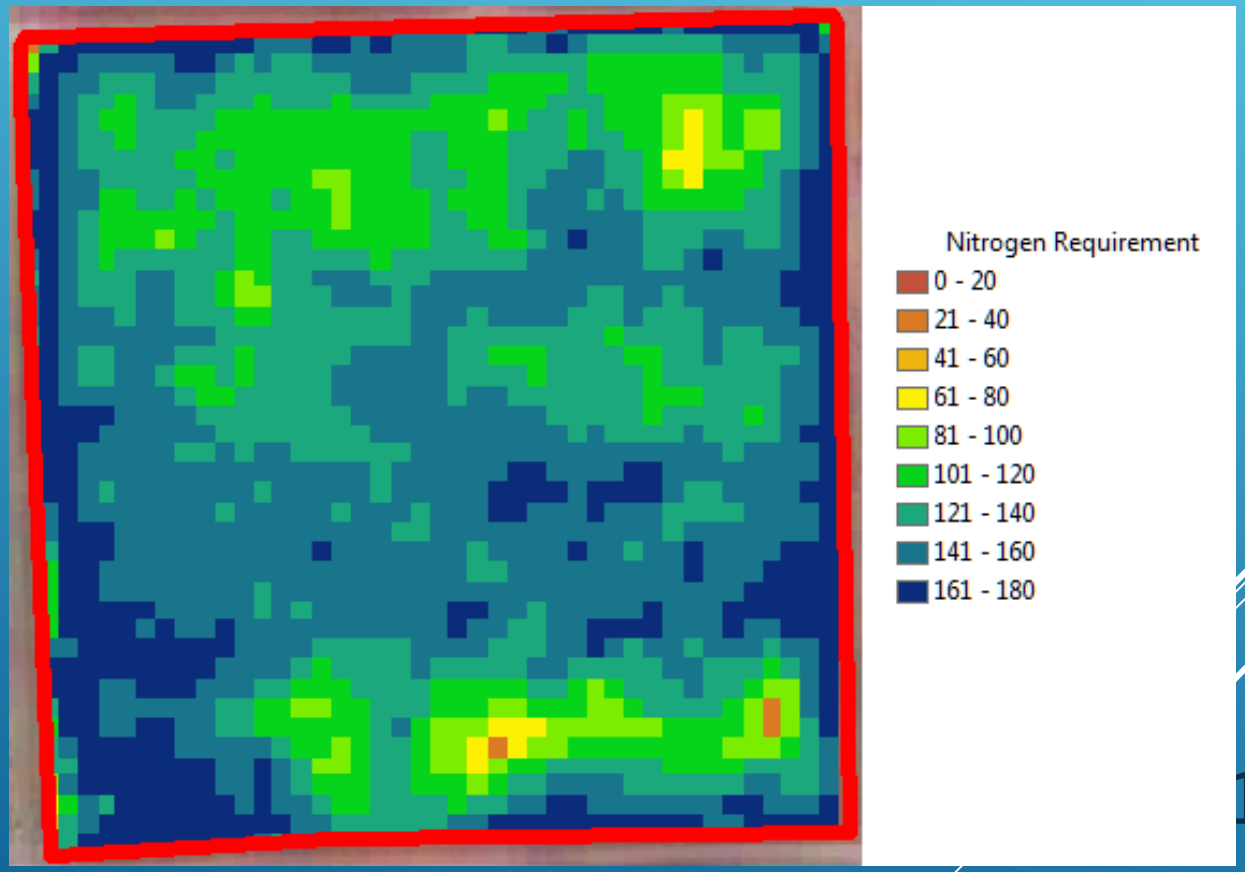




(f) SATELLITE IMAGE PROCESSING

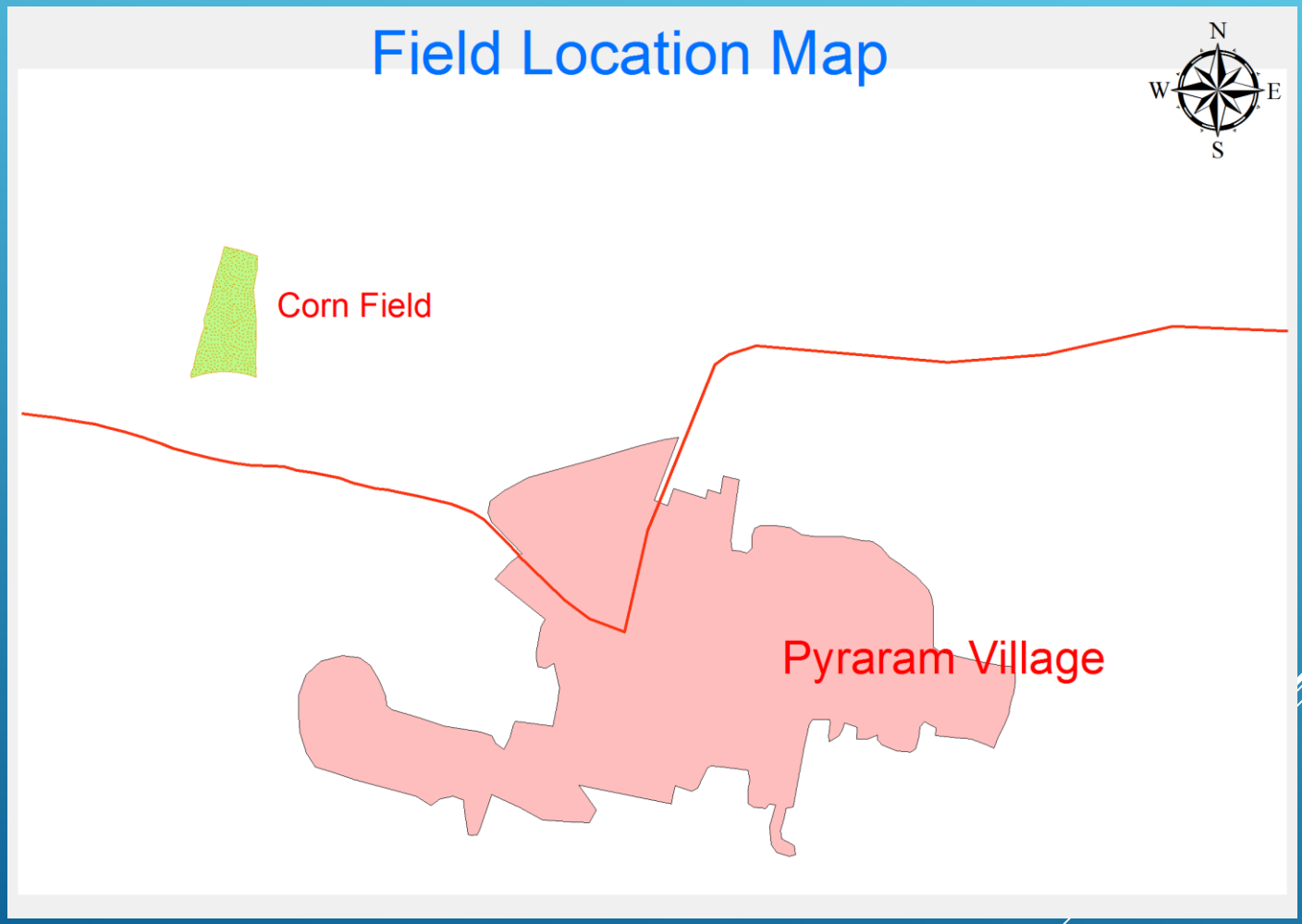
- Preprocessing, NDVI Calculation and Nitrogen Application Rate Calculation.





Field Study-Corn Field

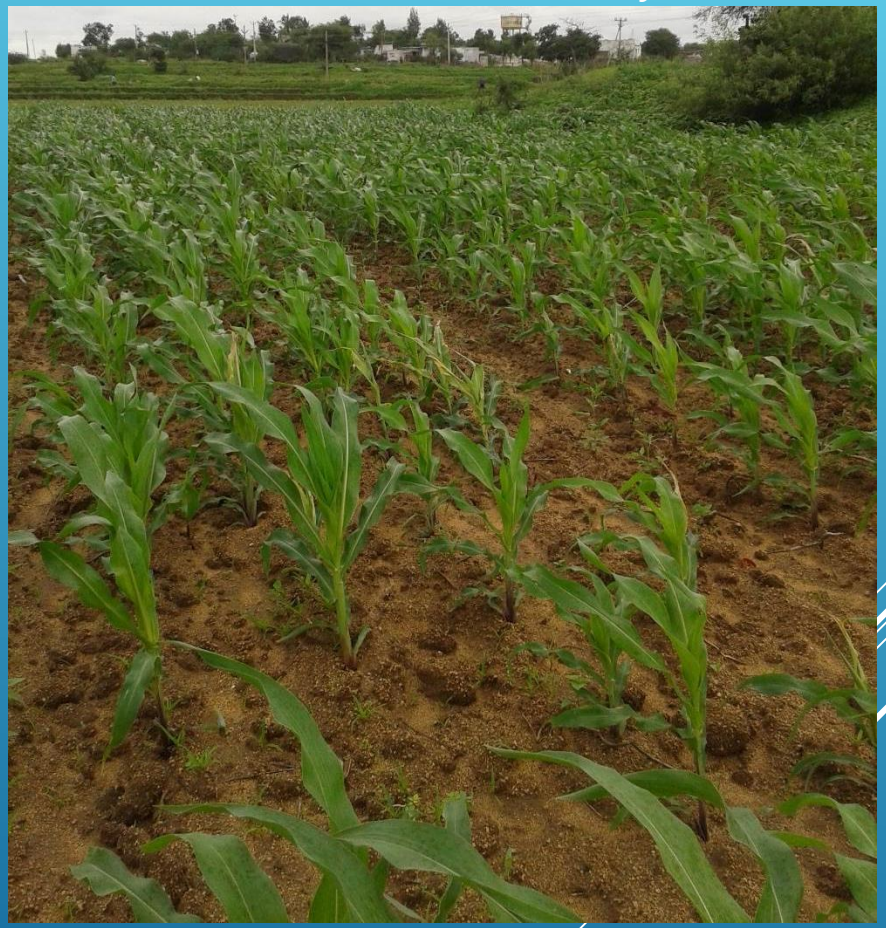
A Corn Field in Pyararam (V), Bommala Ramaram Mandal, Nalgonda District, India



FIELD DATA COLLECTION

Soil Sampling

Corn Cultivation at 28 days

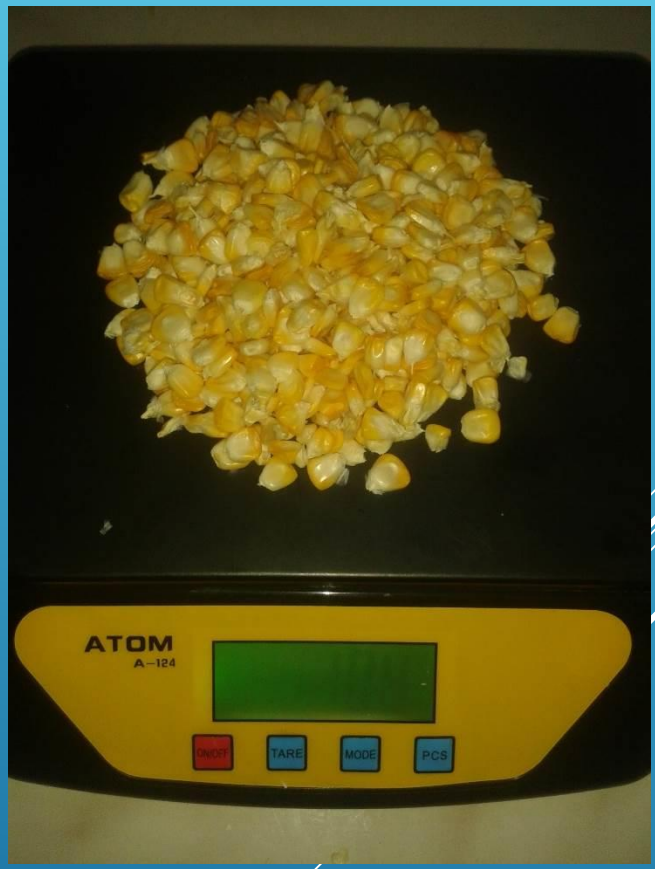


YIELD ESTIMATION

Various Corn Ear Sizes obtained 13,15,17,18,20 Centimeters

Corn of 15 centimeters with 484 Kernels in 14 Rows

Corn of 15 centimeters-Yield 160 Grams



Project Status-Road Map

- The Overall Structure of ISDSSPA is defined.
- Six modules have been developed & two more are to be added.
- Agriculture sites have been selected and evaluation of the models is in progress.
- Integration of Imagery from UAV is being planned.
- Mobile Application is under planned.
- Identification of partners in Canada is in Progress.
- Subject Matter Experts on Precision Agriculture are being consulted in Canada.
- ArcGIS Pro - Beta Version is planned to be released in June 2017.

Thank You