PA- Lecture-1-

Dr. Heman Abdulkhaleq Ahmed

Department of Field Crop and Forestry

Precision Agriculture: An Introduction

Precision agriculture combines new technologies with the agricultural industry to manage crops more precisely. It matches inputs with crop needs for small areas within a field. It has been called GPS agriculture or variable-rate farming, but information is the key ingredient for success. Precision farming manages small areas within fields and requires sound agronomic practices. Good farm management should be in place before adopting precision agriculture.

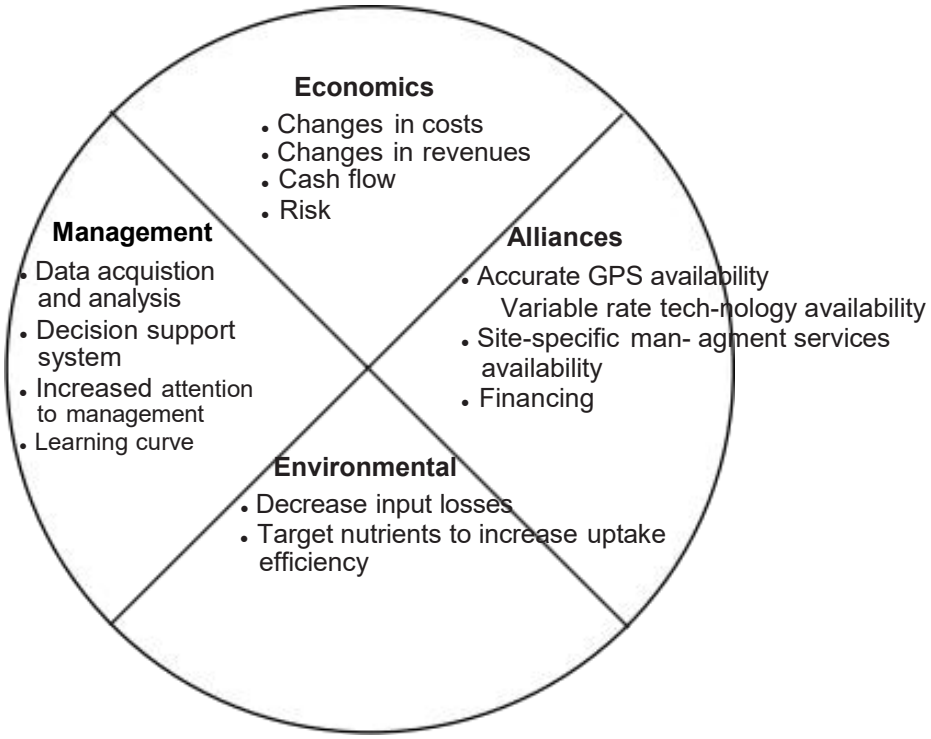

Figure 1. Issues affecting adoption of precision agriculture management.

Tools of precision agriculture

1- Global Positioning System (GPS) receivers

GPS satellites send signals to receivers that calculate position in real time, providing continuous location data while moving. This allows for mapping of soil and crop measurements and returning to specific areas for sampling or treatment. To improve accuracy for agriculture, a differential correction from land or satellite-based sources is needed. This can provide accuracy of 3-10 feet. When buying a GPS receiver, consider the type and coverage of differential correction available in your area of use.

2- Yield monitoring and mapping

Grain yield monitors measure grain flow in a combine and can provide data for yield maps when linked with GPS. Yield measurements are important for management decisions, but environmental factors should also be considered. Proper use of yield information helps determine effects of inputs and cultural practices. Examining records from several years helps determine if yield level is due to management or climate-induced.

3- Grid soil sampling and variable-rate fertilizer (VRT) application

Soil samples are taken from random locations and sent to a lab for testing. Crop advisors use the results to make fertilizer recommendations. Grid soil sampling intensifies the process by taking multiple samples in a systematic grid, allowing for mapping of nutrient needs. These maps are used to create application maps, which are loaded onto a computer mounted on a variable-rate fertilizer spreader to adjust the amount and type of fertilizer applied according to the map.

4- Remote sensing

Remote sensing collects data from afar using devices, aircraft, or satellites. It evaluates crop health and detects stress related to moisture, nutrients, diseases, and other concerns. It can determine in-season variability affecting yield and optimize chemical use with scouting analysis.

5- Crop scouting

In-season observations of crop conditions may include:

- **Weed patches (weed type and intensity)**
- **Insect or fungal infestation (species and intensity)**
- **Crop tissue nutrient status**
- **Flooded and eroded areas**

Using a GPS receiver on an all-terrain vehicle or in a backpack, a location can be associated with observations, making it easier to return to the same location for treatment. These observations also can be helpful later when explaining variations in yield maps.

6- Geographic information systems (GIS)

GIS uses computer hardware and software to create maps using feature attributes and location data. Agricultural GIS stores info like yields, soil survey maps, remote sensing data, crop scouting reports, and soil nutrient levels. It can display geographically referenced data for visual interpretation and evaluate management scenarios by combining and manipulating data layers.

7- Information management

Precision agriculture needs management skills and information databases. Farmers must know business objectives and important data to make decisions. Effective info management needs more than tools, it requires an entrepreneurial attitude toward education and experimentation.

8- Identifying a precision agriculture service provider

Farmers should consider custom services for site-specific crop management. Precision agriculture services can reduce costs and increase efficiency through shared equipment and specialist skills.
Service providers must find committed customers to justify investing in equipment and resources for precision agriculture. This leads to clusters of adopters around the established providers.

A management example

Farm management requires an incremental approach, implementing one or two tools at a time. Yield maps from a Missouri farm show changing patterns from year to year. The high yield areas were in the north-central and southern one-third of the field. Soil test maps showed low values of phosphorus and potassium in the northern area and higher soil pH values in the southern area due to past management practices and limestone dust. Liming other parts of the field could correct this issue.

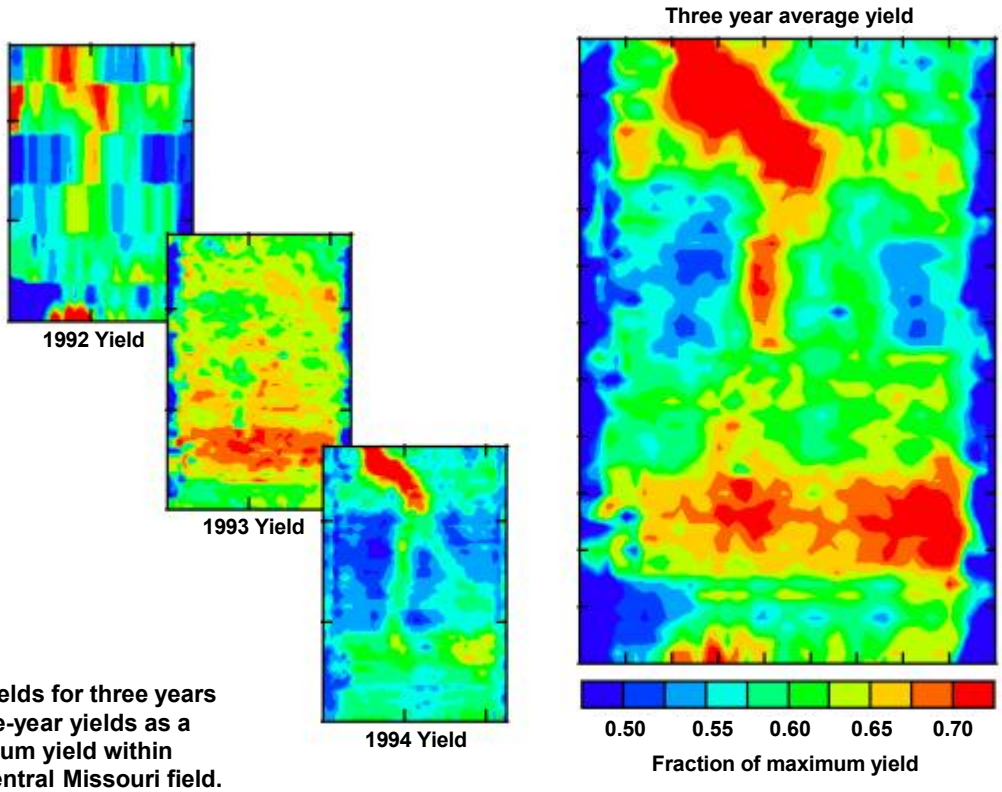

Figure 3. Grain yields for three years and average three-year yields as a fraction of maximum yield within each year for a central Missouri field.

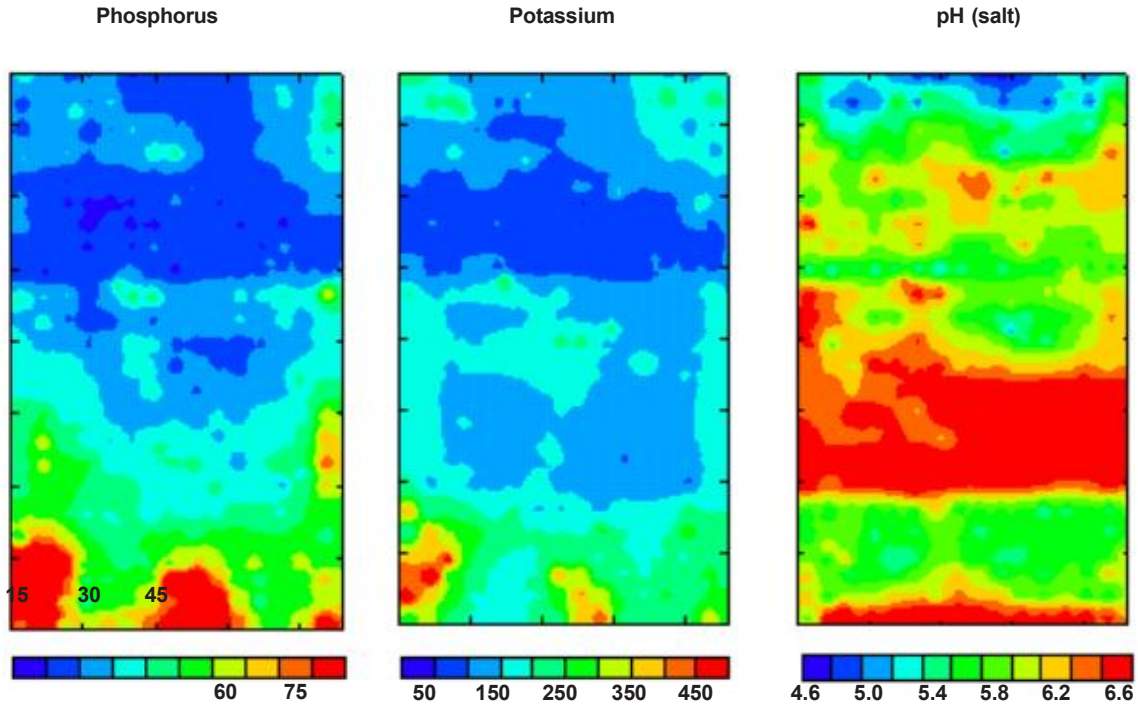

Figure 4. Soil test phosphorus, potassium and pH for a central Missouri farm.

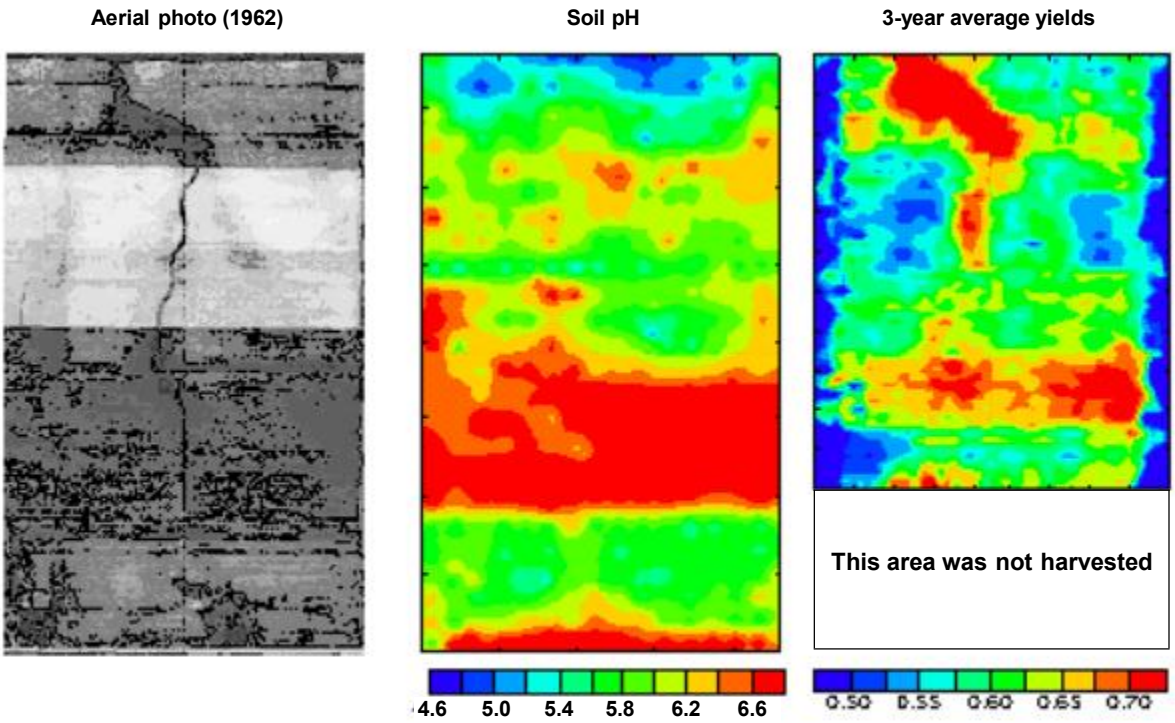

Figure 5. Aerial photograph, soil pH and 3-year average grain yields for central Missouri farm.