Precision farming

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Basic concept of Precision Farming

Assessing variability

- Existing variability

Managing variability

- Land leveling
- VRT
- Site specific planting
- Site Specific Nutrient Management
- Precision water management
- Site specific weed management

- Variations occur in crop or soil properties within a field.
- These variations are noted, and often mapped.
- Management actions are taken as a consequence of the spatial variability within the field.

What Is Precision Farming?

Precision Farming is a management philosophy or approach to the farm and is not a definable prescriptive system.

The spatial variability within that field. Development of geometrics technology in the later part of the 20th century has aided in the adoption of site-specific management systems using remote sensing (RS), GPS, and Geographical information system (GIS). This approach is called PF or site specific management.

Example:

- **Yield monitoring**
- **Yield mapping**
- **Variable rate fertilizer**
- **Weed mapping**
- **Variable spraying**
- **Topography and boundaries**
- **Salinity mapping**
- **Guidance systems**
- **Records and analyses**

Precision Farming and its Objective

It is defined as the application of technologies and principles to manage spatial and temporal variability associated with all aspects of agricultural production (Pierce and Nowak, 1999).

In other words, precision farming is the matching of resource application and agronomic practices with soil attributes and crop requirements as they vary across a field.

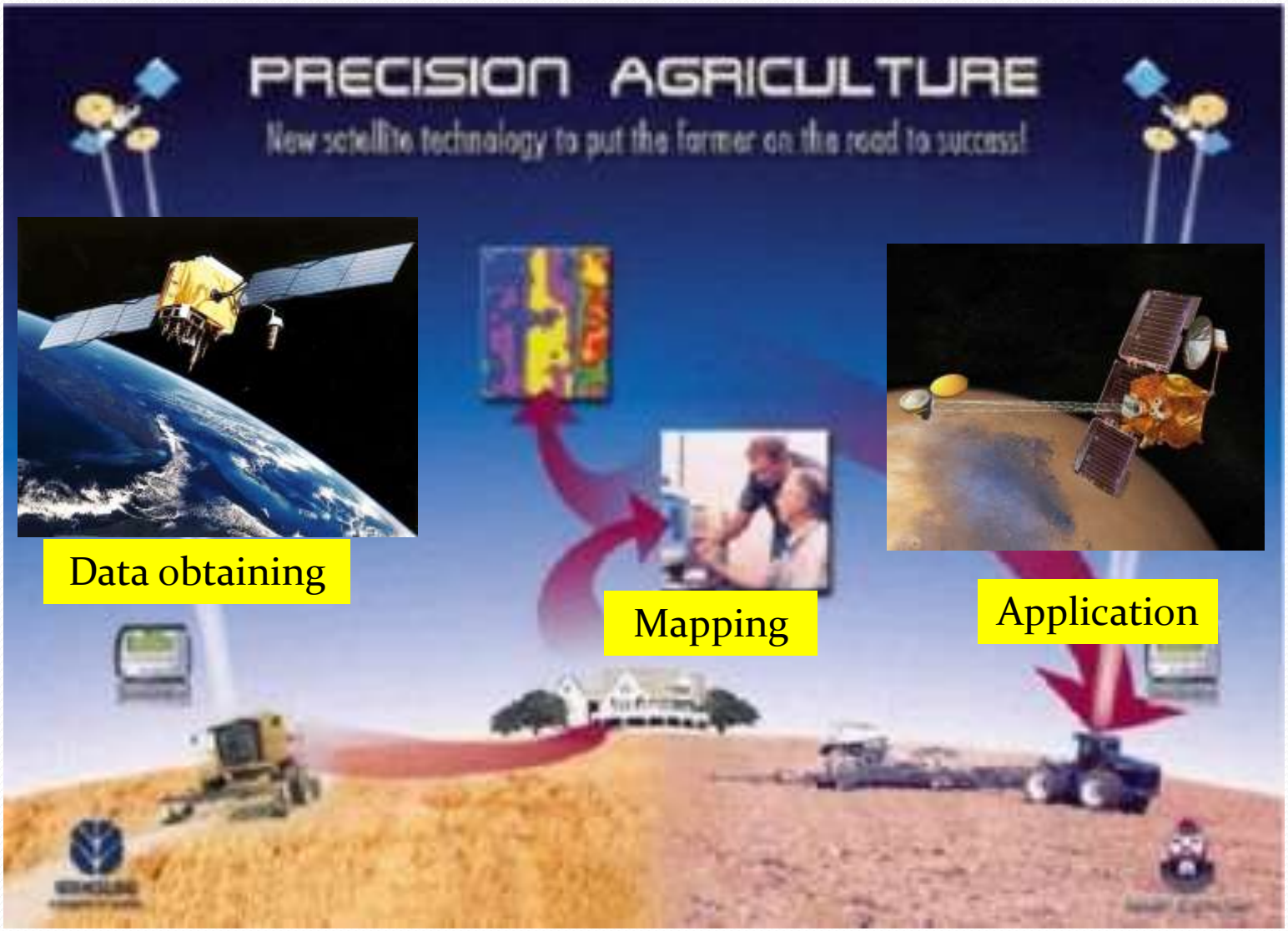
•Precision farming aims to improve crop performance and environmental quality.

Component of precision farming

1. Remote sensing
2. Global Position System
3. Geographical information System
4. Farmers

The **first phrase** is **'Spatially variable**', **'GPS based**', 'Prescription', **'Site-specific'** or 'Precision',

The **second phrase** can be **'Farming'**, '**Agriculture**' or **'Crop production**'.


PRECISION AGRICULTURE
New satellite technology to put the farmer on the road to success!
Data obtaining
Mapping
Application

Developments which prompted PF

Many technological developments, which occurred in 20th century contributed to the development of the concept of precision farming. These technological developments are as follows.

1. **Global Navigation Satellite System**
2. **GPS-Guided agricultural machinery**
3. **Geographical Information Systems (GIS)**
4. **Remote Sensing**

Technology for precision farming

The new tools applicable to this PF are such as RS, GPS and GIS. Three aspects such as

•Data collection, → Analysis or processing → Recommendations

Technologies required are as follows:

Mapping

The generation of maps for crop and soil properties is the most important and first step in PF. Data collection occurs both before and during crop production and is enhanced by collecting precise location coordinates using the GPS. Grid soil sampling, yield monitoring, RS and crop.

Scouting

Mapping can be done by RS, GIS and manually during field operations.

Geographic Information System

What are the Parts of a Geographic Information System?

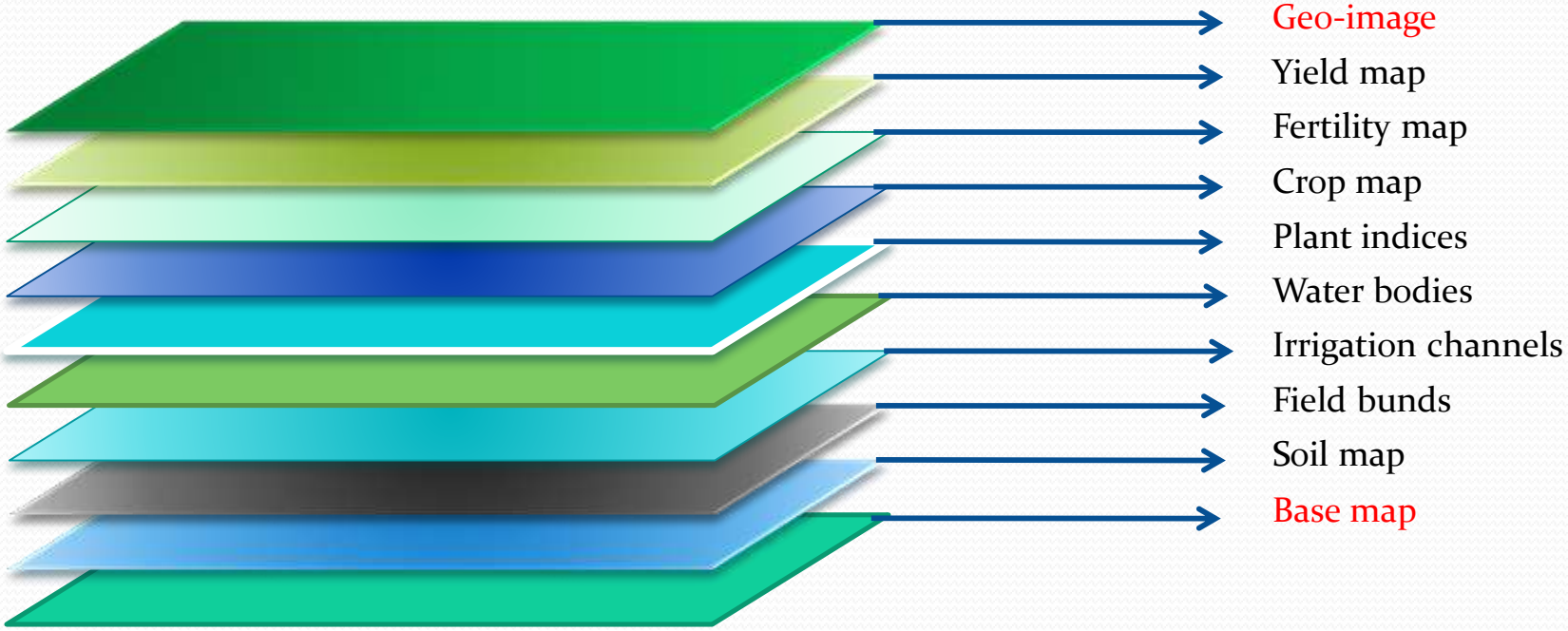
A geographic information system (GIS) is a computer system capable of capturing, storing, manipulating, and displaying spatially referenced information. Intermediate step because it combines the data collected based on sampling regimes, to develop the process models, expert systems, etc.

The manipulation of spatial information had begun in the 1960s,

- Weed control,
- Pest control and
- Site-specific Fertilizer application
- Drought monitoring,
- Yield estimation,
- Pest infestation monitoring and forecasting

GIS coupled with GPS, microcomputers, RS and sensors

DATA LAYERS



GIS – layers of related information

i) Bare soil imagery
ii) Topography
iii) Farmer's experiences

Data in GIS

Spatial data

Maps prepared either with the help of field surveys or with the help of interpreted remote sensed data.

Non-spatial data

Attribute as complementary to the spatial data and discrete what is at a point, along a line or in a polygon and as a socio-economics characteristics from census or other sources.

Topologies of spatial data in GIS

The spatial data in GIS is generally described by X,Y co-ordinates and descriptive data are best organized in alphanumeric fields.

GIS features can be classified in to three categories :

Points Refer to single place and usually considered as no dimension.

Lines Represents the linear feature and consists of series X, Y co-ordinate pairs with discrete beginning and ending points.

polygons Polygons are characterized by area and perimeter and closed features defined by set of linked lines enclosing an area.

Data structure

GIS represents these features in different types of structure.

1. **Raster Model**
2. **Vector Model**
3. **Quadree model**

Fist two are most popular in GIS packages available in the market.

Raster Model Represents the image with help of square lattice grids.

Vector Model Represents the geographical features by a set of co-ordinates vectors as X Y co-ordinates define points, lines and polygons.

GIS Data base design

The GIS has two distinct utilization capabilities

1. First pertaining to querying and obtaining information.
2. Second pertaining to integrated analytical modeling.

Important GIS packages

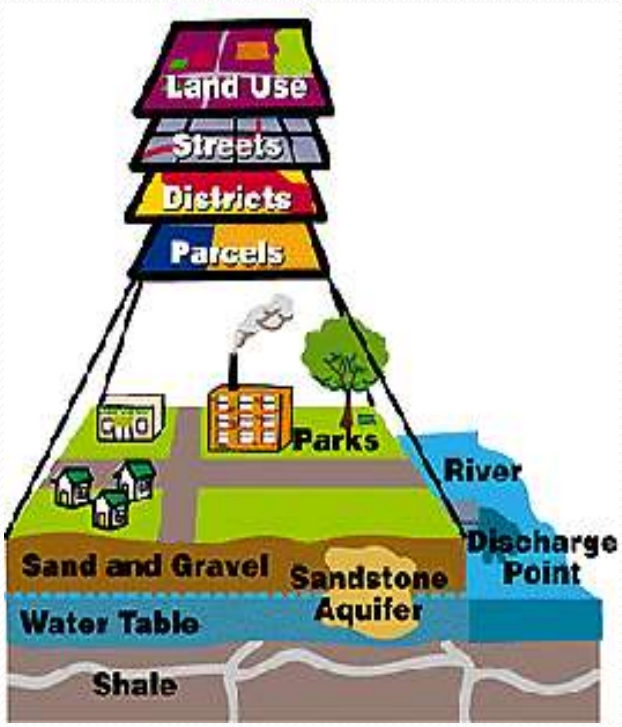
- ARC/INFO
- PAMAP
- MAPINFO
- GRASS
- ISROGIS
- IDRISI
- GRAM

Geographic Position System

Historically, GPS has been embraced as a GIS data collection tool.

- Navigation
- Positioning

Today, GPS is being bound directly to GIS applications for a variety of applications, but principally real-time GIS data use in the field and for database update.



What is Variable Rate Technology?

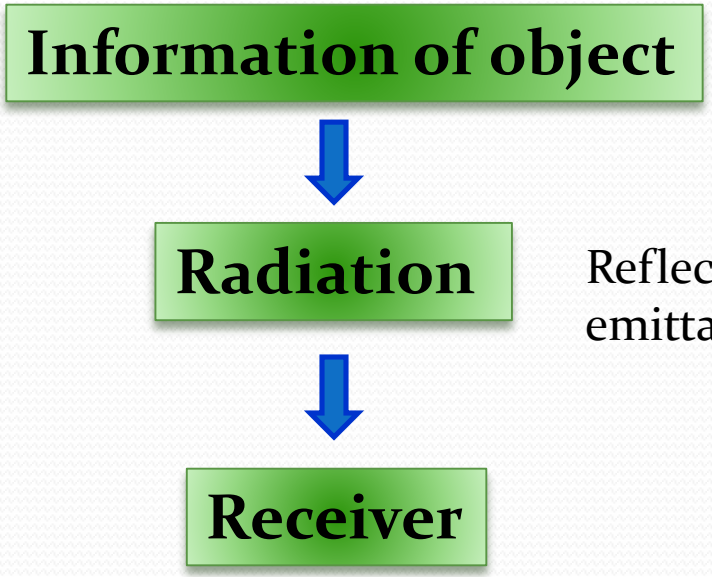
VRT, is a technology that allows variable rates of fertiliser application, seeding, chemical application and tillage throughout a single paddock. The rate is changed according to a preset map or through information gathered "on the go" by sensors.

Two approaches to VRT

- Map based
- Sensor based

Remote sensing

Remote sensing is a technique used to collect data about the earth without taking a physical sample of the earth's surface. A sensor is used to measure the energy reflected from the earth. This information can be displayed as a digital image or as a photograph. The transport of information from an object to a receiver (observer) by means of radiation transmitted through the atmosphere.



Reflection coefficient, emittance, roughness

The specific application of remote sensing techniques can be used for

i) Detection
ii) Identification
iii) Measurement
iv) Monitoring of agricultural phenomena.

Applicable to crop survey

1. Crop identification
2. Crop acreage
3. Crop vigor
4. Crop density
5. Crop maturity
6. Growth rates
7. Yield forecasting
8. Actual yield
9. Soil fertility
10. Effects of fertilizes
11. Soil toxicity
12. Soil moisture
13. Water quality
14. Irrigation requirement
15. Insect infestations
16. Disease infestations
17. Water availability
18. Location of canals

Role of Remote sensing and GIS in Agronomy

Remote sensing technology is used in getting near real time information on various aspects of agriculture. Variety of satellites in orbit providing a routine and continuous coverage of the globe.

- **Crop type**
- **State of maturity**
- **Crop density**
- **Crop vigor**
- **crop geometry**
- **Crop moisture**
- **Crop temperature**
- **Crop health etc.**

Increase production, reduce input costs, and manage the land more effectively in combination with new technology and farming practices.

Challenges for precision farming

- Identification of crops and estimation of area and production of short duration crops grown in fragmented land holding
- Forecasting of drought and/ floods.
- Detection of crop stress due to nutrients, pests and diseases and quantification of their effects on crop yield.
- Automation of land evaluation procedures for a variety of applications using GIS techniques.
- Information on sub surface horizons.
- Extending precision farming database to smaller farm size
- Estimation of depth of water in resevoirs and quality assessment of ground water.

THANKS