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# Precision Agriculture

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Precision farming or precision agriculture is about doing the right thing, in the right place, in the right way, at the right time. Managing crop production inputs such as water, seed, fertilizer etc to increase yield, quality, profit, reduce waste and becomes eco-friendly. The intent of precision farming is to match agricultural inputs and practices as per crop and agro-climatic conditions to improve the accuracy of their applications.

## Why Precision Farming?

1. To enhance productivity in agriculture with respect to profit.
2. Prevents soil degradation in cultivable land.
3. Reduction of chemical use in crop production
4. Efficient use of water resources
5. Dissemination of modern farm practices to improve quality, quantity & reduced cost of production in agricultural crops

## Advantages:

1. Agronomical perspective: Use agronomical practices by looking at specific requirements of crop
2. Technical perspective: allows efficient time management
3. Environmental perspective: eco-friendly practices in crop
4. Economical perspective: increases crop yield, quality and reduces cost of production by efficient use of farm inputs, labour, water etc

The concept of precision farming is strictly based on the Global Positioning System (GPS), which was initially developed by U.S. (United States of America) defense scientists for the exclusive use of the U.S. Defense Department. The unique character of GPS is precision in time and space. Precision agriculture, as the name implies, refers to the application of precise and correct amounts of inputs like water, fertilizers, pesticides etc. at the correct time to the crop for increasing its productivity and maximizing its yields. The use of inputs (*i.e.*, chemical fertilizers and pesticides) based on the right quantity, at the right time and in the right place. This type of management is commonly known as "Site-Specific Management".Precision Farming or Precision Agriculture is generally defined as information and technology based farm management system to identify, analyse and manage spatial and temporal variability within fields for optimum productivity and profitability, sustainability and protection of the land resources by minimizing the production costs.

## Tools and Equipment

Precision Farming is a combination of application of different technologies. All these combinations are mutually inter related and responsible for developments. The same are discussed below:

1. **Global Positioning System (GPS)**: It is a set of 24 satellites in the Earth orbit. It sends out radio signals that can be processed by a ground receiver to determine the geographic position on earth. It has a 95% probability that the given position on the earth will be within 10-15 meters of the actual position. GPS allows precise mapping of the farms and together with appropriate software informs the farmer about the status of his crop and which part of the farm requires what input such as water or fertilizer and/or pesticides etc.
2. **Geographic Information System (GIS)**: It is software that imports, exports and processes spatially and temporally geographically distributed data.
3. **Grid Sampling**: It is a method of breaking a field into grids of about 0.5-5 hectares. Sampling soil within the grids is useful to determine the appropriate rate of application of fertilizers. Several samples are taken from each grid, mixed and sent to the laboratory for analysis.
4. **Variable Rate Technology (VRT)**: The existing field machinery with added Electronic Control Unit (ECU) and onboard GPS can fulfill the variable rate requirement of input. Spray booms, the Spinning disc applicator with ECU and GPS have been used effectively for patch spraying. During the creation of nutrient requirement map for VRT, profit maximizing fertilizer rate should be considered more rather than yield maximizing fertilizer rate.
5. **Yield Maps**: Yield maps are produced by processing data from adapted combine harvester that is equipped with a GPS, i.e. integrated with a yield recording system. Yield mapping involves the recording of the grain flow through the combine harvester, while recording the actual location in the field at the same time.
6. **Remote Sensors**: These are generally categories of aerial or satellite sensors. They can indicate variations in the colours of the field that corresponds to changes in soil type, crop

development, field boundaries, roads, water, etc. Arial and satellite imagery can be processed to provide vegetative indices, which reflect the health of the plant.

7. **Proximate Sensors**: These sensors can be used to measure soil parameters such as N status and soil pH) and crop properties as the sensor attached tractor passes over the field.

8. **Computer Hardware and Software**: In order to analyse the data collected by other Precision Agriculture technology components and to make it available in usable formats such as maps, graphs, charts or reports, computer support is essential along with specific software support.

9. **Precision irrigation systems**: Recent developments are being released for commercial use in sprinkler irrigation by controlling the irrigation machines motion with GPS based controllers. Wireless communication and sensor technologies are being developed to monitor soil and ambient conditions, along with operation parameters of the irrigation machines (i.e. flow and pressure) to achieve higher water use efficiency.

10. **Precision farming on arable land**: The use of PA techniques on arable land is the most widely used and most advanced amongst farmers. CTF (contolled Traffic Farming) is a whole farm approach that aims at avoiding unnecessary crop damage and soil compaction by heavy machinery, reducing costs imposed by standard methods. Controlled traffic methods involve confining all field vehicles to the minimal area of permanent traffic lanes with the aid of decision support systems. Another important application of precision agriculture in arable land is to optimize the use of fertilizers especially, Nitrogen, Phosphorus and Potassium.

Tools and Equipment Needed for Precision Mapping For a farmer to accurately and precisely develop a precision map, a variety of different tools and equipment are needed, including sensors that are attached directly to farm machinery. These pieces of equipment help to read and evaluate many different aspects of crop and soil conditions and help to provide the farmer with valuable information about their fields.

## Some Typical Precision Mapping Tools Include:

1. **A Grain Moisture Sensor**- This sensor detects grain moisture levels and can tell the farmer if an area of crops needs more or less irrigation.

2. **A GPS Antenna**- a GPS or Global Positioning System antenna is a piece of equipment that receives signals from global positioning satellites to provide and record specific locations.

3. **A Grain Flow Sensor**- This sensor helps to determine the volume of grain that has been harvested.

4. **GPS Receiver and Yield Monitor**- the Yield Monitor and GPS receiver work together to gather the information collected by the sensors and collect them in one central location while geo-referencing the data.

5. **Grain Elevator Speed Sensor**- this sensor is very similar to a grain flow sensor and gathers data of grain flow measurements, although having both sensors in place helps to improve the accuracy of measurements.

Although there are still a great deal of other tools and pieces of equipment that are used in precision mapping, these five are the most basic pieces of equipment and sensors that are used for this type of mapping. A variety of other sensors can be added to equipment for more accurate readings or a different variety of readings.

## Site specific Input Application

Site-specific management is used to detect and measure the differences within fields, record these differences at specific locations and then use this information to guide changes in management or inputs. Site-specific farming is managing areas within fields, rather than using the same management on the entire field. To conduct site-specific farming, a producer must be able to do three things:

1. **Know where you are**: Use of GPS or more specifically Differential GPS provides accuracy of the location where the input has to be applied.
2. **Gather information at that location**: Information about locations within fields can be gathered by using sensors or by sampling. Use of sensors is by far the easiest method, but sometimes information on certain inputs, such as crop nutrient requirements, is best determined with sampling. Sensors that are commercially available include:

■ yield monitors
■ soil electrical conductivity or electro-magnetic sensors
■ remote imagery, including satellite images, aerial photography and hand-held active sensors
■ soil compaction sensors
■ on-the-go soil pH (alkalinity or acidity) sensors

3. **Site Specific Application**: Variable-rate controllers are available for whatever inputs need site-specific management. Liquid materials including fertilizers and manure, dry materials including fertilizers and manure, anhydrous ammonia, seed, agricultural chemicals and planter applied starter fertilizers all can be varied with any number of pieces of equipment. Existing flow-monitoring consoles also can be modified to control the application of materials site specifically. The data-input device can be as small as a PDA (personal digital assistant) or a laptop computer. Variable-rate application equipment can be as large as a commercial fertilizer applicator or as personal as a variable-rate seeder or anhydrous ammonia applicator. Most controller consoles today have been developed to work with several application devices. Checking with equipment manufacturers to determine which consoles would work best for a certain suite of application needs would be wise. Many companies also have site-specific experts on staff to aid in selection of the appropriate tools for making site specific farming work for growers.