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Precision farming- Concepts and Practices

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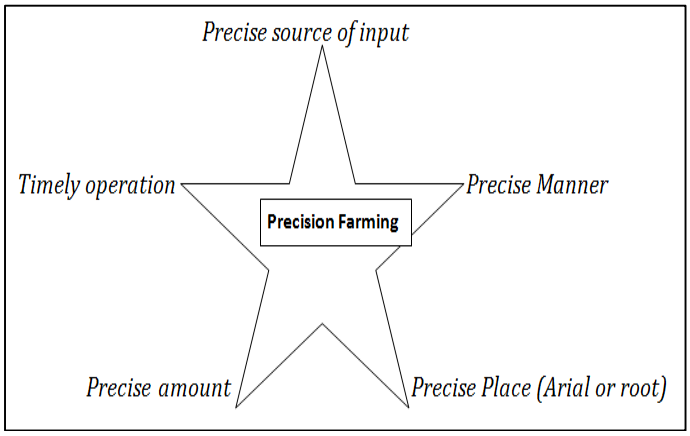
Abstract
The human population continues to grow steadily with the shrinking resources being used for agricultural production situates great challenge against World agricultural system to attain food and environmental security. To counter these challenges there is urgent need of application of modern Hi-tech technologies for enhancing the productivity. Precision farming (PF) improving the capability of agricultural land to produce crops on sustainable basis. The PF is based on the concept of determination of spatial and temporal variability in the crop production which in turn aimed for increasing crop productivity and reducing environmental menaces. It is innovative technology which comprises the application of several Hi-tech tools like Geographical Information System (GIS), Global Positioning System (GPS), Remote Sensing (RS) and Variable Rate Technology (VRT).Thus, precision agriculture is conceptualized by a system approach to re-organize the total system of agriculture towards a low-input, high-efficiency, and sustainable agriculture. Looking to the pressure arising population and erratic climatic variation, more attention required towards the development of technology driven horticulture precision farming is being reviewed as a promise in this regard.

Keywords: Precision farming, World agricultural system.

Introduction

Precision Farming is the use of advances and standards to oversee spatial and worldly changeability related with all parts of green creation for improving harvest execution and condition quality (Nabi *et al*. 2017) [4]. A proficient administration of assets to create ecofriendly and financially savvy quality item is the prime point of precision cultivating. Maintainable agribusiness is the first needs which can be accomplished by exactness cultivating as it include generally logical and present day draws near. Precision farming involves executive of variability in the dimensions of both space and time. The key factor answerable for precision cultivating is inconstancy of assets.

The coordinating of agronomic practices and asset application shifts over the field with soil characteristics and harvest prerequisites. Precision cultivating is essentially site explicit administration. Educator M.S. Swaminathan likewise said that *"Precision farming is a way to achieve an evergreen revolution"*. The five components of exactness cultivating are given



Dimension of precision farming

Scope of adoption of pa in India and future strategy

Reception and achievement of PA in India will rely upon the reality, that whether selection methodologies are structured appropriately or not. An arranged quantities of examinations and investigation are required before utilization of PA to Indian agribusiness.

There are 3 stages to enter PA age, to be specific present stage, middle of the road stage and future stage. Present stage includes uniform harvest and soil the executives, improvement of master labor and establishment for PA, promotion of PA idea by broad communications correspondence, course, workshop and so forth., though transitional stage will follow defined irregular testing inside zone, depiction of the board zone all through the nation approval of PC models with zone explicit information and future stage will include fine framework examining and detecting, utilization of zone explicit PC model to recreate the agronomic information conditions and exact detecting and the executives (Mondal and Basu, 2009) [3].

Need for precision farming

- Decline in the total productivity.
- Diminishing and degrading natural resources.
- Stagnating farm incomes.
- Lack of eco-regional approach.
- Declining and fragmented land holdings.
- Global climatic variation.
- Limited employment opportunities in non-farm′ sector.

Objectives of precision farming:

- To increase production efficiency
- To improve product quality
- More efficient input use
- To reduce ecological degradation
- Energy conservation

Elements of Precision Farming

A) Information
B) Technology
C) Decision support (management)

A. Information

- Crop characteristics like stage of crop, crop health, nutrient requirement etc.
- Detailed soil layer with physical and chemical properties, depth, texture, nutrient status, salinity and toxicity, soil temperature, productivity potential etc.
- Microclimate data (season and daily) about the canopy temperature, wind direction and speed, humidity etc.
- Surface and sub-surface drainage conditions.
- Irrigation facilities, water availability and other planning inputs of interest.

B. Technology

PA is an integrated agricultural management system incorporating several technologies. The technological tools often include computer, GIS, GPS, spectral imagery, aircraft and vari-rate controllers etc (Das *et al*. 2017) [2].

C. Decision support (management)

Just having information about variability within the field does not solve any problems unless there is some kind of decision support system (DSS) in order to make VRT recommendations. Following steps for a DSS:

- Identify environmental and biological states and processes in the field that can be monitored and manipulated for the betterment of crop production.
- Choose sensors and supporting equipment to record data on these states and processes.
- Collect, store and communicate the field recorded data.
- Process and manipulate the data into useful information and knowledge.
- Present the information and knowledge in a form that can be interpreted to make decisions.
- Choose an action associated with a decision to change the identified state or process in a way that makes it more favourable to profitable crop production.

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:

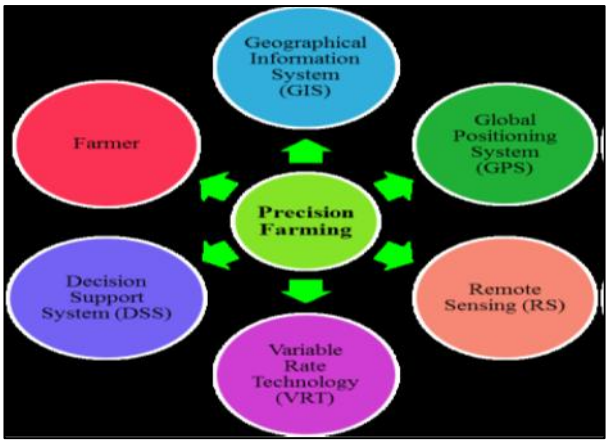


Fig: Tools of precision Farming

1. **Global Positioning System (GPS):** It is a lot of 24 satellites in the Earth circle. It conveys radio signals that can be prepared by a ground recipient to decide the geographic situation on earth. It has a 95% likelihood that the given situation on the earth will be inside 10-15 meters of the real position. GPS permits exact mapping of the ranches and along with fitting programming advises the rancher about the status regarding his yield and which part of the homestead requires what info, for example, water or manure as well as pesticides and so on.

Fig: GPS worn exact mapping

2. **Geographic Information System (GIS):** It is software that imports, exports and processes spatially and temporally geographically distributed information. It is also known as brain of precision farming.

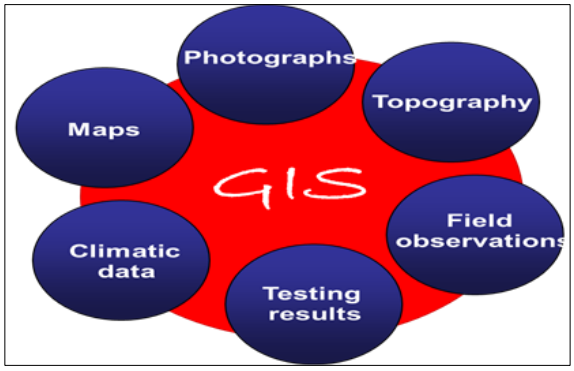


Fig: Functions of GIS

3. **Grid Sampling:** It is a process 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 current field machinery with built-in Electronic Control Unit (ECU) and installed GPS can satisfy the variable rate prerequisite of info. Spray booms, the Spinning disc instrument with ECU and GPS have been utilized viably for fix splashing. During the production of supplement prerequisite guide for VRT, benefit boosting compost rate ought to be viewed as more as opposed to yield amplifying manure rate.

5. **Yield Maps:** Yield maps are created 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 (Bongiovanni and Deboer. 2004) [1].

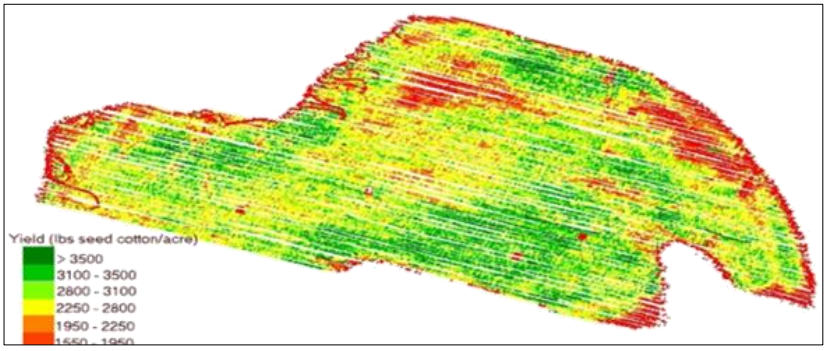


Fig: Yield Map of Farm showing different yield

6. **Remote Sensors:** These are usually categories of aerial or satellite sensors. They can signify variations in the colors 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.

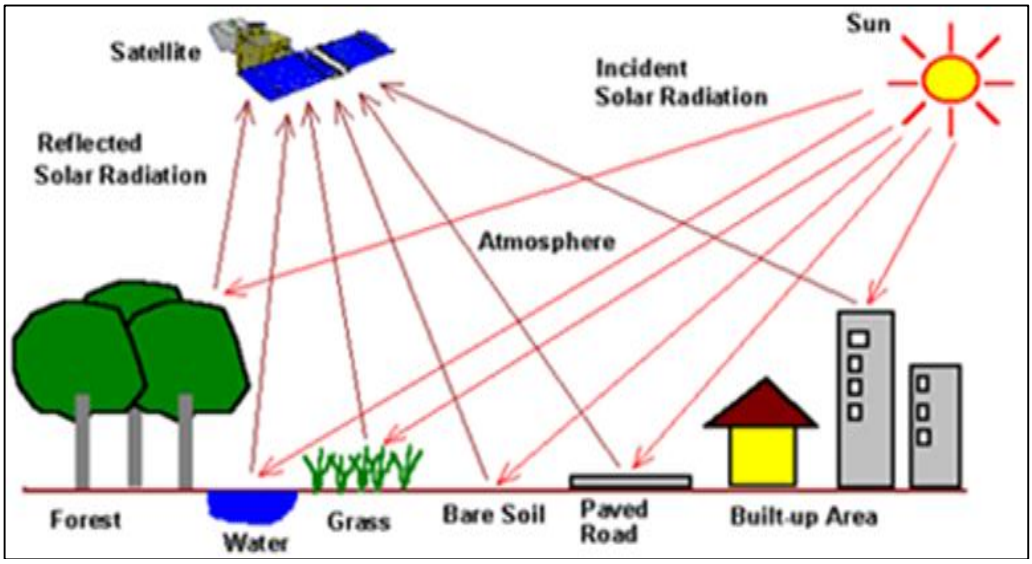


Fig: Remote Sensor

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 analyze the information gathered by other Precision Agriculture technology components and to make it accessible in usable arrangements, for example, maps, diagrams,

graphs or reports, PC support is basic alongside explicit programming support.

9. **Precision irrigation systems:** New developments are being discharged for commercial use in sprinkler system by controlling the system machines movement with GPS based controllers. Wireless communication and sensor technologies are being created to screen soil and surrounding conditions, alongside activity parameters of the irrigation machines (for example stream and strain) to accomplish higher water use efficiency.

10. **Leaf Chlorophyll Content:** The leaf chlorophyll content is an important indicator of plant health, photosynthetic potential, and nutritional state. Although extraction analysis by field sampling provides an accurate estimation of LCC status, such methods are not practical. Non-destructive remote sensing measurement offers an affordable, and frequent way for assessing the LCC of plants over fields in high resolution. The leaf nitrogen content is strongly correlated with chlorophyll content. The optimum rate and application timing of nitrogen fertilizer is crucial in achieving a high yield. Monitoring the Chlorophyll index allows variable-rate fertilizer application and site-specific crop management (Gemtos *et al*. 2016) [5].

Latest technologies in precision farming

1. **Robots:** Self-steering tractors have existed for quite a while works like a plane on autopilot. The tractor does the vast majority of the work, with the farmer stepping in for emergencies Technology is progressing towards driverless apparatus customized by GPS to spread manure or furrow land. Different developments incorporate a solar oriented fueled machine that distinguishes weeds and obviously executes them with a portion of herbicide or lasers. Agricultural robots, otherwise called AgBots, as of now exist, however advanced harvesting robots are being created to recognize ripe fruit, conform to their shape and size, and cautiously pluck them from branches (Pérez-Ruiz M et.al. 2012) [6].

Drones and satellite imagery: Drone and satellite technology are utilized in precision farming. This regularly happens when drone take top notch (high quality) pictures while satellites catch the master (bigger) picture. Light airplane pilots can aerial photography with information from satellite records to foresee future yields dependent on the present degree of field biomass. Collected pictures can make maps to follow where water streams, decide variable-rate seeding, and make yield maps of regions that were pretty much productive.

Fig: Robots used for Vegetable harvesting

2. Smart phone applications: Cell phone and tablet applications are getting progressively well known in precision farming. Cell phones accompany numerous helpful applications previously introduced, including the camera, GPS, and accelerometer. There are likewise applications made dedicated to different horticulture and agriculture applications, for example, field mapping, following creatures, acquiring climate and yield data, and the sky is the limit from there. They are effectively convenient, reasonable, and have a high computation power for eg. Ag Guardian, Open Scout, iSOYL scout and ID Weeds.

Fig: Drones used for analysis of crop field

3. Machine Learning: It is generally utilized related to automatons, robots, and web of things gadgets. It takes into account the contribution of information from every one of these sources. The PC at that point forms this data and sends the fitting activities back to these devices. This takes into consideration robots to convey the ideal measure of manure or for IoT gadgets to give the ideal amount of water legitimately to the soil. The eventual fate of farming pushes more toward a machine learning each year. It has considered progressively proficient and exact cultivating with less human labor.

Steps will help to initiate PA technologies

- Keep records of soil, crops and yield.
- Map exact boundaries of fields and water courses.
- Calculate dimensions and exact area of each field.
- Review current data.
- Obtain additional data including yield data.
- Interpret data.
- Examine results.
- Develop management strategy.

Strategies for adoption of PA technologies For Small fields

- Variable rate technologies.
- Low cost and small machine-based variable rate technologies.
- Application of GIS.
- Progressive farmers should select more than one precision application as a package.
- Private agencies should come forward.

Advantages

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

Drawbacks of precision farming

- High cost.
- Lack of technical expertise knowledge and technology.
- Not applicable or difficult/costly for small land holdings.
- Heterogeneity of cropping systems and market imperfections.

The policy approach to promote precision farming at farm level

- Identify the niche areas for the promotion of crop specific precision farming
- Creation of multidisciplinary teams involving agricultural scientists in various fields, engineers, manufacturers and economists to study the overall scope of precision agriculture
- Provide complete technical backup support to the farmers to develop pilots or models, which can be replicated on a large scale
- Pilot study should be conducted on farmers' fields to show the results of precision agriculture implementation
- Creating awareness among farmers about consequences of applying imbalanced doses of farm inputs like irrigation, fertilizers, insecticides and pesticides.

Conclusion

- ❑ Precision Farming in many developing countries including India has numerous opportunities for farmers to identify better high yielding location specific crops.
- ❑ Precision Farming can immensely help in reducing cost of production and increase profits and marginal return.
- ❑ Using the key elements of information, technology and management; precision faring can be used to increase production efficiency, improve product quality and protect environment.
- ❑ The PF would trigger a techno-green revolution in the world or in India.

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