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Precision Agriculture: Present Status & Scope: A Review

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ARTICLE ID: 046

Introduction

In India, Agriculture is mainly known for its numerous functions from providing food, employment, livelihood to nutritional and ecological securities. There is about total geographical area of 328.7 million ha out of which 182 million ha of the land get affected by land degradation, 141.33 million ha of the land affected due to water erosion as well as wind erosion, water logging and chemical deterioration i.e. salinization and loss of nutrients also considered as land deteriorating agent. On the other end, the higher production cost along with low productivity will throw Indian farmers out of the economic competition. All over again, untimely start of research on advanced technology due to lack of resources is one of the main issues of developing countries. In order to face all these new challenges, study of advanced, environmental friendly technology which can utilize all available resources efficiently for sustainable development of agriculture is necessary.

Precision agriculture is such a new and highly promising technology spreading rapidly in the developed countries. A scientific approach to improve the agricultural production efficiency by application of various improved technology in the field with the timely application of only required amounts of input to optimize profitability and sustainability with a minimized impact on the environment. The precision farming assures the productivity enhancement with decreasing the production cost via efficient utilization of resources. The accomplishment of the precision agriculture mostly depends on accurate evaluation of variability, management and evaluation in space time continuum in crop production.

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Revolution in technology has changed Indian environment as well as created new hopes for agriculture. Therefore, from a sustainability and economic point of view, it is necessary to grasp these developing new technologies and apply them efficiently along with proper utilization of resources in the agriculture sector.

Need for Precision Farming

The popularity of Precision farming in developed countries results in maximization of agricultural productivity with application of different technologies like satellite using technologies and geographical information systems. The application of precision farming proves economically and environmentally beneficial with optimum utilization of water, fertilizers, herbicides and pesticides other than farm equipment. Therefore, Farmers straight away require timely and reliable sources of information regarding supply of inputs for sustainable agricultural production. The challenges led by the changing environment faced by farmers makes technology not only merely useful, but necessary to keep competitive.

Farmers require substantial knowledge and information about improved farming practices, pricing strategy, market betterment, and new policy regarding agriculture technology. When farmers will be able to get information about cost, stock, supply and available market for their produce, he would put up for sale their products at the right price at the right time without any delay. Administration and various Agro based companies can provide a variety of services through mobile technology by which farmers can utilize the information about price, stock and market practices. It will help them either to reduce the risk of under-selling or over or under-supplying with low price for their produce in a given market. It also gives access to early warning systems to mitigate the risk of losses via control of spread of pathogens due to extreme weather conditions.

Basic steps for Precision Farming

Precision agriculture has eminently utilizing natural resources efficiently and protecting natural environment. In India, we have all these technologies available and they can be implemented through agricultural training centers by providing training to agriculture officers. There are following three steps to implement precision agriculture:

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i) **Assessing variation:** Characterizing the degree and scale of variability in soil and crop attributes. Interpreting the significance and causes of variability

ii) **Managing variation:** Managing variability on spatial and temporal basis

iii) **Evaluation:** Monitoring the outcomes resulting from the variability management practices

Development of technology

The Successful achievement of precision agriculture depends on numerous factors such as the extent to which the adequacy of input recommendation and the degree of application control. The enabling technologies used in precision agriculture can be grouped in to major categories: Global Positioning System (GPS), Geographic Information System (GIS) and Remote Sensing (RS). Precision agriculture technology makes combination of application of different technologies and all these combinations are mutually inter related and dependable for developments of Precision agriculture which are discussed below:

Global positioning system (GPS)

Global Positioning System makes use of a series of satellites that recognize the location of farm equipment within a meter of an actual site in the field. GPS receiver provides continuous position information in real time while in motion. The precise location information allows soil and crop management to be mapped at any time. The data can be obtained with GPS receiver either carried to the field or ascended on apparatus allowing users to return to specific locations to treat those areas. GPS receiver with electronic yield monitors usually applied to collect yield data across the land accurately. Farm uses include: mapping yields (GPS + combine yield monitor), variable rate planting (GPS + variable rate planting system), variable rate lime and fertilizer application (GPS + variable rate controller). e.g. Locations of soil samples and the laboratory results can be compared to a soil map; Fertilizer and pesticides can be prescribed to fit soil properties (clay and organic matter content) and soil conditions.

Geographical information system (GIS)

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Geographic information systems (GIS) are computer hardware and software that use location data to generate maps. The key function of an agricultural GIS is to store information for example yields, yield maps, soil survey maps, remotely sensed data, crop scouting reports and soil nutrient levels. GIS played a very important role in natural resources and research management. GIS has been popularly applied in agriculture, such as groundwater recharge estimation and regional distribution maps for heavy metals scheduling and monitoring of irrigation delivery for rice irrigation systems. E.g. Better management of the paddy fields for better efficiency and cost effectiveness also made possible with geographical information systems.

Remote sensing (RS)

Remote sensing technology is a very useful tool for gathering information simultaneously or collection of data from a distance. Data sensors are normally hand-held devices which usually satellite-based are mount on drones. The information useful for soil condition, plant growth, weed infestation etc. can be recorded with satellite containing electromagnetic remittance and reflectance data of crop. Remotely-sensed data make the possibility for evaluation of crop health and cost effective site-specific crop management program. The data regarding water stress, crop insect, pest and diseases, nutrient stress, soil compactions and others becomes easily derived in overhead images. Remote sensing can report in-season variability that affects crop yield and is timely enough to make management policies that improve productivity and profitability for the current crop. Mapping of weeds against bare soil for row crops at early stages of seedlings has been carried out successfully with the help of remote sensing technology.

Grid soil sampling and Variable rate technology (VRT)

The variable rate technology is automatic and in general useful for various farming operations. This kind of technology has three components i.e. computer, locator and actuator. The computer uses the application map and a GPS receiver to direct a product-delivery controller that changes the amount and kind of product according to the application map e.g. Combine harvesters with yield monitors, where yield monitors continuously measure and record the flow of grain in the clean-grain elevator of a combine. The data genetrated from

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GIS can optimises the seeding process, fertilizer and insecticide application as well as herbicide selection and its application at the right time at right place.

Yield monitoring and mapping

Yield mapping is ultimate indicator of variations of different agronomic parameters in different parts within the field. Therefore interpretation and correlation of map with the spatial and temporal variability of different agronomic parameters helps in improvement of next season's crop management plan. Yield monitors can also measures the volume or mass flow rate to generate time periodic record of quantity of harvested crop for that period. Yield maps are an essential layer of data in a spatial database for management of land. Interpreting and using the yield maps is a key step in developing precision management skills.

Key Benefits

1. Decision accuracy-Information technology is very useful for farmers, researchers and other people to make decisions regarding their agricultural activities and marketing. The varieties of different sensors with generated data enables better understanding of an interaction of dynamic crop, soil and weather conditions while machinery data leading to more accurate and fast decision making.

2. Agriculture advancement- with the development of new technologies like improved varities and hybrids, fertilizers, irrigation technologies like drip or sprinkler system, weeding technologies insecticides, pesticides with their optimum dose and their application on optimum time in the agriculture field helps in sustainable production.

3. Suitable planning-Information technology has provided farming software which can keep better track of agriculture and predict yields. Farmers can efficiently improve their agriculture production with superior utilization of modern farming technology and methodology.

4. Prediction of weather–weather prediction becomes also possible with this improved technology. This weather data aware the farmers regarding weather conditions like rainfall, drought, hailstorms etc. and help them to plan accordingly.

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5. Marketing- what and where a suitable market for selling their agriculture produce at a valuable rate is is key issues for the farmer community, which can also get achievable with technologies.

Strategy for adoption of precision farming in India

Precision agricultural technologies can significantly reduce the inputs and environmental pollution. Precision technologies should be started for high value commercial crops that may bring more benefits to farmers. No technology proves economic benefits with their first use, but the long term adoption of a technology definitely brings these benefits. The primary objective should be to optimise crop inputs and prevent excess of and beneath application of agricultural inputs for reducing environmental risks rather than to get maximum yield. Furthermore, to get the farmers attention towards this type of agriculture should be the main focus of this strategy. Small farmers should start with a single precision application, whereas the progressive farmers should select more than one precision application on their farms because it will bring them more benefits. Small farmers can use low cost and small machine-based variable rate technology. Agencies in the private sector can motivate the progressive farmers to use precision agriculture on their farms by providing them infrastructure support, operational support, coordination and control of farming activities and strategic support. There are several examples of precision nutrient management practices from several countries where farmers and practitioners have overcome the challenges and converted them into opportunities by adopting precision techniques appropriate for their region, operations and resources.

CONCLUSION

Precision farming techniques are the only way to feed the upcoming generations as the productivity of land is decreasing day by day because of excessive use of chemicals, fertilizers and unawareness of the farmer specially in developing countries like India also the availability of precision farming tool is not frequently available in these countries and the level of literacy is also low which is a big hurdle in implementing the technology hence this is the responsibility of the government, universities and non-government organisations to spread the awareness about the technology and to find out the ways to reduce the cost of equipments by manufacturing them at local level which will also help in generating job

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opportunities for skilled people. Precision agriculture is facilitating the prospects and scope for switching over to modern agriculture leaving the traditional one by utilizing the right resources in right time and management, which results in an environment friendly sustainable agriculture. Precision Agriculture has created scope of transforming traditional agriculture, through the way of proper resource utilization and management, to an environmentally friendly sustainable agriculture. Application of artificial neural networks, genetic algorithms, fuzzy logic, wavelet techniques, decision tree, smart microprocessors, genetically engineered plants, biosensors along with other future development areas already discussed will make PA not only suitable for developed countries but also for developing countries.