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Precision agriculture

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Abstract
The future for Precision Agriculture holds hope and can become a technology with wide implications in the field of agriculture. Before a widespread application of precision farming technologies in the country, their location particular usefulness and feasibility needs to be realized on experimental farms for possible applications. In precision farming is a crucial need to integrate technologies in Indian agriculture.

Keywords: precision agriculture, precision farming, fatigue of green revolution, present status and scope

Introduction
Precision farming is recently made known as a concept in agriculture that includes numerous information-based technologies for enhancing precision to assess farm variability and input application to increased farm profit and reducing environmental risks (Zhang *et al*., 2002). The ideology behind the application of these precision farming-based management systems is that all the production inputs should be applied only as needed and where needed according to spatial and temporal unpredictability of the field to succeed the most economic crop production. Precision farming is proposed at increasing agricultural output with minimum production cost on the one hand and reducing the ecological issues correlated with the crop production system to achieve the goal of sustainability (Whelan, 2007) [9]. Precision Agriculture also known as precision farming, prescription farming, variable rate technology, site-specific farming, site-specific management, site-specific crop management, is considered the agricultural system of the 21st century, as it symbolizes a better balance between reliance on traditional knowledge and information and management intensive technologies.

Among the total population, the agriculture division sustains the livelihood of approximately near about 50 percent and virtually contributes 17.9 percent to the gross domestic product. The objective of precision agriculture research is to define a decision support system for whole-farm management to optimize returns on inputs while preserving resources. India is considered by small farms. Around 80% of total land holdings in the country are less than 2 ha. Mostly rainfed with only 30% of the land irrigated. Around 60% of the total population of India depends on farming. In other countries and other advanced economies, because of the heavy mechanization of agriculture, it is less than 5%. Poor availability of resources, farm inputs, poor support price structure for the production, and almost no farm insurance, most of the farming is non-remunerative and 50% of the farmers in India are in debt. This is the main reason for the large number of suicides by farmers. India is one of the biggest producers of agricultural products, has very low farm productivity. The average productivity of Indian farms is 33% of that of the best farms the world over. This product needs to be increased so that farmers can get more remuneration from the same piece of land with less labor. Asia and the Pacific region account for more than 75% of the global agricultural population but only 25% of the world's farmland.

Production increases in this region have been reached at significant expense to its resource base and largely using excessive and indiscriminate external uses of inputs: irrigation, seeds, fertilizer, pesticides, etc. Attrition of soil in this region due to water and wind surpasses the natural soil formation. Water quality deterioration is a problem also thoughtful. Drinking water pollution in tobacco and rice ecosystems of Malaysia and groundwater near vegetable fields in Japan are just two examples. The impact of pesticide use on deteriorating farmers' health and boosted pest resistance are also well documented. However, the rate of increase in population demands a much higher rate of increase in food production while maintaining harmony with the environment-the core concept of sustainable agriculture. Hefty subsidies on electricity for pumping water in some countries have led to over-exploitation of groundwater and misuse on farms leading to waterlogging and salinity. Comprehensive and reliable information on land use/cover, soils crops, water resources, natural hazards like drought and floods, and agrometeorology is essential. Season-wise information on crops, their acreage, vigor, and production enable the country to adopt suitable measures to meet shortages. With increasing population, urbanization, and contagious depletion of natural resources, there has to be a paradigm shift in farmers' perception from production to productivity and profitability. In this present scenario, the major challenge arising are shrinking land and depleting water and other related resources in agriculture. There is a need for promoting farmer-friendly location-specific production system management technologies in a concerted manner to achieve vertical growth in horticulture production dully ensuring the quality of products and better remuneration per unit of area with judicious use of natural resources. Precision farming aims to get the maximum production of horticultural produce by using well-organized resources. Precision agriculture is an important key component of modern agricultural revolutions. The first agricultural revolution came along during the advent of increased mechanization, from 1900 to 1930. Each farmer produced enough food to feed about 26 people during this time. The 1960s prompted the Green Revolution with new methods of genetic modification, which led to each farmer feeding about 155 people. It is expected that by 2050, the global population will reach about 9.6 billion, and food production must effectively double from current levels to feed every mouth. With new technological advancements in the agricultural revolution of precision farming.

Present Status and Scope of Precision Farming in India

Precision farming is still a new concept to Indian agriculture. Among all the technologies available the laser land leveling is the only precision technology that has been used in India successfully for a few years especially in the rice-wheat cropping system of the northwestern part of the country. Laser land leveling is a practice of topographic modification, grading, and smoothing land to an even level with little or no slope from its average elevation by using a GPS-loaded scraper. This practice improves irrigation use efficiencies of the farm through the reduction in water losses and increases the uniformity of water application with less chance of over and under irrigation. In traditional practices of irrigation, about 30-50% of total applied water is lost due to various conveyance losses of the irrigation system. Apart from this, the Country has also trying to make significant advances through the use of precision technologies such as micro-irrigation and protected cultivation during the last two decades. This is attributed to the support of government policies, which is encouraging farmers to adopt precision technologies. It is also true that adoption of precision farming in the entire country is not possible as every farmer will not be ready to accept these sophisticated technologies, but there are some relatively developed areas, which can act as incubators for the adoption of these technologies for emerging.

Agriculture in India is performed mainly by small and marginal farmers under the close supervision of farmer's family members and farming is a family responsibility to them. These small and marginal farmers of India mainly adopt management, apply input and take decision related to farming on the basis of their knowledge and experience, financial capacity, extension services provided and availability of resources (Shafi *et al.* 2019) [6]. Micro-situation specific variability agricultural practices are commonly prevailing in the developing countries in decision making by the farmers and this close relation of the farmers with crop management may be considered as some sort of spatial treatment based on supervision and experience. But this crude form of precision technology is needed fine tuning and modification in the light of modern technologies (Mondal and Basu, 2009) [3]. Recent researches in integration farmer knowledge, precision agriculture tools and crop simulation modeling can be very useful for country like India in taking decision and management for poor-performing patches in farming (Oliver *et al.* 2010) [4].

Precision farming is also feasible in small landholding where the contiguous fields with the same management can be considered a large field and map-based precision agricultural applications have a great scope. For instance, the rice-wheat cropping system in the IGP of India where rice and wheat are grown in rotation is the choice for precision technologies. Attractive site-specific decisions can be implemented in this region, such as soil characterization, non-destructive monitoring of crop stresses, crop nitrogen monitoring, weed infestation, and determining crop biomass using precision tools like Remote sensing, GPS, GIS, etc. Similarly, the progressive farmers of the country, with the help of government institutions and private agencies, can adopt some components of precision applications on a limited scale for a demonstration to other farmers and stakeholders as the technology show potential to increase yield and profit.

Need For Precision Farming

India is self-sufficient in the production of food is only due to the Green revolution. It has been possible due to intensive use of available natural resources like increase in fertilization, irrigation, pesticides, higher use of high yielding varieties, increase in cropping intensity, and increase in the mechanization of agriculture. The progressive farmers are aware that the variability in yields across the landscape and many times they manipulate management practices as per their previous experience. These variations can be traced scientifically by different tools for better management practices in terms of responsiveness to different yield causing factors (Mandal and Maity 2013) [2]. Precision agriculture provides the scope to automate the collection and analysis of data for accuracy to make an appropriate decision.

Fatigue of Green Revolution

The contribution of the Green revolution is a lot. However, even with the remarkable evolution in agriculture, the productivity levels of many major crops are below probability. We have not achieved even the lowest level of potential productivity of Indian high yielding varieties, whereas the world's highest productive country has crop yield levels significantly higher than the upper limit of the potential of Indian high yielding varieties.

Natural Resource Degradation

The green revolution is also accompanying negative ecological consequences. The status of the Indian environment shows that, in India, about 182 million ha of the country's total geographical area of 328.7 million ha is affected by land degradation of this 141.33 million ha are due to water erosion, 11.50 million ha due to wind erosion and 12.63 and 13.24 million ha are due to waterlogging and chemical deterioration respectively. On the other end, India shares 17 percent of the world's population, 1 percent of gross world product, 4 percent of world carbon emission, 3.6 percent of CO2 emission intensity, and 2 percent of world forest area. One of the major reasons for this status of environment is the population growth of the country.

In this context, there is a need to convert this green revolution into an evergreen revolution, which will be triggered by a farming systems approach that can help to produce more from the available land, water, and labour resources, without either ecological or social harm (Swaminathan, 2002) [7]. Since precision farming, proposes to prescribe tailor-made management practices, it can help to serve this purpose.

For assessing and managing field variability

We know that our fields have variable yields across the landscape because of dissimilarities to management practices, soil properties, or environmental characteristics. One's mental information database about how to treat different areas in a field requires years of observation and implementation through trial-and-error. To manage in-fields variability, spatially or temporally, data related to biotic and abiotic factors are important and databases in this regard need to be developed. For Soil the physical properties (texture, structure, moisture holding capacity, bulk and particle density); chemical properties (pH, electrical conductivity, available plant nutrients), in terms of Crop the planting geometry (row to row and plant to plant spacing, plant stand); nutrient composition of standing plant, plant stress due to biotic and abiotic factors, weed, insect and disease, potential economic and biological yield. (Bajwa and Tian 2005) [1].

For doing the right thing in the right place at the right time

After assessing the variability precision agriculture allows management decisions to be made and implemented at right time in the right places on small areas within larger fields.

For higher productivity

Since precision farming, proposes to prescribe tailor-made management practices, it will increase the yield per unit of land, provided nature's other uncontrollable factors are in favor.

For increasing the effectiveness of inputs

Increased productivity per unit of input used indicates increased efficiency of the inputs.

For maximum use of minimum land unit

After knowing the land status, a farmer tries to improve every part of the land and uses it for production purpose.

Objectives Of Precision Farming

1. Increased profitability and sustainability
2. Optimizing production efficiency
3. Optimizing product quality
4. Most efficient chemical and seed use
5. Effective and efficient pest management
6. Energy, water, and soil conservation
7. Surface and groundwater protection
8. Minimizing environmental impact
9. Minimizing Risk

Applications of Precision Farming

1. Water Management

In precision farming mainly we consider drip irrigation, sprinkler irrigation, and fertigation.

a. Drip Irrigation

It is described as a regulated or slow application of irrigation water through emitters at frequent intervals near the root zone plant over a long period.

1. It saves water by 50-70%.
2. Reduces labor and energy costs.
3. Weed infestation is almost negligible.

b. Sprinkler Irrigation

In Sprinkler Irrigation water is sprayed into the air and allow to fall on the ground surface somewhat resembling rainfall. The spray is developed by the flow of water pressure through small nozzles.

c. Fertigation

Fertigation makes available essential elements directly to the active root zone, as a result reducing the loss of costly nutrients, which ultimately assistances in improving productivity and quality of farm products.

2. Surface Covered Cultivation

a. Mulching

To increase the temperature, suppress weed growth, and conserve soil moisture mulching is used.

b. Soil Solarization

To control soil-born diseases this method of healing the soil by covering transparent polythene sheets during hot periods.

3. Controlled Environmental Condition

To protect the crop and create a favorable environment for growing crop in the off-season in framed structure covered with a transparent or translucent like a greenhouse, polyhouse, tunnels, etc.

4. Organic Farming

Organic farming is a system of agriculture that uses natural and biodegradable input while deliberately avoiding the use of synthetic fertilizer. It mainly includes the use of vermicompost, manures, biofertilizers, animal husbandry, Greenleaf manures, biological management, and crop rotation.

5. Precise Space Utilization

a. High-Density Planting (HDP)

HDP is a system of planting more plants than optimum through manipulation of tree size. It accommodates 500-100000 plants/ha. Following methods are applied to control the size of plants in HDP:

1. Genetically dwarf scion cultivars
2. Dwarfing rootstock and interstock
3. Training and pruning
4. Use of growth retardants

b. Meadow Orcharding

Meadow Orcharding is also known as an ultra-high density planting system. It accommodates 20000-100000 plants per hectare. It is called grassland. To maintain tree form, severe top pruning is practiced similar to the mowing of grassland.

6. Micro Propagation
Micropropagation refers to the production of plants from very small plant parts, tissues, or cells, grown aseptically in a test tube or containers under a controlled environment.

7. Integrated Pest Management (IPM)
A pest management practices which includes a combination of practices such as the use of resistant cultivars, managing the natural predators of pest, cultural practices and judicious application of pesticides to control the pests.

8. Integrated Nutrient Management (INM)
Application of nutrients from organic as well as inorganic sources. It aims at improving the physicochemical and biological properties of the soil.

Limitations of Precision Farming Under Indian Conditions
- Small farm size.
- Heterogeneity in cropping systems.
- High cost of obtaining site-specific data.
- Complexity of tools and techniques requiring new skills.
- Culture and attitude of farmers including resistance to adoption of new technologies and lack of awareness of environmental problems.
- Precision farming as a new story to Indian farmers needs demonstrated impacts on yields for better adoption.
- Lack of local technical expertise.
- High initial investment.
- Uncertainty on returns from investments on new equipments and information management system.
- Knowledge and technological gaps.

Conclusion
In India, huge scope for precision farming technologies that can be executed in all regions but for this farmers and government experts should look to advance to implement these technologies and tools to increase the efficiency of available scarce resources and reducing the inputs costs. The future for Precision Agriculture holds hope and can become a technology with wide implications in the field of agriculture. Before a widespread application of precision farming technologies in the country, their location particular usefulness and feasibility needs to be realized on experimental farms for possible applications. In precision farming is a crucial need to integrate technologies in Indian agriculture. As a consequence of this technology used in India, there are numerous opportunities for adoption. Progressive farmers with guidance from the public and private sectors, and agricultural associations, can adopt it on a limited scale. It is proposed that despite small landholding and low-income levels, precision technologies have the potential to make a significant variance in the livelihoods of farmers which account for a large share of the national population.

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