A study on significant challenges and viable Opportunities of Precision agriculture as a major source of income in a flat world

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Abstract:

Precision Agriculture is generally defined as an information and technology-based farm management system that identifies, analyzes and manages variability within the fields for maximum production, sustainability and protection of land resources. In this farming environment, modern information technology can be used to make better decisions on many aspects of crop production.Precision farming illustrates the improved productivity that can be gained by understanding and resolving the inherent variation within a region.The aim is not to achieve the same yield everywhere, but rather to manage and distribute inputs on a site-specific basis to increase long-term cost / benefit input costs and decrease product prices. Agricultural precision technology will be a viable option for increasing profitability and productivity.Precision Agriculture has seen exponential growth in the last decade, especially in countries such as the U.S., Germany and others. Through numerous examples of precision nutrient management from many countries, this paper will address the broad definition of precision agriculture.There, farmers and experts have beaten the difficulties related with exactness nourishment the board and changed over them into circumstances by saddling the worldwide data and creating neighborhood accuracy procedures appropriate for their district, activity and assets.With developing worldwide population and constrained or declining arable land accessible for crop creation, the inquiry emerges "will we have the option to determine the difficulties of things to come and accept them as open doors? "Exact cultivating the board combined with hereditary changes in crop qualities will assume an urgent job in meeting worldwide nourishment, feed, fiber and fuel request in the close and far off future.

Keywords:
Precision agriculture, productivity, harnessing technology, sustainability, efficiency, optimum profitability, unpresented growth

Introduction:

When we talk about farming we talk about agriculture, plant life, soil fertility, crop varieties, terrestrial climate, etc. But in today's environment we identify with agricultural concepts such as climate change, irrigation facilities, advances in technology, hybrid seeds, advanced machinery, etc. In short, we're interested in how today's science can support us in the agricultural sector.And so, Precision Agriculture comes into the picture. The general concept is a farm management system based on information and technology that defines, analyzes and manages spatial and temporal variation within fields for optimal productivity and profitability, sustainability, and land resource security by minimizing the cost of production.Simply stated, precision farming is an method in which inputs are used in specific quantities to achieve improved average yields compared to conventional techniques of cultivation. It is thus a comprehensive framework designed to maximize development with minimal negative effects on our earth framework. Data, technology, and management are the three major components of precision agriculture.Farming with precision is highly information-intensive. Precision Agriculture is a management technique that uses IT to gather reliable data from various sources, which factors contribute to the decision making process. It depends on advancements like GPS (Global Positioning Systems), GIS (Geographic Information Systems), yield screens, remote mapping sensors and direction frameworks for application with variable rate which empowers top to bottom observing of field varieties. The appearance of accuracy farming that happened in the created world around two decades prior included utilization of cutting edge and imaginative innovations.Precision farming in developing countries has progressed in that direction and is more advanced and nuanced today than ever. Interestingly, there are a variety of meanings and terms to be found in the precision agriculture literature. The one most widely quoted and used by practitioners is the one consisting of multiple Precision Agricultural "R"s.Robert et al. (1994) put forward three "R"s, the Right Moment, the Right and the Right. The International Plant Nutrition Institute subsequently added another "R" to that list, "the Right Path" and more recently, Khosla (2008) suggested an additional "R," the Right way."Right way," for example, in precision nutrient management, refers to the process of putting nutrient in the soil, (i.e.) transmitted versus banding, dribbling, injection, etc. For agriculture practiced in the developing world, the "right manner" factor may not be very important but it is of great importance for global agricultural precision practices.

Need for Precision agriculture:

In addition to the farm machinery, the ability of precision farming for economic and environmental benefits could be visualized by decreased use of water, fertilizers, herbicides, and pesticides.Rather than managing a whole field based on some generic average situation, which does not occur anywhere in the world, a precision farming approach considers site-specific variations within fields and changes management behavior accordingly (Figure 2b). Farmers are generally conscious that their fields are generating variable yields across the countryside.Such variations can be traced back to management practices, soil properties and/or ecological properties. A farmer's mental knowledge database requires years of study and implementation by trial-and error on how to handle various areas in a region.Today, due to the larger farm sizes and changes in areas farmed due to annual adjustments in leasing arrangements, the degree of awareness of field conditions is difficult to maintain. Precision agriculture provides the ability to automate and simplify information collection and analysis. It enables management decisions to be taken and enforced rapidly on small areas within big farms. The definition of "R"s does not require the use of advanced technology to exercise agricultural precision. For eg, it may take a suite of auto-pilots or a high-resolution guidance system on a 1000-hectare farm in the USA or Brazil to practice precision farming, or it may take a group of skilled laborers / farmers to plant precision on a 0.5-hectare field on a small farm on India or Asia.While the size of farming in the two scenarios is definitely contrasting, both scenarios included and applied the "five R"s to define and control spatial and temporal variation, and thus should come under specific farming practices. Most of recent research, particularly on precision nutrient management, has focused on the spatial and temporal aspects (i.e., the right place and time). The agricultural sector has been successful in offering the creative tools to realize the dimensions of precision nutrient management in space and time management.No doubt substantial progress has been made in handling nutrients more efficiently across crop fields. However, there are still a variety of problems associated with the management of precision nutrition. These are classified for ease of understanding, based on the four "R"s used in precision farming.

The right source:

Since this has long been known and established, the right source of nutrient is not of grave concern. In the complex world of precision nutrient management, however, where the decision based on the system is made in "real-time," it becomes crucial that we realize the limiting nutrient(s) and resolve the need with the right source.For example, differentiating the nutrient deficiency of iron against nitrogen in maize field (Zea Mays. L) using sensing technology is not currently feasible. Sadly, much or all of the work into specific nutrient control centered on macro nutrients (nitrogen, phosphorus, and potassium).Certain nutritional requirements of the crop are also believed to be fulfilled by standardized implementation. We need a series of sensors that could recognise the unique signature of reflectance in crop species for different nutrient deficiencies.

The right place:

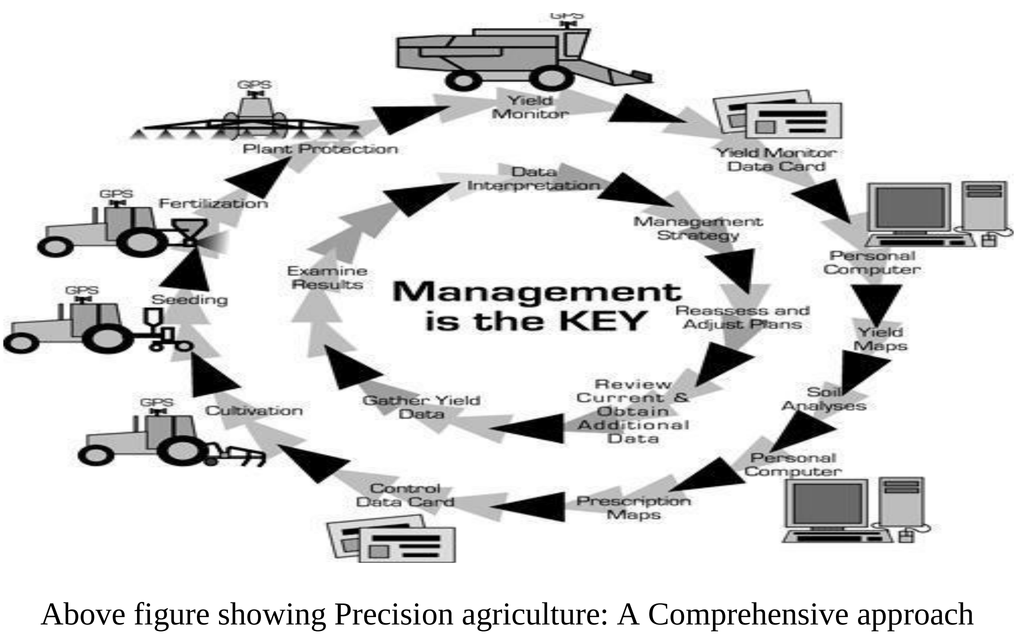
The aspect "the right place" has received the greatest attention from scientists and practitioners since the inception of precision agriculture. There are a number of sampling techniques and designs that allow us to characterize and quantify the spatial variability scale and pattern in fields such as grid soil sampling, site-specific management zones, smart sampling, soil electrical conductivity measurements, etc. Nevertheless, we do need a methodology that is economically feasible to measure spatial variation in soil and crop properties on a scale that occurs in heterogeneous fields.

The right time:

The development of 'active remote sensors' that can be installed on high clearance fertilizer applicators combined the technology of 'mapping variation in the crop canopy' and 'scale application of fertilizer' at the same time in 'real-time.' Although the active sensors have been around for approximately 5 years, their adoption has been sluggish.The 14th annual survey of US agricultural precision activities indicates that the successful sensor-based application of fertilizer ranks at the bottom of the list (Whipker and Akridge 2009). This may be partly due to the frequency at which the commercially available active sensors would reliably measure the crop canopy variability.Work in Colorado, USA, for example, has shown that active sensors can reliably determine crop nitrogen (N) spatial variability needs at the V12 maize growth stage (Ritchie, et al. 1992). Sadly, before that growth point, the majority or all of the farmers in Colorado complete their N application for the growing season.Primarily because farmers are wary of possible delays in getting into the field due to heat, etc., which makes them very reluctant to postpone in-season applications of sidedress fertilizer. It will take a paradigm shift in changing farmers 'thinking process to adopt active-- precision nutrient management or alternatively we need better sensing technology that can sense crop canopy early in the season to provide an estimate of crop nutrition needs, so it coincides with farmers' "time" to apply nutrients (N) to the crop.

The right amount:

With the advent of precision technology, initially using established nutrient recommendation algorithms developed by research and academic institutions / universities, the right amount of nutrient to be distributed across spatially variable fields was accomplished.It was soon realized, however, that the conventional algorithm lacks the robustness required for the site-specific aspect of precision nutrient control. The new recommendation algorithms being built are non-regional in nature, and are unique to the web in some cases.This created a new challenge to build a multi-year field observation database to establish a robust algorithm for precision nutrient recommendations that is accurate over a wider region. There is a potential for technological innovation that would allow estimating the nutrient balance for each area to assist in nutrient management and sustainability of the ecosystem.Regardless of the difficulties associated with precision agriculture and nutrient management in particular, the precision agriculture trend, as observed over the last 20 years, is indeed right. In the future, we'll be venturing into Precision Agriculture, version 2.0, to meet the world's increasing demand for food, feed, fiber, and fuel.



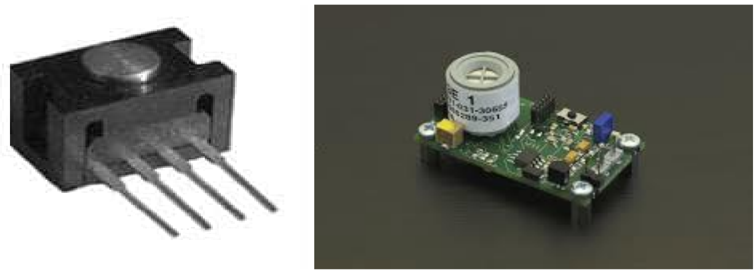
Above figure showing Precision agriculture: A Comprehensive approach

Above image showing basic steps involved in Precision agriculture

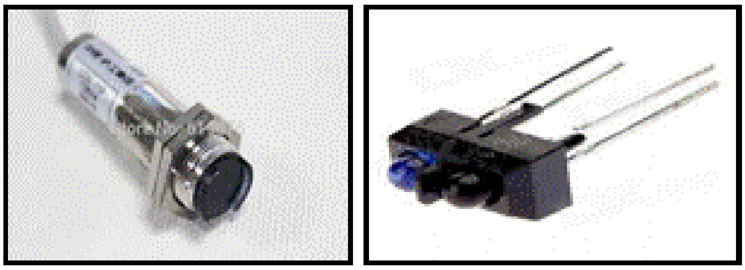
The Flat World:

We are living more and more in the "Empty World" If we were to stretch our horizon across the globe, we would be experiencing it's a flat planet indeed. In today's world, an rise in the demand for fertilizers in Asia is impacting the prices of local fertilizers in the USA.Similarly, a bumper crop produced in South America is affecting commodity prices in Asia or Europe; or food shortages in Haiti or Indonesia are becoming a problem for everyone. We are no longer insulated by external influences in an increasingly flat environment. There are strong signs that there is an increase in the global population and demand for high quality food.Our arable land resource, on the contrary, is diminishing and competing with other factors such as population, bio-energy crops and urbanization. Which role will precision farming play in meeting the world's increasing demand for food, feed, fibre, and fuel?

The developing world frequently misinterprets precision agriculture as a complex technical intervention for agriculture which is intended for large crop fields in the developed world. However in less developed areas of the world, precision agriculture and nutrient management can and should play an important role.In an ongoing article in Economic Times (Dec 2009) by Dr. William Dar, Director General of ICRISAT (International Crop Research Institute for Semi-Arid Tropics), affirmed that "ICRISAT staff had the option to build grain yields of supplement starved soils in Africa via cautiously miniaturized scale resting the supplements to the harvests". This is a magnificent case of exactness supplement the board for little scope ranches without enormous innovative information sources.Similarly, fifteen years ago in the Rice-Wheat Cropping Systems in Asia, Dobermann and Cassman (1996) announced that precision nutrient control should have another on-farm revolution. Wong et al. 2004 published a variety of case studies demonstrating the strategies by which farmers chose to enhance their management of variability within the region.They agreed that agricultural precision research needs to concentrate on improving results and not on the resources needed to better meet farmers 'needs. Precision farming has the potential to contribute to increased production across the globe in diverse agricultural environments and conditions.Will we conquer the obstacles ahead and use them as opportunities? In the near and distant future, precise agriculture management coupled with genetic advances in crop traits would play a crucial role in meeting global demand for food, feed, fiber and fuel.



Above images showing mechanical sensors for soil analysis



Above image showing optical sensors used for scanning crops

Constraints in Adoption of Precision Farming:

Some of the main challenges to be addressed when bringing PA to the Indian market are discussed briefly below, quoted from Tata's case study:

- Conceptualization of ICT systems through consultation with customers. Agricultural practices are common to species, and similar to areas. ICT applications must be tailor-made specifically for consumer needs.
- Production of ICT platforms must be carried out in a phased manner to allow the project to evolve. The best way to ensure that a project idea works in real life is to launch the project in a pilot phase and then test and extend it.
- The key aspect of ICT in rural areas is that the contact person should build a grassroots working relationship and trust.
- Agricultural systems ICT projects have to be built very systematically. Relationships with the users and the site holders must be established.
- BIS Research forecasts that the global market size for precision agriculture will rise by more than $6.34 billion between 2015 and 2022 at an annual CAGR of 13.09%. The patterns say North America will continue to dominate over the forecast years with the US at the forefront.APAC will also emerge as the fastest growing region on the market with the world's most populous nations, China and India, at a CAGR of 18.29 per cent from 2015 to 2022.

In conclusion, the Indian market is fairly ready to implement PA and the time is right for the government to announce a farmer- 2015 budget. The only warning will be to pick progressive states where it's easy to begin implementing PA. The way forward is to build cost-approaches taking into account the real- facing an Indian farmer.Soil conservation, sustainability issues and input optimization are only a few problems that can make a difference to food production research in one of the world's oldest democracies.

Conclusion:

Around the globe there are prospects for implementing agricultural precision techniques. Depending on the innovative mindset of growers, clinicians, scientists and local consultants to the area of interest, the type of precision practices may be different from one place to another.This paper delineates the wide meaning of exactness cultivating with a few instances of accuracy supplement the board rehearses from a few nations where farmers and specialists have conquered the difficulties and changed them into circumstances by outfitting worldwide information and creating neighborhood explicit methods reasonable for their region, movement and assets.Lack of knowledge, problems of connectivity in remote areas and lack of financial support are obstacles in Precision Agriculture's direction. Effective PA adoption consists of three phases including exploration, review and implementation. Although execution of discovery and research is well ahead, it is constantly catch-up.Precision farming tackles both the economic and environmental concerns affecting today's agricultural growth. Coordination is gaining traction between famers and both the MNC's and government. Concerns about cost-effectiveness, however, and the most productive ways of using the technical resources we now have, remain a work-in-progress.Bearing in mind the anticipated need of tomorrow and the urgent need of today, PA needs to become the only option and not an option in the agricultural sector.

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