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# Revolutionizing Horticulture: The Role of Precision Farming in Enhancing Crop Yield and Sustainability

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Horticulture has emerged as the most promising and favoured candidate for promoting diversification and combating climate change. In recent years, the growing demand for horticultural produce for internal consumption and exports has highlighted the need for increasing production and enhancing the productivity of these crops. Efforts made to harness available technologies through plan schemes have yielded good results and India has secured a creditable position in the international scene in the production of many horticultural products such as mango, banana and cashew. Precision farming is one such area that can facilitate the most efficient utilization of resources and improve returns per unit area and time. Precision farming has been the buzzword of horticultural research around the globe in recent times. It is based on the philosophy of heterogeneity within homogeneity and requires precise information on the degree of variability within field management (Patterson and Nair, 2011). The aim is to vary the horticultural inputs in response to the varying conditions within the field. The various attempts that have been made to operationalize precision farming involve the use of intelligent devices like the yield mapper (comprising of a harvester, yield measuring sensor and a GPS), variable rate fertilizer rigs and satellite imagery to supplement the information on the crop variability at a good spatial resolution as well as temporal resolution. Geographic Information System (GIS) incorporates the information from all these devices, which culminates in precision farming. This chapter aims to understand the importance of precision farming in fruit crops.


Today technical innovation has reached a stage where a farmer can have access to information and tools to manage his automated field activities. They may now monitor, analyse and deal with variability within the field (e.g. fertility of the soil, water availability and yields) that was known to exist previously but was not managed, to their advantage. The ability to handle the fluctuation in production in the field and maximize financial return, decrease waste and limit impact on the environment has always been an ambition of an innovative farmer in the horticultural sector, especially those that support solid horticultural techniques. Precision farming offers to prescribe strategic farm management choices in the field operations to aid in fulfilling this aim through mechanization, sensing and communication technologies, automated data collection, recording and usage of this information. Such an approach in horticultural production management gives rise to what is currently known as precision horticulture, soil-specific crop management (SSCM), spatially variable crop production (SVCP), smart farming (SF), etc (Sharma and Nadarajan, 2017).

Precision farming in horticulture comprises the application of technologies to regulate spatial and temporal variability associated with all the aspects of horticultural production for enhancing crop performance and environment quality by employing satellite, sensors and field or thematic mapping. Precision farming advocates for efficient management of resources through location-specific interventions. It comprises several interventions like micro irrigation, fertigation, mulching for in-situ moisture conservation, soil and leaf nutrient-based fertilization management, protected cultivation and organic farming, etc.

Precision farming as precision agriculture which is not just the injection of new technologies but it is rather an information revolution, a more precise farm management system made possible by new technologies that result in a higher level. It means adding the right amount of input at the right time and the right location within a field (Schofield, 2019)

**Objectives of Precision Farming**

Increased production efficiency with higher product quality via more efficient chemical usage, energy conservation and protection of soil and water.

**Higher Profitability And Sustainability:** Maximum profit can be reached in each zone or site of a field by optimizing the precise application of inputs such as variety, seed, fertilizer, herbicide, insecticide and so on as crop demand dictates, which can be done in each zone or site of a field, weather, soil qualities (nutrient availability, texture, and drainage, for example), and historical crop success all play a role.

**Optimizing Production Efficiency:** Identifying variations in yield potential may provide opportunities to maximize production amount at each site or within each zone utilizing differential techniques under a particular set of field conditions.

**Increasing Input Efficiency:** Making efficient use of inputs such as fertilizers, seeds and so on based on the production potential of the soil at a specific site.

**Effective And Efficient Pest Management:** One of the primary goals of precision farming is to reduce crop input costs, which can lead to higher returns and improved environmental services. In comparison to standard farming practices, site-specific variable rate application advocates the use of chemicals, such as herbicides and insecticides, at the site of the problem with a targeted approach.

**Optimizing Product Quality:** Product quality can be optimized by utilizing sensors to identify quality aspects of a crop, which assists in making decisions on input applications based on the aim.

**Conservation of Soil, Water and Energy:** Precision farming takes a complete strategy that begins with crop planning and measuring field variability, which includes tillage procedures that disturb the soil to the bare minimum. Furthermore, water is applied efficiently by using techniques such as drip irrigation, sprinkler irrigation and so on, with the notion of more crop per drop in mind. All of these precision applications utilize extremely little energy, resulting in energy conservation.

**Protection of Surface and Ground Water:** Protecting the environment by efficient use of inputs such as fertilizers, chemicals and so on, which prevents their leakage into ground water or runoff.

**Environmental Impact Reduction:** Precision farming makes better management decisions to change inputs to meet production needs, ensuring small waste of any applied input to the environment.

**Risk Reduction:** Risk management is a popular method used by most farmers nowadays, which may be expected as income and environmental safety. Farmers frequently employ risk management in a production system by overestimating the unit cost of a given input. Thus, a farmer may apply an additional spray, add additional fertilizer, purchase additional machinery or engage farm labour to ensure that the product is produced/harvested/sold on time, thereby ensuring economic return.

## Conclusion

Precision farming is a cornerstone of modern agricultural practices, offering significant improvements in both crop yield and production efficiency. By utilizing advanced technologies, it provides critical data that supports informed management decisions. A major advantage of precision farming is the reduction in chemical and fertilizer costs, achieved through the precise and targeted application of inputs (Zhang *et al*. 2002). This approach not only enhances production but also ensures the consistency and superior quality of crops. Additionally, precision farming enables farmers to maintain accurate farm records, which lead to more strategic and data-driven decision-making. The adoption of precision farming technologies also results in reduced cultivation costs by optimizing the use of resources, such as seeds, water, and fertilizers. Moreover, technologies like variable rate application reduce the reliance on excessive chemical inputs, while the controlled application of irrigation water helps minimize nutrient leaching and deep percolation, fostering more sustainable and environmentally responsible farming practices (Bramley and Buttar, 2007)

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