

PRECISION FARMING SAV- ING WATER, FERTILIZER AND MONEY ON THE FARM

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Precision Farming Saving Water, Fertilizer and Money on the Farm

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Abstract

Precision farming, also known as precision agriculture, utilizes advanced technologies such as GPS, sensors, drones, and data analytics to optimize farm management by addressing spatial and temporal variability within fields. This article highlights the role of precision farming in conserving water, reducing fertilizer use and improving economic returns, making it a key component of sustainable modern agriculture. With increasing challenges posed by climate change, population growth, resource depletion, and food security concerns, precision agriculture offers an efficient and environmentally responsible approach to crop production. Precision farming can reduce water consumption by up to 30% through site-specific irrigation, decrease fertilizer application by 20–40% by matching nutrient supply with crop and soil requirements, and lower operational costs by 10–25%, thereby enhancing farm profitability and productivity. Moreover, these practices contribute to minimizing environmental impacts such as nutrient leaching, soil degradation, and chemical runoff. The article further emphasizes that wider adoption of precision agriculture requires supportive government policies, technological subsidies, infrastructure development, and farmer training programs. Overall, precision farming represents a transformative pathway toward resilient, data-driven, and sustainable agricultural

systems that benefit farmers, consumers, and the environment alike.

Keywords: Conservation, precision farming, efficiency, savings and technology

Introduction

Precision farming represents a paradigm shift in agriculture, integrating technology to tailor farming practices to specific field conditions rather than applying uniform treatments. Traditional farming often leads to overuse of resources such as, water and fertilizers thereby, resulting in environmental degradation and economic losses. However, precision farming addresses these issues by using data-driven tools to optimize inputs, which save water, reduce fertilizer waste, and cut down application cost. According to the Food and Agriculture Organization (FAO), global agriculture accounts for 70% of freshwater withdrawals, making efficient water use critical (FAO, 2020). Similarly, excessive fertilizer application contributes to soil degradation and eutrophication. This article discusses how precision farming achieves these savings, supported by real-world examples and data.

Precision Farming

Precision farming, also known as precision agriculture, is a modern farming approach that uses technology

to monitor and manage crop production more efficiently.

Components of Precision Farming

Precision farming integrates technology, data and management practices to optimize agricultural operations. It typically consists of several key components that work together to enable site-specific decision-making.

- 1. Global Positioning System (GPS):** GPS provides accurate location data for mapping field variations and guiding equipment, enabling precise navigation and reducing overlap in operations.
- 2. Sensors and Monitoring:** Sensors collect real-time data on soil moisture, nutrients, and crop health, transmitting it with IoT for continuous monitoring and proactive adjustments.
- 3. Data Analytics and Software:** Software platforms analyse sensor data using algorithms to generate insights, such as yield predictions and prescription maps for optimized inputs.
- 4. Variable Rate Technology (VRT):** VRT applies fertilizers, pesticides, and seeds at variable

rates based on field data, matching inputs to specific zones for efficiency.

5. Drones and Aerial Imaging: Drones capture high-resolution images for crop assessment, detecting issues like stress or deficiencies early through multispectral analysis.

6. Automation and Robotics: Robotic systems perform tasks like planting and weeding autonomously, using AI for precision and reducing human labour in farming operations.

Advantages

- 1. Increased Efficiency and Yield:** By targeting specific areas, farmers can optimize resource use, leading to higher crop yields (often 10-20 per cent improvements) and reduced waste.
- 2. Cost Savings:** Precision application minimizes overuse of fertilizers, pesticides, and water, lowering expenses. For example, variable-rate technology can cut input costs by up to 30%.
- 3. Environmental Benefits:** It reduces chemical runoff and soil erosion, promoting sustainability and better compliance with regulations like those from the EPA.
- 4. Data-Driven Decisions:** Real-time data helps predict issues like pest outbreaks

or drought, enabling proactive management and better risk mitigation.

5. Scalability: Suitable for large farms but also adaptable to smaller operations with affordable tech like smartphone apps.

Disadvantages

- 1. High Initial Costs:** Equipment like GPS-guided tractors, drones, and sensors can cost tens to thousands of dollars, making it inaccessible for small or resource-poor farmers.
- 2. Technical Complexity:** Requires training and expertise in data analysis, software, and maintenance, which can be a barrier for traditional farmers.
- 3. Data Privacy and Security Risks:** Collecting vast amounts of farm data raises concerns about hacking, data breaches, or misuse by tech companies.
- 4. Dependency on Technology:** Reliance on internet connectivity, satellites, and power sources can fail during



outages, weather events, or in remote areas.

5. Potential Over-Reliance:

It might lead to reduced biodiversity if not managed carefully, as uniform high-tech approaches could overlook ecological nuances.

Challenges and Limitations

- Despite benefits, precision farming faces hurdles.
- In low-income regions, access to reliable internet and electricity limits adoption.
- Data security is another issue, as farm data could be vulnerable to cyber threats.
- Additionally, not all crops or terrains benefit equally, e.g., hilly landscapes may require specialized equipment.
- Overcoming these requires policy support, such as subsidies and training programs, to democratize access.

Future Prospects

1. The future of precision farming

lies in AI-driven predictive analytics, which can forecast pest outbreaks or optimize planting schedules.

2. Integration with blockchain for supply chain transparency and climate-smart agriculture could further amplify savings.
3. Research indicates that by 2030, AI could reduce global agricultural water use by an additional 15% (IPCC, 2023).

Conclusion

Precision farming is a proven strategy for sustainable agriculture, delivering substantial savings in water, fertilizer, and money. By adopting technologies like sensors and VRT, farmers can achieve higher efficiency and resilience against climate variability. While barriers such as cost and training exist, widespread adoption could transform global food systems. Policymakers should promote incentives, and farmers are encouraged to start with pilot programs. Future research should focus on integrating AI for predictive analytics to further enhance outcomes. Ultimately, precision farming not only saves resources but also secures food security for future generations, fostering a more equitable and environmentally conscious agricultural landscape.

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