

Chapter 9

Using AI to Improve Crop Tracking, Soil Investigation, and Nutrient Management in Precision Agriculture


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ABSTRACT

Artificial intelligence (AI) is transforming precision agriculture by enhancing soil analysis, crop tracking, and fertilizer management. AI-powered systems enable real-time monitoring of crop health, soil nutrient levels, and environmental conditions, providing farmers with actionable insights. Machine learning algorithms integrated with remote sensing technologies, such as drones and satellites, help monitor crops, predict yields, and detect early stress signs. In soil research, AI combines data from IoT sensors, GIS, and soil samples to create detailed soil health maps and predict changes. Predictive analytics optimize nutrient management by recommending

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precise application of water, fertilizers, and amendments based on real-time crop and soil needs. Automation, decision support systems (DSS), and variable rate technology improve input efficiency, reducing waste and environmental impact. By leveraging AI in these areas, precision agriculture promotes sustainable farming, lowers costs, and increases productivity through improved data analysis, real-time monitoring, and automation.

1. INTRODUCTION:

The need to feed a fast-growing population, environmental sustainability, and climate change are all putting increasing pressure on the world's agricultural sector to produce more food with fewer resources. Despite their effectiveness in the past, traditional farming methods are becoming less and less capable of addressing these issues. Precision agriculture that incorporates artificial intelligence (AI) offers a viable way to minimize waste and environmental effects while improving crop productivity, soil health, and fertilizer management. The introduction emphasizes how urgently agricultural innovation is needed to meet the twin problems of reducing environmental impact and raising food demand. Despite being fundamental, traditional farming methods are becoming ineffective in a world that is changing quickly. Precision agriculture, which uses cutting-edge technologies to maximize farming methods, has consequently become crucial. In order to make informed decisions, artificial intelligence (AI) uses enormous volumes of data from multiple sources, including satellites, IoT sensors, and remote sensing technologies. AI makes it feasible to continuously monitor crop health, growth trends, and yield forecasts in crop tracking, allowing for the early detection of disease, stress, and nutrient deficiencies.

AI provides insights into soil health and supports targeted soil management by analysing real-time data on soil moisture, pH levels(Sriram et al., 2024), and nutrient content through soil exploration. Artificial intelligence (AI)-powered predictive analytics aid in nutrient management by optimizing fertilizer and irrigation use, guaranteeing accurate and effective application, which lowers expenses and environmental damage. Farmers are further empowered to make data-driven decisions through the integration of machine learning algorithms and decision support systems, which improves resource allocation, productivity, and sustainability results. The introduction concludes by highlighting how AI in precision agriculture has the potential to transform farming by enhancing productivity, sustainability, and adaptability to global issues. The introduction lays the groundwork for examining how AI technologies might improve precision agriculture's environmental stewardship, lower costs, and increase productivity all of which can foster sustainable agricultural methods. The Figure 1 explained the details about the follow of the chapter.

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