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PRECISION AGRICULTURE AND ARTIFICIAL INTELLIGENCE FOR SUSTAINABLE CROP MANAGEMENT

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Introduction

The agricultural landscape is undergoing a profound structural evolution, transitioning from traditional resource-intensive practices to data-driven smart farming. With global food demand rising alongside mounting climate variability, conventional farming methods face critical strains regarding soil degradation, water scarcity and chemical overuse. To address these vulnerabilities, Precision Agriculture (PA) paired with Artificial Intelligence (AI) has emerged as an indispensable paradigm for achieving sustainable crop management, optimizing resource allocation and ensuring long-term food security (Jyoti et al., 2026). Recent advancements in geospatial technologies have further demonstrated that integrating remote sensing and Geographic Information Systems (GIS) enables precise land-resource inventories and reclamation planning for underutilized and degraded agricultural landscapes (Meena et al., 2026).

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Indian agriculture is at a crossroads. Increase in input prices, adverse weather conditions, declining soil health and the most important – feeding 1.4 billion people while reducing greenhouse gas emissions – demand innovation in agriculture. PA can be the science-based solution to the challenge – more, efficient, productive and sustainable farming.

Through the use of sensors, drones, satellites, IoT devices and machine learning algorithms, farmers can take decision based on single plants or plots instead of the entire field. In 2026, India is quickly shaping up to be one of the world's most promising 'AI agriculture labs' with government's strong digital public infrastructure and a vibrant private innovation ecosystem.



Figure 1: Drone-enabled precision spraying in a wheat field in northern India.

Understanding Precision Agriculture and the Role of AI

Precision Agriculture is the science of observing, measuring and responding to the variability of crops and the environment. AI is the system brain that takes all the information and data coming from the disparate systems and sensors and makes recommendations.

Major uses include VRT (Variable Rate Technology) for accurate application of water, fertilizers and pesticides, early pest and disease detection using image recognition, yield prediction, hyperlocal weather forecasting and irrigation automation.

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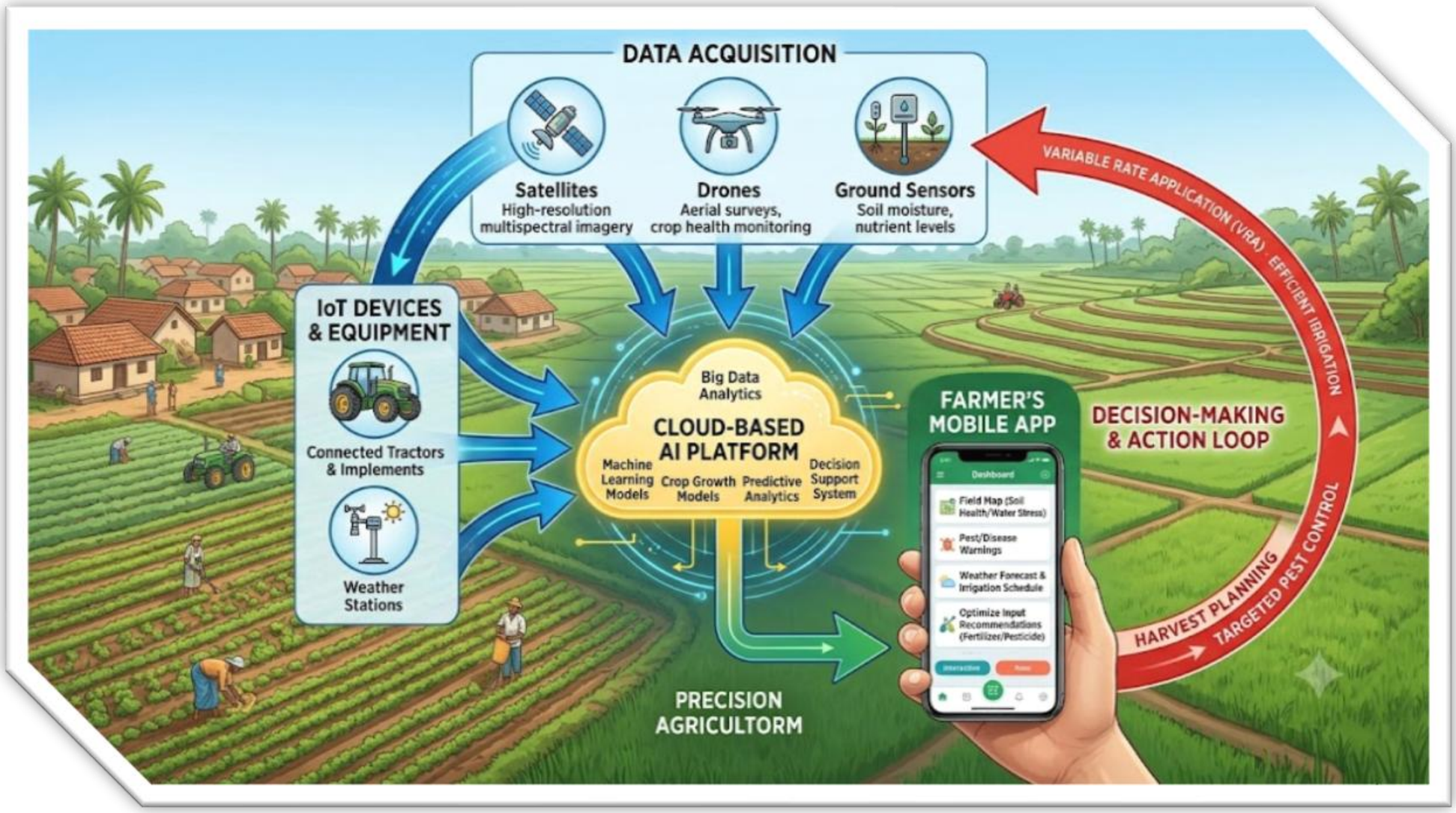


Figure 2: Conceptual framework of AI-powered Precision Agriculture system.

India's Digital Agriculture Push (2024–2026)

India has established one of the largest digital agricultural public infrastructures across the globe through Digital Agriculture Mission (2024-2028). This includes Agri Stack (7.63 crore Farmer IDs generated), Krishi Decision Support System (KDSS), Bharat-VISTAAR (A multilingual AI powered advice platform launched in 2026) and the National Pest Surveillance System (NPSS) which tracks 66 crops and 432 pest types using AI.

The ICAR's Network Programme on Precision Agriculture (ICAR-NePPA) is working on a set of sensor-based, drone-enabled and AI-driven solutions.

Key Technologies and Their Impact

The following table summarises the performance of major precision agriculture technologies in Indian conditions:

Table 1: Performance of Precision Agriculture and AI Technologies in Indian Field Trials (2024–2026)

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Technology	Crop(s)	Water Saving	Fertiliser Saving	Yield Increase	Source
IoT Soil Sensors + AI	Sugarcane, Cotton	60–68%	15–25%	18–70%	Andhra Pradesh Pilots (2025)
Drone-based Spraying	Paddy, Wheat	30–40%	20–35%	8–15%	Namo Drone Didi Programme
AI Image-based Disease Detection	Tomato, Potato, Rice	—	25–40% (pesticide)	12–22%	ICAR & IIT Ropar (2026)
Satellite + AI Advisory	Multiple crops	25–45%	15–30%	10–18%	Bharat-VISTAAR & Microsoft pilots

Success Stories from the Field

Real-world examples are now emerging across states:

- In Andhra Pradesh, using a sensor-based smart irrigation system, coupled with AI based advice on the application of fertilizer and irrigation resulted in increased savings of 68% of water while increasing yields by as much as 70%.
- Microsoft Farm Beats pilots in Maharashtra showed 40% higher yields and 25% less fertiliser.
- Karnataka's AI + Satellite pilot (2026) in drought-prone districts is using machine learning for accurate pest detection, yield forecasting and crop loss assessment.
- IIT Ropar's ANNAM.AI centre is deploying hyperlocal AI weather stations and developing heat-stress and pest-forecasting models in partnership with industry.

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These successes show that precision technologies deliver the best results when adapted to smallholder conditions through local language interfaces and affordable service models.

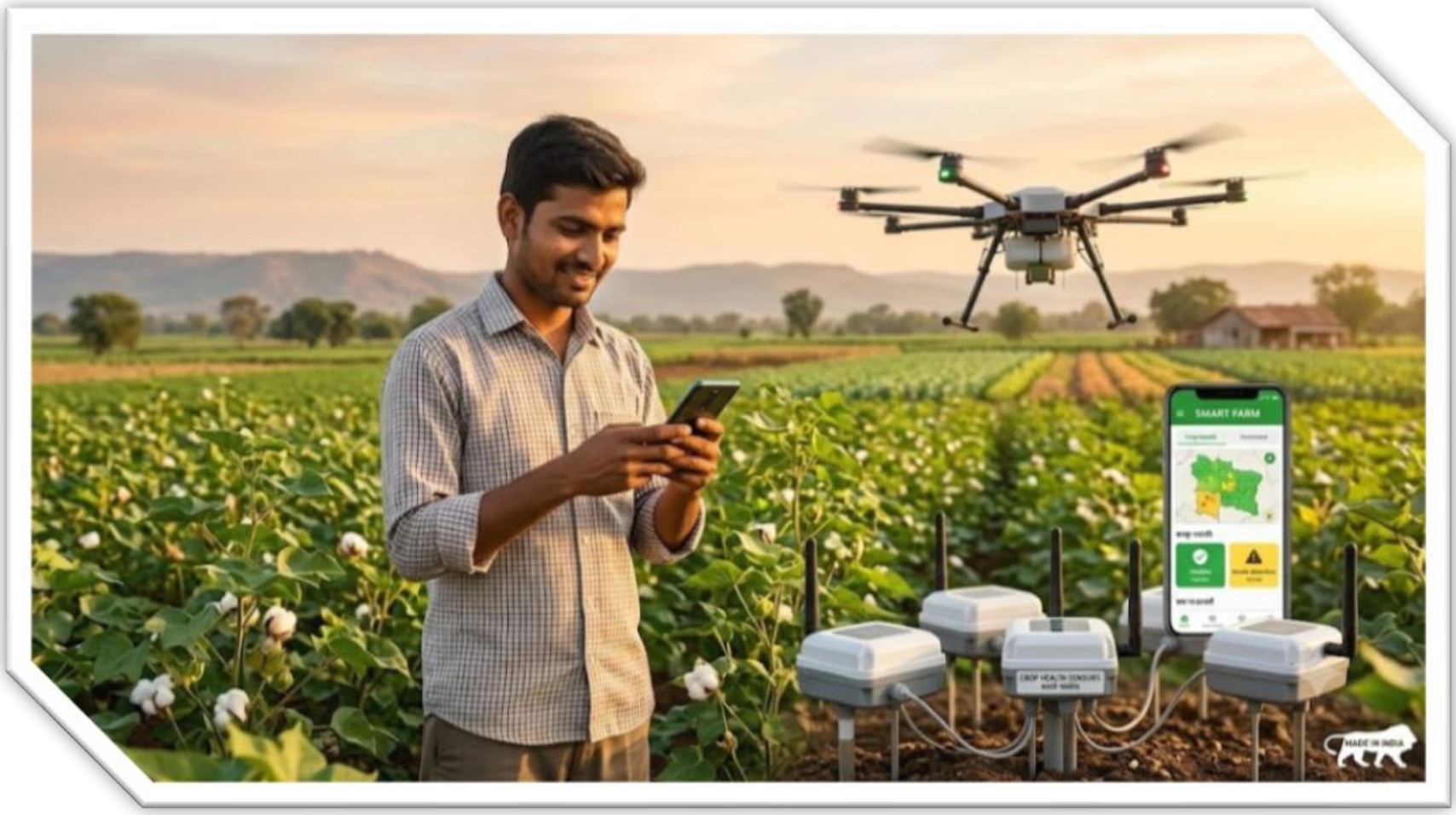


Figure 3: Farmer accessing AI-driven advisory through a mobile application.

Benefits for Sustainable Crop Management

Farmers can realize triple wins (economic, environmental and social) when using precision farming and AI - reducing carbon emissions via effective nitrogen management, limiting chemical runoff, saving water and maintaining soil health in the long term. Yet, perhaps just as significantly, they can reduce labour and overcome the challenges of climate change.

Emerging Trends (2026–2030)

- Massive roll out of voice-based AI chatbots in regional languages.
- Combine digital twins with multimodal AI models.
- Expansion of Agriculture Data Exchange (ADeX) platforms.
- More use of robotics and climate-smart varieties derived by AI.

At a CAGR of over 10.5% the global precision agriculture market is forecasted to grow during this timeframe with the Asia Pacific dominating.

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Challenges and the Road Ahead

High initial costs, limited digital literacy, patchy rural internet and concerns around data ownership remain real challenges. However, the combination of falling sensor prices, improving rural connectivity and strong policy support through the Digital Agriculture Mission and IndiaAI Mission is steadily lowering these barriers.

Yield Prediction and Climate Adaptation

Integrating multi-year historical yields, real-time weather dynamics and vegetative indices via machine learning allows researchers to forecast crop yields with high accuracy (Dinh & Nguyen, 2020). These predictive analytics assist farming communities in planning harvest logistics, storage and market supply chains, building robust resilience against erratic monsoon patterns driven by climate change.

Conclusion

AI in precision farming is no longer just a future concept in India – it is already enabling greater efficiency, productivity and sustainability. If technologies such as these are made more accessible through inclusive design, more skilled training and region-specific solutions, the advantages are truly transformative for climate-smart and profitable food production.

Established. The coming years will reveal how far and fairly these smart tools will reach millions of smallholder farmers in the next five years.

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References

1. Economic Times, Business Standard and AgroSpectrum India field reports (2025–2026).
2. Dinh, A., & Nguyen, T. (2020). Predictive modeling for crop yield estimation using machine learning algorithms. *Computers and Electronics in Agriculture*, 174, 105492.
3. ICAR Network Programme on Precision Agriculture (NePPA) reports (2025–2026).
4. Jyoti, Harish Kumar, H., Negi, S., Jain, G., Kumar, A., Kumar, R., & Singh, R. (2026). Artificial Intelligence and Machine Learning in Agriculture: Transforming Toward Smart, Sustainable and Resilient Farming Systems: A Review. *Indian Journal of Agricultural Research*, 60(8), 1155–1162. https://doi.org/10.18805/IJARe.A-6593
5. Meena, R., Goswami, C., Suresh, C. P., & Hoque, A. (2026). Identification of Cultivable Wastelands in Meghalaya, India using Geospatial Technology for Agricultural Reclamation. *Journal of Geography, Environment and Earth Science International*, 30(10), 1–13. https://doi.org/10.9734/jgeesi/2026/v30i101131
6. Press Information Bureau, Government of India (2026). Updates on Digital Agriculture Mission, Bharat-VISTAAR and ICAR-NePPA.
7. Ramesh Naik et al. (2025). Digital agriculture and data-driven farming solutions. *Indian Farming*.
8. Springer Nature (2026). Current applications of artificial intelligence for advancing agriculture and sustainability.
9. World Economic Forum (2025). *Future Farming in India: AI Playbook for Agriculture*.