

AI-Powered Integrated Farming Assistant for Crop, Pest and Market Management

Mayur Warghade, Parth Chavan, Pradumna Pathade, Rahul Bhor, Prof. Rupesh Hushangabade

Department of Computer Science and Engineering
MIT Art, Design and Technology University, Pune, India
School of Computing

Abstract: *Precision Farming Technologies (PFTs) represent a suite of advanced digital and intelligent tools crucial for sustainable crop protection and pest management. These technologies enable accurate prediction, detection, and control of pests, weeds, and diseases, reducing reliance on chemical Plant Protection Products (PPPs) such as pesticides and herbicides. This meta-analysis systematically reviewed 239 research articles published between 2012 and 2022 to identify technological trends, performance impacts, and adoption gaps in precision crop protection.*

Technologies were classified based on sensors, platforms, crop types, pest types, management stages, and their environmental, economic, and social impacts. The findings revealed a predominant focus on arable crops and weed management, with RGB imaging, Farm Management Information Systems (FMIS), and autosteering systems as the most widely adopted tools. Precision approaches achieved up to 97% reductions in herbicide use, 70% less insecticide application area, and 89% decreases in weed densities, improving resource efficiency and economic returns.

Artificial Intelligence (AI), machine learning, and big data analytics played central roles in processing sensor and imagery data, supporting real-time decision-making within Decision Support Systems (DSS) and FMIS. Integration of IoT-based weather data, UAV imagery, and robotic systems enhanced detection accuracy and treatment precision.

Emerging trends highlight UAVs, proximal sensing, and autonomous robots as key enablers of nextgeneration precision farming. Future advancements integrating edge computing, sensor fusion, AI-driven analytics, and swarm robotics promise fully datadriven pest management systems, advancing sustainable agriculture while minimizing environmental footprints (DSS) and FMIS. Integration of IoT-based weather

data, UAV imagery, and robotic systems enhanced detection accuracy and treatment precision.

Emerging trends highlight UAVs, proximal sensing, and autonomous robots as key enablers of nextgeneration precision farming. Future advancements integrating edge computing, sensor fusion, AI-driven analytics, and swarm robotics promise fully datadriven pest management systems, advancing sustainable agriculture while minimizing environmental footprints.

Keywords: Pesticide, use Precisionfarming, Crop protection, Robot, Platforms

