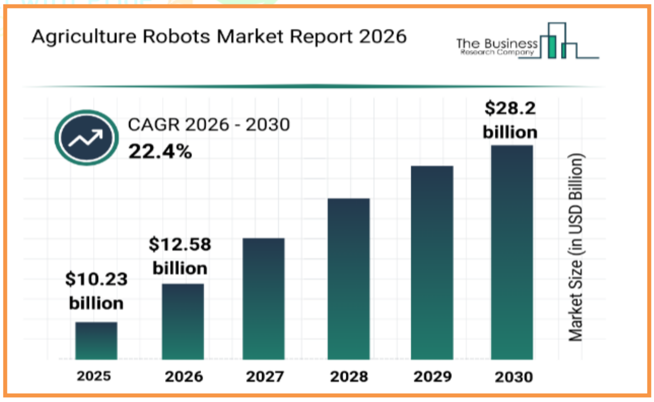
AGRI MAGAZINE
(International E-Magazine for Agricultural Articles)
Volume: 03, Issue: 06 (June, 2026)
Available online at http://www.agrimagazine.in

Robotics and AI in Agriculture Sector

*Boppidi Manasa Reddy[1] and G. Harish[2]
[1]Ph.D. Research Scholar, Department of Agronomy, College of Agriculture, PJTAU, Rajendranagar, Hyderabad, India
[2]Farm Manager, Krishi Vigyan Kendra –Nizamabad (Rudrur), India
*Corresponding Author's email: boppidimanasareddy6@gmail.com

In the last century, global agriculture faces tremendous challenges. Growing populations, climate change, limited natural resources, and growing socio-economic landscapes require more efficient, resilient, and sustainable food systems .The global food production will need to increase 70% by 2050 to fulfill population needs, according to the FAO. Traditional farming practices, while essential, generally rely on manual labor and reactive decision-making that are unsuitable for today's complex agricultural reality.While necessary, traditional farming practices typically involve manual labor and reactive decision-making, which are unsuitable for today's complex agricultural landscape. This context can be transformed by AI and robotics. These technologies facilitate precision and automation throughout all phases of the agricultural cycle, i.e., soil monitoring, planting, crop management, harvesting, and post-harvest logistics. AI facilitates data-driven decision-making by analyzing diverse data, including meteorological forecasts, satellite imagery, and in-field sensor data. Robotics perform repetitive tasks with rapidity, consistency, and minimal oversight. Collectively, AI and robotics catalyze a transformation from traditional agriculture to smart, autonomous farming systems.

Agricultural robotics refers to the use of robots, automation, and intelligent machines in farming and agricultural operations to improve productivity, reduce labour dependency, increase precision, and support sustainable agriculture. In agriculture, AI helps turn **data into simple,** actionable advice that farmers can implement in their day-to-day farming practices. By analysing satellite imagery, weather forecasts, soil data, and crop patterns, AI can **help farmers decide** what to sow, when to sow, how much input to use, and when to harvest. From early warnings about pests and diseases to better planning for irrigation and fertiliser use, AI is making farming more precise, efficient, and less risky.



The agriculture robots market size has grown exponentially in recent years. It will grow from $10.23 billion in 2025 to $12.58 billion in 2026 at a compound annual growth rate (CAGR) of 22.9%. The growth in the historic period can be attributed to increasing labor shortages in agriculture, rising adoption of controlled environment farming, expansion of large-scale commercial farms, improvements in robotic hardware reliability, growing availability of farm automation solutions.

India is emerging as a **global leader** in **Artificial Intelligence, ranking third** worldwide in **AI competitiveness,** according to Stanford University's **2025 Global AI Vibrancy Tool.** The rapid rise, measured across **AI growth and innovation between 2017 and 2024**, reflects India's digital capabilities, data ecosystem, and strengths in AI talent, research, startup, investment, infrastructure, and governance. Artificial Intelligence **(AI)** is also increasingly emerging as a transformative force in agriculture, offering new pathways to enhance productivity, sustainability, and resilience across farming systems. By leveraging data from satellites, sensors, drones, weather stations, and farm machinery, AI-enabled tools support informed decision-making at every stage of the agricultural value chain.

Types of Agricultural Robots

1. Field Robots

Used for crop cultivation and field management.

Examples:

- Autonomous tractors
- Robotic seeders
- Precision sprayers
- Fertilizer applicators

2. Harvesting Robots

These robots identify ripe fruits and vegetables and harvest them carefully.

Common uses:

- Tomato harvesting
- Strawberry picking
- Apple harvesting

Benefits:

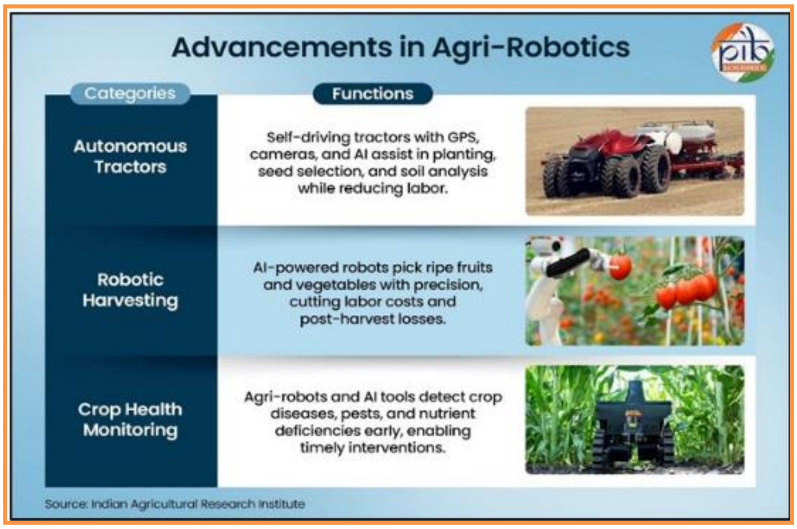
- Faster harvesting
- Reduced crop damage
- Labor cost reduction

3. Drone Technology in Agriculture

Agricultural drones monitor crop health, irrigation, pests, and nutrient deficiencies.

Functions:

- Crop monitoring
- Mapping fields
- Spraying pesticides
- Yield estimation



Applications of Agricultural Robotics

- Precision farming
- Weed detection and removal
- Smart irrigation
- Livestock monitoring
- Greenhouse automation
- Soil analysis
- Crop disease detection

Major Companies Working in Agricultural Robotics

- John Deere

- AGCO Corporation
- Trimble Agriculture
- DJI Agriculture

Future of Agricultural Robotics

Agricultural robotics is expected to play a major role in:

- AI-based farming
- Fully autonomous farms
- Climate-resilient agriculture
- Sustainable food production
- Smart farming systems integrated with IoT and machine learning

Countries like Japan, United States, and India are increasingly investing in smart agriculture and robotic farming technologies

Application and Initiatives in India

Given the vastness and diversity of Indian agriculture, robotics and automation are being explored in various areas to enhance productivity, efficiency, and sustainability. A few of the examples are:

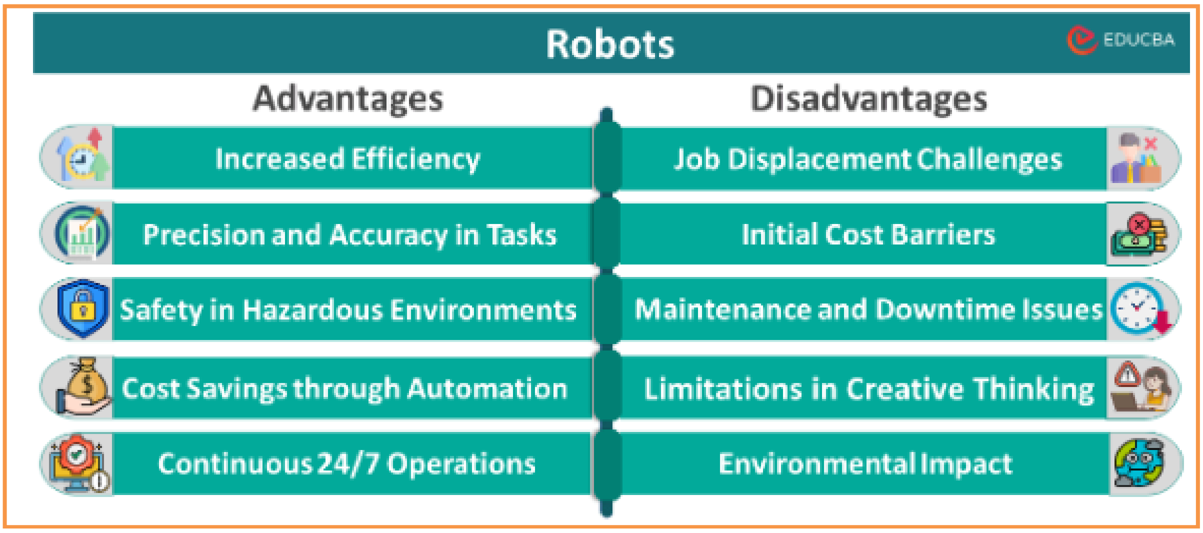
- **E-Krishi Yantra**: This is a multifunctional robotic system that can plough, plant seeds, apply fertiliser, and spray pesticides with precision.
- **Krishibot**: It is an autonomous weeding robot developed by a Kerala-based firm that finds and removes undesired weeds from crops.
- **AI-Kisan**: It is an AI-powered robotic system that can evaluate soil conditions, monitor crop health, and make real-time watering and fertilisation recommendations.
- **Milagrow Agribot**: This is a harvesting-focused agricultural robot. It uses advanced vision technologies and robotic arms to detect ripe fruits and harvest them gently without harming the trees.
- **Bharat Agro Robot**: This is an autonomous robot that helps farmers spray pesticides. It uses artificial intelligence and sensors to calculate the best amount of pesticide to use and the regions that need to be treated
- **MITRA:** The Indian Agricultural Research Institute (IARI) created it. It's a humanoid robot that can do things like seed sowing and fertiliser application.
- **AI-Sow**: It is a cutting-edge agricultural robot built for seeding duties. It sows seeds precisely at the required depth and spacing using artificial intelligence and computer vision.

Effective use of robotics in agriculture would lead to increased efficiency, productivity, and sustainability in the sector. However, there is a need to have a balance between the use of robotics and human intervention. Technology should be limited to a point where there are chances of Human error and failure but the decision-making authority should lie with humans.

Advantages of Robotics in Agriculture

The integration of robotics in agriculture has brought about numerous advantages, significantly transforming the sector. These benefits range from increased efficiency and productivity to environmental sustainability.

- **Increased efficiency and productivity**: Robotics can operate continuously and perform tasks faster and more accurately than human labour.
- **Precision agriculture**: Robots equipped with sensors and GPS technology can perform tasks like planting, weeding, and harvesting with high precision. For example, precision application of water, pesticides, and fertilisers can reduce the overall environmental footprint, minimising soil compaction, and preventing runoff and pollution.
- **Improved quality and consistency**: Robots can perform tasks with a high level of consistency and precision, which can improve the overall quality of agricultural products. For example, robots can harvest fruits without causing damage, ensuring that the produce reaches the market in the best possible condition.
- **Crop health and soil conditions**: With advanced sensors and data analysis, agricultural robots can monitor crop health and soil conditions, making real-time decisions for optimal crop management. This technological advancement is particularly crucial in addressing labour shortages and increasing food demand.
- **Scalability and flexibility**: Robotic systems can be scaled according to the size and needs of the farm. They offer flexibility in operations, as they can be reprogrammed and adapted to different tasks and conditions.



Challenges of Robotics in Agriculture

The adoption of robotics in agriculture represents a major shift in modern-age farming. However, It also faces several challenges that must be addressed to fully realise the potential of robotics in agriculture. These include:

- **High initial cost**: The initial investment required for agricultural robots can be substantially high for many farmers, particularly a large number of small and marginal farmers in the majority of low- and middle-income countries whose majority of GDP is still dependent on agriculture.
- **End user compatibility**: The end users of robotics in agriculture are farmers who are not yet aware of the usage of emerging tech like robotics. This necessitates additional training and education, which can be a barrier to adoption and effective use.
- **Dependence on technology**: An over-reliance on robotics and automated systems can make farmers dependent on these technologies which are often under the control of corporations, thus creating the same troubles for farmers which biotech firms patents created. In cases of technical failures or malfunctions, farming operations could be significantly disrupted.

Further, if Artificial Intelligence (AI) surpasses human intelligence, then it will directly impact food security.

Compatibility with existing systems: Integrating new robotic technologies with existing agricultural practices and equipment can be challenging.

Environmental impact: While robots can potentially reduce the environmental footprint of farming, there are concerns about their impact, including energy consumption and the disposal of electronic waste.

Limited functionality and adaptability: While agricultural robots are advancing, they may still lack the versatility and adaptability of human workers. They might struggle in unstructured environments or with tasks that require complex decision-making and dexterity.

Conclusion

India is undergoing a profound **technological transformation in agriculture**, leveraging Artificial Intelligence to move from traditional methods to a data-driven, precision-based ecosystem. This shift is anchored by the creation of a massive **digital public infrastructure**, including the Digital Agriculture Mission and AgriStack, which provides a verified foundation for delivering targeted services to millions of farmers. The integration of AI is delivering tangible benefits across the entire agricultural value chain.

Tools like **Bharat-VISTAAR** and **Kisan e-Mitra** provide multilingual, real-time advisory services, making expert knowledge accessible even in remote areas and further enhancing decision-making. AI-powered systems for **monsoon forecasting** and **pest surveillance** (NPSS) allow farmers to proactively manage climate and biological risks, significantly reducing potential losses and increasing resilience. Innovations in **precision farming**, agri-robotics, and AI-enabled crop insurance through **YES-TECH and CROPIC** are optimizing resource use and ensuring faster, more transparent claim settlements. **Furthermore,** AI-driven analytics seeks to address structural constraints in the supply chain, improving **price discovery** and market access for **small and marginal farmers.** Collectively, these initiatives reflect a **human-centric approach** to technology, aiming for **sustainable agricultural growth** that prioritizes inclusive development and the welfare of the farming community.