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कृषि विज्ञान की मासिक पत्रिका किसानगज़ट

(A No. 139) Agricultural Robotics and Automation

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The global farming sector faces a chronic **labour shortage** and the urgent need for increased efficiency. **Agricultural Robotics and Automation** offer the solution, moving beyond simple mechanization to true autonomy, where machines can perceive, analyze, and execute complex tasks with minimal human intervention. This transformation promises to stabilize production, reduce costs, and improve occupational safety.

The Imperative for Automation

- **Addressing Labour Shortages:** Robots provide a stable, tireless workforce that can operate 24/7, addressing peak-season bottlenecks in planting and harvesting.
- **Precision and Efficiency:** Robots deliver far greater precision than manual labour, leading to higher resource use efficiency.
- **Safety and Health:** Automation removes workers from hazardous, repetitive tasks (like chemical spraying).

The New Farm Machinery: Types of Agricultural Robots

1. Autonomous Tractors and Guidance Systems

- Equipped with **RTK (Real-Time Kinematic) GPS** and **Computer Vision**, these vehicles perform tillage, seeding, and plowing with **centimetre-level accuracy**.

2. Robotic Weeding Systems (The Most Transformative)

- **Technology:** Use **AI-powered cameras** to accurately distinguish crops from weeds.
- **Methods:** They utilize **Mechanical** removal, **Spot-Spraying** (reducing herbicide use dramatically), or **Laser** ablation for chemical-free weeding.
- **Economic Impact:** Offers fast return on investment (ROI) by cutting both labour and herbicide costs.

3. Robotic Harvesters

- Designed for delicate, high-value crops (strawberries, apples). They use **complex robotic arms** and **sophisticated vision systems** to identify ripeness and pick fruit without damage, increasing consistency and speed.

4. Swarm Robotics (The Future)

- Utilizes dozens of small, lightweight, and autonomous bots working collaboratively. This avoids **soil compaction** (caused by heavy machinery) and is highly adaptable to complex terrain.

Technology Under the Hood

- **Computer Vision and ML:** The 'eye' and 'brain' of the robot, enabling instantaneous identification of species and health.
- **RTK Navigation:** Provides the crucial **centimeter-level positional accuracy** needed for all precision tasks.
- **Specialized End Effectors:** The 'hands' of the robot, engineered with specific grippers (e.g., soft suction) for careful handling of produce.