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INDUSTRY TRENDS REPORT

AGRICULTURE FOOD & BEVERAGE

ROBOTICS AND AUTOMATION IN AGRICULTURE: THE NEW GREEN REVOLUTION

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EXECUTIVE SUMMARY

Agriculture has always been shaped by technology, from the earliest tools to the mechanisation that transformed productivity in the 20th century. Today, the sector faces unprecedented pressures: feeding a growing global population while coping with limited resources, rising costs, and climate variability. At the same time, demographic changes and rural labour shortages are intensifying the need for solutions that reduce dependency on manual work.

These pressures have accelerated the adoption of automation and robotics as key enablers of modern agriculture. The journey began with mechanization, evolved through GPS-guided tractors and precision agriculture, and is now entering a new phase of autonomy and intelligence. Robotics, in this context, refers to physical autonomous systems such as field robots, drones, greenhouse pollinators, and livestock robots, while automation encompasses digital control systems like auto-steering, variable-rate input application, and post-harvest sorting.

Together, robotics and automation represent the next frontier of efficiency and precision, reshaping farming operations across crops, livestock, and supply chains. These technologies offer clear benefits: improved productivity, reduced input use, higher product quality, and enhanced animal welfare.

Beyond efficiency, automation provides the foundation for data-driven agriculture, where every machine action can generate information to optimize decisions. Early adopters have already demonstrated significant reductions in herbicide use, labour costs, and crop losses, proving the value of automation in real-world contexts. In this context, Arkansas soybean trials show that See & Spray™ can cut post-emergence herbicide while maintaining control. In another case study, laser weeding in leafy greens cut weeding labour costs by ~40% in a full-season, commercial deployment.

Furthermore, controlled environments such as greenhouses and vertical farms further illustrate how robotics can enable year-round production and greater uniformity. Livestock farming has also been transformed, with robotic milking and feeding systems improving both productivity and animal health.

Despite these advantages, challenges remain, including high upfront costs, limited robustness in harsh conditions, regulatory uncertainties, and the need for farmer training. Understanding the state of robotics and automation requires examining both the existing technologies already deployed across the agricultural value chain and the emerging innovations that will shape the future. This report explores that continuum: from current solutions in crop, livestock, and supply chain operations to the next generation of technologies, while highlighting the opportunities and challenges ahead.

Agriculture today already hosts a wide range of robotics and automation technologies that are transforming everyday operations. These solutions are no longer confined to experimental fields but are being deployed at scale across major farming regions.

At the start of the production cycle, crop establishment has become increasingly automated through autonomous tractors, precision seeders, and advanced guidance systems. Companies such as John Deere (US), CNH Industrial (UK/Netherlands), and AGCO (US) have introduced machines that allow farmers to plant with centimetre accuracy while requiring minimal human supervision. The related benefits are clear, reduced overlaps, optimized seed placement, and consistent emergence that supports higher yields.

Once crops are established, protecting them against weeds, pests, and diseases is the next challenge where robotics has already made significant inroads. A new generation of weeding robots, such as Naïo Technologies (France) and FarmWise (US), are capable of mechanically or optically removing weeds with minimal chemical use. Laser weeding, pioneered by Carbon Robotics (US), showcases how energy-based systems can deliver precision at scale without relying on herbicides.

In parallel, precision spraying technologies like John Deere's See & Spray (US) and Bilberry (France) allow farmers to reduce herbicide applications by up to 90%. For specialty crops and orchards, autonomous sprayers such as GUSS (US) provide targeted protection with consistent application and reduced operator exposure to chemicals. UAVs like DJI Agras (China) and XAG (China) extend automation into the air, enabling both crop monitoring and targeted spraying in terrains where tractors struggle.

Moving closer to harvest, robotic solutions are increasingly present in fruit and vegetable collection, where labour shortages are most acute. Robotic harvesters such as Octinion (Belgium) and FFRobotics (Israel) demonstrate the capacity of automation to handle delicate produce. Harvest-assist platforms like Burro (US) and Robotics Plus (New Zealand) help with in-field logistics, allowing human pickers to focus on high-value tasks while robots handle repetitive transport.

Beyond the field, automation continues into post-harvest and supply chain operations, where consistency and speed are essential for product quality. In this context, companies like TOMRA Food (Norway) and Compac (New Zealand) have developed advanced grading and sorting machines capable of analysing fruit quality at industrial throughput.

Robotics also supports packaging, palletizing, and automated cold storage, with ABB Robotics (Switzerland) and AgroBot (Spain) bringing factory-level automation to the agri-food chain. These supply chain technologies ensure reduced food waste, improved traceability, and better alignment with retailer and consumer demands.

Controlled environment agriculture further illustrates existing automation: from Arugga AI (Israel) with pollination robots to Octiva (Netherlands) with UV-C disinfection units and Iron Ox (US) with fully automated vertical farms. Furthermore, Livestock operations round out the current landscape, with robotic milking, feeding, and barn-cleaning systems from Lely (Netherlands), DeLaval (Sweden), GEA (Germany), and BouMatic (US) improving productivity and animal welfare.

Taken together, these examples show that robotics and automation are no longer futuristic concepts but are already embedded across crop, livestock, and supply chain operations. Yet, while these technologies are transformative, they also set the stage for the next question: what lies ahead, and how will emerging innovations push agriculture further into a new era of autonomy?

While current technologies are reshaping operations, the pipeline of emerging innovations suggests that the next decade will bring even more profound change. Advances in sensing and perception are at the heart of this transformation, enabling robots to interpret complex environments with greater accuracy. Hyperspectral and thermal imaging, combined with radar and LiDAR, are being fused with AI models to detect plant stress, diseases, and nutrient deficiencies earlier than ever before. Here, startups such as Prospera (Israel) and Plantix by PEAT (Germany) are developing platforms that bring laboratory-level diagnostics into the field.

In crop protection, the frontier lies in swarm robotics, fleets of small, coordinated machines capable of performing tasks in parallel, offering scalability and resilience. Here, Companies like SwarmFarm Robotics (Australia) and Ecorobotix (Switzerland) illustrate both the promise and challenges of this approach.

Beyond swarms, new modalities such as electro-weeding and high-energy laser systems are being refined to target weeds even more precisely and sustainably. In aerial applications, drone swarms are being tested for ultra-targeted spraying, potentially replacing larger machinery in certain contexts.

Harvesting technologies are also evolving, with soft robotics playing a key role in handling delicate crops such as strawberries, tomatoes, and grapes. Machine learning-driven optimization allows robots not just to pick, but to decide which fruits to prioritize for ripeness and quality. The next generation of harvest platforms will be multi-task, able to switch tools seasonally to perform planting, monitoring, and harvesting on the same base platform. Integration and data-driven automation are another frontier; robots are no longer standalone machines but part of interconnected farm management ecosystems.

Furthermore, digital twins of fields and livestock facilities are emerging, where data collected by robots' feeds into predictive models that simulate outcomes before actions are taken. Fleet management solutions like Bluewhite (Israel) illustrate how robotics can be orchestrated across entire farms, creating mixed fleets of autonomous and conventional machinery. Moreover, interoperability frameworks such as Agrirouter by DKE-Data (Germany) and DataConnect (Germany/US collaboration among OEMs) are ensuring that data from multiple providers can flow seamlessly into unified farm management platforms.

Looking further ahead, research is pushing into fully autonomous farm concepts, such as the Hands-Free Hectare project (UK), where crops can be grown from planting to harvest without human intervention. Energy autonomy is another critical research frontier, with experiments in hydrogen-powered tractors (US/EU projects), battery swapping, and renewable-powered microgrids to support fleets of robots. Robotics is also extending into plant science, where high-throughput phenotyping robots such as Phenokey (Netherlands) accelerate breeding programs by generating massive datasets for genomic selection.

These innovation frontiers promise immense benefits, from sustainability gains to new economic models for farming. However, they also bring to light challenges that must be addressed: high costs, technical robustness, regulatory adaptation, and farmer acceptance.

INTRODUCTION

Agriculture has always been shaped by technology, from the earliest tools to the mechanization that transformed productivity in the 20th century

Technology has repeatedly expanded the feasible scale, speed, and reliability of farm work. Early hand tools and animal traction set limits on field size and timeliness; steam and internal-combustion power broke those limits by multiplying human effort and enabling consistent operations over larger areas. Timeliness is not cosmetic in agriculture: many biological processes reward actions taken in narrow windows.

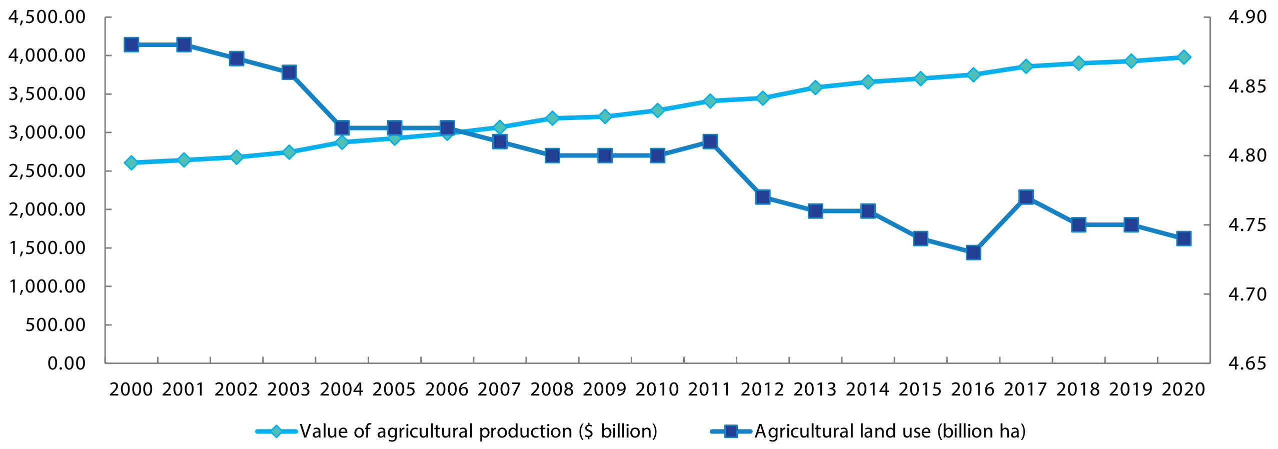
Mechanization standardized core tasks such as tillage, planting, spraying, harvesting, so they could be executed with repeatable quality. Combines and planters did not merely reduce labour. They synchronized agronomy and logistics, ensuring that each operation occurred at the right moment. This synchronization is central to yield formation and quality preservation.

The historical lesson for the present report is straightforward, new waves of technology succeed when they deliver the same fundamentals mechanization did, repeatability, safety, and on-time performance, while adding finer control. Robotics and automation inherit that mandate and extend it with perception, precision, and data.

Today, the sector faces unprecedented pressures: feeding a growing global population while coping with limited resources, rising costs, and climate variability

Demand for food, feed, fibre, and bio-based products continues to rise, while arable land per capita shrinks and water constraints intensify. These structural trends require higher output per unit of land, water, and labour, with stricter stewardship of inputs and emissions.

Agricultural land in use and value of agricultural production



As shown in the figure above, between 2000 and 2020 the **value of agricultural production increased while total agricultural land in use declined**. This divergence indicates that recent gains came primarily from **efficiency and intensification**, higher yields and quality per hectare driven by better genetics, input management, and emerging digital/mechanical technologies.

With a smaller land base, the penalty for mistimed operations and waste rises, making **precision, timeliness, and data-guided decisions** essential. This is the context in which **automation and robotics** become core levers for sustaining output under resource constraints.

Source: Frost & Sullivan

Because fuel, fertilizer, and crop-protection prices can fluctuate, farms have less room for error. When time-critical tasks, such as planting after soils dry or spraying at the first signs of disease, are delayed by even a few days, crops can miss optimal physiological windows, increasing the risk of yield or quality losses. This risk is especially relevant in fast-maturing, high-value crops (e.g., berries, tomatoes, grapes), though the magnitude varies by crop, stage, and conditions.

Climate variability compounds these issues by increasing the frequency of extremes (heat spikes, heavy rainfall, late frosts). In practice, this elevates the value of technologies that improve precision and expand the hours and conditions under which work can be performed reliably.

At the same time, demographic changes and rural labour shortages are intensifying the need for solutions that reduce dependency on manual work

Labour availability is declining just as seasonal demand peaks. Many regions have aging rural populations and fewer workers willing or able to do long, time-critical field shifts; shortages are most visible during planting, crop protection, harvesting, and post-harvest handling.

Missed or shortened operations translate into measurable agronomic penalties. When skilled crews are not available, tasks get delayed or skipped, leading to weed escapes, disease spread, lower pack-out, and shorter shelf life—effects that compound quickly in high-value crops.

Robotics and automation act as force multipliers that stabilize execution. Autonomous or supervised machines extend working hours (including safe night work), deliver consistent quality, and reduce exposure to hazardous or fatiguing tasks, shifting human roles toward supervision and exception handling.

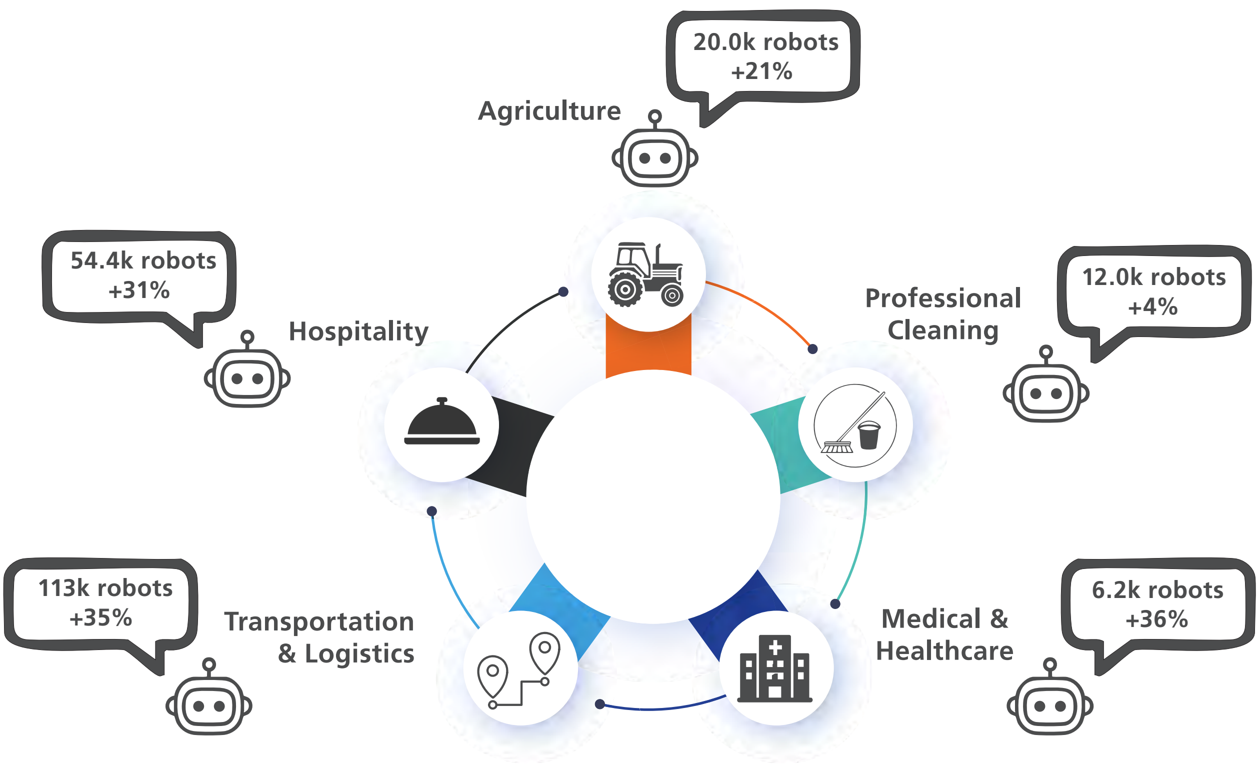
These pressures have accelerated the adoption of automation and robotics as key enablers of modern agriculture

Automation and robotics convert agronomic intent into consistent machine action. Auto-steer, section control, and vision-guided implements laid the groundwork; full tasks are now automated, including driverless tillage/planting support, targeted spraying, robotic weeding, harvest-assist, and packhouse handling.

Each successful deployment builds confidence, capability, and scale. As systems prove reliable in real fields and facilities, operators refine workflows, dealers expand service capacity, and organizations standardize around data-rich, repeatable methods.

A mature support ecosystem turns pilots into everyday tools. Local dealer service, remote monitoring that catches issues early, over-the-air software updates, and integration with farm management software mean these machines are maintained, improved, and coordinated, so they operate as dependable parts of routine farm operations.

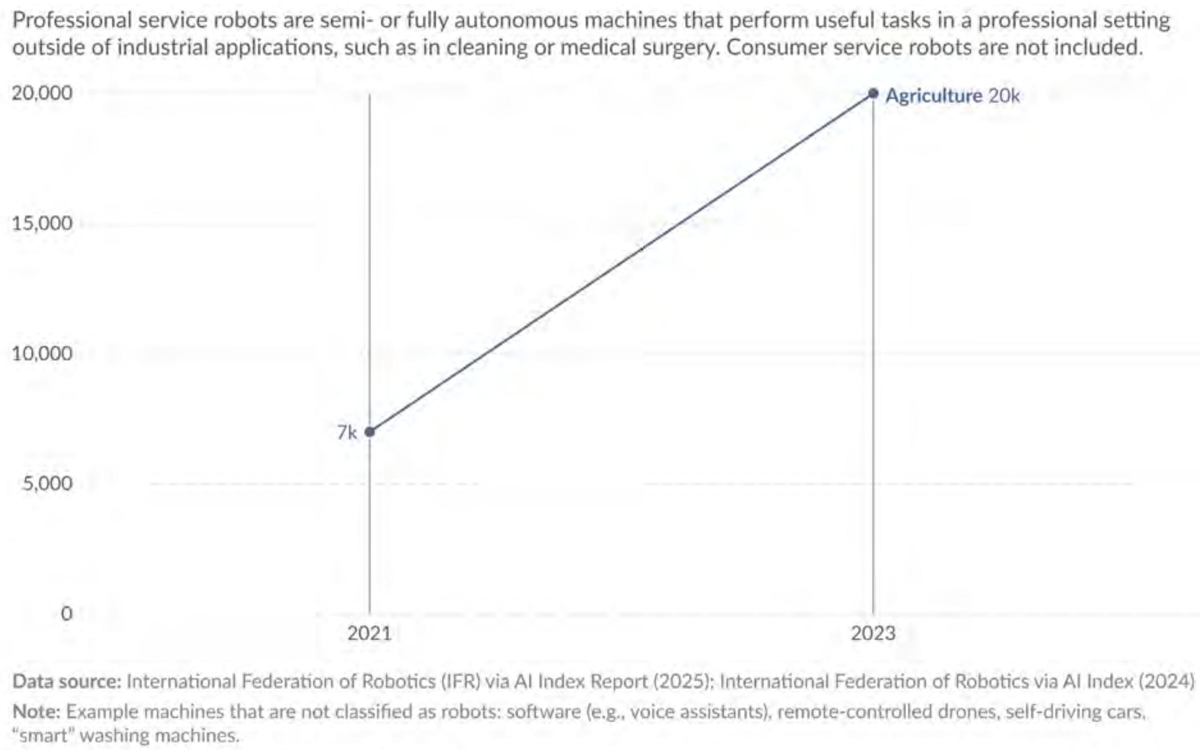
Top 5 application areas for robots in professional and medical use, 2023



Source: International Federation of Robotics (IFR)

Sales of agricultural robots show strong growth (+21%), with almost 20,000 units sold in 2023. The shortage of human labour in times of severe demographic change and the demand for more sustainable precision agriculture make service robots a key player in this market.

Agricultural service robots installed globally, 2021–2023 (IFR)



The journey began with mechanization, evolved through GPS-guided tractors and precision agriculture, and is now entering a new phase of autonomy and intelligence

Precision agriculture uses geospatial data and sensors to vary inputs by location, reducing waste and improving uniformity. It digitized fields (maps, zones) and machines (logs), laying the groundwork for automation.

Autonomy adds perception (cameras, LiDAR, radar), positioning (RTK GNSS), and onboard decision-making so machines can execute tasks with minimal supervision. This enables closed-loop control at field speeds and also other actions that include the ability to detect, decide, act, and verify.

Intelligence refers to algorithms trained to recognize crops, weeds, pests, disease symptoms, and quality attributes, and to adapt actions accordingly. The performance of these models improves with data, creating a feedback loop in which operations make the system itself more capable over time.

Robotics refers to physical autonomous systems such as field robots, drones, greenhouse pollinators, and livestock robots…

Robotics in this report means machines that ***can sense, decide, and act with limited human input***. Examples span autonomous tractors and implement for open fields, robotic weeders and precision sprayers, harvest-assist carriers in orchards and vineyards, UAVs for spraying and scouting, greenhouse pollination and UV-C units, and robotic milking, feeding, and barn-cleaning systems in livestock.

These robots work because the core stack integrates perception, control, and safety. Perception combines cameras (RGB/multispectral), depth sensing (stereo/LiDAR), and precise positioning (RTK GNSS + IMU) to understand crops, rows, and obstacles; edge computing runs AI models in real time; actuators (arms, cutters, nozzles, fans, drives) execute decisions; and safety layers—geofencing, emergency stops, speed limits, redundancy, and remote supervision, manage risk in messy farm conditions.

The practical impact is a shift from manual repetition to supervised, data-driven operations. Robots take on long, time-critical, or hazardous tasks with consistent quality, while people focus on planning, monitoring, and exception handling; at the same time, every action generates structured data that improves traceability, enables continuous optimization, and steadily increases system performance over time.

Together, robotics and automation represent the next frontier of efficiency and precision, reshaping farming operations across crops, livestock, and supply chains

The combined effect is workflow transformation. Planting, crop protection, harvest logistics, packhouse handling, and livestock care become measurable processes with verifiable outcomes. This allows tighter coordination across the value chain.

Three shifts are especially visible: **(1) task-level precision** (e.g., nozzle-by-nozzle spraying), **(2) extended time on task** (night operations, fewer stoppages, stable accuracy under fatigue-free conditions), and **(3) system-level visibility** (live dashboards, alerts, and predictive scheduling).

As more operations emit standardized data, downstream processes, grading, packing, storage, transport, can be synchronized to field realities rather than static schedules, reducing loss and improving quality consistency.

These technologies offer clear benefits: improved productivity, reduced input use, higher product quality, and enhanced animal welfare

- **Productivity (more output from the same time and land):** Robots and automated machines keep working accurately for long hours, including at night, and don't slowdown from fatigue. That means critical jobs, like planting at the right soil moisture or spraying at the right disease stage, happen on time and at a consistent quality. When timing and accuracy are maintained, fields reach their yield potential and total harvested volume (throughput) increases.
- **Lower inputs (spend less by aiming precisely):** Instead of treating an entire field the same way, automated systems target only what needs attention. For example, vision sprayers apply herbicide only where a weed is detected; planters place each seed at the right depth and spacing; irrigation systems deliver water to zones showing stress. Because actions are targeted, farms use less chemical, seed, and water, cutting costs and reducing runoff and emissions at the same time.
- **Higher quality and better animal welfare (gentler, more consistent handling):** Robots handle crops and animals in repeatable ways that reduce damage and stress. In fruit and vegetable harvesting, soft-grip or carefully controlled picking reduces bruising, which improves pack-out and shelf life. In packhouses, automated graders apply the same quality thresholds to every item, improving consistency. In dairies, robotic milking adjusts to each cow's physiology and monitors health signals continuously, catching issues earlier and improving comfort and productivity.

Beyond efficiency, automation provides the foundation for data-driven agriculture, where every machine action can generate information to optimize decisions

- ***From every job to useful data (the feedback loop starts):*** Modern machines record what they do as they work: where they went (GPS location), how much they applied (rates and totals), what they saw (images and sensor readings), and how the machine performed (engine/load/alerts). This information is stored and compared across days and seasons, so plans can be checked against what happened and results can be tied back to specific actions.
- ***From fixed calendars to evidence-based playbooks (decisions guided by maps and models):*** Instead of following a generic schedule, managers act on what the data shows. Weed maps tell sprayers exactly where to spot-treat; canopy-stress maps trigger irrigation only in zones that need water; ripeness and canopy models route harvest crews to blocks that are ready now, not next week. The same logic applies in livestock: behaviour and milk-flow signals guide feeding and health interventions for specific groups or animals.
- ***Compounding gains over time (systems that learn):*** Each season adds more labelled data (images, rates, yields, quality grades) which improves the underlying models. Better models make field actions more precise; more precise actions produce more consistent outcomes; consistent outcomes generate cleaner data. This virtuous cycle makes operations steadily more reliable and efficient the longer the system is used.

Early adopters have already demonstrated significant reductions in herbicide use, labour costs, and crop losses, proving the value of automation in real-world contexts

Regarding what's changing on the ground, farms ***that adopted selective spraying and robotic weeding report large drops in herbicide applied***, especially where weeds are patchy. Because robots and vision sprayers only act where needed, they maintain weed control while cutting total chemical volume.

Regarding ***labour and timing gains is also a relevant***, autonomous or supervised machines keep critical jobs on schedule with fewer people. During tight windows, like planting after soils dry or spraying at first disease signs, automation helps ensure the work happens on time, even if crews are short.

Fewer losses, more consistency also proves the value of automation. With better timing and gentler handling (e.g., harvest assist, stable pack-line grading), farms experience less damage and shrink. That translates into higher realized yield and more consistent quality grades from season to season.

In this context, Arkansas soybean trials show that See & Spray™ can cut post-emergence herbicide while maintaining control

Researchers compared camera/AI-guided See & Spray™ post-emergence applications with conventional broadcast programs across multiple seasons. The aim was to keep weed control non-inferior while reducing chemical load, recognizing that outcomes depend on weed pressure, patchiness, and correct setup (nozzles, boom height, sensitivity, calibration) and that See & Spray™ complements—rather than replaces—residual/pre-emergence programs.

Across site-years, post-emergence herbicide use fell by **about 50% on average (typical range ~28–62%)**, with comparable control when systems were tuned and residuals were in place. Savings were larger in patchy/low-pressure fields and smaller when infestations were uniform, confirming that selectivity tracks actual weed area and translates detection into fewer sprayed hectares.

In another case study, laser weeding in leafy greens cut weeding labour costs by ~40% in a full-season, commercial deployment

Western Growers documented the Carbon Robotics LaserWeeder working across lettuce and spinach blocks, where vision-guided lasers targeted individual weeds in-row and reduced the need for large hand crews between cultivation passes. Control levels met grower standards while avoiding soil disturbance and repetitive, stooped labour.

The case study reports an average ~40% reduction in weeding labour costs versus prior practice, with costs broken out per acre and equipment capital spread over five years. A simple payback view treats labour savings as the primary driver (minus energy/maintenance): payback shortens with higher utilization (acres/year) and local wage rates and lengthens when weed pressure is low or the machine is under-used. This provides clear, real-world evidence that automation can deliver substantial, repeatable labour savings without sacrificing control.

Furthermore, controlled environments such as greenhouses and vertical farms further illustrate how robotics can enable year-round production and greater uniformity

Controlled environments: what they are and why they matter?

Controlled-environment agriculture (CEA) includes greenhouses and vertical farms where temperature, humidity, light, CO_2, and irrigation are regulated. Because weather variability is reduced, crops can be grown year-round with steady growth rates and more uniform size and quality.

In these settings, robots take on repeatable tasks such as pollination, UV-C disease suppression, in-house transport of trays or carts, and camera-based scouting that maps flowers, fruits, and leaf health at high frequency.

Why robots and AI perform especially well in CEA?

Stable conditions make perception (computer vision) and control more reliable. When lighting, backgrounds, and plant spacing are consistent, models that count flowers, detect disease spots, or assess growth stage learn faster and make fewer errors. The facility itself becomes a testbed: teams can train and validate robotic routines under controlled settings, refine them quickly, and then transfer those routines outdoors with better starting accuracy and fewer surprises.

What vertical farming adds and what it teaches?

Vertical farms push standardization further by stacking crops in layers and moving plants through a tightly choreographed sequence, sensing, metered nutrient dosing, and robotic conveyance at each step.

While overall economics depend on crop choice and local energy prices, these systems show that plant workflows can be engineered to be fully standardized and repeatable. The lesson extends beyond indoor farming: the same modular, data-driven approach to tasks and quality checks can inform automation in greenhouses and, increasingly, in field operations too.

Livestock farming has also been transformed, with robotic milking and feeding systems improving both productivity and animal health

From batch milking to cow-led routines, Robotic milking allows cows to be milked when they choose, with individualized settings for teat preparation, vacuum, and flow. This can increase milking frequency for high-yield animals while reducing stress from rigid schedules.

Regarding ***precision feeding and hygiene***, Automated feeders deliver the right ration at the right time and can adjust by group or individual. Barn-cleaning robots maintain consistent hygiene, lowering pathogen load and improving hoof health and air quality.

For ***Continuous health data***, Sensors track milk conductivity, flow, activity, rumination, and temperature. Instead of periodic checks, managers see continuous trends and receive alerts, enabling earlier intervention and better long-term productivity and welfare.

Despite these advantages, challenges remain, including high upfront costs, limited robustness in harsh conditions, regulatory uncertainties, and the need for farmer training

Costs and integration remain a hurdle, but practical paths are emerging. New systems require capital, setup time, and changes to workflows; retrofit kits, staged rollouts (one task first, then more), and robots-as-a-service models reduce upfront risk and align costs with realized benefits. Clear metrics (hectares/hour, percent input reduction, labour hours saved, error rates) make payback easier to evaluate and compare.

Real-world robustness depends on redundancy, protection, and graceful fail-safe. Dust, mud, glare, rain, heat/cold, canopy occlusion, and spotty connectivity stress sensors and drivetrains; resilient designs fuse cameras, LiDAR, GNSS/IMU, protect electronics from ingress/overheating, and default to safe stop or tele-assist when visibility drops. Remote diagnostics, predictive maintenance, and over-the-air updates keep uptime high across long seasons.

Rules, data rights, and skills must be explicit to build trust. Ground robots and UAV sprayers operate under evolving safety and airspace rules, with expectations for supervised modes, geofencing, emergency stops, drift control, and operator responsibility. Clear data governance (ownership, sharing, retention) and practical training pathways let teams supervise multiple machines confidently and safely.

Understanding the state of robotics and automation requires examining both the existing technologies already deployed across the agricultural value chain and the emerging innovations that will shape the future

Separating "deployed" from "emerging" avoids mixing proof with promise. Technology readiness, multi-season performance, units in service, uptime/repair stats, service coverage, total cost of ownership, and integration effort are reliable filters for what works today versus what is still maturing.

Context determines value, so segment and region matter. Broadacre systems optimize hectares/hour, fuel and chemical savings, and soil compaction; orchards and vineyards prioritize row navigation, canopy deposition, and bin logistics; greenhouses emphasize repeatability and biosecurity; livestock focuses on animal-level sensing and hygiene; packhouses target throughput, grading accuracy, and traceability. Local labour costs, field geometry, terrain, water constraints, regulation, and dealer networks shape adoption paths.

A task-based map clarifies where impact is realized now and where it will emerge next. Organizing by establishment, protection, harvesting/logistics, post-harvest/supply chain, controlled environments, and livestock, then layering "Today" (commercial systems, benefits, limits) over "Next" (enablers like sensors, compute, batteries, software) creates a consistent frame. Cross-cutting KPIs (input reduction, labour saved, grade uplift, emissions/runoff proxies) enable apples-to-apples comparisons.

> **This report explores that continuum: from current solutions in crop, livestock, and supply chain operations to the next generation of technologies, while highlighting the opportunities and challenges ahead**

ROBOTICS AND AUTOMATION IN CROP, LIVESTOCK, AND SUPPLY CHAIN OPERATIONS

PRINCIPAL ABBREVIATIONS

3D	*3 dimensional*	**KPI**	*Key performance indicator*
AI	*Artificial intelligence*	**LiDAR**	*Light Detection and Ranging*
API	*Application Programming Interface*	**LLM**	*Large Language Model*
CAGR	*Compound Annual Growth Rate*	**OEM**	*Original Equipment Manufacturer*
CES	*Consumer Electronics Show*	**ROI**	*Return on investment*
CO_2	*Carbon dioxide*	**RTK**	*Real-Time Kinematic*
EU	*European Union*	**SLAM**	*Simultaneous Localization and Mapping*
GNSS	*Global Navigation Satellite System*	**UAV**	*Unmanned aerial vehicle*
GPS	*Global positioning system*	**UK**	*United Kingdom*
Ha	*Hectare*	**UN**	*United Nations*
IFR	*International Federation of Robotics*	**US**	*United States*
IMU	*Inertial Measurement Unit*	**UV**	*Ultraviolet radiation*
K	*Thousand*		

ABOUT INTESA SANPAOLO INNOVATION CENTER:

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Based in the Turin skyscraper designed by Renzo Piano, with its national and international network of hubs and laboratories, the Innovation Center is an enabler of relations with other stakeholders of the innovation ecosystem - such as tech companies, start-ups, incubators, research centres and universities - and a promoter of new forms of entrepreneurship in accessing venture capital. Intesa Sanpaolo Innovation Center focuses mainly on circular economy, development of the most promising start-ups, venture capital investments of the management company Neva SGR and applied research

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