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Transformation

Feeding the world with AI

07 April 2026

Key takeaways

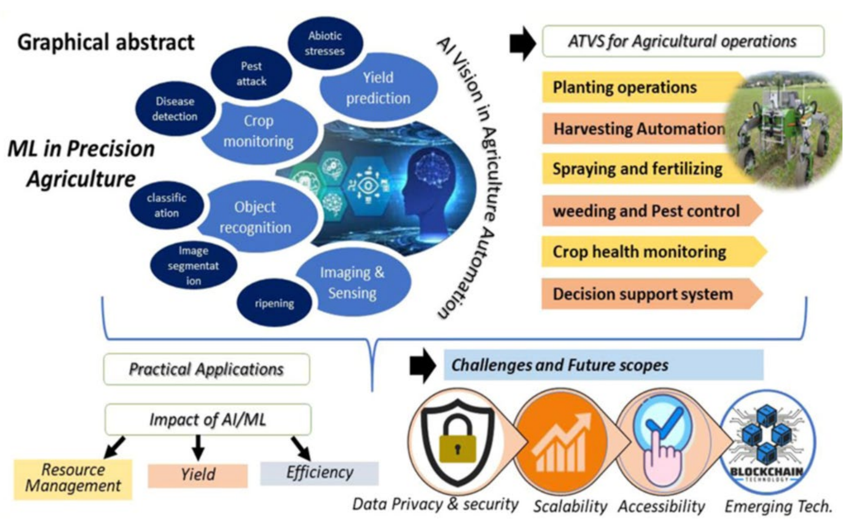
- Agriculture is undergoing its biggest technological shift in decades as AI becomes embedded across soil management, irrigation, fertilization and crop monitoring. By 2024, over half of farmers had adopted or were willing to adopt AI-enabled tools, driven by measurable gains in decision-making, yields, efficiency and sustainability.
- Digital AI has transformed how farmers understand their fields, but insight alone is no longer sufficient amid climate volatility, labor shortages, rising input costs and non-linear yield risks - including geopolitical instability along critical fertilizer supply corridors. These pressures demand not just better decisions, but precise, timely, plant-level action - something traditional advisory AI cannot deliver.
- That execution gap is pulling the sector toward physical AI, which enables real-time, plant-by-plant control. This shift from "AI for advice" to "AI for autonomous agronomy" directly moves revenue, cost and risk curves in a sector defined by tight margins and biological variability.

Agriculture's latest technological evolution

Agriculture, a sector that represents roughly 4% of global gross domestic product (GDP), is undergoing its biggest technological shift in decades, according to BofA Global Research. AI has already become deeply embedded in modern farming practices, improving farmers' decisions around soil, irrigation, fertilization, crop monitoring and disease detection (Exhibit 1). And the use of sensors, drones, satellite imaging and predictive crop models creates a rich layer of digital intelligence that can help farmers understand their fields with unprecedented clarity.

Exhibit 1: Crop monitoring + resource management = higher productivity for sustainable agriculture

Infographic illustrating machine learning (ML) in precision agriculture



Source: www.sciencedirect.com CC-by 4.0[1]; BofA Global Research

Note: ATVs = all-terrain vehicles

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[1] Kumar, A., Kumar, R., Padhiary, M., Saha, D., & Sethi, L.N. (2024, June 3). *Enhancing precision agriculture: A comprehensive review of machine learning and AI vision applications in all-terrain vehicle for farm automation.* ScienceDirect. https://doi.org/10.1016/j.atech.2024.100483

AI moves from early adoption to sector-wide penetration

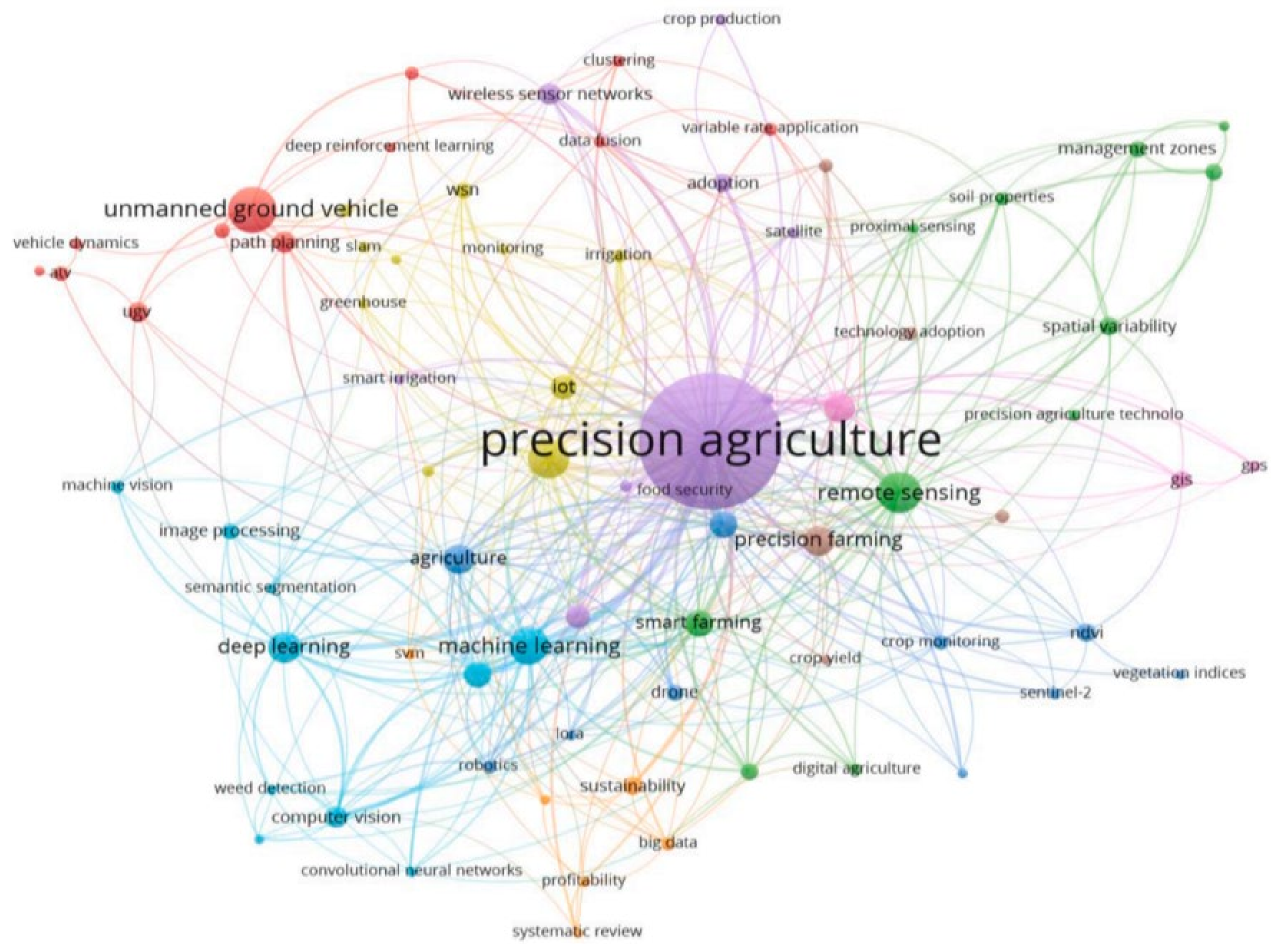
As of 2024, over half of farmers worldwide had adopted or were willing to adopt at least one precision-agriculture or AI-enabled technology.[2] This uptake is driven by tangible agronomic benefits (related to crop growing and soil management): 80% of farmers using data analytics report better decision-making. AI-enabled precision irrigation and fertilization can raise crop yields by 25%.[3] Additionally, AI improves water usage efficiency and fertilizer application accuracy,[4] while also reducing emissions[5] – an increasingly important advantage when fertilizer supplies are constrained – thereby promoting sustainable farming practices.

AI-in-agriculture market: ~$47 billion by 2034E

Applications of AI in agriculture now span an increasingly diverse set of technologies, from AI-guided vertical farming and biological enhancement tools, to AI-based crop modeling and precision agriculture using drones, sensors and satellites for real-time field intelligence. Money flows reflect this shift: agricultural technology (agtech) companies raised $7 billion in 2025, up nearly 4% year-over-year (YoY), with precision-agriculture companies outpacing deals for crop inputs and enhancements.[6]

Exhibit 2: Deploying precision agriculture for farm automation is attracting growing interest from researchers and industry stakeholders

Keyword network diagram for precision agriculture



Source: www.sciencedirect.com CC-by 4.0[7], BofA Global Research

Note: The keyword network diagram based on 77 most occurring keywords out of 2998, with number of occurrences of a keyword being ≥ 5 (Based on 1055 publication accessed from Scopus database with keywords 'ML in agriculture, AI vision, ATV, Precision Agriculture and unmanned ground vehicle')(2024, March 17)

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[2] Statista Research Department. (2024, October). *Share of farmers using or willing to adopt at least one new technology in the US in 2024, by technology type.* Statista.

[3] Ferdusmou, J., Hossain, M.A, Khatoon, R., & Saha, S. (2025, January). *Smart Farming Revolution: AI-Powered Solutions for Sustainable Growth and Profit*. Journal of Management World.

[4] Ibid.

[5] Hoque, A., Padhiary, M., Roy, S., & Saikia, P. (2025, March 18). *Climate-Smart Agriculture: AI-Based Solutions for Enhancing Crop Resilience and Reducing Environmental Impact*. Asian Research Journal of Agriculture 18(1): 291-310. https://doi.org/10.9734/arja/2025/v18i1665

[6] Frederick, A. (2026, January 6). *Agrifood VC First Look.* PitchBook.

[7] Kumar, A., Kumar, R., Padhiary, M., Saha, D., & Sethi, L.N. (2024, June 3). *Enhancing precision agriculture: A comprehensive review of machine learning and AI vision applications in all-terrain vehicle for farm automation.* ScienceDirect. https://doi.org/10.1016/j.atech.2024.100483

Broader market outlooks underscore this transition. The AI-in-agriculture market is forecasted to increase at a 26.3% compound annual growth rate (CAGR) to $46.6 billion by 2034, per Global Market Insights.[8] This is driven by increased use of precision inputs, labor substitution and real-time agronomic decision support. Machine learning – now representing roughly half of the market – underpins emerging technologies such as generative AI, autonomous tractors and robotic sprayers (read AI dictionary, part 1: The basics for an intro to machine learning). It also enables real-time object recognition across key agricultural applications including weed detection, livestock monitoring and yield estimation from aerial imagery.

According to BofA Global Research, North America currently leads agricultural AI adoption with a 36% market share, supported by strong capex appetite and a mature precision-agriculture ecosystem that speeds up deployment of autonomous equipment. All these trends show that farming is shifting from *digital* agronomy (decision support) to *autonomous* agronomy (execution) (Exhibit 2). Furthermore, this expansion of AI-driven and robotics-based farming technology is supported by favorable regulation, which simplifies deployment. Falling hardware costs for sensors, compute and machine vision also make adoption more affordable. At the same time, policy incentives are increasingly aligned with technologies that verifiably reduce chemical inputs, accelerating uptake.

Physical AI: Brains behind the wheel

Physical AI integrates artificial intelligence into physical systems, such as humanoid robots, autonomous vehicles and drones (we further define this topic in Physical AI, part 1: The basics). As a result, AI can perceive, reason and act in the real world – not just generate digital outputs. This matters because the next productivity wave won't come from better dashboards, but from execution at the edge, delivered by robots, drones, autonomous implements and sensor-driven machines that can continuously close the loop between sensing and action, per BofA Global Research.

Capital and capability are accelerating

Over 70 companies are now developing physical AI infrastructure across data, simulation, foundation models and observability. Robotics and physical AI companies raised ~$41 billion in 2025, while equity deals into robot foundation model developers alone increased more than tenfold from three in 2021 to 32 in 2025. Collectively, these advances position physical AI as a shared, reusable infrastructure, deployed across robots, vehicles and drones, rather than an isolated, task-specific solution.

The shift is structural: Climate volatility is tightening constraints of farming

According to BofA Global Research, agriculture is a sector where physical AI can scale in the near term because the underlying operating environment has changed. Fertilizer markets are tightly locked into a handful of regions and energy routes, so even localized geopolitical disruptions can quickly ripple through global input costs.

And on the climate front, drought and heat stress are no longer episodic; they are persistent conditions that directly cap yields and destabilize broader farm economics (Exhibit 3). The European Union's Joint Research Centre found that 52 individual prolonged meteorological drought events occurred from August 2023 to July 2024.[9] Droughts, heatwaves and warm spells have negatively impacted crop productivity across Europe, Southern Africa, Central and Southern America and Southeast Asia. In this regime, many crops exhibit non-linear responses to temperature. Yields can improve gradually up to a threshold, then deteriorate sharply once exceeded. Meanwhile, rising heat accelerates evapotranspiration (loss of water to the atmosphere from soil evaporation and plant transpiration), pulling crops into water stress faster and worsening pest and disease pressure.

Why "advisory AI" hits a ceiling

Digital AI has transformed how farmers understand their fields, but insight alone is no longer enough. The pressures reshaping global agriculture are climate volatility, chronic labor shortages, rising input costs and non-linear yield risks. These require not just better decisions, but precise, timely, plant-level action. This is where traditional "advisory" AI reaches its ceiling. A farmer can know a disease outbreak is emerging, yet without the labor, equipment or precision to intervene quickly and locally, the insight can't be monetized. Modern agriculture now needs systems that can see, decide and act in the real world. That execution gap is what is pulling the sector toward physical AI.

Physical AI addresses the gap by enabling real-time, plant-by-plant control – dynamic irrigation, targeted nutrient delivery, early pest intervention and precision application based on live perception. This marks a shift from "AI for advice" to "AI for autonomous agronomy." In a sector defined by narrow margins and biological variability, that shift directly moves revenue, cost and risk curves.

Economics is driving commercial scale

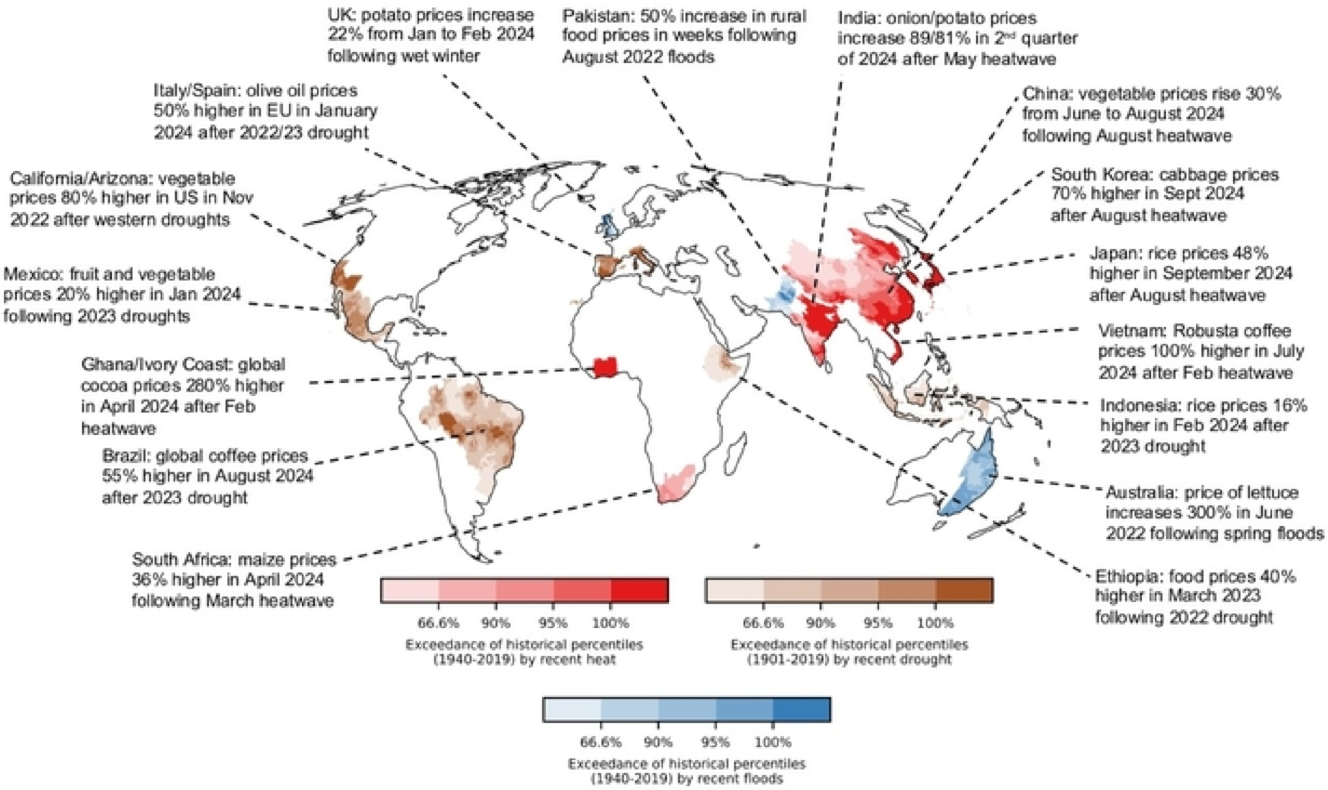
Physical AI is scaling because the economics have turned. Technologies that deliver payback in under a year scale fastest in agriculture and falling hardware costs are strengthening this equation. Precision robotics that reduce labor, chemical use and operational time can pay back in months rather than years. Yield stability in a more volatile climate becomes an additional economic engine. The shift is from automation as a way to reduce costs to a means to boost profitability and resilience.

[8] Global Market Insights. (2025, May). *AI in Agriculture Market Size & Share 2025-2034.*

[9] Joint Research Centre. (2024, October 2). *Global drought threatens food supplies and energy production*. European Commission.

Exhibit 3: Food prices have spiked across the globe in response to extreme climate conditions

Map of climate-induced food price spikes since 2022



Source: ResearchGate CC-by 4.0[10], BofA Global Research

Note: Underlying shading represents the extent to which the associated climate conditions exceeded percentiles of the historical distribution.

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[10] Donat, M.G., Kotz, M., Lancaster, T., Parker, M., Smith, P., Taylor, A., & Vetter, S. (2025, July). *Climate extremes, food price spikes, and their wider societal risks*. Environmental Research Letters. https://doi.org/10.1088/1748-9326/ade45f

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