Journal of International Commercial Law and Technology
Print ISSN: 1901-8401

Website: https://www.jiclt.com/

Article

Shaping the Future of Agritech: Generative AI-Driven Drones and Their Impact on Farming Value Chains

Article History:

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How to cite this article:
Masih J, *et. al*, Shaping the Future of Agritech: Generative AI-Driven Drones and Their Impact on Farming Value Chains. *J Int Comme Law Technol*. 2026;7(1):181–191.

Received*: 03-11-2025*
Revised*: 26-11-2025*
Accepted*: 05-12-2025*
Published*: 16-01-2026*

Abstract: The rapid convergence of Generative Artificial Intelligence (GenAI) and agricultural drone technologies is reshaping the agritech landscape by redefining how value is created, delivered, and captured across farming value chains. This review examines the transformative role of GenAI-driven drones in modern agriculture, moving beyond conventional precision tools to intelligent systems capable of autonomous learning, prediction, and decision support. Drawing on peer-reviewed literature, industry reports, and expert insights, the study analyses how GenAI-enabled drones influence upstream input optimisation, on-farm operations, and downstream supply chain efficiency.
Key applications include adaptive crop health diagnostics, predictive yield modelling, real-time risk assessment, and targeted deployment of water, fertilisers, and crop protection inputs. These capabilities enhance productivity, reduce operational uncertainty, and enable resource-efficient farming practices. The review further evaluates the market implications of GenAI-driven drones, highlighting emerging business models, competitive dynamics, and investment trends within the global agritech ecosystem.
Beyond technology adoption, the paper situates GenAI-enabled drones within an interconnected innovation ecosystem encompassing cloud and edge computing, robotics, data platforms, and system integration services. It also addresses regulatory, infrastructural, and socio-economic challenges influencing large-scale deployment, particularly in smallholder and emerging-market contexts. The study concludes by identifying future research directions and policy priorities required to unlock the full value-chain potential of GenAI-driven drone technologies. Overall, the review positions Generative AI-powered drones as a critical enabler of resilient, intelligent, and sustainable agricultural value chains.

Keywords: - Generative Artificial Intelligence; Agricultural Drones; Precision Agriculture; Smart Farming Technologies; Predictive Analytics; Sustainable Agriculture; Agritech Ecosystem

INTRODUCTION

Agriculture remains a crucial part of the global economy, supplying food, jobs, and livelihoods for a large share of the world's population. It employs over 1.3 billion people worldwide and plays a key role in national GDPs, especially in developing and farming regions. In countries such as India, agriculture is the foundation of rural life, directly or indirectly employing nearly half of the population. However, the sector faces growing challenges, including declining arable land, climate change, water shortages, labour shortages, pest issues, and the need for higher yields to meet global demand [1]. To address these problems, agriculture has undergone a rapid digital transformation, giving rise to smart or precision farming. Technologies such as Artificial Intelligence (AI), Machine Learning (ML), the Internet of Things (IoT), remote sensing, big data analytics, blockchain, and cloud computing are now integral to farming practices. These innovations enable data-driven decision-making, increase productivity, reduce costs, minimise environmental impact, and support automation—particularly through agricultural drones used for aerial data collection, monitoring, and automation [2].

Agricultural drones are widely used for tasks such as crop scouting, field mapping, irrigation assessment, fertiliser and pesticide spraying, and yield estimation. Equipped with multispectral, hyperspectral, thermal, and RGB sensors, they effectively collect high-resolution data over large farming areas. This data provides crucial insights into crop health, soil conditions, moisture levels, and stress indicators that are difficult to detect through conventional ground-based methods. As a result, drones play a vital role in enhancing precision agriculture by enabling targeted and timely interventions [3,4].

While traditional AI and analytics have significantly enhanced the utility of agricultural drones, the emergence of Generative Artificial Intelligence (Gen AI) introduces a new phase in digital farming. Unlike traditional AI, which primarily analyses and categorises data, Gen AI can generate new outputs, forecasts, and recommendations by identifying patterns in large datasets [5]. In the realm of agricultural drones, Gen AI enables advanced functions such as real-time aerial image analysis, crop disease and pest infestation prediction, autonomous descision-making, and adaptable mission planning. These developments allow drones to transition from simple data collectors to intelligent, self-improving systems [6].

Using Gen AI with agricultural drones supports sustainable farming by allowing precise, targeted input application. This reduces the excessive use of water, fertilisers, and pesticides, thereby protecting the environment, lowering costs, and helping meet sustainability standards. Moreover, the growing adoption of Gen AI-powered drone solutions is transforming the agriculture drone market by influencing business models, competitiveness, and service strategies. Agritech firms are increasingly using AI-enabled drones to grow their operations, access new markets, and offer affordable, precision farming services to small and marginal farmers [7,8].

Source: Secondary Research, Interviews with Experts, Industry Journals, Related Research Publications, Press Releases, and MarketsandMarkets Analysis

Figure 1. Adoption of GEN AI in Agriculture Drones

While interest in Gen AI applications in agriculture is growing, the existing research remains scattered. There are limited comprehensive reviews that specifically address the convergence of Generative AI and agricultural drone technology [9]. Many studies investigate AI in agriculture or drone-based farming independently, without analysing in depth how their integration influences operational efficiency, sustainability, market dynamics, and ecosystem growth. This gap underscores the importance of conducting a systematic review to synthesise current findings, identify emerging trends, and guide future research [10].

This review paper examines the role of Generative AI in agricultural drones. It explores key application areas, evaluates market and value chain impacts, investigates the supporting agritech ecosystem, and discusses challenges related to adoption, regulation, and scalability. By synthesising insights from academic research and industry reports, the review seeks to deepen understanding of how Gen AI-powered drones are shaping innovations in sustainable agriculture.

Literature Review

Artificial Intelligence in Agriculture

Over the last ten years, AI's role in agriculture has garnered much attention for its ability to boost productivity, adapt to climate change, and use resources more efficiently. Initial studies concentrated on AI and machine learning for tasks such as predicting crop yields, classifying soil types, forecasting weather, and identifying pests. Results indicated that AI-driven decision support systems outperform traditional statistical methods in handling complex, nonlinear agricultural data. These systems assist farmers in making more informed choices regarding planting schedules, irrigation, and input management [11].

Later research expanded AI's application in precision agriculture, highlighting its combination with remote sensing and IoT technologies. AI-powered analytics improved the spatial and temporal monitoring of crops, allowing for more precise management. However, initial studies have mainly focused on rule-based or predictive AI models, with limited exploration of generative and autonomous AI in farming systems.

Role of Drones in Precision Agriculture

Agricultural drones are now essential in precision farming due to their ability to quickly collect high-resolution aerial data. Multiple studies show their effectiveness in crop monitoring, field mapping, weed detection, irrigation assessment, and spraying. Researchers also found that multispectral and thermal images from drones allow early detection of crop stress, nutrient deficiencies, and pest infestations, enabling quick responses that lead to increased yields [12,13].

Comparative studies indicate that drones provide superior spatial resolution and flexibility compared to satellite imagery, particularly for small and medium-sized farms. Research also highlights economic advantages, including reduced labour costs, lower chemical consumption, and enhanced operational efficiency. Nonetheless, some studies point out limitations like battery life concerns, challenges in data processing, and regulatory constraints that limit large-scale deployment.

Integration of AI and Drone Technologies

The integration of AI and drone technology is often seen as a game-changer in modern farming. Research on AI-enabled drones highlights their capabilities in automated image analysis, object detection, and crop, weed, and disease classification. Machine learning techniques have been effectively applied to drone imagery to identify plant diseases and accurately assess biomass. Current research primarily focuses on discriminative AI models that assess predefined outcomes. While experts acknowledge their efficiency, they often lack flexibility and autonomous decision-making. This limitation has sparked greater interest in Generative Artificial Intelligence, which enables drones to generate predictions, suggestions, and adaptable strategies by analysing dynamic datasets [14,15].

Generative Artificial Intelligence in Smart Farming

Generative Artificial Intelligence represents a significant advancement over traditional AI by enabling systems to learn patterns and generate new insights, simulations, and decisions. Recent studies highlight the potential of Gen AI models, such as generative adversarial networks and transformer-based architectures, in agriculture, including the creation of synthetic data, scenario modelling, and automated decision-making.

In agriculture, researchers have demonstrated that Gen AI can improve predictions of crop diseases, pest outbreaks, and yield changes by analysing large volumes of historical and real-time data. Although its application in farming is still in progress, early results show a promising potential to improve adaptability, resilience, and informed decision-making in farming systems.

Generative AI and Agricultural Drones

An increasing number of studies are exploring how Generative AI can be applied to agricultural drones, focusing on real-time decision-making and autonomous operations. Findings suggest that Gen AI enables drones to do more than collect data—they can actively analyse and respond to it. For instance, AI-driven drones can automatically modify flight paths, adjust spraying amounts, and change monitoring schedules based on current field conditions. Researchers also emphasise that Gen AI enhances predictive analytics by integrating weather, soil, and crop health data, supporting proactive farm management. These capabilities help reduce resource waste, lower costs, and improve productivity. However, scholars point out a shortage of large-scale real-world studies, highlighting a gap between experimental progress and actual application [16].

Sustainability and Resource Optimisation

Sustainability is a central theme in the research on AI-powered agricultural drones. Numerous studies indicate that AI-enabled drones, which precisely apply fertilisers, pesticides, and water, help lessen environmental impact and promote sustainable farming practices. Targeted spraying reduces chemical runoff and soil degradation, aligning with ecological standards and sustainability goals [17]. Researchers also highlight the role of AI-driven drones in advancing climate-smart agriculture by enhancing resource efficiency in response to climate change. Nonetheless, concerns about drone energy consumption, data privacy, and long-term ecological consequences remain, necessitating further investigation.

Market Impact and Agritech Ecosystem

Various studies examine how AI-enabled drones impact the agricultural drone industry and the broader agritech sector. Findings suggest that incorporating AI enhances market competitiveness by supporting scalable, service-based business models like Drone-as-a-Service (DaaS). These models are particularly beneficial in developing economies, where smallholder farmers often cannot afford high initial costs. The research also emphasises the importance of ecosystem collaboration among drone manufacturers, AI developers, cloud providers, system integrators, and policymakers. Value chain analysis shows AI's role across all phases, from R&D to post-sales support. However, challenges such as regulatory uncertainty, skilled labour shortages, and infrastructure gaps pose significant obstacles to broader adoption [18,19].

Research Gaps and Future Directions

Despite growing scholarly interest, the literature reveals significant gaps. There are a few comprehensive reviews explicitly focused on Generative AI-powered agricultural drones. Additionally, there is a lack of long-term, large-scale empirical studies that verify the economic and environmental benefits of these drones. Ethical issues, regulations, and data governance remain underexplored. Future research should focus on developing explainable AI models, integrating Generative AI with blockchain for better data security, providing affordable solutions for smallholder farmers, and creating policy frameworks that encourage responsible AI use in agriculture [20].
Recent research on precision agriculture in India emphasises the growing importance of digital technologies in tackling structural inefficiencies in the farming sector. In this setting, Jolly Masih and co-authors offer a detailed market-focused analysis of agricultural drone adoption in India, as discussed in 'Why Indian Agriculture Needs Drones: A Market Research Perspective on Precision Farming, Productivity, and Sustainability.'
Masih contends that factors such as declining per-capita arable land, highly fragmented landholdings, labour shortages, and increasing sustainability pressures have collectively diminished the effectiveness of traditional mechanisation. This shift creates a strong structural need for drone-based solutions. The study presents agricultural drones not just as technological advancements but as essential operational tools in India's smallholder-focused farming system. Masih emphasises that small and nano drones are particularly well-suited to managing fragmented plots, enabling precise spraying, crop monitoring, and other time-sensitive tasks, resulting in notable efficiency and productivity gains. The evidence in the paper shows significant reductions in labour dependence and improved yield, supporting earlier research that positions drones as vital for precision farming.
Masih's contribution enhances existing research by incorporating market dynamics, regulatory environments, and business models, especially the rise of Drone-as-a-Service (DAAS), which reduces barriers for marginal farmers. By analysing policies such as the Digital Agriculture Mission and the NaMo Drone Didi programme, the study highlights how institutional support can accelerate technology adoption. Overall, Masih's work addresses a significant gap in Indian agricultural studies by providing a comprehensive, market-focused view that links structural agrarian issues with scalable, tech-driven solutions for sustainable farming growth [21].

Research Methodology

This study employs a systematic qualitative review to examine the role of Generative Artificial Intelligence (Gen AI) in agricultural drone technology. It consolidates academic research, industry reports, and expert insights to provide a comprehensive overview of the applications, market impacts, and ecosystem interactions of Gen AI-enabled agricultural drones [22].

Research Design

The study employs a narrative–systematic review methodology, integrating structured literature screening with thematic analysis. This method is appropriate for examining emerging technologies with limited empirical research and the need for interdisciplinary sources. The review centres on the conceptual, technological, and market aspects of Gen AI applications in agricultural drones.

Data Sources

Data were gathered from various secondary sources to ensure comprehensive coverage and reliability. These include:

- Peer-reviewed journal articles from databases such as Scopus, Web of Science,
- IEEE Xplore, and ScienceDirect
- Industry reports from agritech research firms and market intelligence platforms
- White papers, policy documents, and technical reports from international organisations
- Conference proceedings related to AI, drones, and precision agriculture

Only English-language publications were considered to maintain consistency in interpretation.

Search Strategy

A search strategy based on keywords was used, combining the following terms:

- "Generative Artificial Intelligence"
- "Agricultural Drones"
- "AI in Precision Agriculture"
- "Smart Farming Technologies"

- "Predictive Analytics in Agriculture"

Boolean operators (AND/OR) were used to improve the search results. The focus was on literature from the last decade to emphasise recent technological advances, but key earlier studies were included for foundational background.

Inclusion and Exclusion Criteria

The following criteria were used to ensure relevance and quality:

Inclusion Criteria

- Studies addressing AI or Gen AI applications in agriculture or drone technologies
- Research discussing precision agriculture, automation, sustainability, or market impact
- Peer-reviewed articles, authoritative industry reports, and policy documents

Exclusion Criteria

- Studies unrelated to agriculture or drone applications
- Opinion-based articles lacking methodological rigour
- Publications with insufficient technical or contextual relevance

Data Extraction and Analysis

Relevant data were extracted from selected studies and systematically categorised into thematic areas, including:

- Gen AI applications in agricultural drones
- Automation and operational efficiency
- Predictive analytics and decision support
- Sustainability and resource optimisation
- Market dynamics and value chain analysis
- Agritech ecosystem and adoption challenges

A thematic synthesis method was employed to detect patterns, trends, and relationships throughout the reviewed literature. When feasible, comparative analysis was conducted to emphasise similarities and differences in findings across various regions and application areas.

Reliability and Validity

To improve review reliability, data were cross-checked across various sources, including academic papers and industry reports. Priority was given to high-impact journals, reputable market research firms, and peer-reviewed conference papers. Using diverse sources helped reduce bias and provided a more balanced view.

Limitations of the Study

The availability and quality of the existing literature constrain this review-based study. Given the fast pace of Generative AI development, some technologies and applications are likely still in early development stages. Moreover, conducting empirical validation via field experiments and quantitative performance metrics was outside the scope of this review.

Discussion

Generative AI Applications in Agricultural Drones

Integrating Generative Artificial Intelligence (Gen AI) into agricultural drones represents a significant advancement in precision farming. Unlike traditional AI, which mainly detects patterns and classifies data, Gen AI allows drones to learn from large datasets, developing flexible strategies, predictions, and decision-making capabilities. This evolution transforms agricultural drones from basic data collectors into smart, autonomous devices capable of optimising farming activities in real time [21,22].

Automation and Operational Efficiency

Generative AI enables agricultural drones to autonomously perform complex farming tasks such as crop spraying, seeding, field surveying, and soil sampling with minimal human intervention. By leveraging real-time sensor information, environmental conditions, and past field data, Gen AI systems dynamically adjust drone flight paths, spraying intensities, and task approaches. This automation significantly reduces labour requirements, minimises human error, and enhances precision in field operations.

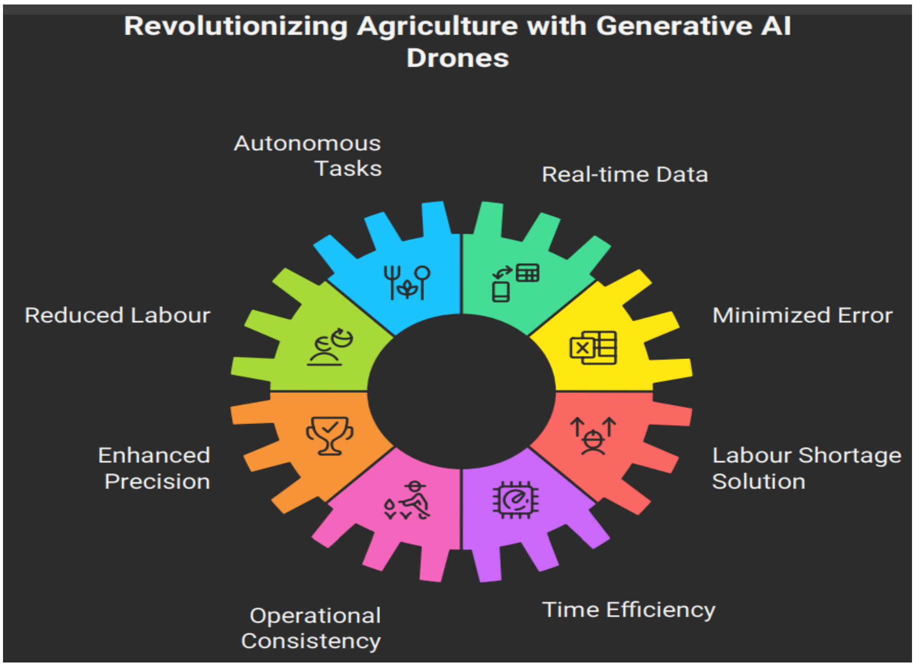


Figure 2: Revolutionising Agriculture with Generative AI Drones

In areas facing severe labour shortages or rising labour costs, AI-powered drones offer an effective solution by supporting ongoing, scalable farming activities. Additionally, automation enhances operational consistency and reduces the time required for vital agricultural tasks, resulting in higher productivity and greater cost efficiency throughout the farming cycle.

Real-Time Monitoring and Crop Health Assessment

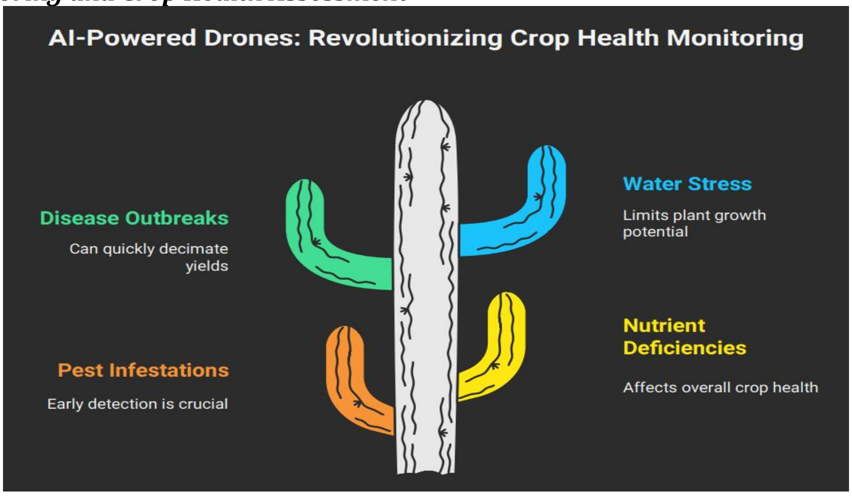


Figure 3: AI-Powered Drones Revolutionising Crop Health Monitoring

AI-powered agricultural drones equipped with multispectral, hyperspectral, thermal, and RGB sensors facilitate continuous, real-time crop health monitoring. Generative AI algorithms process these detailed datasets to detect early indicators of stress, such as pest infestations, nutrient deficiencies, disease, and water stress. Unlike traditional methods that depend on manual inspections, these drones provide quick, accurate assessments across vast fields. Early detection enables farmers to take prompt, targeted actions, reducing crop losses and limiting disease spread. This proactive strategy boosts crop quality, supports food security, and decreases reliance on chemical treatments, aligning economic and environmental goals.

Predictive Analytics for Agricultural Decision-Making

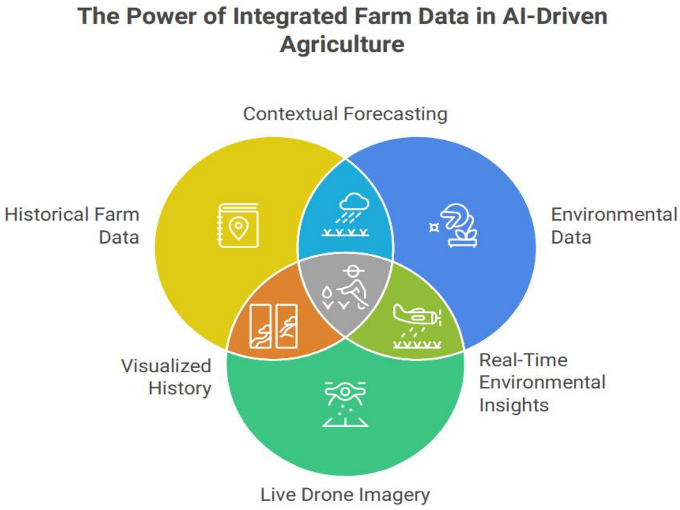


Figure 4: Predictive analysis for Agricultural decision-making

A key breakthrough of Generative AI in agricultural drones is its use in predictive analytics. By combining historical farm data, weather information, soil details, and live drone imagery, Generative AI can predict pest outbreaks, disease risks, crop yield fluctuations, and climate effects. These forecasts help farmers move from reactive to proactive management, improving decision-making. Predictive analytics also optimises resource use by informing decisions on irrigation, fertiliser, and pest control. Consequently, farmers can cut costs, reduce risks, and strengthen farm resilience amid climate change and market shifts.

Enhanced Data Analysis and Insight Generation

Agricultural drones produce large amounts of complex data that can be hard for farmers to understand. Generative AI-powered analytics transform these datasets into clear visualisations, practical recommendations, and decision-making insights. By integrating spatial, temporal, and environmental information, Gen AI offers a comprehensive view of farm conditions. These insights help farmers better understand soil health, crop vitality, and environmental factors, supporting evidence-based decisions. Improved data interpretation also enhances collaboration among farmers, agronomists, and consultants, leading to better advisory services and farm planning.

Sustainability and Resource Optimisation

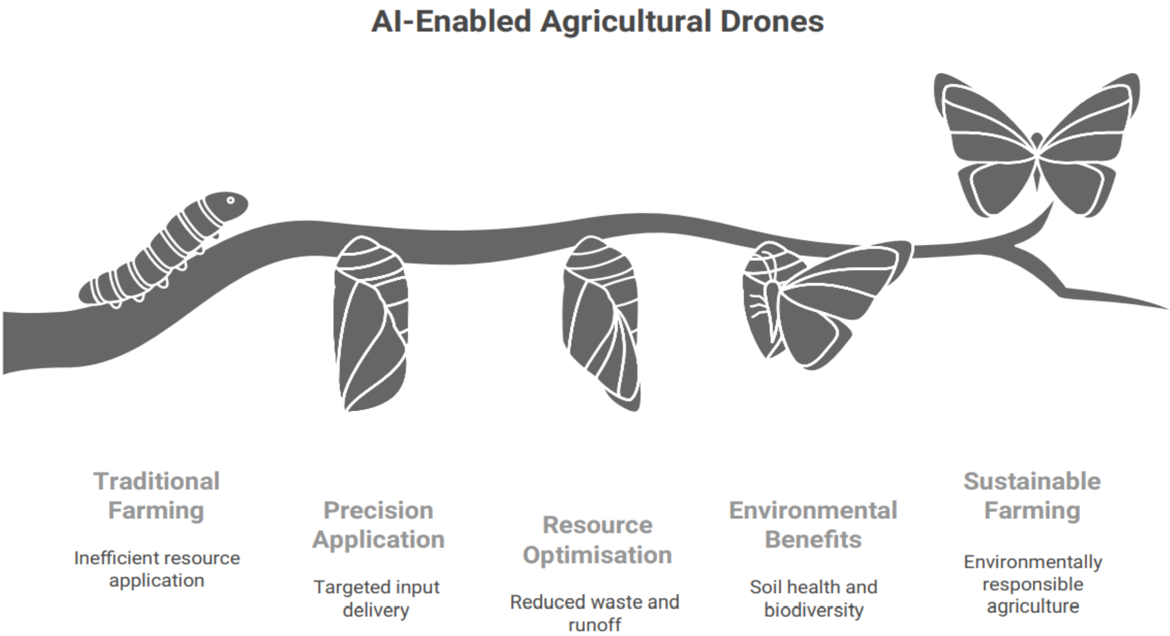


Figure 5: AI-Enabled Agricultural Drones

AI-enabled agricultural drones significantly advance sustainable farming by enabling the precision application of inputs such as fertilisers, pesticides, and water. This targeted method ensures resources are used only when necessary, reducing waste, chemical runoff, and greenhouse gas emissions caused by overuse. By optimising resource use, these drones support soil health, biodiversity, and compliance with environmental standards. Such sustainability benefits are especially vital amid climate change, water shortages, and growing ecological pressures.

Market Expansion and Competitive Advantage

The use of Generative AI (Gen AI) in agricultural drone solutions has become a significant driver of market growth and a key to gaining a competitive edge in the agritech industry. By leveraging sophisticated analytics, automation, and predictive insights, agritech firms can expand their reach beyond traditional farms and provide highly tailored, data-driven services. A notable innovation in this area is the rise of service-based models such as Drone-as-a-Service (DaaS), which significantly reduce barriers to adopting new technology.

By utilising DaaS and subscription platforms, agritech companies can reach small and marginal farmers who often can't afford expensive drone equipment and AI systems. This inclusive strategy expands their customer base and speeds up technology adoption in emerging and developing agricultural markets. Additionally, drones powered by Gen AI enable companies to offer services such as crop health analysis, yield predictions, precision spraying, and advisory tips, transforming agribusiness from a product-focused approach to a comprehensive solutions provider.

From a competitive perspective, AI-powered drone solutions boost efficiency by reducing operational costs, utilising resources more effectively, and speeding up service delivery. Firms that effectively use Gen AI achieve strategic benefits through enhanced decision-making, quicker innovation, and deeper customer connections. These benefits lead to steady revenue streams across agricultural areas, including crop management, input optimisation, and digital advisory services, thereby transforming traditional agribusiness value propositions.

Impact on the Agriculture Drone Market

Generative AI is revolutionising the agriculture drone industry by changing drone capabilities, intelligence, and scalability. Previously, agricultural drones focused mainly on data collection and manual analysis; now, with Gen AI, drones have become intelligent systems capable of making real-time decisions and operating autonomously. Features such as advanced analytics, predictive modelling, and adaptive learning greatly expand their operational potential, driving higher market demand.

Gen AI-powered drones enhance farming with real-time insights, automated spraying, and predictive analytics. They are increasingly adopted by farmers, agronomists, and service providers: better data visualisation, intuitive dashboards, and easy interfaces lower technical barriers, broadening accessibility.

Consequently, the agriculture drone market is experiencing growing investments, swift technological advances, and industry consolidation. Major agritech companies are acquiring smaller startups to boost their AI capabilities, diversify their product range, and enhance their competitive edge. This trend of consolidation is likely to persist as firms aim to develop comprehensive AI-driven solutions and realise economies of scale.

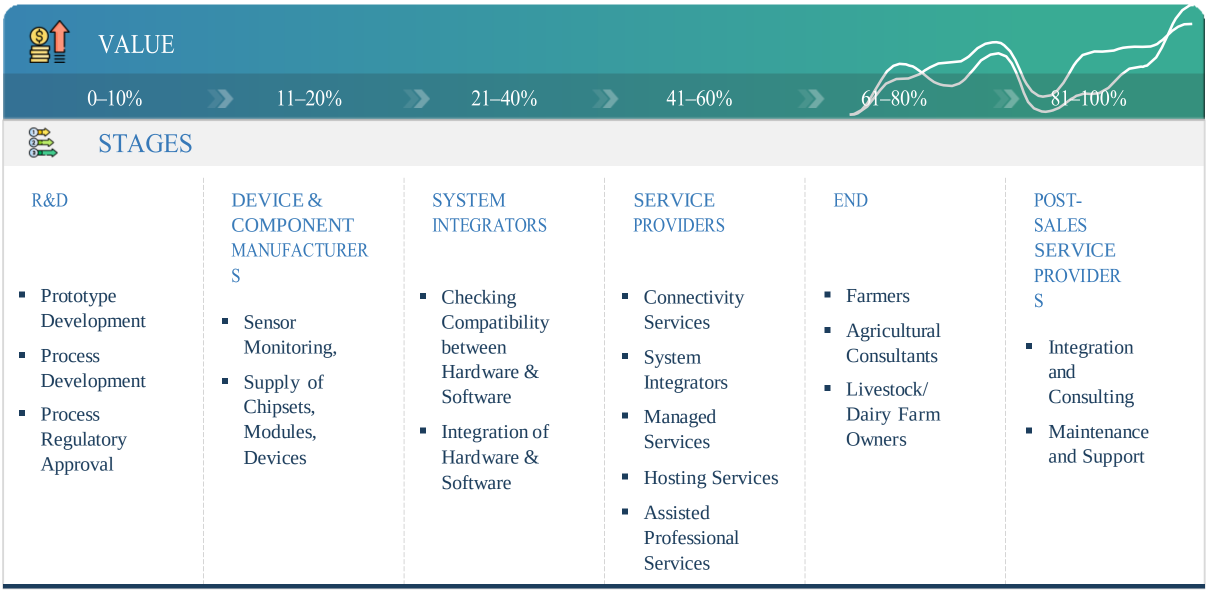
Adjacent Ecosystem Supporting Generative AI

The effective deployment of agricultural drones powered by Gen AI relies heavily on a strong, interconnected supporting ecosystem. This ecosystem includes agricultural robotics, farm management software platforms, cloud computing services, system integrators, and connectivity providers. Each element is essential for ensuring smooth data transfer, model training, and operational execution.

AI-driven agricultural robots complement drone technology by performing ground-based autonomous tasks such as planting, harvesting, weeding, and livestock monitoring. Together, drones and robots create a synergistic, innovative farming environment that enhances operational efficiency and precision. Cloud-based platforms provide scalable infrastructure for data storage, processing, and Gen AI model training, enabling real-time analytics and continuous system improvement.

System integrators ensure interoperability between diverse hardware and software components, while connectivity services enable reliable data transmission from remote agricultural fields. This integrated ecosystem accelerates innovation, reduces deployment complexity, and enhances the overall effectiveness and reliability of precision agriculture solutions.

Transforming the Agricultural Drone Value Chain through Generative AI



Source: Secondary Research, Interviews with Experts, Industry Journals, Related Research Publications, Press Releases, and MarketsandMarkets Analysis

Figure 6. Value Chain Analysis

The agricultural drone value chain involves several connected stages: research and development, component manufacturing, system integration, deployment, and post-sales support. Generative AI adds value at each step by enhancing product design, operational insight, and service quality. In the R&D phase, Gen AI enables quick prototyping, simulation, and performance optimisation of drone systems.

In manufacturing and system integration, AI-driven quality control and compatibility testing enhance product reliability and reduce failure rates. Deployment stages utilise automated calibration, mission planning, and adaptive learning. Additionally, post-sales services focus more on data analytics, performance optimisation, and decision-making support. Effective post-sales support has become vital for market differentiation, as sustained adoption relies on ongoing system updates, maintenance, and consulting. Value-added services like predictive maintenance, analytics subscriptions, and farm performance reports boost customer engagement and generate recurring revenue for agritech companies.

4.6 Industry Trends and Challenges

Various industry trends are influencing the adoption and development of Gen AI-powered agricultural drones. The fast pace of digital transformation, declining available arable land, climate change, and rising food demand are fueling the demand for more efficient farming methods. Both governments and private investors are growing their investments in cutting-edge agricultural projects to boost food security, promote sustainability, and support rural growth.

Although these positive developments are evident, considerable obstacles remain. The high upfront costs, intricate regulations for drone activities, data privacy issues, and cybersecurity threats hinder adoption. In developing nations, limited digital literacy, poor infrastructure, and an insufficiently skilled workforce further restrict large-scale implementation. Overcoming these challenges demands coordinated actions among policymakers, tech companies, and educational institutions.

4.7 Future Research Directions

Future research should focus on developing explainable and transparent generative AI models to foster trust among farmers and regulators. Incorporating blockchain technology can improve data security, traceability, and confidence within agricultural value chains. Moreover, research should aim to develop cost-effective, scalable deployment solutions tailored to smallholder farmers. Additional empirical studies are necessary to assess the long-term economic, environmental, and social effects of AI-powered agricultural drones. Policymakers need to consider regulatory frameworks that encourage responsible AI use while protecting safety, privacy, and ethical standards. Building capacity and fostering interdisciplinary collaboration will be essential for sustainable advancement.

Conclusion

The integration of Generative Artificial Intelligence (Gen AI) with agricultural drones marks a significant milestone in modern farming. By incorporating intelligence, adaptability, and predictive features, Gen AI transforms drones from simple data collectors into autonomous systems capable of real-time monitoring, analysis, and decision-making. This review shows that these drones now serve not just for aerial data gathering but also as intelligent tools for support and autonomous actions, advancing sustainable agricultural practices.

The findings emphasise that Gen AI significantly boosts operational efficiency, accuracy, and scalability across various agricultural settings. With applications such as automated spraying, real-time crop health monitoring, and predictive analytics, AI-powered drones increase productivity while reducing input costs and environmental impact. These advantages are especially vital amid global issues such as climate change, decreasing arable land, labour shortages, and rising food security needs. The capacity of Gen AI-driven drones to optimise resource use highlights their promising role in fostering climate-resilient and sustainable farming practices.

From a market standpoint, the use of Gen AI-powered drone solutions is transforming agribusiness models and competitive landscapes. Service-oriented models, such as Drone-as-a-Service (DaaS), are reducing entry barriers and making advanced technologies more accessible to small and marginal farmers. The broader agritech ecosystem—which includes cloud platforms, robotics, system integrators, and connectivity providers—plays a key role in enabling the scalable deployment and ongoing enhancement of innovative drone systems. Concurrently, the changing value chain emphasises the growing importance of post-sales support, analytics, and advisory services to ensure long-term adoption.

Although Gen AI-enabled agricultural drones offer significant opportunities, several hurdles persist. Regulatory restrictions, high startup costs, data privacy issues, and low digital literacy hinder broader adoption, especially in developing countries. Overcoming these obstacles will demand collaboration among policymakers, tech innovators, researchers, and farmers to establish effective regulations, enhance skills, and ensure ethical AI practices.

In summary, AI-driven agricultural drones could transform smart farming by boosting productivity, sustainability, and resilience in global food systems. Ongoing interdisciplinary research, technological development, and supportive policies are crucial to fully realise their potential and ensure that the advantages of innovative drone technology are fairly shared among agricultural communities worldwide.

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