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Business case for agricultural drones is moving beyond spraying

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Garuda Aerospace's Agnishwar Jayaprakash says the next phase of drone adoption will be defined by agricultural intelligence, not hardware

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Every technological revolution begins with a simple question: what changes first—the tool or the system? In Indian agriculture, drones are rapidly moving beyond being flying machines to becoming the intelligence layer that could redefine how food is grown, financed and traded. But will they truly democratise precision farming for millions of smallholders, or simply deepen the technological divide between those who can access data and those who cannot? As policymakers push for an indigenous drone ecosystem, the real contest is no longer about hardware—it is about ownership of agricultural intelligence and the future of farm economics. The answers will shape not just productivity, but India's competitiveness in the global agri-tech race. **In an exclusive AgroSpectrum interview, Agnishwar Jayaprakash, Founder and Director, Garuda Aerospace,** explains why drones are evolving from operational tools into strategic agricultural infrastructure with far-reaching implications for credit, insurance, sustainability and food security. If India's next Green Revolution is intelligence-driven rather than input-driven, this conversation offers an early glimpse into what that future could look like.

India's agricultural transformation has historically been driven by breakthroughs in seeds, irrigation and crop protection. Do you see drones emerging as the next foundational agricultural infrastructure, and what economic indicators would convince you that India has crossed that threshold?

Every major agricultural transformation has been enabled by infrastructure that helped farmers produce more with fewer resources. I believe drones have the potential to become the next foundational layer of agricultural infrastructure because they bring precision, speed, and data-driven decision-making directly to the farm.

Today, drones are helping farmers optimize the use of water, fertilizers, and crop protection products while reducing labour dependency and improving operational efficiency. As agriculture faces few challenges, drones are evolving from a productivity tool into a necessity for sustainable farming. The real tipping point will be when drone services become as commonplace as tractors or irrigation systems. For India, this will largely happen through a Drone-as-a-Service model, making advanced

technology accessible even to small and marginal farmers.

The economic indicators that would signal India has crossed that threshold include widespread adoption of drone-based spraying and crop monitoring, profitable rural drone service businesses, integration of drone data into crop insurance and agri-credit systems, and drones becoming a standard component of farm operating expenses. When these markers become mainstream, drones will no longer be viewed as an emerging technology; they will be recognized as critical agricultural infrastructure driving India's next phase of agricultural growth and productivity.

Much of the conversation around agricultural drones focuses on operational efficiency. But can drones fundamentally alter farm economics by improving decision quality? In your view, what is the long-term value of intelligence generated by drones compared to the immediate value of spraying and surveillance services?

While operational efficiency is often the most visible benefit of agricultural drones, I believe their greatest long-term value lies in the intelligence they generate. Spraying and surveillance deliver immediate gains through reduced costs, improved precision, and faster operations. However, data-driven decision-making has the potential to fundamentally reshape farm economics.

Drones enable farmers to move from reactive to predictive agriculture. By providing real-time insights on crop health, pest infestations, nutrient deficiencies, water stress, and field variability, they empower farmers to make more informed decisions about when, where, and how to intervene. This not only optimizes input usage but also helps improve yields and enhance overall profitability. Over time, the value of this intelligence will far exceed the value of any single drone operation. Drone-generated data can support precision farming, strengthen crop insurance assessments, improve access to credit, and enable more accurate farm advisory services. As AI and analytics become more integrated into agriculture, drones will serve as the primary data collection layer powering smarter farming ecosystems.

In the long run, I see drones evolving from being tools that perform tasks to platforms that enable better decisions. Spraying creates operational efficiency for a season; intelligence creates compounding value over multiple seasons. That is where the true transformation of agriculture will occur.

India remains one of the world's most fragmented agricultural markets, dominated by smallholder farmers. Does this structural reality limit the scalability of drone technologies, or could it actually create a unique innovation model that differs from large-scale farming economies such as the United States and Brazil?

India's smallholder farming ecosystem is one of the biggest opportunities for drone innovation anywhere in the world. Rather than limiting scalability, it is encouraging the development of business models that are more inclusive, accessible, and suited to the realities of modern agriculture. India's model is increasingly being powered by shared services, FPOs, cooperatives, and rural drone entrepreneurs. This enables even small and marginal farmers to benefit from advanced drone technology without significant upfront investment. What makes this particularly exciting is that India is building a drone ecosystem that prioritizes reach and impact. By leveraging Drone-as-a-Service models, we can bring precision agriculture to millions of farmers, improve productivity, optimize resource usage, and create new livelihood opportunities in rural areas.

In many ways, India's agricultural structure is shaping a uniquely Indian blueprint for drone adoption; one that combines technology, entrepreneurship, and accessibility. If successful, it has the potential to become a model for agricultural economies across the developing world.

As agricultural drones become increasingly sophisticated, are we witnessing the evolution of a new category of farm machinery, or are drones better understood as data platforms that happen to fly? How should agribusiness leaders think about this distinction?

Agricultural drones are evolving beyond the traditional definition of farm machinery. While they perform critical operational tasks such as spraying, monitoring, and surveying, their true value lies in their ability to generate actionable intelligence that enables better decision-making across the agricultural value chain.

Agribusiness leaders should view drones as both a productivity tool and a data platform. The operational benefits deliver immediate value through greater efficiency, precision, and resource optimization, while the data collected helps drive smarter decisions around crop health, input management, risk assessment, and yield improvement.

As agriculture becomes increasingly technology-driven, the ability to capture and analyze real-time field data will become just as important as the ability to execute farm operations. Drones sit at the intersection of these two capabilities, making them a powerful enabler of modern agriculture.

There is a growing policy emphasis on indigenous drone manufacturing. However, true technological sovereignty extends beyond assembly to critical components, software and analytics. Where does India currently stand on that spectrum, and what are the most strategic vulnerabilities that still need to be addressed?

India has made remarkable progress in building a domestic drone ecosystem over the last few years. What is particularly encouraging is that the conversation has evolved from simply assembling drones to developing end-to-end capabilities across design, manufacturing, software, and drone applications.

However, technological sovereignty is a journey, not a destination. True self-reliance requires strength across the entire value chain; from airframes and flight-control systems to sensors, communication technologies, AI-powered analytics, and advanced components. While India has built strong momentum in indigenous manufacturing and software development, there is still significant opportunity to deepen capabilities in certain high-value and specialized technologies.

The focus now should be on accelerating research and development, strengthening component manufacturing, fostering deeper industry-academia collaboration, and nurturing a robust innovation ecosystem that can compete globally. Equally important is building intellectual property within India and creating globally competitive products that are designed, developed, and manufactured domestically.

The combination of supportive policies, a vibrant startup ecosystem, growing demand, and strong engineering talent gives us a unique opportunity to emerge as a global hub for drone innovation. The next phase will be about moving from adoption and manufacturing to leadership in core technologies, software, and advanced analytics that define the future of the industry.

Agriculture is increasingly being shaped by climate volatility, resource scarcity and input inefficiencies. How do you see drones contributing to the broader transition from input-intensive farming to intelligence-intensive farming, and what evidence are you seeing of that shift already taking place?

Agriculture is undergoing a fundamental shift; from relying primarily on higher inputs to relying on better insights. As farmers face increasing challenges from climate variability, resource constraints, and rising production costs, the ability to make precise, data-driven decisions is becoming critical. This is where drones are playing a transformative role.

Drones enable farmers to monitor crop health, identify stress factors, assess field conditions, and apply inputs with far greater precision than traditional methods. Instead of adopting a one-size-fits-all approach, farmers can make targeted interventions based on real-time field intelligence, helping optimize the use of water, fertilizers, and crop protection products while improving productivity and sustainability.

In the long run, I believe drones will serve as a critical intelligence layer for agriculture. Their greatest contribution will not simply be automating farm operations, but enabling smarter decisions that help farmers become more resilient, productive, and sustainable in an increasingly complex agricultural environment.

Precision agriculture promises to optimize every drop of water, gram of fertilizer and millilitre of crop protection product. Yet adoption often lags expectations. Is the primary challenge technological, economic, behavioural or institutional, and how should the industry address it?

The challenge is not technological, today's precision agriculture solutions have already demonstrated their ability to improve efficiency, productivity, and sustainability. The real opportunity lies in accelerating adoption through greater awareness, accessibility, and ecosystem collaboration.

For many farmers, adopting new technologies requires clear evidence of value and ease of access. This is why demonstration-driven adoption, farmer education, and service-based delivery models are so important. When farmers can see tangible improvements in productivity, input optimization, and cost savings, adoption follows naturally.

At the same time, industry, policymakers, agri-institutions, and technology providers must work together to build a supportive ecosystem that simplifies access to precision agriculture solutions. Initiatives focused on skilling, rural entrepreneurship, and last-mile service delivery are already helping bridge this gap.

The focus now should be on scaling access and demonstrating impact at the farm level, because when farmers experience the value firsthand, adoption becomes a natural outcome.

Many emerging technologies create value not by replacing labour, but by augmenting human decision-making. In the context of Indian agriculture, do you see drones as labour-saving tools, productivity-enhancing tools, or knowledge-enabling tools—and which of these ultimately offers the greatest economic value?

I see drones as all three; labour-saving, productivity-enhancing, and knowledge-enabling tools; but their greatest long-term value lies in enabling better decisions.

The first wave of drone adoption in agriculture has understandably focused on efficiency. Drones help farmers save time, reduce labour dependency, and apply inputs with greater precision. These benefits deliver immediate economic value and are important for improving farm operations.

However, the bigger opportunity lies in the intelligence layer. Drones generate real-time insights on crop health, pest outbreaks, nutrient deficiencies, and field variability, allowing farmers to make more informed and timely decisions. In an environment where climate uncertainty, resource constraints, and input costs are increasing, the quality of decisions can have a greater impact on outcomes than the quantity of inputs used.

This is why I believe knowledge-enabling capabilities will ultimately create the greatest economic value. Labour savings and productivity gains are important, but they are often incremental. Better decision-making has a compounding effect; it improves resource efficiency, reduces risk, enhances yields, and strengthens farm profitability over multiple seasons.

The future of agriculture will be driven not just by mechanisation, but by intelligence. Drones are uniquely positioned at the intersection of both, making them one of the most transformative technologies for the sector.

Agricultural data is rapidly becoming a strategic asset. As drone-generated datasets grow in scale and sophistication, who will ultimately capture the greatest value—the farmer, the technology provider, agri-input companies, insurers, financial institutions, or food companies?

The greatest value should; and ultimately will; accrue to the farmer. Drone-generated data has the potential to create value across the entire value chain. Agri-input companies can develop more targeted solutions, insurers can improve risk assessment, financial institutions can make more informed lending decisions, and food companies can strengthen traceability and supply-chain efficiency.

What makes drone data particularly powerful is its ability to create a shared intelligence layer across the agricultural ecosystem. When used responsibly, it can align incentives among stakeholders and enable more efficient decision-making from farm to market. Over the long term, I believe the most successful models will be those that treat data as a tool for collaboration rather than ownership. The organizations that create the most value will not necessarily be those that collect the most data, but those that transform data into actionable insights that benefit farmers and strengthen the broader agricultural ecosystem.

As agriculture becomes increasingly data-driven, the real opportunity lies in ensuring that intelligence flows back to the farmer, because a more informed farmer ultimately creates value for every participant in the value chain.

If India succeeds in deploying drones at scale, what could be the second-order effects on agricultural supply chains, credit access, crop insurance, sustainability reporting and carbon markets? Are we underestimating the broader economic implications of drone adoption?

We are only beginning to understand the broader economic impact that drones can have on agriculture. While the current focus is largely on spraying, monitoring, and operational efficiency, large-scale drone adoption has the potential to create far-reaching benefits across the entire agricultural ecosystem.

As drones generate high-quality, real-time field data, they can bring greater transparency and visibility to agricultural supply chains. This can improve traceability, strengthen quality assurance, and enable more informed decision-making from farm to market.

Drone-generated insights can also support more accurate risk assessment for lenders and insurers, helping improve access to credit and enabling faster, data-driven crop insurance processes. For farmers, this could translate into better financial inclusion and reduced uncertainty. From a sustainability perspective, drones can help measure and optimize the use of water, fertilizers, and crop protection products, creating a stronger foundation for sustainability reporting and environmental compliance. As carbon markets and climate-focused agricultural programs evolve, reliable field-level data will become increasingly important for monitoring outcomes and validating impact.

The larger opportunity is that drones can become a digital intelligence layer connecting agriculture, finance, sustainability, and supply chains. When that happens, their value will extend far beyond farm operations and contribute to a more efficient, transparent, and resilient agricultural economy.

The global drone industry is increasingly converging with artificial intelligence, robotics and autonomous systems. How should Indian agribusinesses prepare for a future where farm operations are increasingly automated, predictive and data-driven rather than reactive and manual?

The future of agriculture will be increasingly defined by intelligence, automation, and predictive decision-making. As drones, AI, robotics, and data analytics converge, agribusinesses will need to evolve from managing farm operations to managing agricultural intelligence.

The first step is to view technology not as a standalone tool, but as a strategic capability. Agribusinesses that invest early in digital infrastructure, data-driven processes, and technology adoption will be better positioned to improve productivity, optimize resources, and respond to changing market and environmental conditions.

Equally important is building a culture that embraces innovation. The future farm will rely on real-time data, predictive insights, and automated interventions. Organizations must therefore focus on developing digital skills, strengthening partnerships with technology providers, and creating systems that can effectively translate data into action.

Farmers, agronomists, and agribusiness leaders will continue to be at the center of decision-making, but they will be supported by technologies that make those decisions faster, more precise, and more informed.

Those who begin preparing today for a more connected, automated, and intelligence-driven agricultural ecosystem will not only improve operational efficiency but also gain a significant competitive advantage in the years ahead. The future belongs to organizations that can combine human expertise with technological intelligence to create more resilient, productive, and sustainable agricultural systems.

Looking ahead a decade, what will distinguish countries that merely use agricultural drones from those that genuinely derive strategic advantage from them? In that future, what role do you envision India—and Garuda Aerospace—playing in the global agricultural technology landscape?

Over the next decade, the distinction will not be between countries that have drones and those that do not; it will be between countries that use drones as tools and those that integrate them into a broader agricultural intelligence ecosystem.

India is uniquely positioned to be one of those leaders. With one of the world's largest agricultural sectors, a rapidly growing drone ecosystem, supportive policy frameworks, and a strong talent base in technology and engineering, India has the opportunity to create a globally relevant model for precision agriculture at scale. What makes this particularly significant is that India's innovations are being designed for accessibility, affordability, and impact; qualities that are highly relevant to agricultural economies around the world.

At Garuda Aerospace, our vision is to contribute to this transformation by building indigenous drone technologies and enabling large-scale adoption of precision agriculture solutions. We see ourselves not just as a drone manufacturer, but as a technology company helping accelerate the transition toward smarter, data-driven farming.

As agriculture becomes increasingly intelligence-led, our goal is to help position India as a global hub for agricultural drone innovation; developing solutions that improve farmer outcomes, strengthen food systems, and demonstrate how technology can drive sustainable agricultural growth at scale.

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