

Evolution of Government Initiatives for Agricultural Drones in India: A Policy Perspective

Dr. R. Govindasamy¹, Deepthi A.²

¹Assistant professor, Department of Economics, Bharathiar University, Coimbatore-641046.

²Research Scholar, Department of Economics, Bharathiar University, Coimbatore-641046.

Abstract:

Agricultural drones are emerging as an important precision technology in India, offering potential applications in crop monitoring, input application, field mapping and agricultural service delivery. However, their integration into agriculture requires a supportive ecosystem encompassing regulatory frameworks, financial assistance, domestic manufacturing, digital infrastructure and skill development. Against this background, the present study examines the evolution of India's agricultural drone ecosystem and evaluates the major policy and institutional interventions introduced during 2021-2026. The study adopts a descriptive policy research design based on secondary data obtained from authentic government publications, official scheme guidelines and relevant research literature. Chronological mapping and thematic policy analysis are employed to examine key initiatives, including the Drone Rules, 2021, Digital Sky Platform, Production Linked Incentive Scheme, Sub-Mission on Agricultural Mechanization, Namo Drone Didi Scheme and Drone-as-a-Service initiatives. The study focuses on Indian agricultural drone ecosystem which has progressively expanded from regulatory facilitation towards a broader framework incorporating manufacturing incentives, financial support, agricultural service delivery and capacity building. However, challenges related to last-mile accessibility, affordability, training and state-level implementation require further attention. The study suggests strengthening local service networks, training infrastructure and institutional coordination to promote inclusive and sustainable agricultural drone adoption in India.

Keywords: Agricultural Drones, Agricultural Policy, SMAM, Namo Drone Didi, Precision Agriculture.

I. Introduction

Agriculture remains central to India's food security, rural livelihoods and economic development, while increasing public investment, technological advancement and digital transformation are reshaping the sector. Despite these developments, Indian agriculture continues to face labour shortages, rising input costs, water scarcity, climate variability and inefficient input use. Conventional spraying is labour-intensive, water-intensive and often results in uneven application of agricultural chemicals. These challenges have increased the need for precision technologies that improve resource-use efficiency and agricultural sustainability. Agricultural drones have emerged as an important technology in this transition.

Agricultural drones have expanded beyond aerial spraying to applications such as crop monitoring, field mapping, nutrient management, irrigation assessment, crop health surveillance and digital crop surveys. Integration with GPS, artificial intelligence, multispectral sensors and automated flight systems enables more precise and timely farm management. Recognizing this potential, the Government of India has introduced the Drone Rules, 2021, Digital Sky Platform (2021), Production Linked Incentive (PLI) Scheme (2021), Sub-Mission on Agricultural Mechanization (SMAM) 2022 – 2024, Namo Drone Didi (2024 – 2025) and other institutional initiatives. Together, these interventions address regulatory, financial, manufacturing, training and service-delivery dimensions of the emerging drone ecosystem. Although existing literature has examined the technological applications, operational benefits and adoption challenges of agricultural drones, limited attention has been given to India's evolving policy and institutional ecosystem as an integrated framework. A comprehensive assessment of the regulatory, financial, manufacturing, service and capacity-building interventions is therefore necessary to understand how the ecosystem is being developed. Against this background, the present study examines the evolution of agricultural drone policies and major government interventions in India using secondary sources. The study further identifies key policy gaps and suggests measures to strengthen the agricultural drone ecosystem.

II. Review of Literature

Ridha Guebsi et al. (2024) systematically reviewed the applications, technological advancements, and future prospects of drone technology using a systematic literature review. The findings showed that drones integrated with multispectral/hyperspectral sensors, AI and IoT enhance crop monitoring, decision-making, sustainable resource management and agricultural productivity. However, Beyond Visual Line of Sight (BVLOS) regulatory restrictions, technological limitations and socio-economic barriers remain major constraints to widespread adoption.

Ranjit Singh and Saurabh Singh (2025) reviewed 237 articles published between 2018 and 2025 on drone adoption in Indian agriculture. The findings showed that drones improve precision farming, input-use efficiency and sustainability through crop monitoring, spraying, irrigation management, disease detection and AI/IoT-enabled decision-making, while reducing labour requirements and pesticide and water consumption.

Beriya and Abhishek (2022) reviewed the applications, policy initiatives, operational aspects and future prospects of drone technology in Indian agriculture, with emphasis on Kisan Drones. The findings showed that drones improve resource-use efficiency, reduce labour requirements, water use and pesticide application costs, while government subsidies, liberalized policies and initiatives such as Kisan Drones and Drone Shakti are expected to accelerate adoption and create rural employment opportunities.

Kalita et al. (2025) examined the Namo Drone Didi Yojana, a Government of India initiative aimed at empowering women-led SHGs, based on government scheme details and published literature. The study highlighted the provision of 80 percent subsidy up to ₹8 lakh, targeting 15,000 women SHGs during 2024-25 to 2025-26 with an outlay of ₹1,261 crore. The scheme is expected to generate at least ₹1 lakh additional annual income per SHG through drone-based agricultural services, creating rural employment and promoting women's empowerment and sustainable agriculture.

III. Objectives of the Study

1. To know the evolution of agricultural drone policies and institutional initiatives in India.
2. To examine the major government subsidies promoting agricultural drone adoption in the country

IV. Methodology

The study adopts a descriptive policy research design based on secondary data and documentary evidence to examine the evolution of India's agricultural drone ecosystem. Secondary information was compiled from official publications of the Ministry of Agriculture and Farmers Welfare, Ministry of Civil Aviation, Directorate General of Civil Aviation (DGCA), Press Information Bureau (PIB), Government of India portals and relevant scheme guidelines, supplemented by peer-reviewed literature and research reports. The study covers major policy and institutional developments during 2021-2026, focusing on regulation, digital governance, domestic manufacturing, agricultural applications, financial assistance, women-led drone services and skill development. The collected information was analysed through chronological mapping, thematic policy analysis and comparative assessment of major schemes and institutional interventions to identify policy gaps and areas requiring further support.

V. Result and Discussion

The evolution of agricultural drones in India has been driven by the growing need to address labour shortages, rising input costs, water scarcity and climate-related challenges through precision agriculture. Initially introduced for aerial spraying of pesticides and fertilizers, drones have rapidly evolved into multifunctional tools for crop monitoring, field mapping, nutrient management, irrigation assessment and digital crop surveys, supported by technologies such as GPS, AI, IoT and remote sensing. Recognizing their potential, the Government of India introduced key initiatives including the Drone Rules 2021, Production Linked Incentive (PLI) Scheme, Sub-Mission on Agricultural Mechanization (SMAM), Digital Sky Platform, Namo Drone Didi Scheme and DGCA-authorized Remote Pilot Training Organizations (RPTOs). Collectively, these initiatives have accelerated the development of a robust agricultural drone ecosystem, promoting precision farming, rural entrepreneurship and sustainable agricultural development.

Table 1: Evolution of Agricultural Drone Government Initiatives and its Impact in India

Year	Major Milestone	Significance
2021	Drone Rules 2021	Simplified regulations and promoted drone adoption.
2021	Digital Sky Platform	Online permission and airspace management.
2021	Production Linked Incentive (PLI) Scheme	Encouraged domestic drone manufacturing.
2021–2023	Standard Operating Procedures (SOPs)	Standard Operating Procedures (SOPs) - pesticide and nutrient application via drones.
2022	Drones-as-a-Service (DaaS)	Introduction of Drone Shakti to promote

		Drones-as-a-Service (DaaS) and operating procedures for Kisan drone pesticide
2022 – 2024	SMAM Implementation	Subsidies and demonstrations for agricultural drones.
2024 – 2025	Namo Drone Didi Scheme	Empowered Women SHGs through drone services.
2025 - 2026	DGCA RPTO Guidelines	Expanded certified drone pilot training infrastructure.

Source: Various Sources

5.2 Government Policy Support for Agricultural Drone Adoption

The government of India has played a crucial role in increasing the drone adoption by introducing several policy frameworks that address the regulatory, financial, institutional and technological barriers.

5.2.1 Drone Rules, 2021:

Issued by: Directorate General of Civil Aviation (DGCA)

Date: 25 August 2025

Important Provisions

- **Fewer Approvals:** Several regulatory requirements, including security clearances, unique prototype numbers, certificates of maintenance and operator permit, were abolished.
- **Reduced Paperwork:** The number of application forms was reduced from **25 to 5**, while the number of fee categories was reduced from **72 to 4**, with nominal flat-rate fees introduced.
- **Digital Sky Integration:** A single-window online system namely Digital Sky was introduced for automated drone registration, flight permissions, and tracking.
- **Type Certification:** Drone manufacturers are required to obtain a **type certificate** for their drone models through the Digital Sky platform, with exemptions provided for nano and model drones.
- **Unique Identification Number (UIN):** Each individual drone is required to have a **registered UIN**, which is linked to its respective type certificate.

5.2.2 Digital Sky Platform (2021):

The Digital Sky Platform, hosted by the Directorate General of Civil Aviation (DGCA), serves as an online platform for managing Unmanned Aircraft System (UAS) activities in India. It integrates drone registration, airspace information, permissions and regulatory processes into a digital system. The Ministry of Civil Aviation describes Digital Sky as a system that facilitates the registration and licensing of drones and operators and provides online clearances for drone operations.

- **Online Registration:** Digital Sky provides an online mechanism for registering drones and undertaking regulatory processes related to UAS operations. The platform also maintains relevant drone and operator records, supporting digital administration and traceability.
- **Airspace Map:** The platform provides an interactive digital airspace map that divides Indian airspace into red, yellow and green zones. Pilots can use the map to identify the applicable airspace restrictions before planning a flight.

- **Flight Permissions:** Drone operators are required to comply with the applicable airspace restrictions. Operations in red and yellow zones require prior permission, while pilots must verify the Digital Sky platform for applicable restrictions before commencing operations.
- **Digital Monitoring and Airspace Management:** Digital Sky functions as a digital repository for airspace information, with authorised government agencies able to update or modify airspace designations. The platform therefore supports coordinated management of drone operations and regulatory oversight.

4.2.3 Production Linked Incentive (PLI) Scheme, 2021

The Production Linked Incentive (PLI) Scheme for Drones and Drone Components was notified on 30 September 2021 to promote domestic manufacturing and strengthen India's drone industry. The scheme links financial incentives to domestic value addition, thereby encouraging indigenous production of drones and components. It also facilitates the participation of MSMEs and start-ups by providing relatively lower eligibility thresholds and supports the development of domestic manufacturing capabilities and associated employment opportunities.

Table 2: Major Provisions of the Production Linked Incentive (PLI) Scheme

Component	Financial Provision
Notification date	30 September 2021
Total incentive	₹120 crore
Duration	3 financial years
PLI rate	20% of eligible value addition
Minimum value addition	40% of net sales
Start-up/MSME threshold – drones	₹2 crore annual sales
Start-up/MSME threshold – components	₹50 lakh annual sales
Individual beneficiary cap	25 percent of total annual outlay

Source: Various Sources

5.2.3 Standard Operating Procedures (SOPs), for Agricultural Drone Applications

The Government of India developed Standard Operating Procedures (SOPs), 2021–2023 to regulate and facilitate the use of drones for agricultural applications, particularly the spraying of pesticides and plant nutrients. The SOPs provide operational guidance on aspects such as drone-based application, safety precautions, application procedures and compliance requirements. These guidelines helped establish a standardized framework for the safe and effective use of drones in agriculture and supported the integration of drone technology into farm input application.

5.2.5 Sub-Mission on Agricultural Mechanization (SMAM), 2022 – 2024

The Sub-Mission on Agricultural Mechanization (SMAM) is a Centrally Sponsored component implemented through State Governments to promote access to agricultural machinery and modern technologies, including Kisan Drones. The scheme supports drone adoption through financial assistance, field demonstrations and Custom Hiring Centres (CHCs), enabling farmers to access drone services through purchase or rental arrangements. It also supports CHCs established by eligible organisations and rural entrepreneurs, including agriculture graduates, while providing assistance for hiring drones for

demonstrations. The 2024 guidelines further provide for georeferenced and monitored demonstrations, strengthening the institutional mechanism for promoting and tracking drone-based agricultural services.

Table 3: Major Financial Provisions Under SMAM

Component	Financial Support
Eligible institutions – drone purchase	100%, up to ₹10 lakh/drone
FPOs – demonstrations	Up to 75% of drone cost
CHCs – drone purchase	40%, up to ₹4 lakh/drone
Agriculture graduates establishing CHCs	50%, up to ₹5 lakh/drone
Demonstration through hired drones	Up to ₹6,000/ha
Demonstration using purchased drones	Up to ₹3,000/ha

Source: Various Sources

5.2.6 Namo Drone Didi Scheme, 2024 – 2025

The Namo Drone Didi Scheme is a Central Sector Scheme aimed at providing drones to selected Women Self-Help Groups (SHGs) and enabling them to deliver drone-based agricultural services to farmers. The scheme integrates women SHGs into the agricultural drone ecosystem by providing training for drone pilots and assistants/technicians and promoting a service-based rental model for activities such as nano fertilizer and pesticide application. It thereby supports women-led rural entrepreneurship and livelihood generation by enabling SHGs to provide drone services to farmers.

Table 4: Namo Drone Didi Scheme's Major Beneficiary Provisions

Indicator	Official Provision
Scheme Outlay	₹1,261 crore
Target	15,000 Women SHGs
Central Financial Assistance	80% of drone package cost
Maximum Assistance	₹8 lakh per SHG
AIF Interest Subvention	3%
Pilot Training	15 days
Drone Assistant Training	5 days
Intended Additional SHG Income	At least ₹1 lakh/year

Source: Various Sources

5.2.7 Drone Shakti and Drone-as-a-Service (DaaS), 2022

Mission 'Drone Shakti' was announced in the Union Budget 2022-23 to promote the use of drones through start-ups and to facilitate Drone-as-a-Service (DaaS). The initiative was intended to expand the use of drones across varied applications by developing a service-based ecosystem in which users can access drone technology without necessarily owning the equipment. The Government also envisaged the use of DaaS across identified Union Ministries, with the Ministry of Civil Aviation facilitating coordination among government departments, industry, academia and start-ups. In addition, drone-related skilling courses were proposed in selected Industrial Training Institutes (ITIs), supporting the development of the human resources required for the expanding drone sector.

5.2.8 Financial Assistance for Agricultural Drones

The Government of India has introduced multiple financial assistance provisions to make agricultural drones accessible to institutions, farmer organisations, rural entrepreneurs and individual farmers.

Table 6: Beneficiary-wise Financial Assistance for Agricultural Drone Adoption in India

Beneficiary Group	Subsidy / Financial Assistance (up to ₹10 lakh)	Key Requirements / Intended Use
Institutions (ICAR, KVKs, Agricultural Universities)	100% subsidy	Primarily for large-scale field demonstrations
FPOs and Cooperatives	Up to 75% subsidy	Demonstration of drones on farmers' fields
Women Self-Help Groups (SHGs)	80% subsidy (up to ₹8 lakh)	Under Namo Drone Didi for providing drone-based agricultural services
CHCs / eligible rural entrepreneurs	40% subsidy (up to ₹4 lakh)	Establishment of drone-based Custom Hiring Centres
Agriculture Graduates	50% subsidy (up to ₹5 lakh)	Establishment of local Custom Hiring Centres
SC/ST, Small & Marginal, Women and NE Farmers	50% subsidy (up to ₹5 lakh)	Individual farm ownership and operation
General Category Farmers	40% subsidy (up to ₹4 lakh)	Individual farm ownership

Source: Ministry of Agriculture & Farmers Welfare

Note: For the remaining balance, farmers can tap the Agriculture Infrastructure Fund (AIF) to unlock bank loans featuring a **3% interest** subvention.

Overall, India's agricultural drone ecosystem has evolved through a coordinated combination of regulatory, financial, technological and institutional interventions. The progression from regulatory reforms and digital governance to manufacturing support, agricultural services, women-led initiatives and skill development reflect a broadening policy approach. However, greater attention is required to strengthen last-mile access, training, affordability and implementation across different agricultural regions. A more integrated and outcome-oriented policy framework can further support the effective and inclusive adoption of drones in Indian agriculture.

VI. Summary

The study examined the evolution of India's agricultural drone ecosystem and the major policy and institutional interventions introduced from 2021 to 2026. The analysis shows that the ecosystem has developed through a combination of regulatory reforms, digital governance, domestic manufacturing incentives, agricultural application guidelines, financial assistance, service-based models and capacity-building initiatives. Key interventions such as the Drone Rules, 2021, Digital Sky Platform, PLI Scheme, SMAM, Namo Drone Didi and Drone Shakti have addressed different dimensions of drone adoption, while training and certification mechanisms support the development of skilled human

resources. Overall, India's policy framework reflects a gradual shift from regulatory facilitation towards broader institutional and service-oriented support for agricultural drone applications.

VII. Suggestions

- **Strengthen last-mile access:** Expand drone services through Custom Hiring Centres, FPOs, cooperatives and local service providers so that small and marginal farmers can access drones without owning them.
- **Improve training infrastructure:** Expand access to DGCA-authorised training and strengthen agricultural-specific training in drone operation, crop application, safety and field-level decision-making.
- **Strengthen state-level implementation:** Encourage State Governments to develop location-specific agricultural drone programmes based on major crops, farm structures and local requirements.
- **Develop integrated agricultural drone data systems:** Promote greater integration of drone-generated information with agricultural databases, GIS and digital advisory systems to support timely farm-level decision-making.

VIII. Conclusion

India has established a progressively expanding policy ecosystem for agricultural drones through regulatory reforms, digital infrastructure, manufacturing incentives, financial assistance, service-based models and institutional capacity building. The evolution from the Drone Rules, 2021 and Digital Sky Platform to SMAM, Namo Drone Didi and Drone-as-a-Service demonstrates increasing policy attention towards integrating drones into agricultural service delivery. However, the continued development of the ecosystem requires stronger last-mile access, skilled human resources, state-level implementation, financial accessibility, domestic manufacturing and systematic monitoring. A coordinated policy approach integrating regulation, finance, technology, training and agricultural service delivery can further strengthen the role of drones in India's transition towards precision and sustainable agriculture.

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