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Agricultural Drone Industry Insight Report

2025/2026

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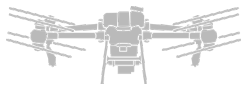

Introduction

In 2025, DJI Agriculture continued to drive the global adoption of agricultural drone technology, further reinforcing its role in the advancement of smart and sustainable farming. As agricultural production faces mounting challenges—from labor shortages and rising input costs to increasing pressure on natural resources—precision drone operations are becoming an increasingly important part of modern farm management. Against this backdrop, DJI Agriculture expanded its worldwide presence, strengthened its service and training network, and delivered measurable environmental value at scale.

As of December 31,2025, **over 600,000 DJI Agriculture drones** had been deployed globally, serving farmers, agricultural service providers, and rural communities in both established and emerging agricultural markets. A robust ecosystem of training, service, and support remained critical to industry growth. In 2025, DJI Agriculture further strengthened this foundation through a network of **more than 3,500 service and repair centers** worldwide. These centers provided localized access to technical support, product maintenance, and after-sales services, helping improve operational continuity and customer experience. At the same time, DJI Agriculture continued to promote standardized and professional drone operations through a global network of **over 7,000 certified instructors** and **more than 600,000 certified pilots**. This growing talent base has played an important role in improving safety, operational quality, and the long-term scalability of agricultural drone deployment.

DJI Agriculture operations had reached **more than 100 countries and regions** worldwide. This broad global presence reflects the increasing recognition of agricultural drones as practical tools for improving efficiency across a wide variety of crops, field conditions, and production systems. The versatility of agricultural drone technology continued to improve in 2025. DJI Agriculture drones were used across **more than 300 crop types**, supporting applications in crop protection, spreading, seeding, and field management. From broad-acre grain production to high-value cash crops and orchards, drone-based operations demonstrated strong adaptability and growing relevance in increasingly diverse agricultural settings.

Beyond productivity gains, the environmental benefits of agricultural drone technology became increasingly evident. By the end of 2025, DJI Agriculture drones had helped reduce approximately **51 million tons of CO2 emissions**. This reduction is comparable to the annual carbon absorption capacity of **240 million trees**, underscoring the meaningful role that precision agriculture technologies can play in supporting lower-carbon agricultural practices. By optimizing field operations and enabling more targeted input application, agricultural drones are helping reduce waste while improving overall resource efficiency.

Water conservation also remained a major area of impact. In 2025, the cumulative use of DJI Agriculture drones helped save approximately **410 million tons of water, equivalent to the annual drinking water** consumption of **740 million residents**. This achievement highlights the potential of drone-enabled precision application to improve water-use efficiency and contribute to more sustainable agricultural production, particularly in regions facing increasing resource constraints.

Overall, 2025 was a year of continued scale, maturation, and impact for DJI Agriculture. The steady expansion of global deployment, the growth of a professional operating ecosystem, and the significant environmental benefits achieved throughout the year all point to the accelerating integration of drones into mainstream agricultural practice. As the industry continues to evolve, DJI Agriculture remains committed to advancing innovation, improving accessibility, and supporting farmers worldwide with more efficient, sustainable, and intelligent agricultural solutions.

I. Events in 2025

January

Global debut of DJI's Agricultural Drone Lifting Course, systematically advancing the construction of lifting operation safety standards and operating specifications.

February

Held an agricultural drone pilot skill competition in Thailand, improving the operational level of local pilots and expanding application in the Southeast Asian market through the competition.

March

DJI agricultural drones participated in spring plowing, sowing and seedling hoisting in Tibet, breaking through the application limitations of agricultural drones in high-altitude and complex terrain.

April

Participated in Brazil Agrishow and officially released the Agricultural Drone Industry Insight Report 2025, sharing global industrial data and trends.

May

Launched the "Agricultural Drone Safety Month" special activity, carrying out safety training and standard promotion for global pilots to strengthen operational safety awareness.

June

Launched the project "Lychees Out of Mountains", using agricultural drones to solve the problem of lychee transportation in mountainous areas and implement a new scenario of mountain agricultural product logistics.

July

Held four Chinese agricultural drone lifting industry summits (each with hundreds of participants), promoting the rapid development of lifting operation standardization and industrialization.

August

The flagship model Agras T100 was displayed at the Skycity exhibition hall, attracting industry attention with its modular design and large capacity.

September

Held a media event in Mexico, deepening the layout of the Latin American market and promoting agricultural drone precision operation solutions.

October

Held the Harvest Guardian Selection Event, commending outstanding pilots and operation teams, and encouraging agricultural drone practitioners to work in the front line.

November

Participated in the Crop Protection Dual Expo (Agritechnica) in Hannover, Germany, and globally released three new models: Agras T100/T70P/T25P, expanding the European high-end agricultural machinery market.

December

New lifting scenarios were widely applied, reaching 6.5 million tons in China

II. Global Policy Trends

From January 2025 to April 2026, global agricultural drone policies trended toward liberalization, standardization, and strategic integration, with key positives including: widespread regulatory relaxation to lower operational barriers, establishment of unified international standards to enhance interoperability, formal recognition within national strategies to boost policy support, expansion of beyond-visual-line-of-sight (BVLOS) permissions to improve efficiency, alignment with sustainability goals to encourage green adoption, and regional initiatives to simplify cross-border compliance and certification.

2.1. Brazil

2.1.1 ANAC

ANAC (National Civil Aviation Agency of Brazil) has updated its drone regulations by proposing the RBAC 100 draft, while optimizing the approval process through the establishment of "standard scenarios" for recurring agricultural operations. These standard scenarios enable the pre-approval of relevant applications, effectively improving the efficiency of the approval process. This regulatory optimization has significantly reduced bureaucratic barriers, thereby encouraging more operators to submit applications for agricultural drone operations. To further standardize the industry, ANAC has also refined the training requirements for agricultural spraying drone pilots and released a new draft of operational rules in June 2025. This new draft introduces the SORA (Specific Operations Risk Assessment) risk assessment framework, aiming to align Brazil's agricultural drone regulations with international standards.
Reflecting the positive effect of these regulatory measures, ANAC processed a large volume of agricultural drone operation applications in 2025, which fully demonstrates the rapid growth momentum of Brazil's agricultural drone market.

2.1.2 MAPA

Brazil's Ministry of Agriculture, Livestock and Supply (MAPA) has implemented a series of targeted policies and management measures, aiming to promote the healthy and rapid development of agricultural drones. These measures cover key areas such as policy norms, training management, and scientific experiments, providing strong support for the popularization and standardized application of agricultural drones in Brazil's agricultural sector.
MAPA updated and improved the relevant norms for agricultural drone operations, optimizing the registration and filing process for agricultural drones and their operators to reduce procedural barriers. It further clarified the technical standards for agricultural drones used in pesticide spraying, fertilizer spreading, seeding and other scenarios, specifying the safety distance requirements from sensitive areas during operations to ensure environmental safety and operational standardization. Meanwhile, MAPA simplified the approval procedures for agricultural drone operations in key agricultural regions, and cooperated with relevant authorities to realize the information sharing of drone registration and operation approval, reducing duplicate declarations and further lowering the operational threshold for operators. In November 2025, MAPA updated the existing regulations on agricultural drone operations, further aligning legal requirements with the technical characteristics of drones, and enhancing legal certainty for operators. Additionally, the registration of agricultural drones is realized automatically through the Sipeagro System (Sistema Integrado de Produtos e Estabelecimentos Agropecuários), simplifying the registration process for operators.
In terms of training requirements, MAPA further standardized the training system for agricultural drone pilots, requiring all operators engaged in agricultural drone operations to obtain the "Remote Agricultural Applicator" (Aplicador Aeroagrícola Remoto) qualification certificate through professional training. The training content covers drone structure and principles, safe operation specifications, pesticide and fertilizer use skills, emergency disposal of flight abnormalities, environmental protection knowledge, and relevant laws and regulations, with clear minimum training duration and practical operation requirements to ensure that pilots have professional operation capabilities and safety awareness. MAPA also authorized professional training institutions to carry out standardized training, established a unified training assessment and certificate management system, and realized the whole-process supervision of training quality, laying a solid talent foundation for the popularization of agricultural drones. In some specific scenarios, MAPA also requires operators to be equipped with professional technical personnel such as agronomists or forestry engineers to coordinate operational activities, ensuring the standardization and scientific of operations.

In terms of scientific tests, MAPA launched a number of agricultural drone application pilot projects in major grain-producing areas and cash crop planting . It organized scientific research institutions, drone enterprises and farmers to carry out joint tests, focusing on verifying the application effect of drones in precision fertilization, pest and disease monitoring, crop growth situation investigation and other fields, and exploring efficient and low-cost drone operation modes suitable for local agricultural characteristics. Referring to advanced drone application technologies in precision agriculture, MAPA promoted the integration of drone remote sensing technology with agricultural production, guiding researchers to use drone-captured multispectral and thermal images to map soil moisture and crop nutrient status, providing accurate data support for precise agricultural management.
In addition, MAPA also carried out extensive publicity and promotion activities for agricultural drone technologies, popularizing the advantages of drone operations in improving efficiency, reducing costs and protecting the environment, and guiding more farmers and agricultural operators to adopt drone technology. The regulatory measures also emphasize the full-process safety management of drone operations, including the preparation of spray liquid, environmental condition monitoring during operations, and data recording and archiving, to ensure that operations are traceable and auditable.
These policies and management measures implemented by MAPA have effectively standardized the development of Brazil's agricultural drone industry, expanded the application scope of agricultural drones, improved the efficiency and quality of agricultural operations, and accelerated the process of agricultural modernization in Brazil.

2.2. Argentina

In August 2025, the National Civil Aviation Administration of Argentina (ANAC) issued Resolution 550/2025, fully modernizing the country's drone regulatory framework by introducing risk-based classification (Open, Specific, Certified categories). The resolution has significantly simplified licensing requirements for rural/productive drone applications, eliminating the license requirement for unmanned aircraft <25kg and reducing operational restrictions in agricultural areas. ANAC has collaborated with Senasa (the National Service for Agri-Food Health and Quality) to improve the pesticide management framework for aerial application, providing greater operational flexibility for agricultural spraying and other productive drone uses.

2.3 Chile

Chile has implemented a series of supportive policies to promote the healthy and rapid development of the agricultural drone industry, with the Dirección General de Aeronáutica Civil (DGAC) as the core guiding authority. In collaboration with the National Agency for Research and Development (ANID) and professional training institutions, DGAC has established a comprehensive support system covering policy incentives, pilot training, and promotion guidance, aiming to facilitate the wide application of agricultural drones and support the development of precision agriculture—a strategic priority for the Chilean government in modernizing its agricultural sector.

In terms of policy and regulatory support, DGAC has formulated favorable policies specifically for agricultural drones to lower operational barriers and encourage industry development. The government has simplified the DGAC registration process for agricultural drones, allowing operators to submit relevant parameters and obtain a unique identification number through a streamlined online platform, improving registration efficiency significantly. To facilitate large-scale agricultural operations involving loads such as pesticides, the government has optimized the operation license and flight authorization process, providing clear guidance and convenient channels for submitting pre-flight plans. Additionally, the government provides policy guidance on civil liability insurance for agricultural drone operations, cooperating with insurance institutions to offer preferential insurance rates, reducing the operational costs of operators. These supportive regulations are based on DAN 151 Edition 3 and DAN 137 provisions, with the upcoming DAN 151 Edition 4 expected to further optimize policy support for drone development and create a more favorable development environment.

2.4. United States

2.4.1 FAA

As of January 2026, the Federal Aviation Administration (FAA) has further advanced supportive policies for the agricultural drone industry, building on the Part 108 Notice of Proposed Rulemaking (NPRM) released in August 2025 and incorporating new adjustments to better facilitate the development of large-scale agricultural drone applications. The FAA has officially finalized key provisions of the performance-based low-altitude Beyond Visual Line of Sight (BVLOS) regulatory framework, which explicitly prioritizes support for large-scale agricultural operations such as spraying, seeding and crop monitoring—an area that previously relied heavily on individual exemptions.

The FAA further expanded its support for the agricultural drone industry by updating the approval list under Section 44807 of the U.S. Code. This update, a key part of the FAA's efforts to streamline regulatory processes and promote industry innovation, adds a number of new agricultural drone models that meet the agency's safety and performance standards, making it easier for operators to access qualified equipment for large-scale agricultural operations. Notably, DJI's new agricultural drone model T100 is among the newly added models on the 44807 approval list, along with several other advanced agricultural drone products.

Make	Model	Approved Maximum Take-Off Weight (MTOW), incl. Payload
ABZ Innovation Kft.	L30 V2*	158.70 lbs.
AgrowDrone	UAS-e-M5	80.5 lbs.
AgrowDrone	UAS-e-M10	146.6 lbs.
AgTS	FireEye	75.8 lbs.
AiRanger	UAS	220 lbs.
Argo	1	280 lbs.
ASW	Heavy Lift Quadcopter	70.5 lbs.
ASW	Heavy Lift Hexacopter	99.2 lbs.
ASW	Heavy Lift Octocopter	158.7 lbs.
Avidrone	490TL*	125 lbs.
BFD Systems	GD40	120 lbs.
BROUAV	U30L-6	146.6 lbs.
BROUAV	52L-8	264.55 lbs.
BROUAV	U60	242.5 lbs.
BROUAV	D-72L-8	324.08 lbs.
CERES AIR	C12	253.53 lbs.
CERES AIR	C31	537.20 lbs.
Chengdu JOUAV Drone	CW-30	75 lbs.
DJI	Agras T10	59.10 lbs.
DJI	Agras T16	92.6 lbs.
DJI	Agras T20P	127.86 lbs.
DJI	Agras T20	104.5 lbs.
DJI	Agras T25P	116.85 lbs.
DJI	Agras T25	127.8 lbs.
DJI	Agras T30	171.96 lbs.
DJI	Agras T40	222.66 lbs.
DJI	Agras T50	227.07 lbs.
DJI	Agras T70P	286.60 lbs.
DJI	Agras T100	390.21 lbs.
DJI	Flycart 30	209.73 lbs.
DJI	Flycart 100*	330 lbs.

FAA's approval list and DJI models

2.4.2 USDA

The U.S. Department of Agriculture (USDA) actively promotes the Drone-as-a-Service (DaaS) model to bridge the gap for small and medium-sized farms, making agricultural drone technology more accessible.

The United States Department of Agriculture Agricultural Research Service (USDA-ARS) conducted a field study published in 2025 examining spray deposition and drift as influenced by wind speed and spray nozzles from a remotely piloted aerial application system. A field study was conducted with a commercially available spray drone outfitted with three commonly used spray nozzles to determine downwind deposition and spray drift. This research, published in 2025, provides critical data for understanding how nozzle selection and wind conditions affect off-target movement from drone applications.

2.5. Canada

2.5.1 Transport Canada

Transport Canada's Phase 2 regulatory amendments to the Canadian Aviation Regulations (CARs Part IX), effective **November 4, 2025**, deliver targeted deregulation and operational simplification for agricultural remotely piloted aircraft systems (RPAS/drones) across 2025–2026, directly supporting spray, mapping, monitoring and precision farming use cases. The core updates eliminate longstanding barriers for medium-weight agricultural spray drones (25–150 kg MTOW, the dominant category for crop spraying) and streamline routine operations: medium drones no longer require case-by-case Special Flight Operations Certificates (SFOC) for visual line-of-sight (VLOS) agricultural work, provided operators hold a valid **Advanced RPAS Pilot Certificate** and an **RPAS Operator Certificate (RPOC)** with documented safety systems, cutting administrative red tape and enabling scalable commercial deployment. The framework also introduces the new **Level 1 Complex (L1C)** Pilot Certification, enabling low-risk beyond visual line-of-sight (BVLOS) operations in uncontrolled rural airspace (Class G) over sparsely populated farmland—without SFOC—for crop mapping, large-field monitoring and extended spraying missions, capped at 122 m AGL and clear of populated zones and aerodromes.

This regulatory shift establishes a risk-based, scalable framework tailored to agriculture: it standardizes rules for heavy-lift spray drones, removes repetitive SFOC approval burdens, and opens BVLOS capabilities for large-scale farm operations, while maintaining core safety guardrails around pilot training, operator oversight and airspace separation. Complementing Health Canada PMRA's PRO2026-01 pesticide use reform (which allows reuse of existing aerial pesticide labels for drone spraying), Transport Canada's 2025–2026 rules create a fully aligned regulatory pathway that accelerates the adoption of agricultural drone technology across Canadian farming operations.

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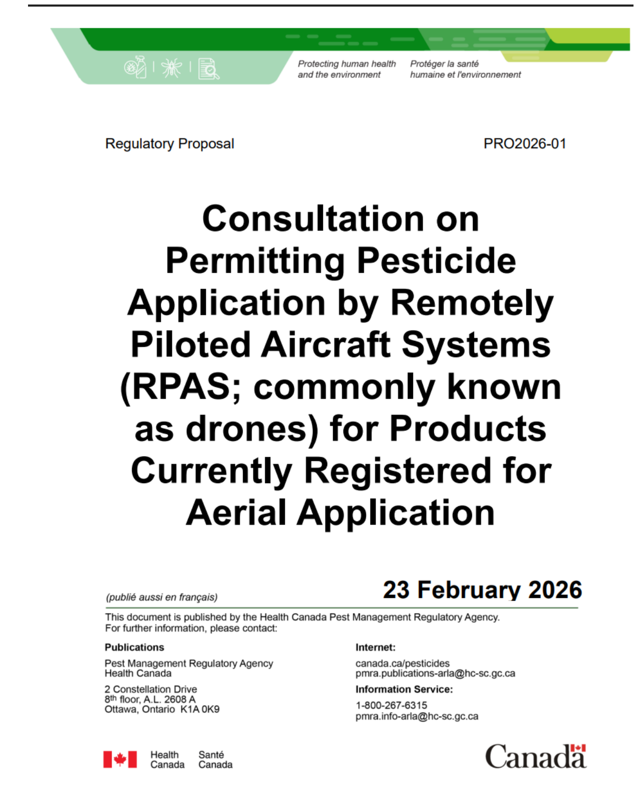
2.5.2 Health Canada

Health Canada's Pest Management Regulatory Agency (PMRA) has put forward the proposed regulatory policy PRO2026-01, a landmark initiative designed to clear a new compliance path for agricultural sprayer drones and drive their large-scale application in Canada's agricultural sector. The core favorable measure of this proposal is the exemption of separate pesticide registration for drone application; specifically, all pesticides already approved for conventional aerial application (fixed-wing aircraft or manned helicopters) can be directly used for drone spraying without the need for additional PMRA registration or label updates, provided that all parameters specified on the original aerial application labels—such as dosage, droplet size, buffer zones, and operational conditions—are strictly followed. The only exception applies when pesticide manufacturers explicitly mark "RPAS application prohibited" on product labels.

PMRA's decision is backed by solid field data, which confirms that the pesticide residue levels, human health risks, and environmental impacts associated with drone spraying are equivalent to those of traditional aerial application methods. Moreover, drone operations keep operators physically separated from the spraying areas, resulting in lower occupational exposure risks compared to conventional approaches. This risk equivalence recognition eliminates the need for specialized risk assessments for drone-based pesticide application, effectively addressing the core compliance barrier that has long hindered the adoption of agricultural sprayer drones in Canada. By unlocking the entire existing library of aerially registered pesticides across various scenarios including field crops, orchards, and specialty crops, the proposal enables sprayer drones to fully leverage their advantages in small, irregular fields, wet and soft plots, and topographically complex areas, thus complementing the limitations of ground machinery and traditional aerial operations.



Protecting human health and the environment
Protéger la santé humaine et l'environnement

Regulatory Proposal PRO2026-01

Consultation on Permitting Pesticide Application by Remotely Piloted Aircraft Systems (RPAS; commonly known as drones) for Products Currently Registered for Aerial Application

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To ensure the smooth implementation of this policy, a clear and coordinated compliance framework has been established. While PMRA focuses on regulating pesticide use compliance, drone operations still need to meet the requirements set by Transport Canada, including mandatory drone registration and operators holding advanced or complex operation certificates, as well as provincial pesticide applicator certification standards. This clear division of responsibilities between PMRA (pesticide regulation) and Transport Canada (airspace and operational regulation) forms a complete set of implementation rules, further enhancing the feasibility of commercial and farm-level adoption of agricultural sprayer drones. As a pivotal deregulatory move, PRO2026-01 shifts the regulatory model from "case-by-case product approval" to "label equivalence recognition," significantly shortening the compliance cycle, reducing costs for pesticide manufacturers and drone service providers, and acting as a powerful catalyst for the widespread popularization of agricultural sprayer drones in Canadian farms to support the development of precision agriculture and efficient crop protection operations.

2.6. Europe

2.6.1 EU commission

In December 2025, the European Commission released draft amendments on drone pesticide spraying as part of the Food & Feed Simplification Omnibus, amending Directive 2009/128/EC on the Sustainable Use of Pesticides (SUD).
Background: The original SUD imposed a comprehensive ban on all aerial pesticide application (including drones), with only case-by-case derogations permitted by individual Member States. This fragmented and costly process has significantly hindered the promotion of agricultural drones. The core of this draft amendment is to shift from a "comprehensive ban + case-by-case derogations" model to a "general derogation + list-based control + risk assessment" framework, establishing a unified EU-wide compliance pathway for drone pesticide spraying.

1. General Derogation Mechanism (Key Benefit): A new clause is added to allow Member States to grant general derogations to specific drone types that meet the criteria specified in the European Commission's delegated act, replacing the previous cumbersome case-by-case application process. The general derogation only applies to pesticide products whose labels explicitly permit "aerial application" and do not prohibit RPAS (drone) use.
2. EU Unified Delegated Act (Authorized List): The European Commission will formulate an authorized list specifying the technical parameters of eligible drones (such as maximum take-off weight, spraying systems, drift control, and precision positioning), which will be subject to public consultation thereafter. Only drones included in this list are eligible for the general derogation, ensuring baseline safety standards.
3. Risk Assessment and Standard Formulation: The European Food Safety Authority (EFSA) is commissioned to develop a dedicated risk assessment guideline for drone pesticide spraying (covering drift, environmental impacts, and human exposure), unifying approval standards across EU Member States and eliminating compliance barriers.
4. Labeling and Compliance Boundaries: The draft clarifies three key points: Pesticides approved for aerial application and not prohibited for drone use can be directly used with drones; Off-label use requires an Emergency Use Permit (EUP); Core safety requirements such as buffer zones, application dosages, and operation timeframes are retained to ensure no reduction in environmental and health standards.
5. Legislative Process: The draft was released on 16 December 2025 and will be reviewed by the European Parliament and the Council in 2026. It is expected to take effect in late 2026 to early 2027, with a clear transition period specified concurrently.

2.6.2 EASA

Focusing on drone operational compliance, EASA concurrently improved the UAS (Unmanned Aircraft Systems) operational framework for agricultural spraying in December 2025, forming synergy with the relaxation of pesticide regulations.

1. PDRA-S01 [F] Spraying-Specific Standard: The Predefined Risk Assessment (PDRA) pathway PDRA-S01, dedicated to agricultural spraying/seeding, is strengthened. It clarifies unified standards for Visual Line of Sight (VLOS)/Beyond Visual Line of Sight (BVLOS) operations, maximum weight, operation altitude, personnel separation, and airspace coordination. Member States can directly adopt these standards without additional approval, significantly simplifying the operational licensing process for agricultural drones.
2. Implementation of SORA 2.5 (Effective September 2025, Fully Enforced in December): The Specific Operations Risk Assessment (SORA) Version 2.5 is updated, optimizing the SAIL (Specific Assurance and Integrity Level) classification for agricultural spraying operations. This reduces the technical evidence and documentation burden for low-to-medium risk agricultural spraying drones, supporting the approval of large-scale, standardized operations.
3. Adaptation for Large Agricultural Drones (>150kg): EASA is concurrently advancing a draft regulation on the airworthiness and operation of heavy UAS (>150kg), incorporating heavy-duty agricultural spraying scenarios.

2.6.3 EU Member States

1). France:

In April 2025, Law No. 2025-365 was passed, officially authorizing drone-based crop treatment under specific conditions (e.g., use of low-risk pesticides, application on sloped land). This law was later integrated into the Duplomb Law (Law No. 2025-794) in August 2025, further standardizing the regulatory requirements for agricultural drone operations.

2).Hungary :

Hungary has established the EU's first structured authorization pathway for drone-based plant protection through the Nébih Decree, which is updated based on Decree 44/2005 (focused on aerial plant protection). Contrary to the initial plan of official implementation in late 2025/early 2026, the regulatory framework for drone spraying under the Nébih Decree was first established in February 2022 via Decree 4/2022 amending Decree 44/2005, and the period of 2025-2026 mainly involves continuous updates and optimizations, such as expanding the list of approved pesticides for drone application and refining operational standards. The structured authorization pathway requires three core conditions: demonstrating clear advantages of drone spraying over ground-based methods, using pesticides approved for aerial application, and ensuring operators hold Nébih-certified qualifications, including drone pilot certifications and supervision by plant protection specialists.

3).Romania:

Romania is advancing legislative improvements for agricultural drone pesticide spraying in 2025-2026 to modernize its legal framework and align with international precision agriculture trends. A legislative initiative has been proposed to simplify the authorization process for drone pesticide application, allowing such operations through a simple notification system without excessive bureaucracy, which aims to address the current inaccessibility of drone technology for local farmers. The proposal clearly defines agricultural drones as unmanned aerial vehicles, mandates the use of pesticides officially authorized by the national phytosanitary authority, and requires operators to obtain certification from the Romanian Civil Aeronautical Authority (AACR). Additionally, a national register of operators and flights will be established to ensure traceability, transparency, and effective supervision, while the national phytosanitary authority will be responsible for periodic monitoring of drone spraying processes. These regulations are formulated in line with EU Directive 2009/128/EC on the sustainable use of pesticides, and the Senate's Agriculture Commission has issued a favorable opinion on the legislative amendments, laying a clear legal foundation for the widespread adoption of agricultural drones in Romania.

2.7. Australia

2.7.1 CASA

In 2025–2026, Australia's Civil Aviation Safety Authority (CASA) maintains a riskbased regulatory framework for agricultural drones under Part 101 of the Civil Aviation Safety Regulations, with targeted simplifications for commercial crop spraying, mapping, monitoring, and precision agriculture operations. All commercial agricultural drone operations require mandatory registration: drones over 500g pay an annual fee of AUD 40 for 12month validity. Licensing rules apply: Remote Pilot License (RePL) is required for 2–25kg RPAs, while Remote Operator Certificate (ReOC) is mandatory for multidrone fleets or complex systems. Landowners operating 25–150kg mediumsized agricultural drones on their own land for noncommercial purposes qualify for limited exemptions, though core safety rules remain in force. Key operational limits include a 120m altitude cap, daytime visual lineofsight (VLOS) only, 30m minimum separation from people, and a 5.5km nofly zone around controlled airports for drones over 250g. For critical largescale farm monitoring, CASA launched a 12month widearea BVLOS trial program valid until 15 October 2026, allowing ReOC holders to obtain 12month operational approvals via selfassessment, replacing the previous 3–6 month casebycase Special Flight Operations Certificate (SFOC) process. CASA will fully migrate airspace authorization services to Air services Australia's Flight Information Management System (FIMS) by late May 2026, advancing the national UTM roadmap and streamlining coordination with controlled airports. On 21 October 2025, CASA released the draft revision of CAO 100.24 (Airworthiness and Maintenance for Large Remotely Piloted Aircraft) and the accompanying AusSORA (Australian Specific Operations Risk Assessment) annex draft (for public consultation March–April 2026), specifically targeting large RPAs over 150kg—heavyduty agricultural spraying and payload drones. Previously, >150kg drones required experimental airworthiness certification under CASR 21.191 (mannedaircraft standards), a 6–12 month, highcost process. The draft establishes a dedicated large RPA airworthiness framework with riskbased tiered certification (SAIL II/III), replacing full mannedaircraft type certification with streamlined SORAbased assessments and key system compliance declarations, drastically lowering entry barriers for heavy agricultural drones. It also reforms maintenance rules: recognizing thirdparty maintenance organizations, simplifying maintenance plan approvals, enabling modular and datadriven compliance, and removing mandatory mannedaircraft AME engineer requirements, cutting longterm operational costs for 150kg+ agricultural drones. Combined with streamlined BVLOS approvals and FIMS integration, these changes shift from casebycase restriction to riskbased standardization, fully unlocking the commercial viability of 150kg+ heavy agricultural drones for largescale, highefficiency crop protection across Australia's vast farmlands.

2.7.2 APVMA

The Australian Pesticides and Veterinary Medicines Authority (APVMA), the independent statutory body regulating agricultural chemicals, oversees pesticide registration and safe use for dronebased agricultural applications, with 2025–2026 policy updates focused on streamlining compliance while upholding safety standards. All agricultural chemicals applied via drones must be registered or listed with the APVMA under the Agricultural and Veterinary Chemicals Code, with no blanket exemptions for dronespecific formulations. In June 2025, the APVMA strengthened approval requirements for "highly similar formulations" (Categories 6 and 7), mandating full reference product data submissions to reduce redundant testing and accelerate approvals for dronecompatible products. Early 2026, it released a reference product guide outlining lowdata submission pathways (Categories 6, 7, 10, 12, 14), further simplifying registration for products matching already approved active ingredients and cutting timetomarket for dronesuitable pesticides. A clear compliance pathway is established: chemicals may be used via drones if their labels explicitly permit "aerial application" (for manned aircraft) and do not prohibit RPAS (drone) use; offlabel applications require an APVMA Emergency Use Permit (EUP), such as the permit for MCPA in sugarcane (PER95459, valid until December 2025). In its 2026–2030 Regulatory Outlook Statement, the APVMA reaffirms a riskbased assessment approach, continuing highpriority reviews of neonicotinoids and deepening AustraliaNew Zealand crossborder regulatory cooperation to align chemical registration standards. Strict label compliance remains in force, requiring adherence to registered rates, droplet size specifications, and buffer zone requirements; operators must hold both CASA pilot certification and statelevel chemical application accreditation (e.g., Queensland Pilot Chemical Rating Licence) to conduct drone spraying legally. The APVMA's streamlined registration, clear label rules, and crossborder collaboration create a supportive regulatory environment for agricultural drone spraying, without imposing unnecessary additional restrictions, complementing CASA's aviation framework to enable safe, efficient precision agriculture operations.

2.8. China

Agricultural drones have been identified as a core application of the low-altitude economy in the agricultural sector and incorporated into national top-level development design. In 2024, four ministries including the Ministry of Industry and Information Technology issued the Innovation and Application Implementation Plan for General Aviation Equipment (2024-2030), which clearly supports the construction of a low-altitude production operation network to meet the needs of agricultural and industrial operations, and plans to form a trillion-level market scale for the general aviation industry by 2030. The official unveiling of the Low-Altitude Economy Development Department of the National Development and Reform Commission in December 2024 has further strengthened the national overall planning for the low-altitude economy, providing strong institutional guarantees for the large-scale application of agricultural drones and their industrial development.

The Ministry of Agriculture and Rural Affairs has continued to advance a full range of supportive measures including best practice testing, voluntary certification.

In January 2025, CAAC and the Ministry of Agriculture and Rural Affairs jointly issued the Interim Provisions on the Administration of Training for Agricultural Drone Operators, which standardized training standards while simplifying the training and certification process. The provisions allow agricultural drone producers to directly organize training or entrust relevant institutions, with the producers independently defining the qualifications of training instructors, and unifying the training syllabus, basic class hours, and certificate styles. This has made operator training more accessible and localized, and a large number of professional training bases have been built nationwide.

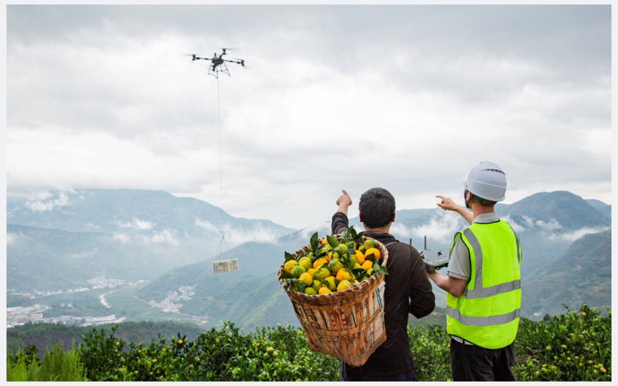
CAAC has issued supporting guidance materials for the airworthiness certification of agricultural unmanned aircraft, and optimized the certification process for agricultural drone models. By May 2025, mainstream agricultural drone models in the market have all obtained design authorization and production licenses, which has standardized the industry development while ensuring the quality of products on the market, and laid a solid foundation for the large-scale promotion and application of agricultural drones

2.9. International Organization

2.9.1 OCDE

In 2025-2026, the Organization for Economic Co-operation and Development (OECD) has focused on coordinating global regulatory standards for agricultural drones and promoting their sustainable application in precision agriculture. Through its Working Party on Pesticides (WPP) and the UAS/Drone Task Group, the OECD has issued guidelines for risk assessment of agricultural drone operations, clarifying expectations and uniform standards for evaluating human health and environmental risks associated with drone-based pesticide spraying. A dedicated international working group under the OECD is developing advanced models to streamline risk assessment processes, aiming to reduce regulatory fragmentation across countries, accelerate the commercialization of drone technologies, and support the adoption of green and sustainable agricultural practices. The OECD has also recognized Hungary's structured authorization pathway for drone-based plant protection as an innovative regulatory model, promoting its experience and framework to member countries to facilitate global coordination of agricultural drone policies.

2.9.2 FAO



The Food and Agriculture Organization of the United Nations (FAO) has integrated agricultural drones into its global precision agriculture and food security strategies in 2025-2026. As part of the World Program for the Census of Agriculture (WCA 2030), launched in December 2025, the FAO has included drone use as a key indicator in its data collection on smart farming technologies, aiming to establish a reliable baseline of drone adoption across global agricultural holdings and support policymakers in formulating targeted support measures. The FAO has also launched its first regional drone pilot training program in Oman in January 2026, focusing on drone application in desert locust control operations, while expanding training initiatives to other regions to enhance the technical capacity of farmers and agricultural operators in using drones for crop monitoring, pest detection, and precision spraying. Additionally, the FAO emphasizes the role of drones in optimizing resource use, reducing pesticide waste, and improving crop yields, aligning its drone-related initiatives with global sustainable agriculture and food security goals.

2.9.3 ISO

In 2025-2026, the International Organization for Standardization (ISO) has advanced several key standards and under-development initiatives focused on agricultural drones, aiming to establish global unified technical and operational benchmarks to support their safe, standardized, and sustainable application. A core focus is on aligning existing standards with the rapid development of agricultural drone technologies, particularly in spraying operations—ISO 16122, a key standard for spray application equipment, is widely referenced in regional regulatory frameworks (such as Switzerland's drone sprayer homologation requirements) to ensure the uniformity and safety of drone spraying systems, including criteria for transverse distribution of spray liquid (coefficient of variation < 15%) and drift control. ISO has also made progress in pilot certification standardization: ISO/IEC 22460-1:2025 was released to facilitate the issuance of a single document that serves as both a domestic and international drone remote pilot license, streamlining cross-border operation of agricultural drone pilots and promoting global mobility of professional operators.

Since 2025, more professional scholars and institutions have joined the testing and research of agricultural drones. Recent reports from international organizations (OECD, FAO, ISO), multinational agricultural enterprises (Bayer, Syngenta), national research institutions (USDA-ARS, Peking University), and multiple peer-reviewed journals, together with three core academic studies and field trial data from the China Aviation Plant Protection Alliance, mutually confirm the significant advantages of agricultural spraying drones in precision application, operational efficiency, economic benefits, and sustainability.

To provide credible, evidence-based support for agricultural industry strategic planning, policy formulation, and large-scale technology promotion, this chapter systematically analyzes peer-reviewed academic studies and field trials from multiple international sources. In addition to the three core peer-reviewed studies fully validated and the classified trial data from the China Aviation Plant Protection Alliance (2025), this chapter incorporates the latest findings from international organizations including the Organization for Economic Co-operation and Development (OECD), the Food and Agriculture Organization of the United Nations (FAO), the International Organization for Standardization (ISO), leading agrochemical companies Bayer Crop Science and Syngenta, the United States Department of Agriculture Agricultural Research Service (USDA-ARS), and the Peking University research team led by Professor Jikun Huang.

III. Agricultural Drone Tests And Technical Validation

3.1 Overview of Studies and International Reports

Three studies here shows the trend. The first study, “Agricultural Applications of Spraying Drones” by Liu and Ampatzidis (2025), published by the UF/IFAS Department of Agricultural and Biological Engineering, establishes a holistic technical and application framework for agricultural spraying drones. It covers nine core application categories: pesticide delivery (herbicides, insecticides, fungicides), fertilizer and nutrient application, irrigation, seeding, biological control, pollination, and aquaculture feeding. The study systematically compares drone-enabled operations with traditional farming methods and identifies critical enabling technologies including Real-Time Kinematic Global Positioning System (RTK-GPS), artificial intelligence (AI), multispectral imaging, and variable-rate application (VRA) systems.

The second study, “Increasing Large-Scale Agricultural Efficiency with the DJI AGRAS T25 Drone: A Case Study in Cilegon” by Furqon and colleagues (2026), provides empirical field validation through a controlled comparative experiment. The study was conducted on a 10-hectare eggplant plantation in Cilegon, Indonesia, over 120 days of full-growing-season monitoring. Five core indicators were measured: operational time efficiency, labor efficiency, water utilization efficiency, total operational costs, and crop yield. The experiment compared drone-based precision spraying and irrigation with traditional manual methods.

The third study, “The rapid global rise of agricultural drones: Evidence, drivers, impacts and an agenda for future research” by Belton and colleagues (2026)[1], published in Global Food Security (Volume 48, 100897), offers a macro-level analysis of global diffusion patterns, supply-side and demand-side drivers, and socio-economic impacts. The study traces the unique reverse diffusion trajectory of agricultural drones since 2020, highlighting how the technology spread from the Global South to major agricultural regions worldwide, in contrast to traditional agricultural mechanization which diffused from the Global North to the Global South.

In addition to these three core studies, this chapter incorporates several authoritative international reports and field trials published in 2025-2026:

OECD Series on Pesticides, No. 105 – “Report on the State of the Knowledge: Literature Review on Unmanned Aerial Spray Systems in Agriculture” (OECD Publishing, 2025). This comprehensive review, concludes that the use of Unmanned Aerial Spray Systems has the potential to improve the sustainability of pesticide use, with benefits including reductions in worker exposures compared to some current spraying equipment, better quality applications in difficult to access situations such as sloped vineyards, and the ability for greater use of precise zone or spot application. The report emphasizes that suitable data must be available to regulators to assess the nature of risks arising from UASS applications, particularly exposures resulting from work practices and spray drift, and how product efficacy might be impacted.

1 https://www.oecd-ilibrary.org/environment/report-on-the-state-of-the-knowledge-literature-review-on-unmanned-aerial-spray-systems-in-agriculture_9240f8eb-en

The Unmanned Aerial Pesticide Application System Task Force (UAPASTF), an industry task force created to address recommendations from the OECD Working Party on Pesticides drone/UAV state of the knowledge report, presented an update and data analysis on UAV field drift studies conducted in 2023 at a major scientific conference on August 20, 2025[2]. The UAPASTF, comprised of pesticide registrants working under the Federal Insecticide Fungicide and Rodenticide Act, has also developed Best Management Practices guidelines for safe and effective application of pesticides using unmanned aerial vehicles.

The International Organization for Standardization (ISO) published ISO 23117-2:2025, “Agricultural and forestry machinery — Unmanned aerial spraying systems — Part 2: Test methods to assess the horizontal transverse spray distribution” [3]. This document specifies field measurements of spray deposition to determine the quantity and distribution of spray in a plane surface area in the transverse direction to the flight direction, treated by specific Unmanned Agricultural Aerial Sprayers with downward directed application. These field measurements can be used to determine the effective swath width of UAAS. The standard was published in February 2025 and represents the first international standard specifically addressing test methods for horizontal transverse spray distribution from agricultural drones.

The FAO AGRIS database published a comprehensive review article titled “Potential and Pitfalls of Using Drone Technology in Sustainable Agriculture: An Overview” (Rishikesavan et al., 2026)[4]. The review concludes that drones have emerged as a promising technology in precision agriculture, supporting Sustainable Development Goals by enhancing sustainable farming practices, improving food security, and reducing environmental impact. The paper emphasizes the role of drones in precision spraying, promoting targeted interventions, and minimizing environmental impact compared to conventional methods.

The Peking University research team led by Professor Jikun Huang published a landmark study in the agricultural economics international journal Food Policy (Volume 139, 2026, 103035), titled “Refining pesticide use to reduce yield loss: How drone plant protection transforms smallholder pest management”[5]. Based on primary survey data from Chinese maize farmers, the study systematically examines the adoption and application effects of rapidly emerging agricultural drone plant protection services. The research found that farmers adoption decisions are influenced by both economic and health factors: compared to control groups not using drone plant protection services, users

2 https://acs.digitellinc.com/p/s/unmanned-aerial-pesticide-application-systems-task-force-analysis-of-drift-deposition-data-from-unmanned-aerial-vehicles-uavs-poster-board-489-633703
3 https://www.iso.org/standard/81053.html

experienced a 29 percent reduction in pesticide application costs (excluding pesticide itself), a 90 percent reduction in pesticide contact time, and an 83 percent lower incidence of self-reported pesticide-related physical discomfort symptoms. Two-way fixed effects models showed that drone plant protection service users increased spraying frequency by 33 percent, concentrated in the post-tasseling growth stage, while pesticide usage per application changed little. Damage control production function estimates indicated that these behavioral adjustments reduced yield losses by 4.6 percent, and the combination of cost reduction and yield increase raised farmer incomes. The study confirmed that digital technology can simultaneously reduce health risks and increase yields, while also noting that policy interventions are needed to overcome institutional and technical barriers to realize environmental benefits.

4 https://agris.fao.org/search/en/records/690c809ae36ca62843605426
5 https://ccap.pku.edu.cn/zxxw/1185043c92974202b0b656e50e2619f3.htm

3.2 Technical Framework and Precision Benefits

Liu and Ampatzidis (2025) conduct a comparative assessment between drone-enabled operations and traditional farming methods, highlighting superiorities in precision, operational efficiency, resource conservation, and environmental sustainability. The study defines a nine-category core application system for spraying drones, breaking the single-function perception of pesticide spraying. Quantitative data from the study verifies significant efficiency and conservation benefits: targeted drone spraying reduces herbicide usage by up to 30 percent compared with traditional spraying; variable-rate fertilization improves nutrient use efficiency by 15 to 25 percent; drone seeding achieves 75.64 percent rice plant uniformity, far exceeding the 54.73 percent rate of manual seeding.

The study also identifies critical supporting technologies. RTK-GPS enables centimeter-level precise positioning, allowing drones to follow complex field boundaries and avoid overlaps or skips. Artificial intelligence processes multispectral images to generate prescription maps, identifying areas of nutrient deficiency, pest pressure, or water stress. Variable-rate application systems then adjust spray or spread rates in real time, applying inputs only where needed. Multispectral imaging, typically using near-infrared and red-edge bands, allows calculation of vegetation indices such as NDVI (Normalized Difference Vegetation Index) to assess crop health.

Additionally, the study objectively outlines the technology's core advantages and limitations. Advantages include terrain adaptability (drones can operate on steep slopes, wet fields, and terraced orchards where tractors cannot go), labor cost reduction (one to two operators can do the work of five to ten manual laborers), operator safety improvement (no direct exposure to hazardous chemicals), and environmental sustainability (reduced runoff and soil compaction). Limitations include high initial investment costs (drone plus sensor payloads typically range from 15,000 to 25,000 USD), limited payload capacity (20 to 50 kilograms depending on model) and flight time (15 to 25 minutes per battery charge), weather dependence (operations are difficult in wind speeds above 5 meters per second or during rain), and regulatory compliance requirements (licensing, no-fly zones, and pesticide application permits).

3.3 Field Validation on Eggplant Plantation

Furqon and colleagues (2026) conducted a controlled experiment on a 10-hectare eggplant plantation in Cilegon, Indonesia, comparing DJI AGRAS T25 precision spraying drones with traditional manual irrigation and spraying methods. The study measured five core indicators over 120 days of full-growing-season monitoring, including the wet season and dry season transitions typical of tropical climates.

The results demonstrate that the drone solution achieves 85 percent time savings per operation. Traditional manual spraying required approximately 8 person-hours per hectare, whereas drone operations reduced this to 1.2 person-hours per hectare. Labor input was reduced by 95 percent: from 20 person-days per hectare (including mixing, carrying water, and manual spraying) to just 1 person-day per hectare (one pilot and one ground assistant). Programmed uniform irrigation reduced water consumption by 42.1 percent per hectare, from approximately 60,000 liters per hectare using manual hose and furrow irrigation to 34,740 liters per hectare using drone-based precision spraying.

Total operational costs decreased by 55.2 percent per hectare, even after accounting for equipment depreciation, battery replacement, and maintenance. The cost per hectare for traditional methods was approximately 1,200 USD (including labor, water pumping, chemical inputs, and equipment amortization), while drone operations cost approximately 537 USD per hectare. Statistical testing (t-test, $p > 0.05$) showed no significant difference in crop yield

between the drone and traditional groups: drone-treated plots yielded 32.5 tons per hectare, while traditional plots yielded 33.1 tons per hectare. This proves that agricultural drones maintain stable production capacity while drastically improving resource efficiency and economic benefits.

The study also highlights practical bottlenecks for scaled promotion. Upfront equipment costs for the drone, batteries, chargers, and spare parts amount to approximately 15,000 to 20,000 USD, which is prohibitive for many smallholders without access to financing or service cooperatives. Professional operator training requires two to four weeks of theoretical and practical instruction, and certification is often mandatory. Battery performance limitations include rapid degradation in tropical heat (high temperatures above 35 degrees Celsius reduce battery cycle life by up to 30 percent) and the need for multiple battery sets to sustain full-day operations.

3.4 Global Diffusion Patterns and Socio-Economic Impacts

Belton and colleagues (2026) fill the gap of industrial diffusion and socio-economic impact research in the agricultural drone field. The study traces the unique reverse diffusion trajectory of agricultural drones since 2020. Unlike traditional agricultural mechanization that spread from the Global North (North America, Europe, Japan) to the Global South, drone technology has rapidly expanded from the Global South (Asia, particularly China and Southeast Asia, and South America) to major agricultural regions worldwide. The year 2020 marked a critical tipping point via the launch of 20- to 30-kilogram large-payload models. After 2022, 50- to 100-kilogram ultra-large-payload models further drove global adoption.

The study dissects dual driving forces for global diffusion.

On the supply side, technological spillovers from the electric vehicle industry have lowered the costs of batteries (lithium-ion cells) and LiDAR sensors, making drones more affordable. The rise of agricultural drone outsourcing services (third-party operators who charge per hectare) has reduced the adoption threshold for smallholders who cannot afford to purchase their own drones. On the demand side, global agricultural labor shortages (driven by rural-to-urban migration and aging farming populations) and growing demand for sustainable intensification (producing more food on the same land with fewer inputs) have accelerated adoption.

Belton and colleagues also summarize dual impacts of drone technology. Positive contributions include bridging the global agricultural technology gap (smallholders in Africa and South Asia now have access to precision spraying that was previously only available to large farms in rich countries), promoting sustainable intensification (higher yields with less chemical runoff), reducing chemical hazards for farmers and the environment, and boosting farm incomes (net margins increase by 30 to 50 percent due to input savings and yield stability). Potential challenges include spray drift risks to non-target crops and pollinators, low-skilled labor displacement (manual sprayers may lose income if not retrained), data privacy concerns (farm mapping data could be exploited by agribusiness or governments), and technological sovereignty dependence (most drones are manufactured in a few countries, creating supply chain vulnerabilities). The study points out current academic research gaps and proposes a transdisciplinary future research agenda focused on equity, sustainability, and global governance.

3.5 Bayer Crop Science Field Trials and Agronomic Validation

Bayer Crop Science[6] has actively integrated drone technology into its agronomic research and crop protection programs. In 2025, Bayer technical product lead Adam Pfeffer conducted field trials demonstrating the effectiveness of drones for early-season sulphur application on winter wheat in Sparta, Ontario, Canada. In 2024, Pfeffer worked with drone application service providers to apply AMS (ammonium sulfate) at 100 pounds per acre (approximately 112 kg per hectare) on his winter wheat fields. In spring 2025, the same approach applied AMS at 80 pounds per acre (approximately 90 kg per hectare) on March 18. With custom application, Pfeffer noted that the ability to apply sulphur early without tracking the field is a great benefit. With two passes for double coverage, he reported a beautiful spread pattern and no visible streaking. Pfeffer has been impressed with the drone improvements and efficiency gains since he first worked with drone application in 2021. At that time, the service provider was flying a DJI T10 drone with capacity for about 18 pounds (8.2 kg) of product. In 2025, the company is using a DJI T50 drone that can fly with about 88 pounds (40 kg) of product. In 2021, they spread 4,000 pounds (about 1,814 kg) in about 15 hours. In 2025, they did 6,000 pounds (about 2,722 kg) in the same field in six hours, representing a dramatic increase in capacity.

In Brazil, Bayer has supported the resumption of cotton cultivation in northern Minas Gerais through the donation of seeds and drones, strengthening family farming and expanding access to technology in Catuti. Drone technology has enabled a 96 percent reduction in spraying liquid while maintaining effective control of the boll weevil and reducing the risk of contamination. This case demonstrates how drone technology can dramatically reduce input volumes while maintaining or improving pest control efficacy[7].

Bayer AG is also investing in next-generation formulation science specifically designed for drone application. Dr. Malcolm Faers (Bayer AG) presented research titled “Applying colloid science to design next generation crop protection formulations for application by drones” at the IQAC Seminar on July 4, 2025, indicating that major agrochemical companies are actively developing formulations optimized for ultra-low-volume drone spraying[8].

6 https://www.realagriculture.com/wheat-school/wheat-school-drones-deliver-early-season-sulphur-for-winter-wheat/
7 https://revistacultivar.com/noticias/bayer-apoia-retomada-do-cultivo-de-algodao-no-norte-de-minas
8 https://www.iqac.csic.es/iqac-seminar-by-malcolm-faers/

3.6 Syngenta Field Demonstrations and Technical Guidance

Syngenta has developed an ultraviolet tracer tool to evaluate agricultural application quality and offer accurate recommendations, announced in October 2025[9]. This tool evaluates multiple aspects of application quality, including coverage and uniformity, across different technologies including drones, ground sprayers, and aircraft, and application types (conventional or selective), correlating the results with the final effectiveness of the applications on the crop.

Neill Newton, global drone application technical manager at Syngenta, has emphasized that the greatest challenge for effectively using drones for spraying is lack of standardization. While ground spray rigs and manned aircraft have a host of international and US standards of operation providing growers with a thorough understanding of how the machines are built and how to operate them to get predictable results, there are many variables for drone options with few instructions on how to effectively use them. At Syngenta, the focus is on understanding how crop protection products perform using drone technology so that customers can use drones in the safest, most effective, and most efficient ways possible[10]. According to Newton, the most common products being applied by drones in cropping situations are fungicides.

Syngenta trials in Germany have tested spot spraying in sugar beet from prescription maps generated by drone images, and in Ireland, a Syngenta study employed an on-boom crop scanner with real-time spot spraying to control weeds in grassland, demonstrating the evolution toward precision spot spraying rather than spread applications.

9 https://news.agropages.com/News/NewsDetail---52198.htm
10 https://syngentathrive.com/articles/tech-research/how-to-get-the-most-from-spray-drones/

3.7 Corteva Field Trial

In 2025, a field trial conducted by a major agricultural company expanded spray drone testing from small research plots to a full-scale farm setting in Canada, using a DJI Agras T50 precision spray drone to assess the performance of crop health products applied by drones compared to conventional methods. The trial aims to develop research methodology for small-plot drone applications and to determine optimal water volumes, droplet sizes, and flight altitudes.

3.8 BASF Agricultural Drone Project

In 2025, a global agricultural solutions company updated its digital farming platform with a new version of digital weed mapping technology that uses drones and algorithms to map infestation pressure and generate precise application prescriptions. The new technology detects weeds on corn and maintains readings on crops such as soybeans, corn, and peanuts, reportedly saving up to 60 percent on inputs, water, and time. Also in 2025, the company participated in the development of Best Management Practices guidance for safe and effective UAV-based spraying of crop protection products through the Unmanned Aerial Pesticide Application System Task Force, in response to recommendations from the OECD Working Party on Pesticides drone/UAV state of the knowledge report. In 2025, the company also launched a program encouraging growers to explore new spray patterns, rates, or application methods including aerial or drone spraying, as part of a broader initiative to improve crop yields through innovative application techniques.

3.9 FAO Drone Technology Initiatives and Food Security Applications

The Food and Agriculture Organization of the United Nations has been actively promoting drone technology for plant protection and food security applications. In January 2026, FAO handed over advanced drones for surveillance and pesticide spraying to the Plant Protection Agency of Mongolia under the Technical Cooperation Program project Strengthening the Capacity of the Newly Established Plant Protection Agency (TCP/MON/4003), to be implemented from 2025 to 2027. The drones, equipped with multispectral and thermal sensors and NDVI technology, will be used in crop fields, pastures, forests, and haymaking areas to enable early detection of pest outbreaks, real-time data collection, precise identification of infestation hotspots, and the controlled application of chemical and biological agents only where necessary. The FAO report[11] specifically quantifies that drone-based spraying reduces pesticide use by 30 to 50 percent and minimizes negative impacts on the environment. Compared to tractors and manual sprayers, drone-based spraying is faster, more cost-effective, and eliminates crop damage caused by machinery. In addition, drones can operate efficiently in sloped terrain and areas inaccessible to conventional agricultural equipment, while reducing health risks to operators.

In February 2026, FAO launched the first regional training program for drone pilots dedicated to desert locust survey and control operations in North Africa and the Middle East. Working with the Desert Locust Control Commission in the Central Region (member countries: Yemen, Sudan, Eritrea, Ethiopia, and Somalia) and the Desert Locust Control Commission in the Western Region (comprising Algeria, Burkina Faso, Chad, Gambia, Libya, Mali, Mauritania, Morocco, Niger, Senegal, and Tunisia), as well as the Ministry of Agriculture, Fisheries and Water Resources of the Sultanate of Oman, the program provided advanced technical and field-based instruction over five days, including practical demonstrations on flight and ULV spraying mechanisms and the use of sensitive cards to analyze droplet deposition accuracy. The training also included hands-on use of Ground Control Station software, automated and manual flight-path planning including zigzag and corridor patterns, as well as calibration, filling, and cleaning procedures for the Micron U16 spraying drone. Dr. Mamoon Al Sarai Al Alawi, Executive Secretary of the Desert Locust Control Commission in the Central Region, stated that this training marks a critical step in moving from pilot initiatives to full operational integration of drone technology in desert locust management, empowering national teams with advanced technical skills, enhancing operational safety, and ensuring the effective and sustainable use of these tools in protecting crops, livelihoods, and food security[12].

The FAO AGRIS database review (Rishikesavan et al., 2026) further emphasizes that drones play a vital role in weed management and crop health assessment, and that data collected by drones is essential for acquiring the necessary information for decision-making concerning irrigation, fertilization, and overall farm management. However, the review also identifies ongoing challenges including batteries and their life, flight time, and connectivity issues particularly in remote areas, as well as legal challenges whereby regulatory frameworks and restrictions in different regions affect the operation of drones. With the help of continuous research and development initiatives, these challenges could be solved, and the fullest potential of drones can be tapped for achieving sustainable agriculture[13].

11 https://www.fao.org/mongolia/news/detail/fao-hands-over-advanced-drone-technology-to-the-plant-protection-agency-of-mongolia/

3.10 China Aviation Plant Protection Alliance 2025 Trial Data by Drone Model and Crop

The China Aviation Plant Protection Alliance (2025) conducted classified trials across multiple provinces, sorting performance data by drone model and crop type. The trials covered grain crops (wheat, rice, corn, soybean), cash crops (rape, citrus, apple, pear), and vegetables (eggplant). All data presented below are exclusive to this source.

For wheat head-stage pest and disease control (targeting scab, powdery mildew, and aphids), the DJI AGRAS T30 and T70 models were tested. The trials achieved 25 to 30 percent pesticide reduction compared to spraying while maintaining 85 to 90 percent comprehensive control efficacy. The optimal operational parameters included an application rate of 225 to 375 liters per hectare, droplet size of 250 to 400 um for herbicides or 100 to 300 um for insecticides and fungicides, flight speed of 20 to 25 kilometers per hour, route spacing of 5.5 to 9 meters depending on the model, and height above the crop of 2.2 to 3.5 meters.

For rice weed control and planthopper prevention, the DJI AGRAS T25 and T30 models were used. Water consumption was measured at 225 to 337.5 liters per hectare, representing a water saving of approximately 95 percent compared to traditional flooding or manual backpack spraying which typically consumes 400 to 500 liters per hectare. The trials also validated drone seeding for rice, achieving a plant uniformity of 75.64 percent, significantly higher than the 54.73 percent uniformity of manual seeding.

For corn mid-late pest control and trichogramma release (biological control using parasitic wasps), large-payload UAVs were found most suitable. The trials solved the long-standing problem of spraying high-stalk crops (corn plants taller than 2 meters) where tractors cannot enter after the V8 growth stage without damaging plants. Drone operations prevented the 5.3 percent crop damage typically caused by tractor wheels navigating between rows. Based on 2023 sales prices and yields, this damage prevention translated to a yield loss avoidance of approximately 47.7 to 63.6 kilograms per hectare per season.

For soybean pod borer and leaf disease control (rust, frogeye leaf spot), drone spraying improved pod fullness and reduced pod damage rate by over 60 percent. The DJI AGRAS T70 and T100 models achieved an application rate of 225 to 375 liters per hectare with droplet size of 100 to 300 um, flight speed of 20 to 25 kilometers per hour, route spacing of 6 to 8 meters, and height above the crop of 2.5 to 3.5 meters.

For rape sclerotinia and aphid control, the DJI AGRAS T70 and T100 models demonstrated no damage to plants and flowers, a significant advantage over tractor-based spraying which inevitably crushes some plants. Operation efficiency reached 4.7 to 6 hectares per hour

. Recommended parameters included an application rate of 225 to 375 liters per hectare for herbicides and 150 to 300 liters per hectare for insecticides and fungicides.

For citrus psylla and red spider control, with the objective of blocking disease transmission (a devastating bacterial disease spread by psyllids), the DJI AGRAS T30 model increased agent utilization by 30 percent compared to traditional manual spraying. The downwash effect lifted leaves and allowed droplets to reach the undersides where psyllids reside, which is impossible with ground-based sprayers. The trials confirmed suitability for mountain orchards with slopes up to 30 degrees.

For apple and pear orchard unified prevention, drone spraying achieved full coverage of leaves and fruits with a 20 percent pesticide reduction. The DJI AGRAS T40 and T50 models operated at an application rate of 225 to 375 liters per hectare, droplet size of 100 to 300 um, flight speed of 20 to 25 kilometers per hour, route spacing of 4 to 5 meters, and height above the crop of 3 to 4 meters.

For eggplant large-scale precision irrigation, the DJI AGRAS T25 was validated on the 10-hectare plantation as detailed in the Furqon et al. (2026) study. The trials confirmed 85 percent time savings, 95 percent labor reduction, 42.1 percent water savings, and 55.2 percent lower total operating costs, with no statistically significant difference in crop yield compared to traditional methods.

12 https://dronenews.africa/post.php?id=9412

13 https://agris.fao.org/search/en/records/690c809ae36ca62843605426

3.11 Integrated Conclusions andRecommendations

The three fully validated peer-reviewed studies, together with the OECD state of knowledge report, the FAO Mongolia project, the Bayer and Syngenta field trials, the ISO 23117-2:2025 standard, the USDA-ARS drift study, the Peking University smallholder impact study, the DOAJ peer-reviewed precision spraying system evaluation, and the China Aviation Plant Protection Alliance (2025) trial data, collectively verify that agricultural spraying drones are a transformative core technology of modern precision and sustainable agriculture.

Technically, the integration of centimeter-level positioning (RTK-GPS), intelligent sensing (AI and multispectral imaging), and variable-rate application breaks through the precision bottleneck of conventional spreading. The OECD report confirms that appropriately regulated use of drone technology could provide reductions in worker exposures, better quality applications in difficult to access situations, and the ability for greater use of precise zone or spot application. ISO 23117-2:2025 now provides an international standard for measuring horizontal transverse spray distribution, enabling regulatory harmonization. The DOAJ peer-reviewed study confirms that variable-rate precision spraying systems show strong potential to optimize inputs and yields, though response delays and path tracking errors require further refinement.

Economically, drones resolve widespread global agricultural labor shortages, slash labor and operational costs. The Peking University study provides rigorous evidence that smallholder farmers using drone plant protection services experience a 29 percent reduction in pesticide application costs (excluding pesticide cost), a 90 percent reduction in pesticide contact time, and an 83 percent lower incidence of self-reported pesticide-related symptoms, with yield losses reduced by 4.6 percent and incomes increased. The FAO Mongolia project confirms that drone-based spraying reduces pesticide use by 30 to 50 percent compared to tractors and manual sprayers, is faster and more cost-effective, eliminates crop damage caused by machinery, and can operate efficiently in sloped terrain and areas inaccessible to conventional equipment while reducing health risks to operators.

In terms of sustainability, the technology advances green agricultural transformation, reduces chemical exposure risks for farmers, and narrows the global divide in access to advanced agricultural tools. The FAO desert locust training program demonstrates the transition from pilot initiatives to full operational integration of drone technology for food security protection. Bayer Crop Science field trials show that drone technology can enable a 96 percent reduction in spraying liquid while maintaining effective pest control. Syngenta has demonstrated ultra-low-volume spraying that significantly optimizes crop protection product use and reduces water consumption while extending the spraying window under difficult weather conditions.

For large-scale industrial popularization, key actionable

priorities include: establishing standardized agricultural drone outsourcing service systems to lower upfront investment thresholds for smallholders, as demonstrated by the FAO Mongolia project and the Peking University findings on service adoption; formulating unified operational specifications and regulatory compliance frameworks, building on ISO 23117-2:2025 and OECD guidance; upgrading core components to extend battery life and improve weather adaptability, as identified in the FAO AGRIS review; and rolling out targeted operator training programs with certification pathways, as exemplified by the FAO desert locust drone pilot training program.

With continuous technological iteration (larger payloads, longer flight times, better autonomous obstacle avoidance, and formulations optimized for drone application as pursued by Bayer AG), supportive industrial policies, and international standardization (ISO 23117-2:2025), agricultural drones will evolve from a supplementary precision tool to foundational equipment for global sustainable agriculture. They will play an irreplaceable role in ensuring food security, improving agricultural productivity, reducing pesticide exposure risks for farmers, and promoting low-carbon ecological farming.

IV. Drone Application

The application of drones extends beyond field crops to include orchard management; it encompasses not only spraying operations but also spreading tasks. New scenarios and innovative application methods are providing more farmers with cost-effective management solutions.

4.1 Spraying Application

4.1.1 Soybean

The Global Importance of Soybean

Soybean is one of the world's most essential agricultural commodities. Originating in East Asia, it now underpins global food security, animal feed production, and biofuel industries. In 2024, global soybean production exceeded 390 million metric tons, making it the fourth-largest crop by volume. Its high protein content feeds livestock and aquaculture, its oil is used for cooking and industrial purposes, and its versatility has made it a strategic crop for economies worldwide.

Major soybean producers include the United States (Midwest), Brazil, Argentina, China, and India. Among these, Brazil has risen to become the world's largest soybean exporter, accounting for nearly half of all international trade.

Better Growth, Better Life

Soybean in Brazil – A National Treasure

IIn Brazil, soybean is far more than a crop – it is an economic engine. In the 2024/25 season, Brazil planted over 45 million hectares of soybeans, producing an estimated 160 million tons. The main producing states are Mato Grosso, Paraná, Rio Grande do Sul, Goiás, and Mato Grosso do Sul. Soybean

generates billions of dollars in export revenue, supports millions of jobs, and drives agtech innovation.

However, Brazilian farmers face serious challenges: tropical pests (stink bugs, caterpillars, Asian rust), unpredictable rainfall, and high operational costs. Traditional tractor-based spraying also causes *amassamento* – plant crushing from wheel tracks – which, according to EMBRAPA, reduces yields by 4-7%. These problems demand a smarter, more agile solution.

Agricultural drones have transformed soybean production. Unlike tractors or crop-dusting aircraft, drones fly over the crop without touching it, eliminating trampling losses. They can spray just hours after rain, when fields are too muddy for heavy machinery. Drones also enable precision agriculture: variable-rate application (VRA) based on weed maps reduces chemical use, and the downwash from rotors pushes droplets deep into the canopy.rainfall, and high operational costs. Traditional tractor-based spraying also

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Key contributions of modern agricultural drones (especially DJI Agras T70P and T100) include:

Zero crop damage – No wheel tracks, no crushed plants.

● **Timeliness** – Spray within 1-2 hours after rainfall, capturing critical pest windows.

● **Water savings** – Use only 10-20 litres per hectare versus 400-500 litres with tractors.

● **Labor reduction** – One or two operators cover hundreds of hectares daily.

● **Operator safety** – No direct contact with pesticides.

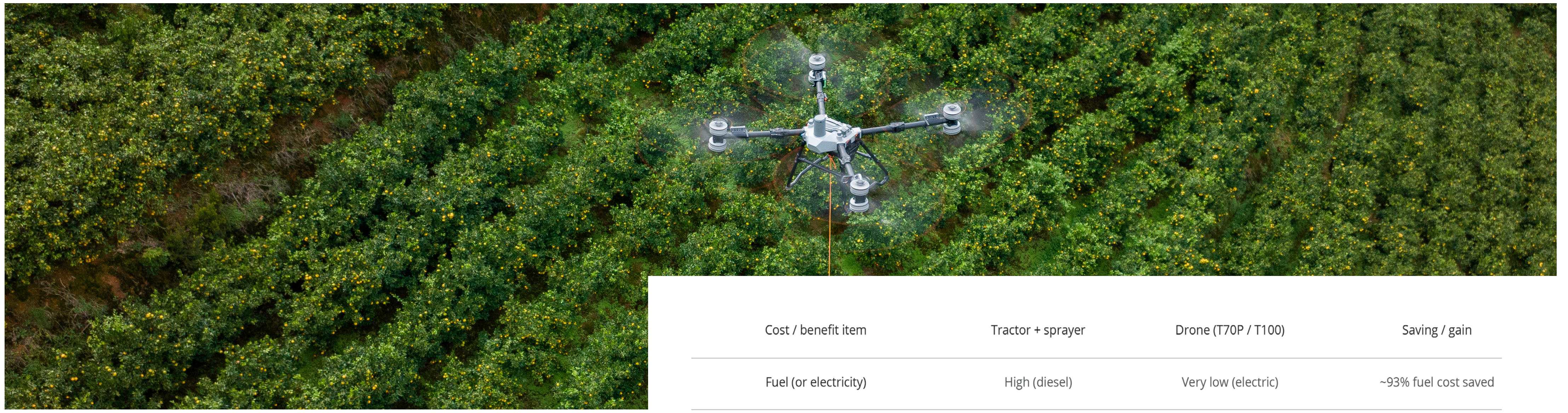
● **Precision** – RTK navigation and spot spraying save up to 35% of herbicides.

Agricultural Drone Industry Insight Report

Best Practice: From Tractors to Drones in Caiçara, Rio Grande do Sul

A soybean grower in Caiçara, in the northwestern part of Rio Grande do Sul, managed a 17-hectare farm. For years, the farmer relied on a pull-type tractor sprayer. The process was slow, expensive, and damaging. After each rain, the farmer had to wait one to two days for the soil to dry – often missing the ideal moment to spray fungicide against Asian rust. Worse, the tractor's wheels crushed an estimated 5% of the plants, directly reducing income.

In the 2024/25 growing season, the farmer decided to innovate. A DJI Agras T70P was purchased for precise operations (herbicides, desiccants) and a DJI Agras T100 for high-volume coverage (fungicides, insecticides). The results exceeded all expectations.



Challenges Before Drones

- **Plant trampling (*amassamento*)** – 5% yield loss = 180 kg/ha.
- **Delayed post-rain application** – waiting 1-2 days allowed rust to develop, risking 20% loss.
- **High water consumption** – 400-500 L/ha, increasing logistics cost.
- **Labour intensity** – 2-5 people required, with direct chemical exposure.
- **Terrain limits** – Slopes and wet areas led to uneven coverage.

The farmer designed a season-long spray program following EMBRAPA's recommended growth stages. During the early vegetative stages (V1 to V3), a single herbicide application was made using the T70P. From V4 to R1, which includes flowering and early pod set, two or three combined sprays of insecticide, fungicide and foliar fertiliser were applied, again with the T70P for its precision. During the reproductive stages R1 to R3, one or two fungicide plus insecticide treatments were carried out, and this work shifted to the larger T100 for higher efficiency. The same T100 was used for one or two fungicide applications during pod filling (R4 to R6). Finally, just before harvest, a single desiccant spray was applied with the T70P if needed. Both drones operated with RTK centimeter-level navigation, terrain-following radar, and dual-atomisation centrifugal nozzles.

Table 1: Operational Parameters for T70P and T100 in Soybean

Drone mode	(L/ha)	(μm)	(km/h)	(m)	(m)	(ha, 7h)
T70P – Herbicide / Desiccant	15–20	300–450	22–26	6.5–7.5	3.0–3.5	240
T70P – Fungicide / Insecticide	10–12	100–250	24–28	8–9	3.0–3.5	260
T100 – Fungicide / Insecticide	10–15	200–350	26–32	9–10	3.2–3.8	280
T100 – Desiccant (pre-harvest)	12–18	100–300	24–30	8–9	3.5–4.0	270

All operations are fully automatic with RTK. The T100's larger tank (70 L spray / 80 kg spread) further reduces refill stops.

After the 2024/25 harvest, the farmer compared the drone-managed fields with previous tractor-based seasons. The improvements were clear.

Cost / benefit item	Tractor + sprayer	Drone (T70P / T100)	Saving / gain
Fuel (or electricity)	High (diesel)	Very low (electric)	~93% fuel cost saved
Water consumption	400–500 L	12 L	97% water saved
Labour cost (per day)	R$ 250 (2–5 people)	R$ 80 (1–2 people)	68% lower
Machinery maintenance	R$ 40 / ha	R$ 6 / ha	85% lower
Chemical use (herbicide)	100% (blanket spray)	65% (spot spraying)	35% herbicide saved
Yield loss from trampling	5% (180 kg/ha)	0%	+180 kg/ha = +3 bags
Extra revenue from avoided trampling	–	R$ 360 / ha	+R$ 360 / ha
Total operational cost reduction	Baseline	~40% lower	R$ 210 / ha saved

Soybean price assumed at R$ 120 per 60-kg bag. Numbers based on EMBRAPA and field records.

Other Non-Table Benefits

- **Timeliness:** Drones sprayed within two hours after rain; tractors needed one to two days. The grower prevented an Asian rust outbreak that affected neighbouring farms using ground equipment.
- **Safety:** Direct pesticide contact was completely eliminated for the farm workers – no more mixing chemicals by hand or walking through treated fields.
- **Environment:** No soil compaction, no diesel spillage, and the carbon footprint was reduced by approximately 2.4 tons of CO_2 over the season for the 17-hectare area.

Soybean is the lifeblood of Brazilian agribusiness, and agricultural drones have proven to be the ideal partner for modern, sustainable production. The DJI Agras T70P and T100 deliver unmatched precision, speed, and safety. They eliminate the ancient problem of crop trampling, slash water and chemical use, and allow farmers to act the moment conditions are right – not when the soil finally dries.

For any soybean farmer still relying on tractor-mounted sprayers, the drone revolution is already here, and it pays for itself. The experience in Caiçara clearly demonstrates that adopting drone technology is not just an upgrade – it is a competitive necessity.

4.1.2 Sugarcane

Sugarcane (Saccharum) is one of the world's most vital cash crops. It provides approximately 80% of global sugar production and is the primary feedstock for bioethanol, a renewable fuel that reduces greenhouse gas emissions. In 2024, global sugarcane production exceeded 1.9 billion metric tons, with the top producers being Brazil, India, China, Thailand, and Pakistan. The crop's versatility extends to molasses, rum, bagasse (used for electricity generation and paper), and bioplastics. For many tropical nations, sugarcane is not only a source of food and energy but also a pillar of rural employment and industrial development.

Brazil is the world's largest sugarcane producer and exporter. In the 2024/25 season, the country harvested over 700 million tons from approximately 8.5 million hectares. The main producing regions are the CentreSouth and the Northeast. Sugarcane supports a complex value chain: from sugar mills and ethanol distilleries to cogeneration of electricity. Brazil's flexfuel fleet runs largely on hydrous ethanol, making sugarcane a cornerstone of the nation's energy security.

However, sugarcane farming faces severe challenges. The crop is perennial (harvested once or twice a year over several ratoon cycles), and traditional tractorbased spraying causes significant plant crushing, soil compaction, and operational delays after rain. Pests such as the sugarcane borerand diseases like orange rust and smut require timely fungicide and insecticide applications. The tall, dense canopy also makes uniform spray coverage difficult with ground equipment.

Agricultural drones have revolutionised sugarcane management. Unlike tractors or selfpropelled sprayers, drones fly above the crop, causing zero trampling or soil compaction. They can operate immediately after rainfall, when fields are too wet for heavy machinery. The powerful downwash from drone propellers pushes droplets deep into the dense sugarcane canopy, improving pest and disease control. Drones also enable spot spraying of weeds and early detection of stressed areas via multispectral mapping.

Key contributions of modern agricultural drones (especially DJI Agras T70P and T100) include

- **Zero crop damage** – No wheel tracks, no crushed stalks, no soil compaction.
- **Timeliness** – Spray within 12 hours after rain, capturing critical application windows.
- **Water savings** – Use only 1015 litres per hectare versus 400500 litres with tractors.
- **Labour reduction** – One or two operators cover hundreds of hectares daily.
- **Operator safety** – No direct contact with pesticides or ripeners.
- **Precision** – RTK navigation and variablerate application save up to 35% of herbicides.

Best Practice: From Tractors to Drones in Espírito Santo, Brazil

A sugarcane grower in Espírito Santo (ES) manages 700 hectares of land, cultivating two sugarcane harvests and one soybean crop per year. Until 2023, the farmer relied entirely on groundbased sprayers (tractormounted boom sprayers). The process was costly, inefficient, and damaging. After each rain, operations had to be suspended for one to two days until the soil dried. Tractor wheels crushed many young shoots, reduced ratoon regrowth, and caused uneven chemical distribution across the undulating terrain typical of ES.

In 2023, the farmer began testing drone spraying and quickly saw superior results. By 2024, the operation had been largely converted to drones, using a DJI Agras T70P for smaller or precisioncritical blocks and a DJI Agras T100 for the majority of the 700hectare area.

Challenges Before Drones

Challenges Before Drones

- **Crop trampling and soil compaction** – Reduced ratoon yields and increased replanting costs.
- **Delayed postrain application** – Onetotwo day waiting periods allowed pests and diseases to spread, especially sugarcane borer and rust.
- **High water consumption** – 400500 L/ha, requiring frequent refill trips.
- **Labour intensity** – Three to four people per sprayer (driver, mixer, water tender).
- **Terrain limitations** – Slopes, wet spots, and irregular field shapes led to skips and overlaps.

The Drone Solution – T70P & T100

The farmer adopted a seasonlong spray programme aligned with the four main growth stages of sugarcane: establishment, tillering, grand growth, and maturation.

During the establishment phase (after planting or ratoon cutting), a single combined spray of herbicide, fungicide and insecticide was applied using the T70P to ensure clean, healthy regrowth. In the tillering phase, one or two applications of insecticide, fungicide and foliar fertiliser were made – again with the T70P for precision. As the cane entered the grand growth phase (rapid stalk elongation), two or three applications of fungicide and insecticide were carried out, and this work shifted to the larger T100 for higher efficiency and coverage. Finally, at maturation, a single application of chemical ripeners (maturadores) was applied using the T100 to synchronise sugar content and harvest timing. Both drones operated with RTK centimetrelevel navigation, terrainfollowing radar, and dualatomisation centrifugal nozzles. Before each season, the grower used a DJI M3M multispectral drone to map weed pressure and crop vigour, enabling variablerate herbicide application.

Table 1: Operational Parameters for T70P and T100 in Sugarcane

Operation type / Drone model	Application rate (L/ha)	Droplet size (μm)	Flight speed (km/h)	Route spacing (m)	Height above crop (m)	Daily coverage (ha, 7h)
T70P – Herbicide (establishment)	10–15	180–250	36–50	9–11	4–6	240
T70P – Insecticide / Fungicide / Foliar	10–15	180–250	50–72	11–13	4–6	260
T100 – Insecticide / Fungicide / Foliar	10–15	180–250	50–72	11–13	4–6	280
T100 – Ripener (maturador)	10–15	180–250	50–72	11–13	4–6	280

After one full season of droneonly spraying (over 700 hectares), the grower compared costs and yields with the previous tractorbased method. The economic advantages were compelling.

Table 2: Economic Comparison – Traditional Tractor vs. Drone (T70P/T100) per Hectare

Cost / benefit item	Tractor + boom sprayer	Drone (T70P / T100)	Saving / gain
Fuel (or electricity)	High (diesel)	Very low (electric)	~90% fuel cost saved
Water consumption	400–500 L	12 L	97% water saved
Labour cost (per day)	R$ 300 (3–4 people)	R$ 100 (1–2 people)	67% lower
Machinery maintenance	R$ 35 / ha	R$ 6 / ha	83% lower
Chemical use (herbicide)	100% (blanket spray)	65% (spot spraying via M3M maps)	35% herbicide saved
Yield loss from trampling	6–8% (estimated 6 tons/ha loss)	0%	+6 tons/ha
Extra revenue from avoided trampling	–	R$ 540 / ha (at R$ 90/ton)	+R$ 540 / ha
Total operational cost reduction	Baseline	~45% lower	R$ 280 / ha saved

Sugarcane yield assumed at 80 tons/ha, price R$ 90/ton. Numbers based on grower records and EMBRAPA trampling studies.

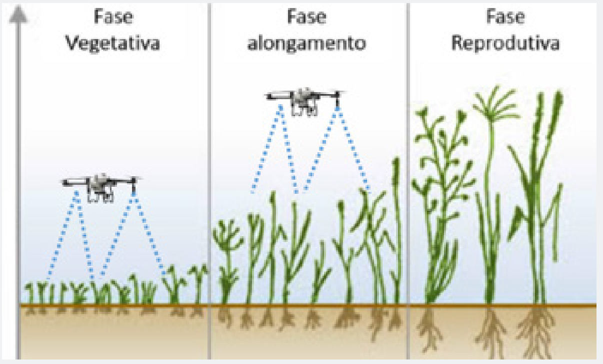
4.2 Whole Cycle Application (Spreading and Spraying)

4.2.1 Pasture Seeding and Spraying

Pasture and forage crops are the foundation of the world's livestock industry. They provide feed for cattle, sheep, goats, and other ruminants, supporting meat, milk, and wool production. Globally, permanent meadows and pastures cover approximately 3.3 billion hectares – more than half of the world's agricultural land. In countries like Brazil, Australia, the United States, and Argentina, wellmanaged pastures are essential for economic productivity and environmental sustainability. Forage species such as Brachiaria (Urochloa), Panicum, and Cynodon are cultivated not only for grazing but also for hay, silage, and as cover crops in integrated croplivestock systems.

Brazil has the world's largest commercial cattle herd, with over 200 million head, and most of these animals are raised on planted pastures. The country's pasture area exceeds 160 million hectares, making it a critical land use. Major pasture regions include the Cerrado (Mato Grosso, Goiás, Mato Grosso do Sul), the Amazon fringe (Pará, Rondônia), and the Pampas (Rio Grande do Sul). Wellmanaged pastures improve soil health, sequester carbon, and reduce pressure on native vegetation.

However, pasture management presents unique challenges. Weeds (e.g., Brachiaria itself can become invasive when mixed with other species), pests (spittlebugs – Mahanarva spp.), and fungal diseases reduce forage quality and carrying capacity.



Rather than replacing ground machines or aircraft, agricultural drones serve as a flexible and efficient supplement. Key complementary roles include

- **Spot spraying of weed patches** – Drones can treat only infested areas, reducing herbicide use by up to 35%.
- **Rapid response after rain** – When pastures are too wet for tractors, drones can operate immediately.
- **Precision in environmentally sensitive areas** – Near rivers, springs, and native vegetation reserves, drones minimise drift and avoid soil compaction.
- **Seed spreading for pasture renovation** – Drones can spread forage seeds (e.g., Brachiaria, millet) into existing pastures without damaging the sward, with high uniformity and efficiency.
- **Service provision** – Farmers with small to medium pasture areas can use drones for their own needs and offer spraying/spreading services to neighbours, improving ROI.

Best Practice: From Mixed Methods to DroneComplemented Pasture Management in Marabá, Pará

A cattle and crop farmer in Marabá, in southeastern Pará (Amazon biome transition zone), manages 200 hectares of planted pasture – primarily Urochloa brizantha (Brachiaria). The pasture is divided into lots of 1520 hectares for rotational grazing. The farm also grows soybeans and maize in rotation, using pasture as a cover crop between cash crops. Until 2023, the farmer relied on a combination of a tractormounted boom sprayer (for larger, drier areas) and, occasionally, a fixedwing agricultural aircraft (for very large contiguous blocks). However, both methods had shortcomings: the tractor could not enter wet pastures for days after rain, and its wheels compacted the soil, reducing forage regrowth. Aircraft, while fast, required complex permitting due to nearby natural reserves and water bodies (the Itacaiúnas River basin), and drift risk onto native vegetation was a concern.

In 2023, the farmer began testing a DJI Agras T50 drone. By 2024, the operation had been expanded to include a T25P for smaller lots and precision spot spraying, and a T70P plus T100 for larger areas. Today, approximately 50% of drone time is for the farmer's own pasture management, and 50% is offered as a paid service to neighboring farmers – a model that accelerated ROI to just 1.5 years.

The farmer emphasizes that drones do not replace ground sprayers or aircraft entirely. Instead, they are used strategically: ground sprayers still handle large, dry, flat areas when soil conditions permit; aircraft are reserved for very large emergency applications. Drones fill the gaps – wet conditions, irregular lots, sensitive zones, spot treatments, and seeding operations.

One of the most valuable applications of drones in pasture management is seeding. The farmer uses the spreading capabilities of the T70P and T100 to sow forage seeds – either to establish a new pasture on prepared land or to renovate degraded existing pasture. Compared to tractorbased seeders or manual spreading, drone seeding offers several advantages: no soil compaction, uniform distribution even on wet or sloping terrain, and the ability to seed precisely where needed without disturbing the existing sward.

Seed Preparation and Selection

- **Seed types:** The farmer primarily uses Urochloa brizantha (cv. Marandu or Piatã) and Urochloa ruziziensis, as well as millet (Pennisetum glaucum) for quick cover. Seeds are typically purchased as untreated or with a polymer coating to improve flowability.
- **Seed coating and mixing:** For better flow through the drone's spreader, the farmer sometimes mixes seeds with a small amount of dry sand or granular fertiliser (e.g., 1020% sand by volume). This prevents clogging and ensures a consistent spread pattern. Coated seeds (with fungicide or insecticide) are also compatible with the drone's metering system.
- **Storage and handling:** Seeds are stored in a dry, cool place. Before loading, they are sieved to remove large debris or broken pods that might jam the hopper gate.

Spreader Configuration for Pasture Seeds

The T70P and T100 spreading systems are equipped with a solid tank (up to 100 kg capacity) and a highflow rate (up to 400 kg/min). For smallseeded forages, the farmer installs the small hopper gate (suitable for granular materials of 0.54 mm). The spinner speed is adjusted according to the desired swath width and seed density.

Key settings for pasture seed spreading:

- **Spinner speed:** 1,1001,300 RPM – higher speeds widen the spread pattern but may damage delicate seeds; the farmer uses 1,200 RPM for Brachiaria seeds.
- **Hopper gate opening:** 1015% for fine seeds; adjusted based on calibration tests.
- **Flight height above ground:** 710 metres – this provides a spread swath of 812 metres, depending on wind and spinner speed.
- **Flight speed:** 2436 km/h – slower speeds improve accuracy on small lots; faster speeds are used for large, open areas.
- **Route spacing (swath overlap):** 10 metres – this ensures even coverage with a 5060% overlap to avoid gaps.
- **Application rate:** 1520 kg/ha for pure Brachiaria seeds; 1015 kg/ha if mixed with fertiliser.

Calibration and Test Flights

Before each seeding operation, the farmer performs a simple calibration:

1.Bench test: With the drone stationary, run the spreader for 30 seconds into a collection bag. Weigh the output and adjust the gate opening until the desired rate (kg/min) is achieved.

2.Field test strip: Fly a single pass of 50100 metres over a prepared area (e.g., a bare soil strip or a tarp). Collect the seeds from several 1m² quadrats to verify uniformity and rate.

3.Adjust parameters: Finetune flight height, spinner speed, or route spacing based on the test results.

Operational Workflow for Seeding

1.Field preparation: For new pasture, the land is lightly disked or harrowed to create a firm seedbed. For oversowing into existing pasture, the farmer may first graze the area heavily or mow it short to reduce competition.

2.Mapping and flight planning: The field boundaries are mapped with RTK. Obstacles (trees, rocks, water troughs) are marked in the app. The farmer sets a 510 metre safety margin around sensitive areas.

3.Loading seeds: The spreading tank is filled with the calibrated seed mix. The drone is placed on a level surface, and the battery is inserted before loading to prevent dust from entering the power connectors.

4.Automatic seeding: The drone follows the planned routes, turning automatically at the end of each pass. The spreader engages only over the target area, stopping at the edges to avoid waste.

5.Postseeding followup: For new pasture, a light roller or harrow may be used to incorporate seeds (if soil conditions allow). For oversowing, the farmer may postpone grazing for 46 weeks to allow seedlings to establish.

Agricultural Drone Industry Insight Report

Efficiency of Drone Seeding

Using the T100, the farmer can seed at a rate of **30-40 hectares per hour** (including refill stops). A 200hectare pasture can be completely seeded in 57 hours – a fraction of the time required for a tractordrawn spreader, and without any soil compaction. The drone's ability to seed immediately after a rain (when soil moisture is ideal for germination) gives a significant advantage over ground equipment.

Spraying Operations – Weed, Pest and Disease Control

Beyond seeding, the farmer uses drones for chemical applications throughout the pasture's growth cycle.

● **Pre and postemergence weed control:** One or two herbicide applications are made using the T70P or T100. For spot spraying of weed patches (identified via scouting or M3M multispectral mapping), the farmer treats only affected areas, saving up to 35% of herbicide compared to blanket spraying.

● **Growth stage (forage maintenance):** One or two applications of fungicide (to control rust and other foliar diseases), insecticide (mainly for spittlebugs), and foliar fertiliser are carried out. The T25P is preferred for smaller lots (1520 ha) because of its agility, while the T70P and T100 cover larger continuous areas.

Both the T70P and T100 operate with RTK centimetrelevel navigation, terrainfollowing radar, and dualatomisation centrifugal nozzles. For herbicide applications, the farmer uses coarser droplets (250350 μm) and lower flight speeds to minimise drift – especially important near the river reserves.

Table : Operational Parameters for T25P, T70P and T100 in Pasture

Operation type / Drone model	Application rate (L/ha for spray; kg/ha for seed)	Droplet size (μm) or Spreader RPM	Flight speed (km/h)	Route spacing (m)	Height above crop (m)	Daily coverage (ha, 7h)
T25P – Herbicide (spot or blanket)	8–10 L/ha	180–250	23–36	4–5	3.2–4.0	70–80
T25P – Insecticide/Fungicide/Foliar	8–10 L/ha	180–250	23–36	4–5	3.2–4.0	70–80
T70P – Herbicide	10–15 L/ha	180–250	36–50	9–11	4–6	240
T70P – Insecticide/Fungicide/Foliar	10–15 L/ha	180–250	50–72	11–13	4–6	260
T100 – Herbicide / Insecticide / Fungicide	10–15 L/ha	180–250	50–72	11–13	4–6	280
T100 – Seeding (spreading)	15–20 kg/ha	Small feeder (0.5–4 mm), 1,100–1,300 rpm	24–36	10	7–10	30–40 ha/hour (seeding)

All spray operations are fully automatic with RTK. For herbicide in windy conditions, coarser droplets (250350 μm) and lower speeds are recommended. The T100's solid tank (100 kg) and high flow rate make it ideal for largearea seeding.

Other Benefits Observed

- **Environmental compliance:** By using drones near the Itacaiúnas River and natural reserves, the farmer eliminated the need for complex aircraft permits. Drift incidents dropped to near zero, protecting native vegetation.
- **Soil health:** No wheel tracks means better water infiltration, less erosion, and healthier root systems – particularly important for pasture persistence over multiple years.
- **Rapid response to pest outbreaks:** Spittlebug infestations can destroy a pasture within weeks. With drones, the farmer can spray within hours of detection, even after rain, saving the forage.
- **Service provision model:** During the peak season for row crops (soybean, maize), when many farmers are busy, the pasture farmer offers drone seeding and spraying services to neighbouring grain farmers. This generates additional income and makes the drone investment more viable.

Conclusion – Drones as an Essential Complementary Tool for Brazilian Pasture Management

Pasture is the foundation of Brazil's beef and dairy industries, but managing it efficiently and sustainably requires a mix of tools. Ground sprayers, agricultural aircraft, and drones each have their place. Drones excel where other methods struggle: wet soils, small or irregular lots, environmentally sensitive zones, spot treatments, and spread seeding. They do not replace tractors or airplanes but rather complement them, filling critical gaps in timeliness, precision, and environmental compliance.

The experience in Marabá, Pará, shows that a farmer with 200 hectares of pasture can achieve rapid ROI (1.5 years) by using drones for their own operations and offering services to neighbours. With models like the T25P for small lots, the T70P for medium areas, and the T100 for highcapacity spraying and seeding, drones have become an indispensable part of modern pasture management in Brazil.

4.2.2 Citrus Orchards in Whole Process Management

Citrus is one of the world's most widely cultivated fruit crops, with global production exceeding 150 million metric tons annually. Oranges, mandarins, lemons, grapefruits and other citrus varieties are essential for fresh consumption, juice production, and the food processing industry. Major producers include Brazil, China, the United States, Mexico, and Spain. Citrus orchards are often located on hillsides and slopes to take advantage of drainage and sunlight, which makes mechanisation difficult. Traditional manual spraying and fertilising are laborintensive, timeconsuming and increasingly unattractive to younger workers.

Agricultural Drone Industry Insight Report

Citrus in Japan – A Sector Under Pressure

Japan has a long tradition of citrus cultivation, particularly mandarins (Citrus unshiu) in regions such as Ehime, Hiroshima, Wakayama and Shikoku. Ehime Prefecture is especially famous for its Mikan oranges. However, the Japanese citrus industry faces a severe crisis. Between 2015 and 2020, the national citrus cultivated area decreased by 27.4%, and the number of farming households fell by 47.6%. Among the remaining growers, 74% are aged 65 or older – a 4% increase from 2015. Labour shortages mean that many orchards are abandoned or poorly maintained. Furthermore, most citrus orchards are on steep slopes where boom sprayers and tractors cannot operate. Conventional powered sprayers (knapsack or small enginedriven) are slow, heavy and dangerous for elderly farmers. Agricultural drones have emerged as a practical complement – they can spray, fertilise and even transport fruit on slopes without risk to human operators.

A typical citrus orchard requires 1524 applications per year: 810 insecticide sprays, 78 fungicide sprays, and 23 fertiliser applications (topdressing). Drones can perform all these tasks autonomously, even on steep terrain. Additional benefits include:

- **Highvolume spraying** – Largecapacity drones like the T70P can apply lowdilution pesticides at 100500 L/ha, directly compatible with conventional agrochemicals (not only specialised drone formulations).
- **Precision spot targeting** – Using orchard mode with premapped tree positions, drones can spray each tree individually, reducing chemical use by 5070%.
- **Granular fertiliser spreading** – Drones broadcast fertiliser at 100200 kg/ha, solving the longstanding problem of no mechanised topdressing on mountain orchards.
- **Cargo transport** – The same drone can lift up to 70 kg of fruit or supplies, replacing orchard monorail systems or manual carrying. This is especially valuable for bringing harvested citrus down from steep slopes or taking fertiliser bags up.
- **Rapid response** – Drones can spray within hours of detecting pest or disease outbreaks, while ground crews may need days.

Best Practice: Full Drone Adoption in a Steep Citrus Orchard in Ehime Prefecture

In Uwajima City, Ehime Prefecture, a 2hectare mandarin orchard is located on a steep hillside with gradients exceeding 20 degrees. The grower had previously relied on a power sprayer (enginedriven, hosereel type) for all pesticide applications. Each spray session for a 0.2hectare block took 2.5 to 3 hours of walking and climbing, carrying heavy equipment. Fertiliser was broadcast by hand – slow, uneven and hazardous on the slope. Harvested fruit was carried down in baskets or by a small monorail that required high installation and maintenance costs.
In 2022, the grower introduced a DJI mapping drone and began using DJI Terra to create orchard flight routes. By 2024, the entire 2hectare orchard was managed with a **DJI Agras T70P** (upgraded from earlier models). The T70P's 70 L spray tank and 80 kg solid hopper (for fertiliser) proved ideal for the scale and terrain. The drone now handles all spraying, fertilising, and even some cargo transport, completely replacing manual and powersprayer methods.

FullCycle Drone Operations

The grower follows a standard annual programme for Unshu mandarin:
- **Dormant season (FebruaryMarch):** Dormant oil spray (insecticide) and copper fungicide. T70P applies 150 L/ha with fine droplets (80120 μm) to cover bark crevices.
- **Bud break to flowering (AprilMay):** Insecticides for aphids and citrus leafminer, fungicides for scab and melanose. Two to three applications. The drone uses orchard mode, hovering over each tree for 58 seconds, delivering 200300 mL per tree. Total spray volume ~200 L/ha.
- **Fruit set to early growth (JuneJuly):** Insecticides for citrus psylla and fruitpiercing moths, fungicides for canker and greasy spot. Two to three applications. The T70P flies at 68 km/h with 100150 μm droplets, 45 m above canopy.
- **Midseason (AugustSeptember):** Main pest pressure (mites, mealybugs). Two to three insecticide sprays. Also, the first topdressing of slowrelease fertiliser – the drone spreads 150 kg/ha of granular NPK at 15 km/h, route spacing 7.5 m, height 3 m above ground.
- **Preharvest (OctoberNovember):** Final fungicide (to prevent storage rots) and possibly a second fertiliser application. The drone also helps transport harvested fruit: a T70P with a cargo hook can lift 70 kg of fruit in a net bag from the orchard to a collection point at the bottom, replacing the monorail or manual carrying.
- **Postharvest (December):** Dormant copper spray and a third fertiliser application (if needed).

The grower performs approximately 1820 drone missions per year (insecticide 9, fungicide 7, fertilizer 2, plus cargo flights). Each mission is fully automated using preplanned orchard routes generated from a multispectral map.

Table: Operational Parameters for T70P in Citrus Orchards (Ehime, Japan)

Operation type	Application rate	Droplet size/ Spreader setting	Flight speed (km/h)	Route spacing / Pattern	Height above crop (m)	Coverage per hour
Insecticide / Fungicide (fine spray)	100–200 L/ha	50–100 μm	6–10	Orchard mode (per tree) or 5–6 m continuous	34–6	0.8–1.2 ha
Herbicide (spot or blanket)	10–15 L/ha (liquid) or 10 kg/ha (granules)	300–450 μm (liquid) or small gate (granules)	10–15	5–6 m (continuous)	4□6	1.5–2 ha
Fertilizer spreading (granular)	100–200 kg/ha	Small gate, 1,100□1,300 rpm	15–20	7.5 m	3	2–3 ha
Cargo transport (fruit or supplies)	70 kg per lift	Cargo hook	5□8 (climb/descent)	Waypoint□to□waypoint	N/A	10–15 lifts/hour

**All operations are fully automatic with RTK. Orchard mode requires premapped tree positions (using DJI Terra). The T70P's spray tank holds 70 L; solid hopper holds 80 kg. For cargo, the drone flies without spraying/spreading attachments. **

Measurable Results

After two full seasons using the T70P for all orchard tasks, the grower compared costs and time with the previous powersprayer method. The economic advantages are striking.

Table 2: Economic and Time Comparison – Power Sprayer vs. T70P Drone (per 0.4 ha block, typical for a small orchard)

Japan's citrus industry is shrinking due to ageing farmers and difficult terrain. Agricultural drones offer a complete solution: spraying, fertilizing and even cargo transport. The DJI Agras T70P, with its 70 L tank and 80 kg hopper, is wellsuited to the 1524 annual applications required for highquality mandarin production. As demonstrated in Ehime Prefecture, a 2hectare steep orchard can be managed entirely by a single drone, reducing labor time by 93%, cutting chemical use, eliminating the need for costly monorails, and improving yields. For regions facing similar challenges – from the Mediterranean to California – drone technology provides a path to sustainable citrus farming.

4.2.3 Oil Palm Plantations in Indonesia

Oil palm (Elaeis guineensis) is the world's most productive vegetable oil crop. One hectare of oil palm yields four to ten times more oil per year than soybean, rapeseed or sunflower. Global palm oil production exceeded 80 million metric tons in 2024, with applications ranging from cooking oil and processed foods to biofuels, cosmetics and industrial lubricants. The crop is a critical economic driver for tropical countries, particularly Indonesia and Malaysia, which together account for more than 80% of global supply. Palm oil supports millions of smallholder farmers and plantation workers, and its high productivity makes it an efficient landuse option when managed sustainably.

Oil Palm in Indonesia – A National Economic Pillar

Indonesia is the world's largest producer of palm oil, with over 15 million hectares of planted area. The industry contributes significantly to export earnings, rural employment and regional development. Major production centres include Riau, North Sumatra, Central Kalimantan and West Kalimantan. However, oil palm cultivation faces persistent challenges: labour shortages for manual fertiliser spreading and pest control, difficult terrain (hills, wetlands), and the need for precise, timely applications across large, dispersed blocks. Traditional methods – manual workers with buckets or backpack sprayers – are slow, inconsistent and increasingly difficult to staff. Fixedwing aircraft are rarely used due to high costs and drift risks near settlements and natural forests. Agricultural drones have emerged as a complement ary solution that brings precision, efficiency and realtime monitoring to oil palm management.

How Agricultural Drones Contribute to FullCycle Oil Palm Management

Drones are not limited to a single task. On an oil palm plantation, they can be deployed throughout the crop's long lifecycle – from land preparation before planting, through the seedling and immature stages, to mature palms that produce for 2530 years. Key contributions include:
- Herbicide spraying – Before planting and between mature palms, drones apply nonselective herbicides precisely, avoiding drift onto desirable vegetation.
- Fungicide and insecticide spraying – During seedling and immature stages, drones protect young palms from leafeating beetles (Oryctes rhinoceros is a major pest) and fungal diseases.
- Fertiliser spreading – Mature oil palms require regular fertilisation (34 times per year). Drones can broadcast granular fertiliser uniformly across large areas or perform spot spreading – delivering 1.52 kg of fertiliser precisely at each palm base, which is the most efficient method.
- Growth regulator and pesticide application – In the transplanting and prematurity phase (13 years), drones apply growth hormones and targeted pesticides.
- Realtime monitoring – Drone operations are logged on platforms like DJI SmartFarm or AGMS, allowing managers to track fertiliser usage, coverage and productivity per drone.

Drones solve the labour crisis: a single T100 can spread 56 tons of fertiliser per day (continuous mode) or 34 tons per day in spotspreading mode, compared to a manual worker's 0.51 ton per day. They also work on wet, hilly or muddy terrain where workers or vehicles struggle.

Case Study: PT Asian Agri – FullCycle Drone Adoption in Riau, Indonesia

In Uwajima City, Ehime Prefecture, a 2hectare mandarin orchard is located on a steep hillside with gradients exceeding 20 degrees. The grower had previously relied on a power sprayer (enginedriven, hosereel type) for all pesticide applications. Each spray session for a 0.2hectare block took 2.5 to 3 hours of walking and climbing, carrying heavy equipment. Fertiliser was broadcast by hand – slow, uneven and hazardous on the slope. Harvested fruit was carried down in baskets or by a small monorail that required high installation and maintenance costs.

In 2022, the grower introduced a DJI mapping drone and began using DJI Terra to create orchard flight routes. By 2024, the entire 2hectare orchard was managed with a **DJI Agras T70P** (upgraded from earlier models). The T70P's 70 L spray tank and 80 kg solid hopper (for fertiliser) proved ideal for the scale and terrain. The drone now handles all spraying, fertilising, and even some cargo transport, completely replacing manual and powersprayer methods.

Background

PT Asian Agri is one of Indonesia's largest palm oil producers, with over 100,000 hectares of plantations across Riau, Jambi and North Sumatra. The company has been actively pursuing precision agriculture and sustainable practices. In 2024, Asian Agri began integrating DJI agricultural drones – specifically the Agras T70P and T100 – into its standard operating procedures. The trial took place in a 500hectare block in Riau province, covering mature palms (820 years old) as well as a 50hectare area of immature palms (13 years) and a newly cleared block for replanting.

Before drones, all fertiliser spreading was done manually: workers walked between rows carrying 2025 kg bags of granular fertiliser and broadcasting by hand or with simple spreaders. Pest control for Oryctes rhinoceros (rhinoceros beetle) was also manual, using backpack sprayers to target the palm heart. Labour shortages had become critical – young workers were unwilling to do this heavy, repetitive work. Moreover, manual spreading was uneven: some palms received too much fertiliser (causing burn), others too little (reducing yield). Spray coverage for beetles was inconsistent, leading to low pest control rates.

FullCycle Drone Operations

Asian Agri adopted a complete dronebased programme that follows the oil palm lifecycle.

Preplanting stage (land clearing): For areas being replanted, a single herbicide application is made using the T100 to control existing weeds. The drone applies 30 L/ha of nonselective herbicide (e.g., glyphosate) with coarse droplets (300450 μm) to minimise drift. This replaces manual knapsack spraying and ensures uniform coverage.

Seedling stage (012 months): Young palms in the nursery or freshly planted in the field are vulnerable to fungal diseases and insects. The T70P applies a mix of fungicide and insecticide at 1015 L/ha, with fine droplets (180250 μm) to cover the small canopy. Flight height is kept low (34 m) to avoid offtarget drift.

Transplanting and prematurity stage (13 years): During this period, palms are growing but not yet producing. The main applications are growth hormones (to stimulate vegetative growth) and pesticides against leafeating beetles. Asian Agri uses the T70P for spot spraying on each palm – the drone hovers over the centre of each young palm and delivers a precise 200250 mL of pesticide mix. This method, known as spot spraying, ensures the chemical reaches the palm heart where beetles hide. With automatic flight planning via DJI Terra (Orchard Mode), the drone visits each tree location, sprays, then moves to the next. Efficiency reaches 23 hectares per day (with dense young palms at 120140 trees/ha).

Maturity and stable yield stage (330 years): This is the longest phase. Mature oil palms require fertiliser 34 times per year, plus occasional fungicide and pesticide applications. Asian Agri uses two spreading modes:

- **Continuous selective spreading:** For large blocks where fertiliser can be broadcast evenly between palm rows, the T100 flies at 45 m/s with a route spacing customised to the planting distance (typically 89 m between rows). Application rate is 300 kg/ha of NPK granular fertiliser. The spreader uses a small hopper gate (for 0.54 mm granules) and spinner speed of 1,1001,300 rpm. Daily coverage reaches 56 tons (approximately 20 hectares, depending on density).
- **Spot spreading (only supported by T50 and newer models like T70P/T100):** For more efficient use of fertiliser – especially on sloping terrain or where palms are unevenly spaced – the drone delivers 1.52 kg of fertiliser precisely at the base of each palm. The hopper outlet is set to 2030% opening, flight speed 57 m/s, height 67 m above ground. Each tree receives the exact dose, eliminating waste. Daily output in spot mode is 34 tons.

For pest control in mature palms, Asian Agri continues spot spraying for rhinoceros beetle, using a 200 mL/tree dose of insecticide. The drone's ability to target only the palm centre (not the entire canopy) reduces chemical use by 70% compared to blanket spraying.

Table 1: Operational Parameters for T70P and T100 in Oil Palm Plantations

Operation type / Drone model	Application rate	Droplet size / Spreader setting	Flight speed (m/s)	Route spacing/ Pattern	Height above crop (m)	Daily output
T70P – Herbicide (pre–planting)	30 L/ha	300–450 μm	6	6.5–7 m (continuous)	3–3.5	70–80 ha
T70P – Fungicide/Insecticide (seedling)	10–15 L/ha	180–250 μm	4–5	5–6 m	3–4	50–60 ha
T70P – Spot spraying (pest, immature palms)	200–250 mL/tree	Fine nozzle	4–5	Orchard mode (per tree)	5 (above ground)	2–3 ha
T100 – Continuous fertiliser spreading	300 kg/ha	Small gate, 1,100–1,300 rpm	4–5	8–9 m (custom)	7–8	5–6 tons/day
T100 – Spot fertiliser spreading	1.5–2 kg/tree	20–30% opening	5–7	Orchard mode (per tree)	6–7	3–4 tons/day
T100 – Spot spraying (pest, mature palms)	200 mL/tree	Fine nozzle	4–5	Orchard mode (per tree)	5	2–3 ha

All operations are fully automatic with RTK. Spot operations require premapped tree positions (via DJI Terra or SmartFarm Web). The T100's solid tank capacity is 100 kg for fertiliser; the T70P carries 70 L for liquid.

Measurable Results

After six months of drone integration (covering a full fertilization cycle and one pest outbreak), Asian Agri documented significant improvements in efficiency, cost and accuracy.

Oil palm is a permanent, highvalue crop that demands regular, precise inputs over decades. The labor crisis in Southeast Asia is not temporary – young workers increasingly reject manual fertilizer spreading and pest control. Agricultural drones offer a practical, scalable solution. As demonstrated by PT Asian Agri in Riau, drones cover the full plantation cycle: from preplanting herbicide, through seedling and immature protection, to mature palm fertilization and pest control. The combination of continuous spreading for large areas and spot spreading for individual palms delivers efficiency gains of 510 times over manual labor, with better accuracy, lower chemical use and realtime data.

For plantation companies and smallholders alike, adopting drones is no longer a luxury – it is a competitive necessity. The DJI Agras T70P and T100 have proven their value in Indonesia's challenging oil palm environment, and their role will only grow as precision agriculture becomes the norm.

4.3 Lifting Applications

In recent years, new application scenarios for agricultural drones have emerged continuously, each designed to enhance the quality and efficiency of agricultural production and address practical challenges in rural areas. These innovative practices and breakthroughs are valuable experiences that deserve to be shared and learned by all practitioners in the agricultural drone industry.

4.3.1 Drones Facilitating Navel Orange Transportation in Mountainous Areas

There is a renowned navel orange producing region in one of China's mountainous areas, Zigui, a county covering approximately 26,667 hectares. For years, the undulating terrain has hindered the popularization of mechanization, forcing local fruit farmers to manually carry harvested navel oranges down steep slopes. Known as "orange porters," these workers—with an average age of 45 to 65—transport 60 kilograms of oranges per trip, trekking 2 to 3 kilometers along slopes with an incline of over 20 degrees. This traditional method is not only inefficient but also poses significant safety risks. Since 2025, local operators have been consistently using agricultural drones for orange agricultural lifting, offering a stable and efficient solution to this long-standing problem.

Throughout 2025, drone-based agricultural lifting of navel oranges has been carried out continuously, with the T100 agricultural drone serving as the primary equipment due to its exceptional performance. Boasting strong load capacity and stable flight capabilities, the T100 has effectively resolved the transportation difficulties of navel oranges in mountainous areas, greatly improving both the efficiency and safety of orange transportation while injecting new vitality into the upgrading of the local navel orange industry.

Local agricultural professionals have continuously optimized drone agricultural lifting plans based on the actual conditions of orange planting and transportation. They have formulated scientific flight routes, optimized take-off and landing points, and standardized operational procedures, making the agricultural lifting process more efficient and systematic. By 2025, drone agricultural lifting has been applied to most of the navel orange planting areas in the region, significantly reducing the labor intensity for fruit farmers and minimizing safety hazards associated with manual transportation.

With its robust load capacity, the T100 agricultural drone can complete the agricultural lifting of 85 kilograms of oranges in less than two minutes—dozens of times faster than manual labor. This year-round continuous operation mode in 2025 has not only accelerated navel orange transportation but also ensured that fresh oranges reach the market promptly, directly boosting fruit farmers' incomes.

4.3.2 Drone Agricultural Lifting banana

China's mountainous areas are major producers of high-quality bananas, with plantations scattered across rolling hills and mountains. While the warm and rainy climate nurtures sweet and glutinous bananas, it also creates significant challenges for transportation. Traditional transportation methods are severely constrained by both complex terrain and the perishability of bananas. The innovative use of agricultural drones for banana agricultural lifting, combined with ground-based red flag guidance, has opened up an efficient and safe new transportation route for China's banana industry.

1) Long-standing Challenges in Banana Transportation in China's Mountainous Areas

Banana planting areas in China's mountainous regions feature complex terrain, with narrow and rough roads that are inaccessible to transport vehicles in many places. In the past, after harvesting, bananas could only be carried manually or transported by small tricycles. Each banana bunch is heavy, weighing up to 40-50kg, making manual handling not only inefficient but also extremely labor-intensive. In these mountainous areas, workers carry bananas along muddy and slippery paths, where a minor misstep can lead to slips, resulting in banana damage and even personal injuries.

Furthermore, bananas are highly perishable. During bumpy transportation, fruits are easily squeezed and collided, causing skin damage and rot—a problem that traditional transportation methods struggle to avoid. Annually, the loss rate of bananas due to improper transportation reaches 20% to 30%, seriously impacting growers' incomes. Meanwhile, rising manual transportation costs have further squeezed profit margins, becoming a key bottleneck limiting the development of China's banana industry.

2) Drone Banana Agricultural Lifting: Precise Collaboration Guided by Red Flags

Prior to agricultural lifting operations, a professional team conducts a detailed survey of the banana plantation, marking the location of each grove, the distribution of surrounding obstacles, and suitable take-off and landing points. Given bananas' short growth cycle and concentrated ripening period, agricultural lifting areas are divided by ripeness, with fully ripe bananas prioritized to maximize efficiency.

Simultaneously, drones are debugged according to the average weight of banana bunches. High-strength yet soft agricultural lifting ropes are selected to ensure load-bearing capacity while minimizing friction damage to banana skins. Drone flight parameters—including speed, height, and hovering stability—are optimized to guarantee a smooth agricultural lifting process.

During operations, ground staff have clear divisions of labor: harvesters cut ripe banana bunches and tie agricultural lifting ropes to appropriate positions, while guides signal drone pilots to approach by waving red flags.

Pilots control drones precisely based on red flag signals. When a drone hovers at the optimal height above the agricultural lifting point, the guide waves the red flag in a circular motion, prompting ground staff to quickly hang the rope with bananas onto the drone's hook. After confirming proper attachment via the drone's camera, the pilot lifts the drone steadily and transports the bananas to a centralized processing point along the pre-planned route.

During agricultural lifting, if unstable valley air currents or forest cover are encountered, pilots flexibly adjust the drone's flight attitude based on real-time images and environmental information transmitted by ground guides via red flags. Upon reaching the destination, the guide signals the drone to land accurately, and ground staff unload the bananas promptly to complete one cycle of agricultural lifting.

After each operation, technical personnel conduct a comprehensive inspection and maintenance of the drone: cleaning dust and banana juice residues from the fuselage, checking wear on agricultural lifting devices, and performing charge-discharge maintenance on batteries. They also collect operational data—such as flight time, agricultural lifting weight, and route deviation—analyze existing issues, and continuously optimize agricultural lifting plans and drone parameters to inform future operations.

Drone agricultural lifting has significantly improved banana transportation efficiency. In the past, manual transportation could only move dozens of banana bunches per day, whereas drones can transport hundreds—increasing efficiency by more than tenfold. During the peak ripening season, drones quickly transport bananas from plantations to the market, shortening delivery time, ensuring freshness, and enhancing market competitiveness.

The stable agricultural lifting process of drones reduces squeezing and collision between bananas, lowering the transportation loss rate to less than 5%. Additionally, the fast-agricultural lifting speed allows bananas to enter the cold chain quickly, further preserving their freshness and quality and reducing economic losses for growers.

While initial investment in drone purchase and maintenance is required, long-term use significantly reduces labor costs. By minimizing banana losses and increasing actual incomes, drones deliver substantial economic benefits. For example, a 6.67-hectare banana plantation can save hundreds of thousands of yuan in labor costs annually and increase income by nearly one million yuan after adopting drone agricultural lifting, greatly boosting growers' enthusiasm.

Drone agricultural lifting has brought revolutionary changes to China's banana industry. This innovative transportation method not only solves long-standing transportation challenges but also injects new vitality into the sustainable development of the industry. With ongoing technological advancements and promotion, drones will play an increasingly important role in more agricultural fields, supporting rural revitalization efforts.

4.3.3 Bamboo Agricultural Lifting for the Papermaking Industry

A mountainous area in southwest China features complex and diverse terrain, with mountains, hills, and plateaus accounting for 97.46% of its total area. In the vast mountain forests, the bamboo industry serves as a crucial source of income for local farmers. However, traditional bamboo transportation methods face significant difficulties due to the area's rugged terrain. Today, the application of agricultural drones for bamboo agricultural lifting has introduced a new operational model, ushering in an efficient era of bamboo transportation.

Bamboo forests in the area are mostly distributed on steep slopes and deep canyons, with narrow and rough roads—many of which are inaccessible to vehicles. In the past, bamboo farmers relied on shoulder carrying to transport bamboo out of the mountains. Each day, they spent considerable time and energy trekking along gravel-strewn, thorny mountain roads, transporting only small quantities of bamboo per trip—making the process extremely inefficient. Long-term high-intensity labor has also taken a toll on farmers' health, with waist and leg injuries becoming common. Rising manual transportation costs have further compressed profit margins, restricting the development of the local bamboo industry.

Before operations, technical personnel use high-definition cameras and surveying systems mounted on drones to conduct a comprehensive survey of bamboo forests and surrounding terrain, creating high-precision maps. Based on bamboo distribution and transportation needs, they plan optimal drone agricultural lifting routes to avoid obstacles and minimize flight distance and time. Ground staff also sort and pack bamboo by weight in advance to facilitate drone hanging.

During agricultural lifting, operators control drones to fly stably to bamboo locations, where the bamboo is securely bound to the agricultural lifting device. Drones fly along pre-planned routes at stable speeds and heights, navigating quickly through mountain forests. When encountering complex terrain, drones flexibly adjust their flight attitude using obstacle avoidance systems to pass safely. Upon reaching the designated transportation point, drones land accurately, and operators untie the agricultural lifting ropes

to complete the operation. The entire process is efficient and smooth, saving significant time and labor costs compared to manual transportation.

After daily operations, technical personnel conduct thorough cleaning and inspections of drones, identifying and addressing equipment issues promptly. They focus on maintaining key components such as agricultural lifting devices and batteries to ensure stable performance. Meanwhile, they optimize flight parameters and agricultural lifting plans based on accumulated operational data and experience, continuously improving efficiency and safety.

In the region's mountainous areas, a single agricultural drone can carry bamboo 40 to 60 times per day, with a transportation volume several times—even dozens of times—that of manual labor. For instance, a bamboo forest in the area that once required a week to transport can now be completed in just one day using drones, significantly improving transportation efficiency and allowing bamboo to reach the market faster to seize business opportunities.

Drone agricultural lifting reduces manual input and labor costs while avoiding bamboo backlogs and losses caused by poor transportation, minimizing economic losses. Although initial drone purchase and maintenance costs exist, their efficient operation significantly increases bamboo farmers' incomes in the long run, injecting new momentum into the local bamboo industry's development.

Manual bamboo transportation in mountainous areas poses numerous safety risks, such as slips and falls. Drone agricultural lifting allows operators to complete transportation tasks from relatively safe areas, effectively ensuring their safety and reducing accident occurrences.

The successful application of drone agricultural lifting for bamboo in this area provides a new solution for the development of the mountain bamboo industry. With continuous technological progress and promotion, agricultural drones are expected to play a more important role in various fields, contributing to the economic development and rural revitalization of China's mountainous areas.

4.3.4 Seedling Agricultural Lifting for Large-Scale Greening Projects

A large-scale greening project in China, centered on a major river, stretches 200 kilometers, covering the visible range of the first mountain ridges on both banks and involving numerous towns across multiple counties (districts). Scheduled to run from 2021 to 2030, the project aims to complete 137,800 hectares of afforestation, with the goal of "greening the mountains and rivers in five years and making the area lush in ten years."

The project has progressed steadily since its inception: the first tree was successfully planted in 2008; in 2011, a local forestry research institute conducted seedling trial plantings, providing scientific guidance for seed selection and afforestation methods; a high-altitude pilot project was launched in the southern mountains in 2012; the "Green Encirclement City" project was implemented in 2015; northern mountain greening began in 2018; and the large-scale greening project was officially launched in 2021.

From 2021 to the end of 2024, the project completed over 46,667 hectares of greening, accounting for 34% of the total target.

This year, the number of DJI agricultural drones used for seedling agricultural lifting in the area exceeded 1,000, with total flight sorties surpassing 1 million—including nearly 20,000 hectares of grass seed aerial seeding and spraying operations. According to local news reports, approximately 20,000 hectares of greening will be completed in 2025, representing a 1.7-fold increase in efficiency compared to previous years. To date, the total greening area has reached over 66,667 hectares, accounting for about 50% of the total target. With the maturity of drone agricultural lifting scenarios and the addition of more operators, the total greening target is expected to be easily achieved within the next five years.

Under the project's plan, areas above 4,100 meters above sea level are primarily designated for closed afforestation and grass cultivation (i.e., aerial seeding of grass seeds); areas between 3,900 and 4,100 meters above sea level focus on shrub forest cultivation; and areas below 3,900 meters above sea level are mainly for arbor forest cultivation. The main tree planting period is from late February to June, with supplementary seedling operations in December. Agricultural lifting operations last approximately 180 days a year, and from May to August, plant protection and spraying are conducted to prevent diseases and insect pests on greening seedlings.

Before the adoption of drone agricultural lifting, all greening materials—including seedlings, cultivated soil, fertile soil, water pipes, and water storage tanks—had to be transported manually or by mules. The average altitude at the foot of the mountains is 3,680 meters, with thin air and a vertical height difference of over 400 meters per transportation trip. A round trip by animal power or manual labor takes about one hour, requiring frequent rest to replenish energy—making the process extremely inefficient and prone to slips on mountain paths.

The recommended load capacity of the DJI T100 in this area is 72kg (85kg below 1,000 meters above sea level). It can carry 10 to 16 small seedlings or 3 bags of cultivated soil per trip and climb 400 meters in just 2.5 minutes. In terms of daily agricultural lifting capacity, drones average 5,500kg per day (50kg per trip)—14 times that of mules (a mule can carry approximately 32 small seedlings, or 130kg, per trip, completing 3 trips a day for a total of about 400kg).

V. Best Practices

The use of agricultural drones is a multi-directional combination of personnel technology, product technology development, agronomy, agricultural technology, and pesticide application. This is inseparable from the joint efforts of the entire industry and the continuous exploration of the formation of "best practices".

5.1 Personnel Training

In 2025, DJI Academy expanded its global training layout to address the huge gap in agricultural drone professionals, focusing on the systematic training of agricultural drone pilots and instructors to support the standardized development of the global agricultural drone industry. For instructors, DJI Academy established in-depth cooperation with local agricultural authorities, professional training institutions and industry associations around the world, launching specialized training programs that integrate theoretical teaching, practical operation and teaching methodology guidance, covering core content such as drone performance parameters, safe flight norms, operational skills and teaching skills, aiming to cultivate high-quality instructors who can independently carry out local training and pass on professional knowledge. For agricultural drone pilots, the training adopted a scenario-based and hierarchical model, combining global regional agricultural characteristics to customize training content—for example, targeted training on mountainous area agricultural lifting, grassland spraying and seeding, and large-scale greening seedling transportation—covering basic operation, emergency handling, equipment maintenance and other practical skills, helping trainees of different foundations master professional operation capabilities. A large number of trained pilots and instructors have obtained official certification, and they have been widely engaged in agricultural drone operation, training and technical guidance in various regions, effectively filling the talent gap in the industry and providing strong talent support for the popularization and application of agricultural drones in global agriculture, forestry, animal husbandry and fishery fields.

5.2 Technology Development

As the core products of DJI Agriculture's 2025 global product matrix, the Agras T70P and T100 (170kg maximum take-off weight version) have achieved comprehensive upgrades in performance, intelligence, safety, and multi-scenario adaptability, built on over 12 years of R&D experience in agricultural drone technology. Designed to meet the diverse needs of large-scale commercial agricultural operations worldwide, these two models break through the performance bottlenecks of previous generations, delivering higher efficiency, more reliable safety, and more flexible operational capabilities, which are fully demonstrated in the following technical upgrade points in line with global white paper standards.

5.2.1 Technical Upgrade Highlights of DJI Agras T70P

The T70P (170kg maximum take-off weight version) is positioned as a high-efficiency multi-scenario agricultural drone, focusing on upgrading operational efficiency, load capacity, and safety performance, while maintaining excellent adaptability to complex agricultural environments. Its core technical upgrades are as follows:

Compared with its predecessor, the T70P achieves a significant leap in load capacity and operational efficiency. With a maximum take-off weight of 170kg, it supports a maximum spraying payload of 70L, a maximum spreading payload of 100L, and a maximum lifting payload of 65kg, meeting the operational needs of large-scale farms, orchards, and pastures. The maximum flight speed is increased to 20m/s, which greatly shortens the operation time for large-area plots. In terms of spraying efficiency, the standard dual-nozzle configuration achieves a flow rate of 30L/min, and the optional four-nozzle configuration can increase the flow rate to 40L/min, ensuring uniform and efficient coverage. The spraying system supports adjustable droplet sizes ranging from 50μm to 500μm, and the optional mist atomizer can achieve finer droplets (about 50μm), which is suitable for penetrating dense crop canopies and improving the effect of pesticide application.

The T70P is equipped with an upgraded spreading system, adopting a brand-new screw feeder design that doubles the load capacity compared to the previous generation and increases the maximum discharge rate by 270%. The 100L spreading hopper is compatible with a variety of granular materials, and four interchangeable feeder sizes are available to adapt to different materials such as fertilizer (0.5mm-10mm), seeds (0.5mm-4mm), and granular pesticides, with a maximum discharge rate of 400kg/min (tested with compound fertilizer). A high-precision weighing sensor is integrated to provide real-time weight feedback and automatic calibration, ensuring accurate and uniform spreading, with an effective spreading width of 3-10m.

The T70P is equipped with the upgraded Safety System 3.0, integrating millimeter-wave radar and a tri-vision system to achieve comprehensive obstacle detection and avoidance capabilities. The millimeter-wave radar and tri-vision system cover a horizontal 360° and vertical ±45° detection range, with a maximum detection distance of 60m, enabling intelligent obstacle avoidance and route adjustment in complex environments such as mountainous areas, orchards, and woodlands. The system supports automatic terrain following, which can adapt to steep slopes and undulating terrain, ensuring stable flight and avoiding crop damage. In addition, the active phased array radar with EIRP < 20 dBm (complying with NCC/MIC/KC/CE/FCC standards) further enhances environmental perception capabilities, ensuring safe operation even in low-light or complex texture scenarios.

The T70P is equipped with a high-performance power system, including 155×22mm stators and 65rpm/V motors, matched with 62-inch carbon fiber composite propellers, providing strong lifting force and flight stability, and can withstand a maximum wind speed of 6m/s. It is compatible with the DB2160 intelligent flight battery (41000mAh, 52V, weight 14.7±0.3kg), which supports ultra-fast charging: the D12500iE all-in-one variable frequency charging station can charge the battery from 30% to 95% in 10-11 minutes, and the CC15000 on-board charger can complete the same charging task in 7-8 minutes, minimizing downtime between flights and improving overall operational efficiency.

The T70P is compatible with the DJI RC Plus 2 remote controller, featuring a 7-inch touch LCD screen with a resolution of 1920×1200 and a brightness of 1400cd/m², ensuring clear visibility even in strong sunlight. The remote controller has a built-in battery life of 3.8 hours (3.2 hours with an external battery), supporting long-time continuous operation. The drone supports 4G enhanced image transmission and O4 image transmission relay (for network-free environments), ensuring stable and unobstructed signal transmission within a maximum flight radius of 2km. The D-RTK 3 agricultural version is optional, achieving a hovering accuracy of ±10cm (horizontal and vertical) when enabled, ensuring precise operation and avoiding missed or repeated spraying/spreading.

5.2.2 Technical Upgrade Highlights of DJI Agras T100

The T100 (170kg maximum take-off weight version) is positioned as a large-scale commercial agricultural drone, focusing on large-load, high-efficiency operations, and achieving comprehensive upgrades in load capacity, safety, and multi-scenario adaptability, making it suitable for large-scale farms, pastures, and complex terrain operations globally.

With a maximum take-off weight of 170kg, the T100 achieves a qualitative leap in load capacity compared to the previous generation. It supports a maximum spraying payload of 100L, a maximum spreading payload of 150L, and a maximum lifting payload of 100kg, which is twice as efficient as the previous generation in high-volume spraying and significantly faster in large-capacity spreading. This load capacity enables the T100 to handle a variety of agricultural operations, including large-scale spraying of field crops, spreading of fertilizer and seeds, and lifting of agricultural materials (such as seedlings, bamboo, and fruits) in mountainous areas, fully meeting the needs of large-scale commercial agriculture.

The T100's spraying system adopts a dual atomizing centrifugal nozzle design (standard), with an optional four-nozzle configuration. The standard dual-nozzle flow rate is 30L/min, and the optional four-nozzle flow rate can reach 40L/min, with adjustable droplet sizes ranging from 50μm to 500μm, suitable for both broadacre crops and dense orchards. The magnetic-drive impeller pump is corrosion-resistant and durable, and the dual-channel electromagnetic flow meter provides real-time precision control without contacting the liquid, ensuring uniform spraying. The spreading system is equipped with a 150L hopper, a brand-new screw feeder, and a centrifugal spreading disc, with a maximum discharge rate of 400kg/min, double the load capacity of the previous generation, and a 270% increase in maximum flow rate. The four interchangeable feeder sizes support a variety of granular materials, with an effective spreading width of up to 10m, ensuring efficient and uniform spreading.

The T100 is equipped with an industry-leading multi-sensor safety system, integrating lidar, millimeter-wave radar, and a penta-vision camera array to achieve 360° full-range situational awareness. The lidar generates 300,000 data points per second, enabling high-resolution terrain mapping and real-time obstacle detection. The penta-vision camera array includes a low-light FPV camera, ensuring reliable visibility even in low-light environments. The system supports AR flight overlays and real-time lidar point clouds, providing intuitive operational awareness for pilots. The automatic obstacle avoidance and terrain following functions enable the T100 to safely navigate complex environments such as steep slopes, deep canyons, and dense forests, with an effective obstacle avoidance□□ speed of ≤13.8m/s and a safe distance of 2.5m (the distance between the drone and obstacles after braking and stable hovering).

The T100 is equipped with a high-power power system, adopting high-performance motors and carbon fiber composite propellers, providing strong lifting force and flight stability, and can withstand a maximum wind speed of 6m/s, suitable for operations in complex weather conditions. It is compatible with high-capacity intelligent flight batteries, supporting ultra-fast charging with the D12500iE all-in-one variable frequency charging station and CC15000 on-board charger, which can charge the battery from 30% to 95% in 7-8 minutes, ensuring continuous large-scale operations without long downtime.

The T100 is equipped with advanced intelligent flight algorithms, supporting fully automated operations, including automatic route planning, automatic spraying/spreading, and automatic return. The drone supports 4G enhanced image transmission and O4 image transmission relay, ensuring stable signal transmission in remote areas. The D-RTK 3 agricultural version is optional, achieving high-precision hovering and operation, which is compatible with global agricultural operation standards. The T100 is designed to meet the technical requirements of various regions around the world, complying with NCC/MIC/KC/CE/FCC and other international certification standards, and can be flexibly adapted to the agricultural operation needs of different regions, including Europe, Central Asia, Africa, and other markets.

Both the T70P and T100 (170kg version) inherit DJI Agriculture's consistent technical advantages, with comprehensive upgrades in load capacity, operational efficiency, safety, and intelligence. The T70P focuses on high-efficiency multi-scenario operations, suitable for medium and large-scale farms and complex terrain operations; the T100 focuses on large-load, large-scale commercial operations, meeting the needs of large-scale agricultural production. Both models adopt advanced safety systems and intelligent operation functions, complying with global white paper standards and international certification requirements, providing professional, efficient, and safe agricultural operation solutions for global farmers, and promoting the development of precision agriculture and sustainable agriculture worldwide.

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VI. Epilogue

As a brilliant integration of cutting-edge technology and agricultural productivity, agricultural drones are constantly evolving with breakthroughs in load capacity, expanding applicable scenarios, and iterative application of innovative technologies, which aligns seamlessly with the core goals of international organizations such as the FAO to achieve food security, promote sustainable agricultural development, and reduce rural poverty; by transforming arduous, labor-intensive farming into efficient, intelligent, and precise operations, they not only elevate the overall value of agricultural production, enhance resource utilization, and break through geographical constraints to promote equitable food distribution, but also kindle hope for rural revitalization, beckoning young people back to their hometowns to leverage technological literacy for entrepreneurial dreams, and as they continue to evolve, they will undoubtedly breathe more vitality into global agriculture, bridge the urban-rural divide, and help realize FAO's commitment to a world with safe, sufficient, and sustainable food.

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