CropLife INDIA

FICCI

Technical Discussion Paper on

DRONE USAGE FOR AGROCHEMICAL SPRAYING

JULY 2020





Introduction

Drones have proven to be among the most promising technologies emerging from the Fourth Industrial Revolution. Unmanned aircraft systems (UAS), commonly referred to as drones, are democratizing the sky and enabling new participants in aviation.

Indian agriculture is yet to reap the full benefits of the economic reforms initiated in 1991. In addition, they are faced with structural challenges that include fragmented landholdings, lack of adequate market connect, rising costs (especially of human labour), poor/below par yields in most crops and – not the least – low usage of modern technology relative to their counterparts in the US, Europe, Brazil, Argentina or China.

Satellite-driven technology, big data analytics and digital solutions are helping farmers in many countries today to make better and more informed cropping decisions with regard to weather changes, soil nutrient application, and pest and disease control. Many of these technologies are likely to be introduced in India over the next few years.

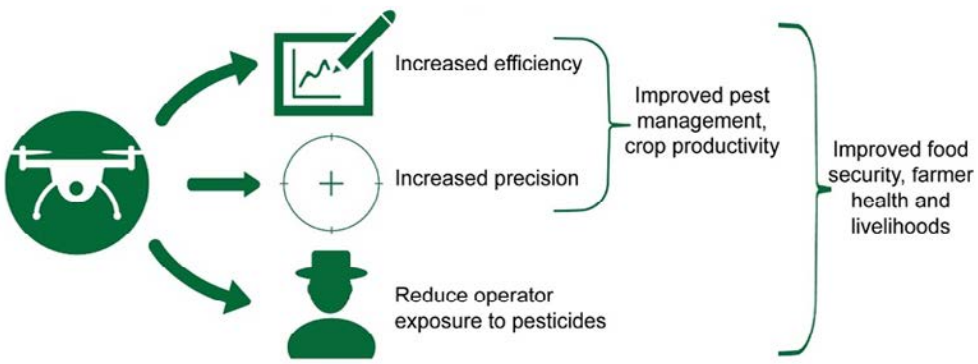
One area, which can have a major impact on our farms and needs quick government intervention is the use of drones for spraying of agrochemical products.

The objective of this Technical Discussion Paper is to **recommend that Indian Government develops a regulatory framework for deploying drone in agrochemical spraying based on best practices.**

The main benefits of drones in agrochemicals are the following:

- Increased efficiency and precision of agrochemical application that, in turn, leads to improved pest management and crop productivity and eliminate or reduce wastage of CP products.
- Significant reduction in risk of operator exposure during spray operations
- The field capacity of drone-assisted spraying is about 20 times higher compared to that of manual spraying
- Lower water consumption
- Development of certified applicators, including community spraying professionals providing application services, thereby creating new skilled employment and entrepreneurship potential in rural India

Benefits of drones for pesticide application



The benefits of this innovative technology to farming can be maximized by minimizing the potential risks that comes with the unfamiliarity and rapid adoption of such emerging technologies.

Asian Scenario

Drones in agrochemical application have, in just a few years, grown in sophistication and scale, boosting the ease, confidence and affordability of use. The good news is that this innovation is being driven largely by Asia. The adoption of drones in farms is the highest in countries such as China, Korea and Japan, which are also confronting growing labour shortage challenges from urbanization and aging populations

- According to a study by Goldman Sachs[1], the agriculture sector is predicted to be the 2nd largest user of drones in the world by 2021.
- As per a study by Food and Agriculture Organization of the United Nations[2]; in China alone, the number of agriculture drones is estimated to have doubled between 2016 and 2017, reaching 13,000 aircrafts and 30M hectares of crop land was sprayed by drones in 2019.
- The economies of scale in usage have meant that the operating costs per hectare in some Asian countries are now equivalent to just Rs. 100 - 150 for field crops (rice, wheat and maize) and Rs. 250 - 400 in orchards.

Indian Scenario

Indian Agriculture has gone through many advancements and benefited by research and adoption of new technologies by farmers. Technologies like drip irrigation, mechanized farming for planting and harvesting are being successfully used for sustainable agriculture in India. In recent years, use of drone in agriculture has gained lot of attention on digital space including its use as an alternative equipment for spraying. The intelligent use of UAV technology can help fight highly mobile invasive pests such as Fall Armyworm (FAW) and desert locusts more efficiently and effectively; prevent them from becoming endemic and reduce the cost of production while maintaining high agricultural productivity.

Recently Government of India, as a special case has recommended usage of drones for spraying operations to control the locust as band application and save the crops, where certain State Governments have issued e-tenders for the inclusion of drones in aerial pesticide applications. Ministry of Agriculture[3] has come up with broad specifications for drones that can fly at night and stay airborne for night duty in locust flight, making India the first country to do so.

While the safety and exposure of operator during application of Crop Protection Products (CPPs) have been a concern, labor shortage and economics of crop protection are emerging issues. Use of drone for spraying with proper training of operators and use of PPEs would offer many advantages, which calls for looking at this technology in more holistic way considering its benefits.

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[1]For more details please refer - https://www.goldmansachs.com/insights/technology-driving-innovation/drones/ ;Neha Chamaria, 'Drone Usage in Agriculture Could Be a $32 Billion Market', Fox News Business, 25 November 2016. Available at - https://www.foxbusiness.com/markets/drone-usage-in-agriculture-could-be-a-32-billion-market

[2] Gerard Sylvester (Edited),'E-Agriculture in Action: Drones for Agriculture'Food and Agriculture Organization of the United Nations and International Telecommunication Union, Bangkok, 2018. Available at - http://www.fao.org/3/I8494EN/i8494en.pdf

[3]Alnoor Peermohamed, 'Agriculture ministry eyes drones to fight off locusts swarms', The Economic Times, 29 June 2020. Available at - https://tech.economictimes.indiatimes.com/news/technology/agriculture-ministry-eyes-drones-to-fight-off-locusts-swarms/76681156

Use of Drone for spaying CPPs will overcome the challenges faced in current conventional sprays as follows:

Challenges with Conventional Spray	Benefits by using Drones for Spraying
• Laborious, time consuming and less efficient.	• Convenient, fast and highly efficient.
• Operator pesticide exposure can occur during application using backpack or tractor sprayers	• No / minimal exposure during spraying.
• Improper application and non-uniform coverage caused by backpack application that requires a moving spray wand, maintaining a consistent walking pace, and influenced by human	• Autonomous flight capacity with consistent speed, flight stability, and RTK/GPS capability provides precision spray with uniform coverage.
• When there is sudden pest/disease outbreak, farmer's ability to complete an application may be slow resulting in suboptimal crop protection	• In case of sudden pest/disease outbreak, spraying operations can be done efficiently and acreage covered quickly in a short period of time.
• Unskilled and novice operators	• Trained and certified operators
• Low ROI (time consuming, more water consumption, increasing labor cost)	• Better ROI (Return on Investment) offsetting the high operational cost
• More water consumption	• Less water consumption
• High variation in accuracy delivering labeled product rates.	• Low variability in accuracy delivering labeled product rates.

Drone use Regulations – Global Scenario:

- Use of Drone for spraying crop protection products offers more benefits and is suitable equally for smallholder farms as well as the large farms; it is gaining more popularity in Asian countries.
- Japan has an extensive 30 years of experience using single rotor remote-controlled helicopters (unmanned drones) for spraying crop protection products and have well established guidance document.
- Similarly, use of Drone for spraying crop protection products is regulated in South Korea and Malaysia. China has established a civil aviation law and SOP, tolerating chemical spray applications of conventionally registered products while fine tuning the guidance. In other countries such as Philippines, Indonesia, Thailand, Taiwan etc. the guidance documents are under development.

- Latin American countries are commercially using drones in small scale and also determining suitability for multiple crops.
- In the USA, the EPA (Environmental Protection Agency) allows the use of pesticide application using drone technology when in compliance with federal aviation rules and if manned aerial application is present on the label.
- The European Union, known for their restriction of manned aerial application, is now considering the use of drone pesticide application. The EU is developing guidance for use of Drones for spraying CPPs for areas inaccessible to vehicles and where manual spraying is difficult e.g. Grapes orchards on sloppy hills. Recently, Switzerland has approved use of Drone for spraying on agriculture crops.
- Australia and New Zealand have embraced Drones technology and are governing the use of drones in Agriculture and management of weeds.

Drone use Regulations in India

In India usage of drones for military purposes started during 1999; however in 2014, India imposed a sudden ban on the use of civil drones. Ministry of civil Aviation, Government of India published a regulatory policy regarding the use of drones in 2018.

The Directorate of Plant Protection, Quarantine & Storage, Faridabad issued 'Standard Operating Procedures (SOP)' [4] on aerial spraying using aircraft/helicopter/drone for control of Desert Locust on 18th May 2020 (please refer Annexure- 6 on point-wise comments from CropLife India).

While on the other hand, the Ministry of Civil Aviation issued Draft Notification on 'The Unmanned Aircraft System Rules, 2020' [5], on 2nd June, 2020

We strongly believe, that it would be in the interest of farmers and the Agriculture in India if drone technology can be deployed on a large scale for agrochemical applications.

This should be supported by a robust and pragmatic science-based policy framework; with Japan's revised guidance document serving as the most suitable point of reference, while drafting our guidance documents. The focus should be to minimize the potential risks by promoting active learning and rapid adoption of this well-developed & globally extensively tested technology.

Principles for Building a Sound Regulatory Framework



[4] For more details please refer to - http://ppqs.gov.in/divisions/locust-control-research/important-information; http://ppqs.gov.in/sites/default/files/sop_on_aerial_spraying_including_use_of_drones_0.pdf

[5] Draft The Unmanned UAS Rules, 2020, Ministry of Civil Aviation. Available at - https://www.civilaviation.gov.in/sites/default/files/Draft_UAS_Rules_2020.pdf

The first step in establishing a robust policy framework is to identify & minimize the various risks associated with drone application and the processes and procedures to deal with them. These cover the specifications for the drones (unmanned aerial vehicles or UAVs) and the product formulations being used, the capabilities and training standards of the spray operators, and environmental variables. Based on these, a Standard Operating Procedure should be put in place for spray operators, drone manufacturers and agrochemical companies to comply with (Annexure- 3).

It is worth looking at Japan and borrowing from their requirements, both for licensing of UAVs and operators as well as product registration for drone spraying, as stipulated in the country's most recently revised 2019 guidance document. Having one of the longest histories in the use of UAVs – particularly, remote controlled helicopters (RCH) – for spraying of agrochemicals and with over 30 years of data generation, Japan provides the strongest point of reference for regulators to frame the appropriate rules and SOPs.

Keeping the above points in background, the following needs to be considered prior to drafting a guidance document -

- The necessary regulations should take into consideration (1) civil aviation laws (both local and umbrella) and setting of vehicle specifications, (2) SOPs and piloting requirements for safe use of drones, and (3) product approval and permissions for spray operations.
- In addition to these general regulations, we would recommend at least five other criteria to be met for obtaining permission: (1) approval of vehicle needs, (2) licensing or certification of pilots/operators and training for agrochemical application by drones, (3) registration of agrochemical product sought to be sprayed, and (4) Encouragement for fast approval of ULV formulations or allowing mixing of mineral oils to the existing formulations, so as to serve the purpose of ULV formulations, however, by proper testing of flash point (5) Strict adherence to product label instructions (depicted in annexure 2).
- More specifically, we propose[6] setting up a system for certification or licensing of drone operators to ensure their capability to pilot the UAV machines safely. Such certification/licensing should be subject to regular renewal and conducting of refresher courses. The authorities should also accredit training facilities to put in place a standardized programme for all agricultural drone operations.
- The **Product Registration Process** for inclusion of drone as alternate equipment for application of CPP must be simplified & time-bound and should not be duplicated from scratch as the drone use is just an extension in the case of a formulation already approved for conventional manual spraying. The idea is to reduce registration timelines and make available the same crop protection products to farmers quickly, without compromising on safety and efficacy. A reasonable and predictable timeframe for all the regulatory clearances will create a vibrant and a compliant ecosystem that attracts more investment in the sector.

[6]Asitava Sen ' Flight to Safety', The Indian Express, March 12, 2020. Available at - https://indianexpress.com/article/india/flight-to-safety-the-case-for-drones-in-spraying-agrochemicals-6310121/

- Japanese guidelines stipulate that the bio-efficacy and maximum residue limits data for drone/UAV applications be considered equivalent to that of conventional spraying, so long as the critical parameters (active ingredient dose per hectare, pre-harvest interval and number of applications/sprayings) are within a determined range. There is no need, therefore, for any separate UAV bio-efficacy and residue trials, even if an additional crop safety study might be required in some conditions.

Japan: Registration requirements of pesticides by drone application

Type of date requirement	**Label extension** of registered formulation from conventional application to UAV application	**New formulation** for UAV application
Bio-efficany data	**Exempted** if pest/disease claim and critical GAP (Crop, Dose PHI) is within the range of existing registration. If not, full data requirement	**Full data requirement** by UAV application
Crop residue data	**Exempted** if critical GAP is within the range of existing registration. If not, full data requirement	**Exempted** if critical GAP is within the range of existing registration
Crop safety data	**Full data requirement** by UAV application	**Full data requirement** by UAV application



Potential Risk & Mitigation Strategy

1. Identifying and mitigating the potential risks associated with drone application in spraying of crop protection products is an important aspect. These include risks to the operator, bystander, the crop itself as well as the environment.
2. The potential mitigation measures used globally cover:
    a. Use of duly approved remotely piloted aircraft systems (RPAS)
    b. Agrochemical formulations being used
    c. Capabilities of the pilots and operators
    d. Environmental variables
3. Given these aspects, spraying operations should be permitted only for authorized drone spraying entities under certification / license from the regulatory authorities and must adhere to the policy and guidelines issued from time to time. In addition, the RPAS itself must comply with the Indian regulations as required by the Government.
4. In some provinces of Australia, aircraft pilots and companies operating in the domain of chemical spraying on agricultural lands are required to possess licenses[7]. Moreover, such aircraft pilots are mandatorily required to have undergone necessary training for such operations[8]. Such relevant regulatory requirements mandated by governments in different countries must be studied and incorporated in preparation of risk mitigation strategy and SOPs with respect to spraying of CPPs through UAV platforms in India.
5. We propose that FICCI Committee on Drones and CropLife can jointly coordinate consultations with all stakeholders including various ministries[9] and agencies. Such deliberations shall be most useful to ferret out genuine concerns and prepare comprehensive guidelines, best practices and standard operating procedures for such operations.

[7]Using chemicals responsibly', Northern Territory Government, Australia. Available at - https://nt.gov.au/industry/agriculture/farm-management/using-chemicals-responsibly/spray-applicator-licences

[8]Aerial distribution of agricultural chemicals', Queensland Government, Australia, Available at - https://www.business.qld.gov.au/industries/farms-fishing-forestry/agriculture/land-management/chemical-controls/aerial-distribution ; 'Agricultural Chemicals Distribution Control Regulation 1998', Queensland Government, Australia, Available at - https://www.legislation.qld.gov.au/view/pdf/inforce/current/sl-1998-0135 ; 'Agricultural And Veterinary Chemicals (Control Of Use) Act 2004', Northern Territory Government, Australia, Available at - https://legislation.nt.gov.au/en/Legislation/AGRICULTURAL-AND-VETERINARY-CHEMICALS-CONTROL-OF-USE-ACT-2004

[9]In case of Israel, the regulations on aerial spraying of pesticides were shaped by multiple ministries. For more details see – 'Natural Resource Aspects of Sustainable Development In Israel', Submission of Israel at the 5th Session of the United Nations Commission on Sustainable Development, 01/04/1997. Available at - https://www.un.org/esa/agenda21/natlinfo/countr/israel/natur.htm

Potential Risks Associated with Drone Operation

Risk Category	Guidance	Measures
Vehicle Risk	• Civil Aviation	• Permits for UAVs meeting defined specifications
Flight Operations	• Standard Operational practice (SOP) • Pesticide Guidance	• Pilot training and licensing scheme • Set safe boundary conditions (height, velocity etc.)
Risk to Operator & Bystander	• Standard Operational practice (SOP) • Label Instructions • Stewardship • Pesticide emergencies and emergency response	• Set boundary conditions for drone use ensuring safety • Label instructions for spray applications • PPE requirements for mixing and loading
Risk to the Environment	• Standard Operational practice (SOP) • Label Instructions • Stewardship	• Clean-up and contrainer disposal • Minimize drift by ▫ Set boundary conditions of (velocity, wind speed etc.) ▫ Nozzle type, pressure and calibration ▫ Mitigation measures as per label
Risk to crops	• Avoid phytotox damage • Standard Operational Practice (SOP) • Label instructions • Stewardship	• Check for phytotox risk • Mitigate drift by boundary conditions and label • instructions • Select suitable application parameters (e.g. coarser nozzle selection, broadcasting granules etc.)

Proposed Roadmap for application of agrochemicals via Drones in India

I. **DAC should issue separate SOP for spraying of agrochemicals through aerial operations and through use of UAV (drone) as both are based on exclusive technologies and employed for different uses in field or agriculture.**

ii. **ICAR expert committee report on drone to be considered for framing SOP/ guidelines for "Krishi drones".**

iii. **Adopt learnings of Regulatory framework and best practices from a forward moving country like Japan.**

iv. **Permission on usage of "Krishi drones" to be facilitated through digital sky platform registration in ICAR platform linked to civil aviation portal.**

v. **Guidance Document:** There is urgent need to develop a guidance document for regulating use of Drone for spraying CPPs by Ministry of Agriculture & Farmers Welfare (MoA&FW).

vi. **Standard Operating Procedure (SOP):** Develop Best Management Practices (BMP's) that mitigate variables impacting optimal drone pesticide application.

vii. **Guidelines for Endorsement of Use of Drone in product Label and Leaflet as Additional Equipment for Application of CPPs -** To be established by Central Insecticides Board and Registration Committee (CIB&RC) and use of Drone as alternate equipment for spraying is to be endorsed on label and leaflet of the CPPs. The data requirements for obtaining endorsement of use of drone as alternate equipment on label and leaflet of an already approved crop protection product is proposed in Annexure 1.

Provisional approval for use of CPPs having approved label claim on specific crop against specific pest/disease /weed as foliar spray using conventional spray equipment be allowed for use on same crop against same pest / disease / weeds with same active ingredient dose as foliar spray using Drone as alternate equipment for spraying until next five years.

viii. **Enabling Environment:** Ministry of Agriculture and Farmer's Welfare (MoA&FW) to create favorable environment for promotion of drone use in commercial farming besides its use for research, field trials, education, demonstration, validation or other agricultural uses by or on behalf of farmers or its use as a service by commercial/private organizations via opening of Training centers for agri-pilots, imparting knowledge of agriculture/product attributes and extending subsidies to certified trained pilots for purchasing/renting of Agri-Drones etc.

Conclusion

It would be in the interest of farmers and Agriculture in India if UAV/drone technology can be deployed for agrochemical applications. This should be supported by a robust and pragmatic science-based policy framework. We hope that the Ministry of Agriculture & Farmers Welfare (MoA&FW), CIB&RC, Ministry of Civil Aviation (MoCA) and Ministry of Home Affairs (MHA) will jointly facilitate a supportive policy framework for use of drones for application of crop protection products in India.



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List of Annexures

1. Proposed Requirement for Approval of Drone Use as Alternate Equipment for Spraying Crop Protection Products
2. Workflow for Using Drone for Spraying Crop Protection Products (CPPs)
3. Recommended Standard Operating Procedure (SOP) for Drone Operation
4. The JMAFF (Japan) Communication on UAV simplification 2019: talks about the registration requirements
5. CropLife International Stewardship Guidance for Use of Unmanned Aerial Vehicles (UAVs) for Application of Crop Protection Products
6. CropLife India's Feedback/Observations/Perspective on SOP for Aerial Spraying by Aircraft /helicopter/drones and Report of the Sub-committee to frame the guidelines for use of drones for pesticide applications in Locust control, Plant protection and Public health.



Annexure-1
Proposed Requirement for Approval of Drone Use as Alternate Equipment for Spraying Crop Protection Products

Pre-requirement:

1. **Formulation Suitability:** Stability of formulations after diluting in required quantity of water i.e. 15 to 50 lit. Water / ha (which is required for application by Drone). There should not be foaming, sedimentation, etc.

   (Note: Generally, most high-quality formulations/Products are suitable for Drone including SC, WDG, OD, EC types.)

Requirements:

A] Product is Already Approved for Use with Conventional Spray Equipment:

For Crop Protection Products which have approved label claims for use on specific crops against specific pests / diseases / weeds when foliarly applied using conventional spray equipment's e.g. back pack sprayer, etc. and submitting application for obtaining label claims on same crops against same pests / diseases / weeds with same approved active ingredient dose as foliar spray using Drone as alternate equipment for spraying.

Studies	Insecticides	Fungicides	Herbicides	Plant Growth Regulators
Bio-effectiveness	NR	NR	NR	NR
***Phytotoxicity (crop safety)**	1-2 L 1 S	1-2 L 1 S	1-2 L 1 S	1 L 1 S
Effect on parasites & predators	NR	NR	NR	NR
Effect on Succeeding Crop	NR	NR	NR	NR
Persistence in Plant	NR	NR	NR	NR
Residue in Plant	NR	NR	NR	NR
Residue in Soil	NR	NR	NR	NR

L – Location S – Season NR – Not Required

Minimum plot size (International Standard): 320 sq. m (20 m x 16 m)

*J-MAF permits a simple potted plant phyto-toxicity test

B] For New Products Approval (for combined approval with Knapsack and Drone application):

Studies	Insecticides	Fungicides	Herbicides	Plant Growth Regulators
Bio-effectiveness	3 L 2 S	3 L 2 S	3 L 2 S	3 L 2 S
Phyto toxicity (crop safety)*	3 L 2 S	3 L 2 S	3 L 2 S	3 L 2 S
Effect on parasites & predators	3 L 2 S	NR	NR	NR
Effect on Succeeding Crop	NR	NR	3 L 2 S	NR
Persistence in Plant	NR	NR	NR	NR
Residue in Plant	4 L 1 S	4 L 1 S	3 L 2 S	4 L 1 S
Harvest time Residue in Soil	4 L 1 S	4 L 1 S	3 L 2 S	4 L 1 S

L – Location S – Season NR – Not Required

All studies with back pack sprayer

*Additional study with Drone (1L1S if label claim is for both knapsack and drone spray, ***keeping rest of the studies data using conventional spraying only)***

Minimum plot size (International Standard): 320 sq. m (20 m x 16 m)

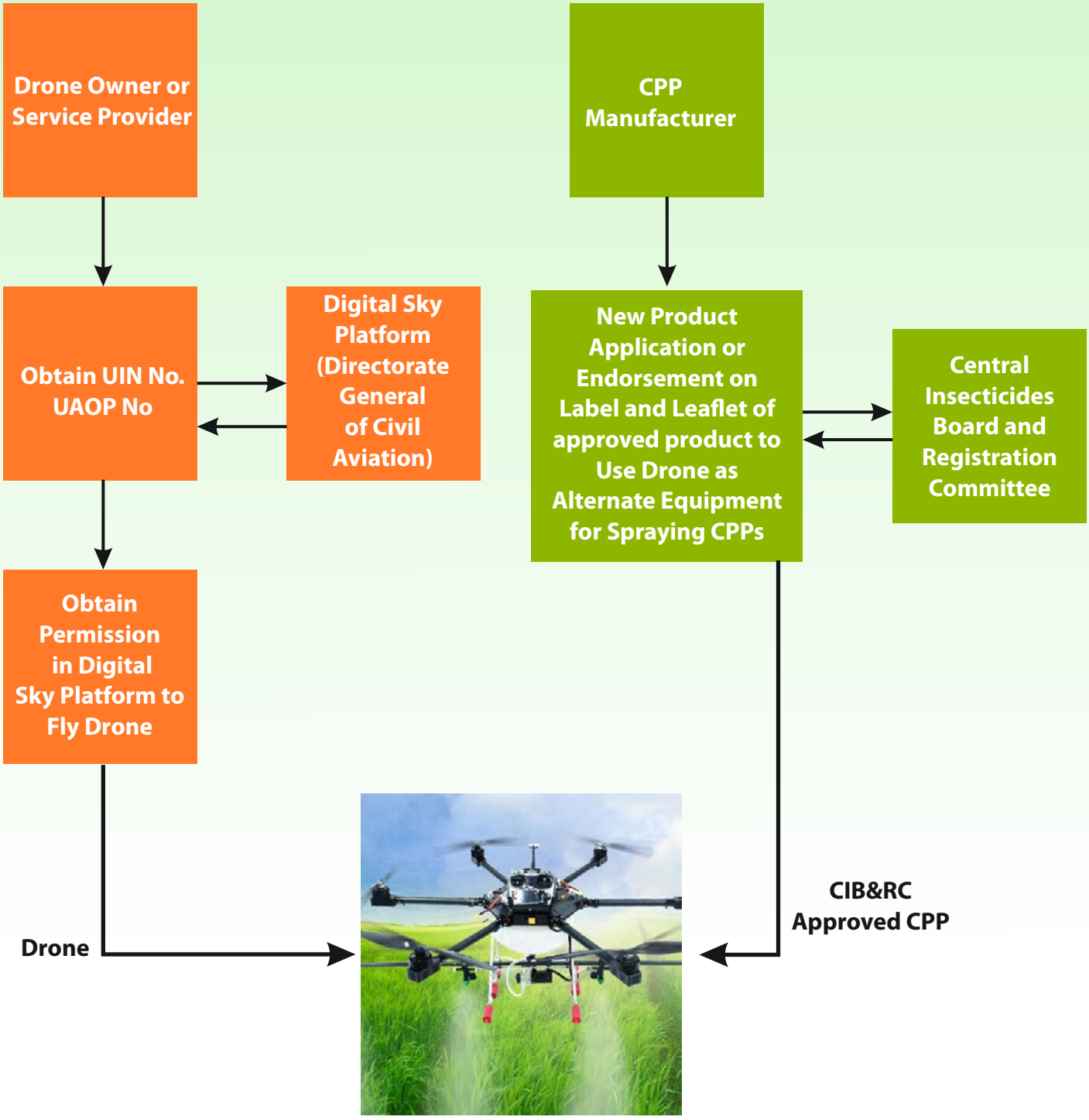


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Annexure-2
Work Flow for Using Drone for Spraying Crop Protection Products (CPPs)



Spraying of CPP on Crops Using Drone

UAOP: Unmanned Aircraft Operator Permit

UIN: Unique Identification Number



Annexure 3
Recommended Standard Operating Procedure (SOP) for Drone Operation

Pre-application:

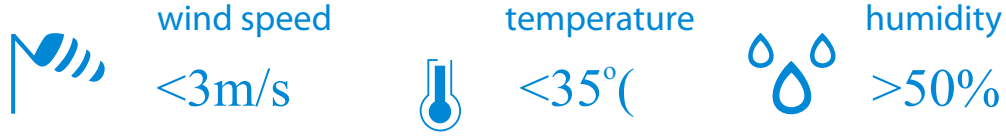
1. Confirm not to fly in the drone-forbidden area (airport or electronic station).
2. Understand the local aviation laws and regulations where they operate.
3. Ensure the operators are trained on both drone operation and safe use pesticide. Use adjuvant against evaporation and drift ability (methylated seed vegetable oil – MSO or other oils).
4. No alcoholic drinks within 8 hours preceding operation.
5. Calibrate drone spray system to ensure nozzle output and accurate application of labeled rates.
6. Check drone in good condition, no leak in the spraying system.
7. Confirm place for takeoff and landing, tank mix operations.
8. Check and mark the obstacles (walls, trees) around the field for safe operation.
9. Set up at least buffer zone (as specified in SOP) between drone treatment and the non-target crop.
10. Confirm water sources - Do not spray pesticides near water sources (less than 100 m) to avoid polluting water sources.

During Application:

1. Read labels carefully to understand safety guidance.
2. Wear Personal Protect Equipment (PPE).
3. Do not eat, drink or smoke while spraying.



4. Confirm the flying route was reasonable to minimize turn around.
5. Operation team shall always stay at the downwind end of the field and backlight direction.
6. To spray with pure water first to test operation for at least 5 min.
7. Two step dilutions to fully dissolve the pesticide.
8. Adopt proper pressure for optimized droplet spectrum (approx 200µm).
9. Check weather conditions:
    a. Wind speed less than 3m/s,
    b. Temperature lower than 35 degrees,
    c. Humidity above 50%).



10. Flying height: 3m above target crop.
11. Water volume: normally 15-50 Lit./ha.
12. Flying speed: 3 - 6 m/s.
13. Avoid having to walk through crop which has been contaminated by drifting spray.
14. Do not spray during active bee foraging period of the day. Avoid spray drift to flowering nectar crop.
15. When spraying pesticides that are toxic to non-target organisms such as fish, birds and silkworm, strictly abide by the product label requirements and take effective measures to avoid risks.
16. Use anti-drift nozzle to decrease drift to human and environment (Air-mix, 110 01, 110 075).

Post Application:

1. Timely evacuation and transfer to fresh air.
2. Triple rinse of empty container is mandatory.
3. Ensure waste generated is kept to a minimum.
4. The disposal of waste must conform to the local laws.
5. Never burn or bury hazardous waste.
6. Never leave empty containers in the field. Send triple rinsed empty containers to the nearest approved collection site.
7. Set up warning signs in the spray area for reminding people.
8. Take a shower and put on clean clothes.
9. To prevent leakage of plant protection products in the process of transport and waiting to use.
10. Securely stored plant protection products away from unauthorized people, animals and food when transporting and storing PPP. Safely dispose all spills immediately.

Different Standards in Terms of; Prerequisites to Use Drones, Minimum Area, Climatic Conditions viz Temp., Wind Speed, Height of Application, Droplet Size, etc. to be followed in use of Drones to offset Drift and Air pollution.

Application / spraying of Crop Protection Products (CPPs) either using conventional spray equipment's or using drone, requires to follow stewardship measures. For use of Drone for spraying CPPs following key stewardship measures to be followed for excellent performance and safety.

	Flying Height	Travelling / Flying Speed	Spray Width	Water Volume /Ha	Nozzle Type
Drone	1.5 – 3 m above crop	3 – 6 m/s 10 minutes per acre	3 – 5 m (depends on rotor number and boom length)	15 – 50 Liters	Flat fan or controlled droplet applicator (CDA) nozzle with approx 200 µm Droplet size
Knapsack	0.6 – 1.0 m from the top and sides	1-2 m/s One hectare/ 8 hours	Single nozzle	360 – 500 Liter	Standard Hollow Cone / Flat Fan Nozzle
Tractor mounted boom sprayer	0.45 – 0.9 m above the crop	3 kms/hour One Hectares / Hour	Boom length approx. 11 meters (depend on nozzle number and boom length and position)	500 – 1000 Liter	Standard Hollow Cone / Flat Fan Nozzle





Annexure 4
The JMAFF (Japan) Communication on UAV simplification 2019

2018 MAFF/FSCAB Notification No 5541

22 February 2019

To

MAFF Food Safety and Consumer Affairs Bureau Plant Products Safety Division Director

HANDLING OF STUDIES WHICH REQUIRE DECLARATION AND SUBMISSION OF A METHOD FOR USING AN AGRICULTURAL CHEMICAL

In recent years, progress in the active use of drones for spraying agrochemicals, in order to save energy and increase efficiency, has led to studies regarding application of the Agricultural Chemicals Regulation Law (Law No. 82 of 1948) in relation to spraying of agricultural chemicals by using drones, etc., and/or the content of the test results which need to be submitted in relation to such spraying of agrochemicals.

Here we wish to clarify our interpretation of the Agricultural Chemicals Regulation Law in relation to the declaration of methods for using agricultural chemicals and spraying equipment, as in 1 below, and also inform you of reassessment of the results of studies required in relation to spraying of agrochemical, using drones, etc., as in 2 below.

Declarations of Understanding

1. According to the Agricultural Chemicals Regulation Law, in declaring "spraying of stems and leaves of weeds" and "comprehensive spraying of soil", etc., as methods for employing an agrochemical, the person employing the agricultural chemical is free to judge the spraying equipment to be employed for spraying the agricultural chemical, without any restriction as to the choice of the spraying equipment, including use of a drone.

2. The "Data Requirements for Registration of Agricultural Chemical" (2000 MAFF/APB Notification No. 8147 (12-Nousan-8147) by the Director, Agricultural Production Bureau, Ministry of Agriculture, Forestry and Fisheries dated 24 November 2000) has been revised in "Partial Revision of "Data Requirements for Registration of Agricultural Chemical" (MAFF/FSCAB Notification No 5464 (Director General, MAFF Food Safety and Consumer Affairs Bureau) dated 22 February 2019), (Appendix)

According to this revision, when applying for modification of the registration of an already registered agricultural chemical for use at a high concentration diluted several times in order to spray by using a drone, etc.,

(1) If the amount of the active ingredient deposited per unit surface area is within the range initially applied for, there is no need to submit crop residue tests in addition to those at the time of the initial application for registration.

(2) When a study on phytotoxicity can confirm the existence or otherwise of phytotoxicity, there is no restriction as to field studies.

- Table comparing data requirements for registration of agricultural chemicals (2000 MAFF/APB Notification No. 8147 (12-Nousan-8147) by the Director-General, Agricultural Production Bureau, Ministry of Agriculture, Forestry and Fisheries dated 24 November 2000) before and after the proposed partial revision (abridged) (Underlining shows the revised portions)

After revision

(Appendix)

2 Regarding conditions relevant to preparation of study results

The test results cited in Section I must be obtained by implementing the tests cited in the "Test items" column in Appendix Table 1, on the basis of the conditions cited in the "Conditions Necessary for Implementing Studies / Tests" column in the same table. The test methods are to be those stipulated in the appendix entitled "Guidelines on Preparation of Test Results Submitted When Applying for Registration Of Agricultural Chemicals"; but among results of studies relating to calculating predicted environmental concentrations "Monitoring of concentrations of the agricultural chemical in rivers" should only be applied in the case of agricultural chemicals which are currently receiving registration.

(Appendix Table 1)

Study / Test results	Test items	Conditions Necessary for Implementing Studies / Tests			
		Type of test substance	No. of trials/type of test crops or test animals, etc.	Implemen tation method number (see annex)	Implemen tation method number (see annex)
(omitted)	(omitted)	(omitted)	(omitted)	(omitted)	(omitted)
Results of studies / tests of residues in crops	Crop residue studies	(omitted)	(omitted)	Study /test facilities conforming to GLP standards for agricultural chemicals. However, for a crop whose production volume is low, GLP compliance is not required. Field trials shall be conducted according to the following standards. (1)-(6) (omitted) (deleted)	3-1-1
(omitted)	(omitted)	(omitted)	(omitted)	(omitted)	(omitted)

Current

(Appendix)

2 Regarding conditions relevant to preparation of study results

The test results cited in Section I must be obtained by implementing the tests cited in the "Test items" column in Appendix Table 1, on the basis of the conditions cited in the "Conditions Necessary for Implementing Test" column in the same table. The test methods are to be those stipulated in the appendix entitled "Guidelines on Preparation of Test Results Submitted When Applying for Registration Of Agricultural Chemicals"; but among results of studies relating to calculating predicted environmental concentrations "Monitoring of concentrations of the agricultural chemical in rivers" should only be applied in the case of agricultural chemicals which are currently receiving registration.

(Appendix Table 1)

Study / Test results	Test items	Conditions Necessary for Implementing Studies / Tests			
		Type of test substance	No. of trials/type of test crops or test animals, etc.	Implemen tation method number (see annex)	Implemen tation method number (see annex)
(omitted)	(omitted)	(omitted)	(omitted)	(omitted)	(omitted)
Results of studies / tests of residues in crops	Crop residue studies	(omitted)	(omitted)	Study / test facilities conforming to GLP standards for agricultural chemicals. However, for a crop whose production volume is low, GLP compliance is not required. Field trials shall be conducted according to the following standards. (1)-(6) (omitted) (7) When aerial spraying or unmanned helicopter spraying is added as a method of using an agricultural chemical registered for ground application, the number of test examples of this aerial spraying or unmanned helicopter spraying shall be at least half of the necessary examples (2 or more, when the number of examples necessary is 3).	3-1-1
(omitted)	(omitted)	(omitted)	(omitted)	(omitted)	(omitted)

After revision	Current
(Annex) **"Guidelines for Preparation of Study Results Submitted When Applying for Registration of Agricultural Chemicals"** **<Efficacy Studies>** **Efficacy study for target pests** **Efficacy and phytotoxicity studies (1-1-1)** 1. • 2. (omitted) 3. Study method (1) A study is carried out in the field (or in such facilitiesas are applicable). However, for phytotoxicity studies in the case of an already registered agricultural chemical, when the concentration used or the quantity used (quantity of active ingredient delivered) is increased, if a study can confirm the existence or otherwise of phytotoxicity, there is no restriction as to field studies. In addition, in order to achieve the purpose of the study there shall be plots treated with the agricultural chemical and untreated plots and as a rule plots treated with a control chemical, of an adequate area. Treatment with the agricultural chemical in the agricultural chemical treatment plots is with the method and at the quantity (concentration) used according to the request for registration. (2) • (3) (omitted) 4. (omitted)	**(Annex)** **"Guidelines for Preparation of Study Results Submitted When Applying for Registration of Agricultural Chemicals"** **<Efficacy Studies>** **Efficacy study for target pests** **Efficacy and phytotoxicity studies (1-1-1)** 1. • 2. (omitted) 3. Study method (1) A study is carried out in the field (or in such facilities as are applicable), with plots treated with the agricultural chemical and untreated plots and as a rule plots treated with a control chemical, of an adequate area for achieving the purpose of the study. Treatment with the agricultural chemical in chemically treated plots is with the method and dosage (concentration) relevant to the application for registration. (2) • (3) (omitted) 4. (omitted)

Supplemental (22 February 2019)
The stipulations as revised according to this notification shall apply to the results of studies submitted in support of applications for registration of an agricultural chemical carried out from 22 February 2019 onwards.

CropLife INDIA

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Annexure 5

CropLife International Stewardship Guidance for Use of Unmanned Aerial Vehicles (UAVs) for Application of Crop Protection Products

- Know and comply with the relevant laws.
- The Drone Operator should be trained both in Responsible Use of Agrochemicals & Drone Operations.
- **Spray Equipment –** Before spraying, flush water through the systems to remove residual air bubbles and check if any leaks can be identified from damaged connections, hoses, etc.
- **Documentation –** Check necessary documentation including UAV registration and license, pest control and/or chemical handling license. If a farmer hires a service to apply pesticides by UAV, they should check that the company being contracted has the appropriate documentation.
- **UAV fit for flight –** Carefully go through the manufacturer's pre-flight checklist and check every part for signs of damage or obstruction. Ensure that batteries and reserves are adequately charged, and that battery charging equipment is available if required. Check functioning, controller, etc. If the UAV is hybrid or gas powered, ensure that there is sufficient fuel in a container safe to store and transport.
- **Firmware –** According to the manufacturer's instructions, check the UAV firmware and ensure it is up to date. Ensure that your UAV is always calibrated for connectivity, navigation, and behaviour. Check pre-flight settings e.g. compass, LED status, satellite locks, gimbal level, and flight controls.
- **Calibrate Sprayer –** Good UAVs will be fitted with an automatic internal-pump calibration system. Test water should be added according to the manufacturer's instruction, the amount and nozzle types entered into the system and the UAV set to run the calibration system on the ground. This should be repeated for a second pump if it is present. Placing graduated measuring cups under the nozzles will allow the comparative outputs to be judged. Any irregularities could mean that nozzles are worn or damaged and need to be replaced. If this is not the case, then there is an imbalance in the system that may require further investigation according to manufacturer's recommendations.
- **Flying conditions and itinerary –** Check the weather and temperature. Understand the area to be treated, as well as the surrounding area, including water bodies, other cropping areas, residential areas, and beehives.
- **Crop and pest targets –** The identity of the crop, growth stage and canopy height should be confirmed along with the location of pests and diseases. It is important to check that the nozzles, pressure settings, and formulation are appropriate for delivering the right sized droplets for the job. Only pesticides appropriately registered for use against the target from UAV application should be used. Understand the pesticidal attributes of the product and follow label directions-for-use to optimize crop protection.

✓ **Always Use Personal Protective Equipment, while handling Agro-chemicals.**
✓ **Save yourself from fake products by insisting on Receipt of Purchase.**



Annexure 6
CropLife India's Feedback/Observations/Perspective on SOP for Aerial Spraying by Aircraft /helicopter/drones and Report of the Sub-committee to frame the guidelines for use of drones for pesticide applications in Locust control, Plant protection and Public health.

Report/ Observations of CIB Sub-committee	CropLife India's Observations/ Comments/Perspectives
Provisions under the Insecticides Act/Rules	
• The Board after deliberation approved the Sub-Committee Report to frame guidelines for use of drones for insecticide (pesticides) applications in locust control, plant protection and public health…..and Standard Operating Procedure (SOP) for aerial spraying of insecticides prepared by the Directorate of Plant Protection Quarantine and Storage, Department of Agriculture, Cooperation and Farmers Welfare, which also include use of drone, as per Annexure XIII. • One of the functions of the board is to specify the uses of the classification of insecticides on the basis of their toxicity as well as their being suitable for aerial application (Rule 3(b)).	• The SOP of Aircraft and Helicopter should not be applied to Drones (UAS) for application of pesticides for locust control as Drones are based on exclusive technologies and employed for different uses in agriculture ecosystem. • It would be appropriate to develop a separate SOP on use of UAS (Drone) for application of pesticides in locust control, plant protection and public health. • The MoCA has also released separate draft UAS Rules, 2020 for regulating Drones to separate it from Aircraft Rules, 1937. • The height of spray with Drone and Aircraft/Helicopter are not comparable and consequentially spraying through drones (1-3 m height) offers a much safer and precise application of pesticides.
• As per the provisions of the Insecticides Act and Rules, Label/leaflets are approved by the Registration Committee (RC) under the Act. These label/leaflets besides other information also provide information on the type and stage of crop, pest-diseases to be controlled, equipment to be used for application of pesticide, dilution, rate of spray, conditions of spray etc. based on the data submitted by the applicant to the Registration committee. Hence, before permitting the application of pesticide through Drones, data generated as per guidelines of the RC (yet to be framed for drones) need to be evaluated for ensuring the efficacy of the product and its safety to human and environment.	• Pesticide application via Drone should be considered as alternate equipment for application of pesticides and there should not be undue apprehension about their safety and success under Indian agricultural conditions. • Integration of Drone is not going to impact our approved product usages viz. stage of crop, pest-diseases to be controlled, rate of application of pesticide, conditions of spray etc., therefore, generation of additional data as insisted by CIB & RC is not going to give further benefit, rather it will delay the introduction of Drone technology. • Drone technology can ensure proper coverage of the foliage, it can operate over sodden fields and tall crops where no machine could normally move, go quickly to exact locations to treat target areas precisely, as well as be pre-programmed to navigate their own way around. • Integration of Drone should be considered as endorsement of alternate equipment for application /spraying of pesticides which broaden the scope for farmers to use advance and user-friendly technology for our own farm treatment. However, if insisted or required, the crop injury / phyto-toxicity studies from one or two location may be asked to make sure the crop safety. • In future and under COVID situation, this technology

Report/ Observations of CIB Sub-committee	CropLife India's Observations/ Comments/Perspectives
	should be considered as boon because labour crisis in the field of agriculture is becoming one of the biggest challenges, as younger workers leave to seek more profitable employment in cities, an aging workforce is left in rural areas. In India and many developed countries, it is increasingly becoming an issue leading to an increased demand for labor saving, efficient technologies. Spraying from Drone offers substantial labor-saving opportunities.
Development of Guidelines for Drone use in India	
• A committee was constituted by Department of Agriculture, Cooperation & Farmers Welfare (M& T Division), Ministry of Agriculture & Farmers Welfare, Government of India in May 2019 under the chairmanship of Dr. K. Alagusundaram, DDG (Agri. Eng.), ICAR • The terms of reference of the Committee are to develop guidelines for operation of drones in application of spraying of pesticides, growth hormones, fertilizers in different crops at different stages.	• Committee under chairmanship of Dr. Alagusundaram worked extensively on use of Drone in agriculture for application of pesticides. They involved & considered views of stakeholders ranging from Drone manufacturers & service provider to pesticide industry and farmers. • The report / recommendations of Dr. Alagusundaram Committee jointly discussed in meeting held on 20th February 2020 (also attended by representatives of CIB&RC) may kindly be considered in holistic manner as it incorporate inputs from multiple stakeholders.
• No further guidelines of M/o Civil Aviation exist w.r.t. clause 12.18 which refers to special clearance for discharging or dropping the substances. • Clarification is required from the M/o Civil Aviation w.r.t. clause 12.19 in their guidelines which prohibits the transport of hazardous material in RPA.	• Ministry of Civil Aviation (MoCA) published draft UAS Rules, 2020 through Gazette Notification dated 2nd June 2020. • As per rule 36 and 38 of this draft Rules, DGCA shall specify the payload to be carried by Drones and dropping of articles from Drone, respectively.
Guidelines /Scenario in other Countries	
• EU: Aerial application including use of drones is completely banned.	• The European Union, known for their restriction of manned aerial application, is now considering the use of drone pesticide application. EU is developing guidance for use of Drones for spraying pesticides for areas inaccessible to vehicles and where manual spraying is difficult e.g. Grapes orchards on sloppy hills. Recently, Switzerland has approved use of Drone for spraying on agriculture crops.
• Switzerland: pilots must receive authorisation, meet comprehensive safety regulations and keep drift below a defined threshold.	
• USA: Use of drones is permitted provided pilots comply with strict Federal Aviation Operational Rules as well as requirement of aerial application.	

Report/ Observations of CIB Sub-committee	CropLife India's Observations/ Comments/Perspectives
• Canada: Drone use for pesticide application is illegal. • As most of the agriculture systems in India belongs small and marginal sector, it would not be the best option for small and marginal farmers to apply pesticides by drone technology. • Given the warm climate with wide range of variability it would be difficult to mitigate exposures and drift risk caused by pesticides. • Usually farmers have their residential huts/houses also in the same premises at a little distance and the live-stocks are also kept in the same farm making it further difficult to avoid the exposure. • The technology is expensive and its affordability by small and marginal farmers is to be seen. There are some sectors where the use of this modern technology may deliver benefits like • for control of big locust swarms; • in some public health situations to control vectors of diseases; and • for plant protection where corporate plantation is practiced like tea estates.	• When land holdings are very big, the application of pesticides through Aircraft or Helicopter is more economical than Drone. That is why acceptance of Drone for application of pesticides is more in Asian countries where land holdings are comparatively smaller than North America and Europe. • Drone Application Technology is also suitable for spraying pesticides in small and marginal agriculture farms including areas where manual spray operation is difficult as it offer following advantages • Precision in spraying • Less time required to spray unit area • Minimal or no operator exposure • Low water volume • The use of Drone for pesticide application is suitable for spraying in small land holdings as the spray area can be defined with precision (Geo-tag of the spray area). • The Drone Technology provides provision to avoid obstacles in the flying path which prevent any accidents and exposure as well. • Unlike backpack sprayers, farmers are not required to own the Drones & they can avail spray services from Drone service provider. • In addition to use of Drone in locust control, public health and plant protection where corporate plantation is practices like tea estates, Drone Application Technology is also suitable for spraying pesticides in small and marginal agriculture farms including areas where manual spray operation is difficult. • Advantages of Drone Spraying • Precision in spraying • Less time required to spray unit area • Minimal or no operator exposure • Low water volume Hence, drones are also useful in small and marginal agriculture farm sector for spraying pesticides.
Recommendations by Sub-committee	
• 1. A clarification is required from the M/o Civil Aviation w.r.t. clause 12.19 in their guidelines on Drones which prohibits the transport of hazardous material in RPA. As pesticides are hazardous substances, hence the clarification is required.	Clause 12.18 and 12.19 are related to Civil Aviation Requirements 1.0 published by DGCA under provision of the Aircraft Rules, 1937, which became effective in India from 1st December 2018. However, UAS Rules, 2020 (draft) have been published by MoCA through draft Gazette Notification dated 02.06.2020. As per these draft UAS Rules, DGCA shall specify the payload and dropping of articles as per rules 36 and 38, respectively.

Report/ Observations of CIB Sub-committee	CropLife India's Observations/ Comments/Perspectives
2. Applicant seeking permission for spraying of pesticide by RPA should obtain special clearance from M/o Civil Aviation for discharging or dropping the substances as per clause 12.18 of their guidelines.	
3. Applicant should comply and follow the guidelines of the Civil Aviation Ministry for use of RPA /drones and should have permission for undertaking the pesticide application operation.	Permission for Drone operations including payload and dropping of articles need to be taken by the applicant and comply with Drone regulations issued by MoCA. However, permission for undertaking pesticide application should be given by CIB&RC by way of label claim approval for products which are already approved for use with knapsack sprayer and have already undergone adequate risk assessment for their safety and efficacy. Suitable provisions needs to be made in Digital Sky Platform.
The application of pesticides through drones is permitted only for the following situations:	
ii) Use of Drone in Public Health • To control vectors of the diseases by M/o Health & Family Welfare under National Vector Disease Control Program. • In addition to compliance of requirements of the Civil Aviation Rules and other provisions under the Insecticides Act & Rules and other safety precautions, detail guidelines/SOP may be formulated by the M/o Health & Family Welfare • The proposal received from the Government authorities (Central or State Government/ Municipal Corporation) which comply to SOP shall be placed before the Central Insecticides Board for grant of permission.	• Guidelines/SOP may be formulated by the M/o Health & Family Welfare for use of Drone in Vector control. • There are provisions like, No Permission No Take-off (NPNT) available in Digital Sky Platform. • Drone application technology should be treated as alternate equipment and to be endorsed on the product label as alternate equipment only. The registered products have already undergone adequate risk assessment during the registration. • Since, spraying through Drone is not comparable with aerial application by using Aircraft and Helicopter (separate draft UAS Rules, 2020 issued by Ministry of Civil Aviation), the approval for use of Drone for spraying as alternate equipment in product label and leaflet may be granted by CIB&RC.
The proposals received by the IPM Division, Directorate of PPQ&S for granting permission for use of drone in agriculture/ horticulture will be examined by a Technical Committee (comprising of Plant Protection Experts& Medical Toxicologist) constituted by the Plant Protection Adviser prior permitting use of drone in agriculture/ horticulture. Plant Protection Adviser will submit details of such approvals in the subsequent meeting of the Board. The proposals complying to above requirements for application of pesticides through drones will be placed before the Central Insecticides Board for consideration and grant of permission for application of pesticides through drones for the specific purpose and for the specified period. Thereafter, renewal of permission will be required.	Spraying with Drone is not comparable with aerial spray done through Aircraft and helicopter. Hence, • The permission for use of Drone for spraying of pesticides may be given by CIB&RC by way of endorsement on label leaflet as alternate equipment for spraying. • Once Permission from CIB to use drone as an alternate equipment for spraying the pesticides is obtained, the renewal of such permission should not be required separately.

Report/ Observations of CIB Sub-committee	CropLife India's Observations/ Comments/Perspectives
Decision by CIB	
• The Board after deliberation approved: ➢ **The Sub-Committee Repor**t to frame guidelines for use of drones for insecticide (pesticides) applications in locust control, plant protection and public health. ➢ **Standard Operating Procedure (SOP)** for aerial spraying of insecticides prepared by the Directorate of Plant Protection Quarantine and Storage, Department of Agriculture, Cooperation and Farmers Welfare, which also include use of drone.	• We request that Industry / stakeholders views/comments on the Sub-committee report may kindly to be sought and considered before approval by CIB.



About FICCI Committee on Drones

FICCI has many specialised committees where key concerns of the industry are debated and discussed with the specific aim of presenting the recommendations to the Government for favourable decisions. FICCI has identified drones as one of the priority areas. FICCI Committee on drones (UAV / UAS / RPAS) has been working on the policy advocacy and the regulatory framework to facilitate the growth of ecosystem for drones in the country. This committee has been advocating for the holistic and responsible use of Drone technology across government agencies, agriculture, and enterprises.

Some of the focus areas of the Committee are -

- Regulatory Evolution
- Industry licensing regime
- Operations regulations
- Import/export-regulation
- Counter drone technologies
- UAV exports from industry
- Demand analysis for drones
- User sensitization / Formal education

Snapshot of the various FICCI studies on Drones:



FICCI Recommendations on the Draft UAS Rules, 2020



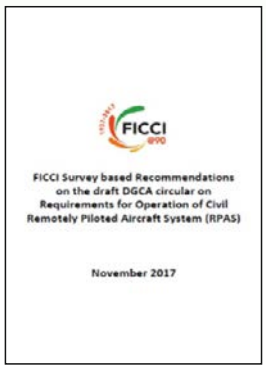
Covid 19 Scenarios–Emerging Role of Drones, 2020



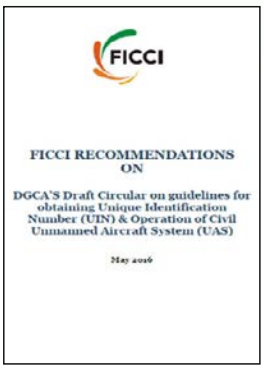
FICCI EY Countering Rogue Drones, 2019



Make in India for Unmanned Aircraft Systems (UAS), 2018



FICCI Survey based Recommendations on the draft DGCA circular on Requirements for Operation of RPAS, 2017



FICCI submission on DGCA's draft circular on Guidelines for obtaining UIN and Operation of Civil Unmanned Aerial Systems (UAS), 2016

About CropLife India

CropLife India is committed to advancing sustainable agriculture and it is an association of 15 R & D driven member companies in crop protection. We jointly represent ~ 70% of the market and are responsible for 95% of the molecules introduced in the country. Our member companies have annual global R & D spend of 6 billion USD and are firmly committed to engaging with the farming community to enable Safe, Secure Food Supply.

Our Members

Our Associate Members

About FICCI

Established in 1927, FICCI is the largest and oldest apex business organisation in India. Its history is closely interwoven with India's struggle for independence, its industrialization, and its emergence as one of the most rapidly growing global economies. A non - government, not - for - profit organisation, FICCI is the voice of India's business and industry. From influencing policy to encouraging debate, engaging with policy makers and civil society, FICCI articulates the views and concerns of industry. It serves its members from the Indian private and public corporate sectors and multinational companies, drawing its strength from diverse regional chambers of commerce and industry across states, reaching out to over 2,50,000 companies. FICCI provides a platform for networking and consensus building within and across sectors and is the first port of call for Indian industry, policy makers and the international business community.

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