Recommendations for building a Standard Operating Procedure (SOP) for pesticide application by drone

Executive summary

What has been driving the rapid adoption of agricultural drones in Asia?

In the last few years, the influx of digital technologies has disrupted the agriculture ecosystem, bringing with it however, significant promise to the shifting demographic in Asia and the world. These are some of the drivers that have led several farmers in Asia to ride on the global digital wave:

- A rapidly ageing or urbanizing population
- Land consolidation, that demand less intensive and more efficient agricultural application methods
- Widespread adoption of drone technologies has driven costs down, making them more accessible and affordable
- Increase sophistication in drone technologies boosting the ease and confidence of use

Governments need to respond swiftly to manage agricultural drones properly

The swift adoption of such nascent technologies requires governments to respond with a sound regulatory framework in a timely manner to prevent uncontrolled and inappropriate use of these applications. This paper provides a baseline document on managing the potential risks associated with drone application to guide governments with three main guiding points:

Take a risk-based approach:

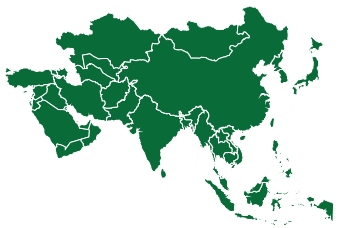
1. Consider the various risks associated with drone application which include operator capability, environmental variables, drone specifications and product formulation.
2. Based on these risks, a Standard Operating Procedure should be put in place for spray operators, drone manufacturers and pesticide manufacturers to comply with in order to be authorized to operate these drones in pesticide spray.

A foundation to build on further based on local conditions:
As a foundational set of recommendations, this paper is intended to be general to support local stakeholder needs flexibly and should be used as a starting point for a more elaborate regulatory framework, in consultation and consideration of unique local conditions and stakeholders.

Japan as an industry best practice to reference:
Japan, who has been regulating the safe use of UAV successfully for decades, is considered as best practices by the industry. The country has one of the longest history of UAV (specifically Remote Controlled Helicopters or RCH) use for crop protection products with over 30 years of data generation to inform its regulatory position.

Asia to lead in agricultural innovation

These technologies will continue to evolve and enhance the competence and responsible use of drones to benefit farmers. This innovation will be driven largely by Asia and its adoption and impact will be most strongly felt in Asia. It is therefore important governments in Asia take a proactive approach to developing both a sound and enabling regulatory framework to breed innovation for the future of farming in the region.



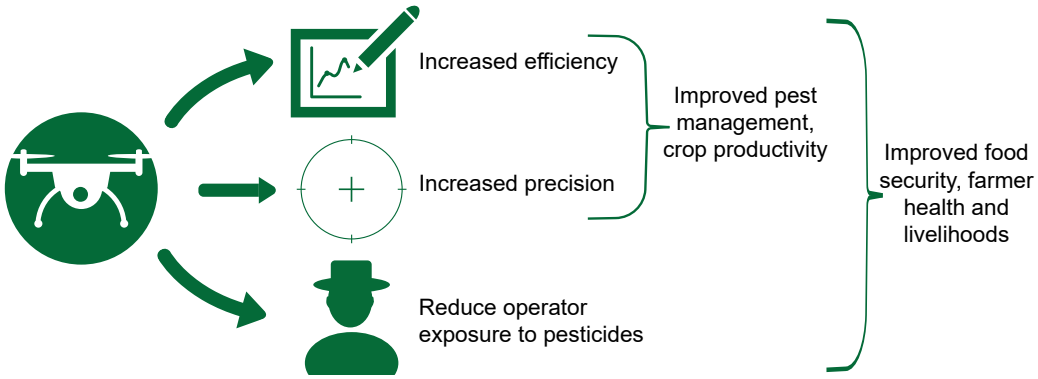
Introduction

The agricultural sector has been no stranger to the digital revolution that is unfolding in the world today.

- According to a study by Goldman Sachs, the **agriculture sector** is predicted to be **the 2nd largest user of drones** in the world in the next five years.
- In China alone, the number of agriculture drones is estimated to have **doubled between 2016 and 2017**, reaching 13,000 aircrafts.

This change is already being driven rapidly in Asia in countries like China, Korea and Japan, where the use of drones provides new possibilities in addressing the pressing food security challenges amplified by aging population and urbanization resulting in labour shortage in the region.The Crop Protection industry sees the use of drone for the application of crop protection products highly promising in enhancing farmer lives.

Benefits of drones for 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.

Setting up a regulatory framework for drone application

There are three core areas to manage the potential risks associated with operating drones for pesticide spray namely. This paper provides a basic set of guidelines on the **second** and **third** tier of regulations for drone application.

Local civil aviation laws:
Operating under the umbrella civil aviation law, vehicle specifications are regulated by the competent authority

Standard Operating Procedure (SOP) for the Safe Use of Drones for pesticide application:
Safety during spray operations is enforced within pesticide regulations setting piloting requirements and safe use practices

Permission for spray operation:
Product approval for spray operations may refer to existing spray-registrations and established or amended regulatory procedures

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 container disposal • Minimize drift by ▪ Set boundary conditions of (velocity, windspeed 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.)

Standard Operating Procedure (SOP) for the Safe Use of Drones in Pesticide Application

Good drone application practices are important to manage and significantly reduce the potential risks on the health of the operator and environment he operates in. The basic do's and don'ts of operating drones are summarized below. It is further recommended that national authorities consult and work together with drone manufacturers and local stakeholders to finetune the SOP according to local use conditions.

Preparing for spray	During spray application	After spray application
1. Compliance • Are the drone operators **licensed/ trained** for both drone operation and safe use of pesticides? • Check **local laws and regulations** on drone applications **2. Check/ calibrate the drone for use** • Select the **right nozzle** for right droplet size/ spray pressure and spray pattern, recommend the use of anti-drift nozzle • Ensure **no leaks** in spray system (spray with water for first 5 min to test) • Confirm **stick model and battery power** **3. Mixing and loading** • **Minimize exposure** to body and face – do not eat, drink or smoke during mixing and loading or use hands to stir the mixture • Follow **CPP label** recommendations • Follow **mixing-order** (solid-liquid-others), two-step dilution to **fully dissolve** pesticide, and **filter pesticide liquid** before loading into drone tank, **avoid leak** of liquid into battery box when loading • **Check compatibility** if mixing two products • Use the right adjuvant against evaporation and spray drift • **Tank mixing** should be restricted to minimum (no more than 2 if possible) and pre-mix formulations should be used if available **4. Check your surroundings** • Check **weather conditions** (wind speed less than 3m/s, temperature lower than 35 degrees, humidity above 50%) • Follow label instructions (to avoid aquatic harm) • Avoid spraying during **honeybee activity** and spray drift to flowering nectar crop • When spraying pesticides that are toxic to **non-target organisms** (fish, birds, silkworm), abide by product label requirements and take effective measures to avoid risks	**1. Operator protection** • Always read the product label and wear the recommended **PPE** for application • Operator should always stay at the downwind end of the field and backlight direction to avoid spray drift • Always **keep 5 meters distance** between operator and drone during spraying • Only approach the drones when the ground propeller stops completely **2. Protect your surroundings** • Keep the people, other farmers, beekeepers around the treated area **informed** • Look out for surrounding poles/ cable or high voltage lines and farmers in the field to **prevent collisions** **3. Operating the drone** • **Flying height** should be 1.5m- 2.5m above target crop • **Flying speed** should be 4-6m/s	**1. Exit and re-entry** • Evacuate treated area in a timely manner and transfer to fresh air • Check product label for re-entry interval and put up clear signs to warn against entering field before appropriate re-entry time **2. Clean and check application equipment** • Fill drone tank with clean water and wash the drone to reduce residues • Charge the battery and ensure drone is ready for the next treatment **3. Safe disposal of pesticides** • Triple rinse empty containers • Ensure waste is kept to a minimum • Disposal of waste must conform to local laws. Residual or waste liquid should be diluted further and sprayed onto discarded area or recycled • Securely store any CPP products away from unauthorized people, animals or food. **4. Operator protection** • Take a shower and put on clean clothes • Follow cleaning instructions on washing PPE and dispose PPEs that are disposable according to local laws and regulations.

Licensing of operators and UAV machines

According to Unmanned Aerial Vehicles (UAV) Flight Manual issued by Aviation Bureau of Japan Ministry of Land, Infrastructure, Transport and Tourism in March 2018, those who want to use UAV must submit application in given template to Aviation Bureau and obtain the permission before actual flight. CropLife recommends that in addition to requirements stated in local civil aviation laws, at least four criteria are met to obtain permission:

- Vehicle needs are approved
- Pilots are licensed and trained for pesticide application by drone
- Pesticide product is registered
- Label instructions of the product are adhered to

CropLife strongly recommends countries to adopt the approach taken by the Aviation Bureau in Japan of setting up a system to require certification or licensing of UAV operators preferably for each of UAV machine model to ensure the capability of operators to pilot the UAV machine safely. Country authorities should also supervise and accredit training facilities to ensure a standardized training program is in place for all agricultural drone operations. Certification and licenses should also be regularly renewed and refresher courses conducted routinely.

Registration requirements of pesticides for drone application

For formulations that have been specifically developed for drone application, residue studies may be exempted as far as certain conditions are met (if critical GAP e.g. AI dose/ ha, PHI and number of applications is within a determined range of conventional spray), but efficacy and crop safety data are required.

Japan as an industry best practice

In March 2019, the Ministry of Agriculture, Fisheries and Forestry of Japan (J-MAFF) released a regulatory update of its UAV regulation based on their analysis of bio-efficacy and residue data collected through over **30 years** on registered applications via radio-controlled helicopters (RCHs) for various crops.

The revised guidance stipulates that bio-efficacy and residue data specifically for drone/ UAV and conventional spray applications may be considered to be equivalent for identical use patterns (if critical GAP e.g. AI dose/ha, PHI and number of applications is within a determined range of conventional spray) and therefore do not require specific UAV bio-efficacy and residue trials,
but require an additional crop safety study, under the following conditions:

- The drone use is an extension of a registered formulation from conventional spray
- Registrants ensure the formulation can be properly used by UAV with ULV

CropLife's recommendation is to use Japan's revised guidance as the most suitable point of reference for regulators to develop regulations for the emerging adoption of similar drone applications.

CropLife recommendations on Registration data requirements for drone spray

Type of data requirement	Label extension of registered formulation from conventional application to UAV application	New formulation for UAV application
Bio-efficacy 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

In addition to the registration data requirements described above, applicants should be responsible for the compatibility of the formulation for UAV application, and ensure clogging of nozzles does not occur at low dilution rates for UAV application.

The future of farming

In the long term, the industry envisions that the widespread adoption of agricultural drones will significantly diminish the practice of conventional spray. This will further minimize existing human exposure risks during pesticide application while improving efficiency and productivity on the farm.

The industry will continue to further research and innovation to enhance the competence and responsible use of drones. In Japan, authorities will also launch a project in 2020 to generate further data and information towards increasing the safety of drone agricultural applications. As these efforts progress, the industry is committed to work with governments within transparent, science-based and flexible regulatory frameworks that can enable these technologies to continually evolve for the future of farming.