Guidelines for

Development of Regulatory Frameworks for Use of Drones in Pesticides Application in Africa Middle East

CropLife
AFRICA MIDDLE EAST

BACKGROUND

Worldwide, Uncrewed Aerial Spray Systems (UASS) have been used positively in health care, relief work, wildlife protection, the film industry, mining activities, security surveillance, and recently in revolutionalising[1] agriculture. Integrating UASS into modern agriculture has marked a significant shift, impacting crop farming practices. UASS, or Uncrewed Aerial Spray Systems, have become indispensable tools for precision agriculture. Their ability to capture high-resolution imagery and collect real-time data has transformed how farmers monitor, manage, and optimise their crops. From assessing crop health and detecting potential issues to precisely applying fertilisers and pesticides, UASS have ushered in an era of efficiency, sustainability, and data-driven decision-making in crop farming. UASS have a transformative influence on crop agriculture, unlocking new possibilities associated with better protection of the crops, cost-effectiveness, flexibility, reduced worker exposure, environmental conservation and overall agricultural sustainability.

Gradual Adoption

The adoption of drone technology in agriculture has been gradual. 'Compared to other countries like China (small-holder agriculture) and Brazil (large-scale agriculture), the adoption of UASS technology in the AME region has been gradual.

The gradual adoption in AME has likely been due to the conservatism of traditional farming practices that have been handed down through generations, the rapid evolution of different UASS models available in the marketplace from globally focused manufacturers of UASSs, and the start-up costs in machinery and knowledge that come with the implementation of new technologies. However, regulatory constraints - from both aviation/airspace and pesticide regulators - have played an essential part in the gradual adoption of UASS technology; for example, limitations from beyond visual line of sight (BVLOS) operations, security or weaponization concerns have often led to regulation that stifles innovation instead of providing a regulatory framework that facilitates adoption. While the agricultural systems of China and Brazil are different in terms of farm size, both countries have facilitated the introduction of UASS with the implementation of appropriate regulatory frameworks that provide regulatory certainty; the complementary approach taken by aviation and pesticide authorities in these examples is needed in the countries in the AME region. It is estimated that up to 42% of global ag land could be treated via UASS by 2035, primarily driven by APAC and LATAM.

[1] https://borgenproject.org/UASS-and-precision-agriculture/

BENEFITS OF UASS IN CROP PROTECTION

Flexibility

- Amenable technology for hard-to-access locations: UASS can easily reach areas that are difficult and unsafe for traditional/ ground equipment to access, such as muddy fields, areas below power lines, and irregularly shaped fields
- A complimentary spray solution alongside traditional application technologies such as tractors and airplanes
- Larger areas can be treated precisely with multiple coordinated UASS called swarms
- Can treat more extensive areas faster than a knapsack sprayer
- Timely applications can mean more effective applications
- Potentially easier to implement Mode of Action-based resistance management

Cost

- Relatively less expensive machinery compared to more expensive and larger equipment (e.g., large ground sprayers)
- Decreased application costs due to optimized applications and potential reduction of chemicals needed
- Decreased crop damage due to minimizing field passes
- Potentially lower costs per unit area
- Address labour shortages and knowledge deficiencies among small holders
- Reduced water requirement compared with ground-based application
- The land may not always be suitable for the tractor due to reasons such as mud. Thanks to the drone, we can spray immediately, prevent the disease from spreading further and prevent yield loss.

Worker Exposure

- Decreased operator exposure, especially in the case of replacing backpack applications, due to the physical separation of the application and the operator, thus enhancing worker safety.

Innovation

- Enabling the future of digital and precision tools including targeted and optimized applications
- Positive industry disruption, including attracting a diverse and technology-advanced workforce, creating new business models such as spray-as-a-service, and engaging technology partners not traditionally associated with agriculture
- Uses beyond agriculture that support public and environmental health: (mosquito applications, dam and railway maintenance, forestry, rights-of-way maintenance, land, invasive species, etc.)

Environment and Sustainability

- Input reduction via customized rates, optimal timing, and placement: UASS can apply inputs such as fertilizers and pesticides more efficiently
- Emissions reduction: Using UASS, which primarily rely on battery power, can lower the carbon footprint compared to traditional machinery if they utilize solar power
- Reduced water consumption due to lower required water volumes
- Soil health due to less soil compaction
- Enables specialty crop care in small acreages, orchards, and vineyards, promoting agricultural diversity in the food supply
- Potential for reduction in drift

The creation of all-encompassing policies from aviation and pesticide authorities is necessary to provide clear and complementary criteria to ensure responsible and safe operations as UASS in agriculture continues to increase.

Examples of such complementary criteria are:

- Aviation authorities should develop rules and guidance on how UASS and crewed/manned aircraft should share national airspace and
- Agriculture agencies should develop rules and guidance for the precise application of fertilisers, invertebrate biocontrol agents, and all categories of pesticides (i.e., conventional and biologically based pesticides).

It is crucial to ensure that these necessary rules and guidance lead to procedures that can be implemented to ensure safety for humans and the environment while creating a regulatory framework that allows the reaping of benefits that UASS technologies can bring. Establishing the balance between allowing innovation, like the introduction of UASS technologies and regulation, requires a complementary framework built by aviation and agricultural / pesticide authorities.

SITUATION ANALYSIS: **GLOBAL ENVIRONMENT**

Global Expertise

OECD Working Party on Pesticides (WPP)– Drone/UASS Subgroup

- Tasked to review the existing information and data to determine recommendations for the regulation of UASS-based pesticide application: State of the Knowledge Literature Review on Uncrewed Aerial Spray Systems in Agriculture
- Tasked with developing information and data in the areas of off-site movement, including compiling an empirical database that could be utilized to develop standard drift curve exposure estimates for off-target exposure/risk assessment & the potential development of a mechanistic exposure model (work package 1), the establishment of criteria that could be utilized to categorise UASS types for regulatory purposes (work package 2), development of 'best practices' (or best management practices) for UASS-based pesticide application (work package 3).
- An OECD Cooperative Research Program grant was awarded to support a conference to advance the work of the OECD WPP Drone / UASS Subgroup and to provide input into a draft best management practices document; this conference was organised by the UK Health and Safety Executive & was held in York, UK (2023).

Uncrewed Aerial Pesticide Application System(s) Task Force (UAPASTF):

- Task Force with registrants as members that work with regulatory agencies to define areas of data generation and development related to OECD WPP Drone / UASS Subgroup recommendations. (www.uapastf.com)
- **EU Precision Application (EUPAF) Drone Subgroup.** This group is working on a larger project centred around all precision ag techniques to evaluate drone refinements and mitigations. It comprises industry experts and EU regulators and regularly connects to the OECD group and UAPASTF.
- **Pesticide Program Dialogue Committee (PPDC) Emerging Ag Technology Workgroup:** USDA, US EPA, Industry groups, Academia, State Departments of Ag, Grower Groups, Trade Associations, NGOs, and Drone manufacturers
- **CropLife International Drones Working Group:** CropLife International Stewardship Guidance for use of Uncrewed Aerial Vehicles (UASSs) For Application of Crop Protection Products.
- **CropLife America Working Group:** Developed position paper on UASS equivalencies/gaps to conventional application methods, funded support for publication to update OECD WPP 'state of knowledge' document (Bonds et al. doi:10.1301/ja.15646)
- **CropLife Asia Drones Task Force:** Developed drone Operator tools box Dec 2021
- **CropLife Africa Middle East working Group:** Developed a guideline for the development of regulatory frameworks for the use of UASSs in Pesticides in the African Middle East.

Regional and Country Developments

- **North America: US:** Substantial growth in drone use for products with crewed/manned aerial use directions with regulatory provisions from FIFRA, US Federal Aviation Agency (FAA); Flight Standards District Office (FISDO), and chemical handling authorisation departments. **Canada** also requires licensing through a special flight operations certificate or SFOC. Applying crop protection products using Uncrewed aerial vehicles (UASSs) is limited (e.g., less than 5 products with UAV use directions).
- **Latin America: Brazil:** Substantial growth in UASS for products working under SOP for UASS-based applications (e.g., Ministerial Ordinance nº 298 of 09/22/2021). **Costa Rica, Uruguay:** UASS-based application is allowed for products with crewed/manned aerial application use directions on the label. **Guatemala, Colombia, and Mexico:** Some UASS-based applications are permitted; the establishment of a UASS fit-for-purpose regulation is under discussion. **Ecuador, Peru:** UASS-based application is not yet allowed; the establishment of a UASS fit-for-purpose regulation is under discussion.
- **Australia:** UASS-based applications are allowed, using crewed/manned aerial requirements to guide use.
- **New Zealand:** Legalised drone-based spraying
- **United Kingdom:** Training, licensing, and registration of pesticides for drone application required Aviation authority:
    - (https://register-UASS.caa.co.uk/). Have a drone code: https://UASSafe.uk/drone-code/
    - Laws that apply to drone operation in the UK: https://www.caa.co.uk/Consumers/Uncrewed-aircraft-and-UASS/ and drone policy: https://publicapps.caa.co.uk/docs/33/CAP722_Edition7_A3_SEP2019_20190903.pdf
    - Drone Safe Website: https://UASSafe.uk/safety-apps/
- HSE CRD (pesticide authority) is reviewing/approving experimental use permits for research, but no wide-scale commercial use is allowed; their leadership as the Chair of the OECD WPP Drone / UASS Subgroup has been very important to the success of the Subgroup.
- **EU:** UASS are widely used for mapping and surveillance. Pesticide applications using UASSs are considered aerial applications and are only allowed in special circumstances. Agricultural ministries are conducting research on UASS-based applications[2], and Germany has established a derogation to allow the use of UASS for applications to sloped vineyards (Note: while not part of the EU, Switzerland has established a similar derogation). The EUPAF (European Precision Application Task Force) for drone-based applications has been put in place, led by the chairman of the OECD drone pesticide working group.

[2] Examples: Journal für Kulturpflanzen, 75 (05-06). S. 151–157, 2023 | DOI: 10.5073/JfK.2023.05-06.04 | Herbst et al GO_PHYTODRON (EU-funded project in Spain)

SITUATION ANALYSIS: **ASIA**

- The rapid adoption of UASS for pesticide application has been witnessed in many Asia Pacific countries, including China, Japan, Korea, India, Vietnam, Indonesia, the Philippines, Thailand, and Malaysia.
- This is a growing region in UASS adoption for agriculture. In China, the use of UASSs is expansive and more diversified across more agricultural areas, including the application of pesticides, fertilizers, seeds, forestry management, fodder application, pollination, and transportation of goods.

Table 1.0 Data Requirements for Pesticides Registration for Drone Application in Asia

- Same GAP (crop & pest, PHI, dose) as Registered conventional use:

Countries	Product Registration Required?	Data Requirement		
		Bioefficacy	Residue	Crop Safety
Japan	Y	✗	✗	✓
Korean	Y	✓	✓	✓
China	N	N/A	N/A	N/A
India	Y	✗	✗	✓
Thailand	N	N/A	N/A	Under development
Philippines	Y	✓	✗	Part of bioefficacy trial
Malaysia	Y	✓	✗	Part of bioefficacy trial
Indonesia	Y	Under development	✗	Under development
Vietnam	Y	✓	✗	Part of bioefficacy trial

- New Gap comparing to registered conventional use: follow regular label extension data requirement.

Source: CropLife Asia Drone Operator Toolbox 2021

Country	Civil Aviation Law Enacted (Civil Aviation Authority)	Procedures on Drone Operation Activity - SOP (Department of Agriculture)	Clear Guidelines on Registration Data Requirements for Drone Spraying (Regulatory Authority)	Commercial Application of PPP (Drone Service provider/ Drone Operator)	Guidance document for use of Drone in Agriculture
Japan	✓	✓	✓	✓	If product already registered, only phytotox trail is required. If product not yet registered for any use, standard registration requirements apply.
South Korea	✓	✓	✓	✓	Requirement: 2 trails biological efficacy data & phytotoxicity & residue data.
Australia	✓	🔒	✓	✓	SOPs not established. Possible drone spray with existing labels where aerial application allowed.
China	✓	✓	🔒	✓	Commercial spray of registered products permitted, while guidelines evolve.
Taiwan	✓	✓	✓	✓	Commercial spray of registered products permitted.
India	✓	✓	✓	✓	Regulatory requirements & SOP crop-specific established.
Philippines	✓	✓	✓	✓	Regulatory requirements & checklist of requirements for licensing of Commercial Applicator - drone spraying operator established.

Country	Civil Aviation Law Enacted (Civil Aviation Authority)	Procedures on Drone Operation Activity - SOP (Department of Agriculture)	Clear Guidelines on Registration Data Requirements for Drone Spraying (Regulatory Authority)	Commercial Application of PPP (Drone Service provider/ Drone Operator)	Guidance document for use of Drone in Agriculture
Malaysia	✓	✓	✓	✓	SOP from DoA established. Commercial drone spray is allowed.
Indonesia	✓	🔒	✓	✓	All registered products/ crops can be applied with same dose rate and less water. Commercial drone spray is allowed.
Thailand	✓	🔒	✓	✓	All registered products/ crops can be applied with same dose rate and less water. Commercial drone spray is allowed.
Vietnam	✓	🔒	✓	✓	SOP for bioefficacy trial protocol published in Jan 2023.
Myanmar	✓	🔒	🔒	🔒	No drone application allowed - unstable political situation.
Pakistan	✓	🔒	🔒	🔒	SOPs included in draft policy presently under review.

Source: CropLife Asia Drone Operator Toolbox 2021 and Presentation on Asia's situation on UASS use in pesticides application during CLAME webinar in 2022 (Recheck table)

SITUATION ANALYSIS: **AFRICA & THE MIDDLE EAST**

Based on the benefits noted in other regions, UASS offer exciting possibilities for the region's development. However, navigating the UASS regulatory landscape to avoid potential downsides that will hamper the appropriate implementation of UASS use remains critical. Thus, the need for creating clear and complementary aviation and pesticide regulations to ensure safety and prevent misuse cannot be overemphasized.

The regulatory environment for UASS use in pesticide application within the region is as diverse as the region, creating a patchwork that largely lacks standardisation or harmonisation; given this regional diversity, CropLife Africa Middle East recommends focusing on the following areas:

- Training and certification of the drone pilot/applicator in pesticide knowledge
- Regulatory review and approval of the pesticide to be applied using UASS considers the following
  - Pesticides to be applied using UASS
  - Efficacy trials to establish appropriate GAPs
  - Label information indicating the rate, residue guidance, safety, and emergency measures.
  - Management of spray drift to ensure that negative impact (exposure) on off-target organisms and the environment is minimised.
  - Ensuring human safety by minimising exposure of operators during mixing, loading, and application and residues after application.
- Aligning and developing complementary regulations among regulatory authorities governing aviation and pesticide management.

As in other areas of the world, the use of UASS in agriculture and pesticide application is flourishing in various parts of Africa; however, specific regulations and or guidelines to govern and establish best management practices for their operation are lagging behind. It is essential to ensure responsible use by establishing and implementing appropriate guidelines and keeping pace with rapid advancements in drone technology.

STATUS OF REGULATORY PROVISIONS FOR UASS AFRICA AND THE MIDDLE EAST

Country	Civil Avn.	Guidelines to Data Generation for Use of Drone in Agriculture
Kenya	✓	UAS registration manual released in 2020, www.kcaa.or.ke • No regulatory framework in place for PPP to be used in drone application. Authorities discussion and in favor of the technology. • SOP on STW practice for spraying: not available • SOP on flight operation • Civil aviation for drone in place
Tanzania	✓	Guidelines - TCAA has put in place regulations on the use of UAS • No regulatory framework in place for PPP to be used in drone. Authorities positive and open for discussion. In favor of the technology. • No SOPs on flight operation and STW practice for spraying available • Civil aviation for drone in place
Mauritius	✓	07/2016- MDCA enacted the regulations governing the use of UAS
Morocco	✓	Directorate General of Civil Aviation (DGCA) has put in place general rules for use of UAS (Ministry of Interior) • No regulatory framework in place (nothing requested up to now to apply with this technology), possibility to shape the regulatory framework (exception: king of Morocco who use drone in own farms) • No SOPs available • Civil aviation for drone in place
Rwanda	✓	05/2016- RCAA enacted its UAS regulations
South Africa	✓	Regulations on the application of registered products was published in 2015 • Regulatory framework for PPP to be used in drone in place. • No SOPs on flight operation and STW practice for spraying available • Civil aviation for drone in place • 2023 SABS standards in place for drone use
Nigeria	✓	Application of registered products permitted (NCAA, 2017) • No regulatory framework in place for PPP to be used in drone. Authorities positive and open to support and discuss with relevant bodies. • SOP on flight operation: available • SOP on STW practice for spraying available: CLI SOP • Civil aviation for drone in place, but complex context due to terrorism
Uganda	✓	• PPP regulation for drone-based application under-finalisation. • SOPs on flight operation and STW practice for spraying: in case of specific need, e.g., pandemic, CLI SOPs could be used. • Civil aviation for drone in place for drone use

Country	Civil Avn.	Guidelines to Data Generation for Use of Drone in Agriculture
Ghana	✓	05/2016- GCAA enacted its UAS regulations on 12/2016- another directive on the use of UAVs was added • No regulation in place for PPP drone-based application as such, but EPA Ghana in favor of the technology, and provide product registration when efficacy proven • SOPs available • Civil aviation for drone in place
Cameroon	✗	SOPs and guidelines are well established by the CCAA • No regulatory framework in place for PPP to be used in drone. Authorities positive and open to support. • No Civil aviation in place allowing drone for PPP application • No SOPs in place
Zimbabwe	✓	Guidelines developed by CAAZ • No regulatory framework in place for PPP to be used in drone. Authorities positive and open for discussion. In favor of the technology. • No SOPs on STW and flight operation available for Ag use
Zambia	✓	ZCAA- has put in place the guidelines on the use of UAS • No regulatory framework in place for PPP to be used in drone. Authorities positive and open for discussion. In favor of the technology. • No SOP on STW and flight operation available for Ag use • Civil aviation for drone in place
Togo	✗	Guidelines and regulations established by Agence Nationale de l'Aviaton Civile (ANAC) du Togo on use of UAS • No regulatory framework in place – Authorities not in favor • No SOPs available • No civil aviation regulation on drone
Ivory Coast	✓	Autorite Nationale de l'Aviation Civil (ANAC) has put in place guidelines measures for use of UAS. • No regulatory framework in place for PPP to be used in drone. Authorities positive and open for discussion. In favor of the technology. • No SOPs available • Civil aviation for drone in place
Ethiopia	✗	Draft regulations in 2019 • No regulatory framework in place for PPP. Not in favor at all. • No SOPs available • No civil aviation for drone in place
Egypt	✗	Strong legislations in 2017 prohibiting the use and trade of drones unless permitted by Ministry of defense. Army is only allowed to use drone for spraying, scouting in their farms. Otherwise for civilian uses: • No regulatory framework in place for PPP. Not in favor at all. • No SOPs available • No civil aviation for drone in place
Senegal	✓	National Agency for Civil Aviation and Meteorology (ANACIM) regulates the use UAS. Not specific for agriculture but can be used for agriculture. • No Regulatory framework in place on drone-based application- Authorities positive and open for discussion. In favor of the technology. • Civil aviation in place for drone • SOP on STW and operation

LESSONS & BEST PRACTICES IN ESTABLISHING REGULATORY FRAMEWORKS

As with other application technologies, specific guidelines for the use of UASS in pesticide applications should be based on shared principles and considerations to ensure safe and responsible drone operations.

Here are some general guidelines that may be applied:

1. **A sound policy framework is needed** to ensure high standards of product use and protection for human health and the environment. This promotes the harmonisation of international policies and practices wherever possible while considering local needs and conditions.
2. **Registration and licensing/Aviation:** Registering drones with relevant aviation authorities is fundamental in ensuring accountability and traceability of UASSs. Registration gives authorities essential information about the drone, such as its owner, make, model, and specifications.

- Obtaining **appropriate licenses or certifications** is crucial to ensuring that drone operators possess the necessary skills, knowledge, and understanding of regulations to conduct safe and responsible flights. In-country aviation authorities mandate that drone operators undergo training programs to understand the principles of flight, airspace regulations, emergency procedures, and ethical considerations, including not using cameras on UAVs to observe people etc.
- Most UASSs have GPS to aid in positioning the Remote Piloted Aircraft when using position mode. Enterprise drones can be loaded up with a planned flight with waypoints. This can be done from applications such as Drone Deploy, DJI Terra etc. In countries where BVLoS Operations have been approved by their local CAA, the waypoints can span over 100 nautical miles provided they have a relevant UTM (Unmanned Aircraft Systems Traffic Management) to avoid incursion with other aircraft in the airspace.
- Filing flight plans is mandatory in controlled airspaces. These said airspaces are classified as Class A,B,C,D,E airspaces. In uncontrolled airspaces (class F & G), the rules of the air are adhered to and UASSs are to make broadcasts in the uncontrolled airspace frequency if they are RadioTelephone rated.
- Licensing ensures drone operators adhere to local, regional, and national regulations governing airspace use and agricultural activities. This includes understanding restrictions, permitted altitudes, and compliance with privacy laws.

3. **Training and licensing of Drone Operators in Pesticide Knowledge**

- A **Drone Spray Service Provider** will have a combination of skills acquired through training as a drone/ UASS operator and are typically engaged or plan to be involved in providing multiple services to customers in agriculture. These service providers may have existing expertise in general UASS operation or are pesticide spray service providers and farmers and incorporate drone applications into their service offerings. In both cases, UASS spray operators will need to acquire and combine additional knowledge of either UASS or pesticides on top of their existing areas of expertise.

- Comprehensive training should cover both aviation and pesticide application aspects; examples of training topics should be included:
  - Provisions of the established laws and Regulations – Dos and Don'ts
  - Operational/Technical Knowledge of UASS focusing on the technical aspects of drone operation from basic operation, flight maneuvering skills, care and maintenance, and technical information related to pesticide application.
  - Standard Operation Procedures (SOP) for Safe Pesticide Application and or 'Best Management Practices' developed by the Unmanned Aerial Pesticide Application System Task Force (UAPASTF- www.uapastf.com):
    - Risk-benefit analysis of UASSs for pesticide application.
    - How to read and adhere to pesticide label instructions
    - SOP for pre-application, application, and post-application.
    - Pesticides-specific guidance for Responsible Use both in general and specific to UASS application
  - Pesticides Knowledge covering:
    - Adherence to country regulation (registered products, specific drone label where applicable)
    - Adherence to label (human and environmental safety precautions in mixing, loading, and application)
    - Crop protection products.

4. **Pesticide Application Guidelines for Drone Operations in Agriculture:**
   Regulatory compliance to stipulate the acceptable pesticide application rates, ensuring adherence to safety standards and environmental regulations. This includes specifying the concentration of pesticides in the spraying solution, often found or placed on the label.

   In this regard, the establishment of stewardship and or best management practice measures is critical:
   - Outline approved methods of pesticide application using UASS, including considerations for altitude, speed, and the appropriate angle of application to achieve optimal coverage without drift.
   - Real-time monitoring of the application process to include:
   - Flight recording, which is a standard feature on many new UASS to allow automatic recording on respective transmitters (Remote Pilot Station). However, for assembled UASS or those without automatic recording, manual recording of flight time and PIC (pilot in command) should be done electronically or in writing.
   - As per the requirements from the local authorities, detailed records of each pesticide application are kept, including the type and quantity of pesticides used, areas covered, and any deviations from the planned application.
   - Establish buffer zones around sensitive areas such as water bodies, residential areas, wildlife habitats, etc, to minimise the potential risk of pesticide drift and environmental contamination.

- Specify techniques (as per recommendations from studies) to minimise drift, including optimal weather conditions, appropriate drone altitude and flight angle, and the use of drift-reducing additives in pesticide formulations.
- Provide a list of approved pesticides for drone application, ensuring that only authorised and regulated chemicals are used.
- Outline emergency response protocols in case of equipment malfunction, unexpected weather changes, or other unforeseen circumstances during pesticide application. Operators should have established communication procedures to notify relevant authorities and stakeholders in an emergency.

5. **Adherence to Privacy Laws:** The emphasis is on strict adherence to existing privacy laws and regulations governing the use of UASS.
   - Drone operators are to provide clear and advance notice to individuals and communities when drone operations are scheduled in their vicinity. This communication helps raise awareness, address concerns, and foster transparency.
   - Stress the importance of minimising unnecessary data and image collection, focusing only on information directly relevant to agricultural monitoring or research. Operators should ensure that captured images and data are securely stored, and that access is restricted to authorized personnel. This safeguards the privacy of individuals captured in the imagery.
   - Identifying and avoiding sensitive areas, such as residential properties, schools, healthcare facilities, and other locations where people expect a high degree of privacy. Some jurisdictions may have designated no-fly zones over specific sensitive areas to protect privacy, and operators should strictly adhere to these restrictions.
   - Periodic privacy impact assessments to evaluate the potential privacy implications of drone operations. This process involves reviewing data collection practices and their impact on individuals' privacy rights.
6. **Guidelines for Environmental Impact:** agricultural drone operations enable precision applications, allowing for applications that account for the importance of preserving biodiversity and avoiding adverse impacts on ecosystems. As with any technology employed in agriculture, UASS operators should steer clear of sensitive habitats and wildlife areas during drone activities.
   - Identifying and mapping sensitive ecological zones, including wildlife habitats, water bodies, and protected areas, where drone flights may have environmental consequences.
   - Riparian zones along rivers and lakes are critical for biodiversity. Guidelines may advocate for protecting these areas during UASS-based pesticide application to minimize undesired environmental impacts.'
   - UASS generate noise and can be visually disruptive, potentially affecting wildlife behavior. Guidelines may advise on maintaining a safe distance to reduce noise and visual disturbances, particularly in areas with vulnerable or endangered species. Recommendations may include conducting UASS - operations when wildlife activity is minimized to mitigate potential disturbances.

- Operators should collaborate with environmental experts, conservationists, and relevant agencies to assess potential environmental impacts and develop strategies for minimizing harm. They should highlight the benefits of participating in conservation programs, where drone data can contribute to ecological research without compromising the environment.

7. **Guidelines on Human Safety:**
   - Operators should cooperate with relevant authorities and comply with application specifications, usually on the label, to ensure human safety, including during mixing, loading, and cleaning.
8. **Data Security:** Emphasis on using encrypted communication channels during data transmission from UASS to ground stations. This helps protect sensitive information from interception or unauthorized access using secure and industry-standard communication protocols to ensure the integrity and confidentiality of data in transit.
   - Align with data protection laws and regulations to ensure that data collection, storage, and transmission comply with legal requirements.
9. **Monitoring and enforcement of mechanisms** need to ensure there is full compliance with and implementation of safety measures.
10. **Insurance Requirements** may specify comprehensive coverage that includes a range of potential risks, ensuring that operators are protected from various liabilities arising from their drone activities. Operators may opt for customized insurance policies that align with the specific risks associated with agricultural drone operations.

JAPAN | **BEST PRACTICE**

Japan's mature regulatory framework for drone use in pesticide application, which spans over 30 years, provides salient features for consideration in developing procedures, including:

- Regulatory conditions for safe UASS operations in Japan:
  1. UASS needs to be approved for use by authorities
  2. Pilots are licensed and trained for pesticide application by drone
  3. Pesticide product is registered as well as for drone application
  4. Label instructions of the product are adhered to
- Country authorities to supervise and accredit training facilities to ensure a standardized training program
- Certification and licenses are regularly renewed, and Refresher courses are conducted routinely.

Table 2.0 Japan's Registration Requirements for Pesticides by Drone Application

Japan has 30 years of experience in drone trials and regulations, and concluded on the *equivalence* of efficacy & residues after drone & conventional at the same use rate

Type of data requirement	**Label extension** of registered formulation from conventional application to drone application	**New formulation** for drone 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 drone 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 drone application	**Full data requirement** by drone application

Source: CropLife Asia Drone Operator Toolbox 2021 and Presentation on Japan UASS use in pesticides application during CLAME webinar in 2022 & 2023

FINAL **CONSIDERATIONS**

The rapid transformation currently experienced with the increased use of UASS in the agricultural sector creates an urgent need for governments to respond with a sound and complementary aviation and pesticide regulatory framework to prevent uncontrolled and inappropriate use of UASS-based applications; this regulatory framework needs to provide for safe use under local conditions while providing for future implementation of innovation:

Take a risk-based approach:

1. Consider the risks associated with UASS application across the aviation and pesticide application spectrum, including operator capability, environmental variables, drone specifications, and product formulation.
2. Establish a Standard Operating Procedure for spray operators, pesticide manufacturers, and agro-dealers to be authorized to operate these UASS in pesticide spray.
3. Aviation authorities should establish a standard operating practice to approve UASS models for use in agriculture and pesticide applications in collaboration with the pesticide authorities.
4. Adopt best practices: following the regulatory framework established in Japan, which has been regulating the safe use of UASS successfully for decades. The country has one of the longest history of UASS (specifically Remote-Controlled Helicopters or RCH) use for crop protection products, with over 30 years of data generation to inform its three-pronged regulatory framework covering both aviation and pesticide aspects:
    - Approvals and certification of UASSs, pilots, and pesticide registration requirements for drone application
    - Supervision and accreditation of training facilitiesto ensure a standardized training program.
    - Regular reviews and refreshers: Certification and licenses are regularly renewed, and Refresher courses are conducted routinely.

References

Kenya

- The Kenya Civil Aviation Authority announced the development of its national regulations governing the use of remotely piloted aircrafts in February 2017. http://www.iapad.org/wp-content/uploads/2018/10/UASS-on-the-Horizon-Transforming-Africas-Agriculture-en.pdf
- February 2017 the KCAA approved draft regulations on the commercial use of UASS in the country. https://www.fao.org/e-agriculture/news/kenya-civil-aviation-authority-has-approved-draft-regulations-commercial-use-UASS

Tanzania

- Tanzania does not have specific regulations on the use or UASS for agriculture. The regulations are general i.e.: UASS should not be flown over people or large crowds, and they should not be flown in sensitive areas including government or military facilities or use drone cameras in these areas. Companies that use UASS for agriculture in Tanzania are: Werebotics, Researchgate and Gale.
- https://blog.werobotics.org/2019/05/20/in-tanzania-UASS-are-helping-farmers-stake-their-claim/
  https://www.researchgate.net/publication/333113661_UASS_FOR_AGRICULTURE_IN_TANZANIA
  https://go.gale.com/ps/i.do?id=GALE%7CA598128840&sid=googleScholar&v=2.1&it=r&linkaccess=abs&issn=20955405&p=AONE&sw=w

Mauritius

- In Mauritius drone use is regulated by the Mauritius Civil Aviation Authority. “A farmer flying his drone for his own purpose will not be getting paid to do it or receive remuneration for that flight. It is all about the flight. Therefore, we would deem that a farmer using a drone on their own land to check/survey their own fields would not require a Permission for Commercial Operations PfCO.” CAA https://www.fas.scot/downloads/UASSs-in-agriculture-rules-and-regulations/

Morocco

- The Directorate General of Civil Aviation (DGCA) in Morocco has put in place general rules for use of UAS. Drone operations are not regulated. However, if the drone weighs more than 25kgs you are required to obtain a permit before operating it. https://drone-laws.com/drone-laws-in-morocco/
- Morocco uses UASS for various agricultural purposes including treatment, diagnosis and crop control. https://www.tridge.com/news/agriculture-20-UASS-at-the-service-of-farmers

Rwanda

- "The Rwanda Civil Aviation Authority enacted its UAS regulation in June 2016 but has issued only one permit to a local company so far." http://www.iapad.org/wp-content/uploads/2018/10/UASS-on-the-Horizon-Transforming-Africas-Agriculture-en.pdf

South Africa

- "South Africa has regulations in place. According to a licensed UAS operator (Wijnberg L., 2017) the heavy- handed approach has forced some UAS companies to either operate outside the framework of the law or operate in neighboring countries in order to stay in business. In South Africa, the regulations consider that using an UAS for Agricultural Data- generation means that UAS are used commercially and should be governed in the same way as commercial manned aircraft. This requires the operator to comply with a number of key steps that are costly for a single operator." These may include,: (i) obtaining a remote pilot license; (ii) registering the aircraft; and (iii) obtaining an air service license (ASLhttp://www.iapad.org/wp-content/uploads/2018/10/UASS-on-the-Horizon-Transforming-Africas-Agriculture-en.pdf

Nigeria

- May 2016 - government banned the unlicensed use of UASSs and stipulated guidelines for drone operators in Nigeria. The Nigerian Civil Aviation Authority Issued its first operator certificate in June 2017 (NCAA, 2017) and plans to set up an online portal for allowing the registration of all UASS users in the country." http://www.iapad.org/wp-content/uploads/2018/10/UASS-on-the-Horizon-Transforming-Africas-Agriculture-en.pdf

Uganda

- Drone use is allowed in Uganda. However, exact drone laws are not yet specified. In January 2016 the Ministry of Agriculture of the Ugandan government proposed the use of UASS especially in pesticides application. It also suggested that UASS would be used to monitor plant health. https://reliefweb.int/report/uganda/ugandan-government-use-UASS-enhance-food-security

Ghana

- "The Ghana Civil Aviation Authority enacted its regulations in June 2016. In December 2016, it issued another additional directive instructing all UASS operators or users to obtain written permission from regional or local police stations before operating UASSs. The enabling environment makes it possible for UAS operators to service the agricultural sector." http://www.iapad.org/wp-content/uploads/2018/10/UASS-on-the-Horizon-Transforming-Africas-Agriculture-en.pdf

Cameroon

- Individual operators can report to the general management of the Aeronautical Authority for examination of their situation on a case-by-case basis. The Aeronautical Authority has published an instruction setting the procedures for requesting authorization of use remotely piloted aircraft in space aerial and on Cameroon territory for occasional aerial work operations. https://www.droneregulations.info/Cameroon/CM.html

Zambia

- Zambia Civil Aviation Authority (ZCAA) published their drone regulations in June 2016. They also included drone safety and limitations. http://www.afgoesdigital.com/UASS-assessing-crops-in-zambia-and-malawi-to-serve-an-insurance-company/

Zimbabwe

- The Civil Aviation Authority of Zimbabwe (CAAZ) has rules laid down in 2018 https://allafrica.com/stories/202202110190.html

Togo

- The country has allowed the use of UAS if the operators follow the stipulated drone laws. These are general in nature. Togolese farmers are using UASS especially in spraying pesticides to their crops. https://www.theafricareport.com/83514/togo-UASS-usher-in-small-revolution-for-west-african-rice-growers/

Ivory Coast

- The country has set general drone laws to regulate both recreational and commercial use of UASS. https://UASSsystemsinternational.com/pages/cote-divoire-drone-laws. Though at a low pace Ivorians are turning on UASS for precision agriculture especial in monitoring and optimizing the growth of their crops. https://www.commodity-port.com/2019/07/30/cote-divoire-how-UASS-are-helping-agriculture/

Ethiopia

- No specific regulations are currently known. Draft regulations were validated at a meeting on September 10, 2019, at the Ethiopian Civil Aviation Authority (ECAA). https://drone-laws.com/drone-laws-in-ethiopia/ Agriculture Transforming Agency (ATA) is making huge strides on using UASS in the field of agriculture in Ethiopia. https://www.cta.int/en/event/uas-for-agriculture-capacity-building-in-ethiopia-sid04832f3ca-ae7f-404a-a563-d739586db24c

Egypt

- Egypt enacted strict laws in 2017 that prohibit the use and trade of UASS unless one get a permit from the Ministry of Defense. https://drone-laws.com/drone-laws-in-egypt/

Senegal

- Senegal had set general laws for use of UASS - commercial and recreational operators. “Senegal Flying Labs works in collaboration with the local Civil Aviation Authority and the Ministry of Digital Economy to develop an adequate framework of regulations concerning the use of UASS.” https://flyinglabs.org/senegal/
- Dronelife (https://dronelife.com/)
- UASSCAN Africa (https://www2.deloitte.com/us/en/pages/public-sector/articles/humanitarian-UASS-in-africa.html)
- The African Drone Association (https://africandrone.org/what-we-do)
- CropLife Asia UASS Webinar


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