



ICRISAT

Drone Technology to Transform Dryland Agriculture



Background

The use of drone technology in agriculture is rapidly advancing worldwide, and ICRISAT has been at the forefront of this innovation. Beginning its research in 2018, ICRISAT was among the first organizations in the region to secure exclusive exemption from 15A of the Aircraft Rules, 1937 by Ministry of Civil Aviation (MoCA), GOI for utilization of drone for agricultural research. With the introduction of national-level Drone Rules 2021 on Unmanned Aerial Vehicle (UAV) systems in 2020–2021, ICRISAT expanded its team of certified drone pilots from 1 to 7 with a good representation of female pilots, further enhancing its capabilities in this field.

Drone technology offers immense potential for dryland agriculture, particularly in regions characterized by smallholder farms and challenging terrains where tractors are less effective. Drones significantly reduce manpower for tasks like spraying herbicides, insecticides, and pesticides, covering much larger areas – up to 50 acres per day – compared to tractors, which manage only 10-20 acres a day depending on the crop, chemical or field condition. With their precision and accuracy, drones also minimize chemical usage, and human exposure to chemical while spraying, making agricultural practices more sustainable & safer.



ICRISAT's Drone Research

ICRISAT has been a pioneer in drone-based crop trait phenotyping and stress mapping, leading the way in RGB, multispectral and hyperspectral sensors utilization in agri R&D, flight SOP development, image quality matrix development and image analysis pipeline optimization.

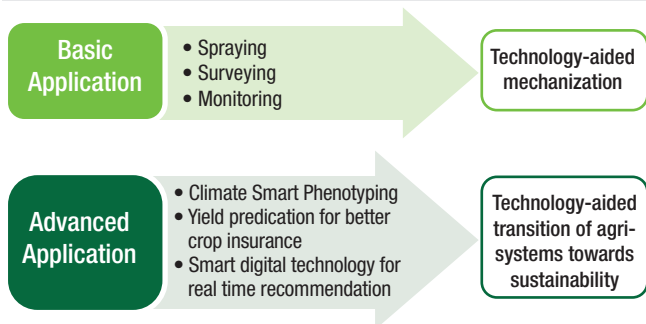


Research

ICRISAT's drone research spans four key areas:

In agriculture, at present, UAV is mostly seen as tool for spraying, surveying, and monitoring which is leading to mechanization advancement. However, this technology has huge potential to serve high-end science for better crop production towards sustainable agriculture and climate smart technologies. ICRISAT is developing standardized operating procedures (SOPs) for phenotyping, pest and disease mapping (including bacterial leaf blight), spraying, and surveying. The organization also focuses on using drones for agricultural data collection based on spectral information, such as crop type identification, yield estimation, and analysis. Trained models are developed to process drone-captured images for further analysis.

Applications of drone technology in agriculture sector



- 1. Phenotyping:** UAVs are being developed as powerful tools for crop phenotyping, a key step in the crop breeding and agricultural research to develop new varieties. Traditionally, phenotyping involves visually assessing thousands of genetic lines in the field, a time-consuming process. By using drone-captured images and deep learning algorithms, ICRISAT is working to automate this process, allowing breeders to extract important plant traits efficiently and synchronously from MLTs. This drone-based image analysis pipeline will help reduce breeding time, improve precision, and lessen the manual labor involved in plant phenotyping.
- 2. Pest and disease monitoring:** ICRISAT is working on identification of unique spectral signature of major disease and pest like Bacterial blight in rice with Cornell University so that in future precise disease identification and mapping is possible. With the help of high-resolution imaging, drones can quickly identify affected areas, outbreak direction and enabling timely intervention. This technology allows for real-time monitoring and better pest and disease management strategies.
- 3. Agriculture data collection:** UAVs are also used by ICRISAT to research on critical agricultural data gathering. This includes surveying crop fields, stress assessment, estimating yields, and conducting agronomic analysis. This can be used for various purposes like low high ground validation for remote sensing, farm input optimization application etc. This technology is helping transform agricultural practices by providing cost-effective, high-quality data for research and decision-making.



Capacity Building

As part of the Government of India's vision to make India a drone hub by 2030, initiatives like the Kisan Drones scheme under the Agricultural Mechanization program, Eklavya initiative and the Drone Didi scheme for capacity building have accelerated the adoption of drones in agriculture. In partnership with the Telangana State Aviation Academy, ICRISAT provides hands-on training and drone pilot certification, empowering farmers, industry players, and drone experts to integrate UAV technology into agriculture.



Hardware Co-Development with Industry Players

ICRISAT collaborates with startups, ICAR-ATARI and drone manufacturers in India to customize nozzles based on farmers and crop need and develop SOPs for image acquisition, ranging from simple RGB drones to more advanced multispectral models. It also offers on-field testing services and quality control to ensure optimal performance of agricultural drones.



Advisory

ICRISAT plays a key role in shaping the future of drone technology in agriculture, working closely with organizations like TIHAN, the Telangana Aviation Academy, NSIC, NSN etc in India. It provides critical input for state and national-level policies, helping to expand the use of UAVs in the agriculture sector.

Through its innovative research, ICRISAT aims to harness drone technology to drive the transformation of dryland agriculture while supporting government initiatives to strengthen national capacity in UAV technology.

