Using Drones in Agriculture and Natural Resources

In order to maximize resilience and productivity, researchers, farmers, and natural resource managers need to know how plants and animals—and landscapes as a whole—are affected by changing environmental conditions and other stressors. This knowledge enables farmers and natural resource managers to respond quickly to stressors with appropriate, targeted mitigation tactics. This knowledge also guides researchers as they breed tougher plants and animals and develop better management practices and tools.

Remote sensing with drones—unoccupied or unmanned aerial systems—offers a promising new way to characterize landscapes, individual plants and animals, and their various stressors; however, regulations, costs, limited research and education, and other barriers have kept drones from being widely used for agriculture and natural resources.

Since 2016, land-grant university researchers and educators have worked to increase adoption of drones for remote sensing and precise management of agriculture and natural resources.

Working together as a multistate project has many benefits.

Regular communication fosters creativity and productivity and primes the group to respond quickly to emerging issues.

With diverse expertise and members in multiple states, this team can test drones in a wide variety of real-world agriculture situations. In contrast, most prior research has focused on drone use in a single field or a specific crop or stressor. Coordination spreads the workload, reduces duplication, and lowers some costs. Sharing information, equipment, and other resources helps overcome the limited capacity of a single institution.

With members at many universities, the team can tackle the lack of education in the classroom and among other researchers and Extension agents.

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What has this project accomplished so far?

Researchers are improving drone sensing and developing new drone-based systems.

This project continues to evaluate and identify the most reliable, cost-effective, and user-friendly drone platforms and sensors for monitoring and managing stressors in agriculture and natural resources.

To maximize the accuracy of the data collected, project members developed hardware, software, and detailed protocols for calibrating and using drones.

Researchers developed new drone-based strategies that can help:

- Scout pests and diseases in fruit, nut, and row crops and apply targeted treatment. These industries face major pest issues that are exacerbated by declining labor availability and increasing consumer demand for fewer chemical inputs. Drones can help overcome these challenges. *Clemson University, University of Georgia, Purdue University, Washington State University*
- Monitor plant water stress, helping farmers target irrigation. *Clemson University*
- Evaluate the responses of various genotypes to various stressors and identify plants for crop breeding programs. Drones are less labor-intensive, faster, and can screen more plants than manual screening and they are enabling new types of measurements and biological discoveries. *Montana State University, Texas A&M, Virginia Tech, Washington State University*
- Manage pastured livestock. Drones can detect stray herds, create 3D renderings of animals to calculate market value, and assess forage quality. *University of Kentucky, Mississippi State University*
- Monitor water quality on a large-scale. *Mississippi State University, North Carolina State University, Virginia Tech*
- Provide higher resolution data for flood risk models and water resource management. *Auburn University, Mississippi State University, North Carolina State University, Virginia Tech*

New tools help drone users manage the data they collect.

Drone sensing systems can generate a lot of data. Project members developed a user-friendly digital log book for drone operations. Multidisciplinary expertise helped ensure that the log book has the right features for a variety of users. *Purdue University*

Project members are sharing their knowledge about drones.

Over the past five years, project members have shared their knowledge in many ways, including:

- Fact sheets to help stakeholders understand the regulations and licensing required for drone use.
- Workshops on risk management for current and potential drone users. *University of Arkansas, Clemson University, Texas A&M*
- Trainings to help forest land managers use drones for less labor-intensive estimates of timber value. *Auburn University, University of Florida*
- Extension workshops, programs, and materials. *University of Arkansas, Clemson University, The Ohio State University, Purdue University, Washington State University*
- Digital resources like websites, videos, and datasets.
- 100 peer-reviewed publications, the most recent of which have already been cited 85 times.
- A book on drones for vegetation monitoring.
- Industry magazine articles that reached thousands of readers in multiple countries.
- Popular press articles.
- Regional, national, and international conferences.
- Technical sessions at meetings of professional associations, including the American Society of Agricultural and Biological Engineers.

What are the impacts?

This group's multistate, multidisciplinary research and outreach have helped overcome barriers and accelerate broader use of drones in agriculture and natural resources. By efficiently collecting large amounts of data, drones can help guide better decision making, greater advances in plant and animal breeding, and more profitable and sustainable management.

Drones developed for agriculture can also have impacts beyond the field. After a tornado destroyed a nearby Native American historical site, scientists at Stephen F. Austin State University in Texas used drone data to create 3D models of the site. These models will help tribe members reconstruct the site.

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