Drones and Precision Agriculture

Kadin Norris

South Dakota State University

GEOG 270: Introduction to Small Unmanned Aircraft Systems

Richard Stephens

December 2020

Introduction

Drones have been part of the Agriculture Industry since the 1980s, and their appeal has become more and more popular as the agriculture drone market is set to pass $5.19 billion by 2025. Precision agriculture is a growing practice that many farmers are taking advantage of to maximize their yields in the field. Drones are a big part of precision agriculture, as they bring many benefits to the table. However, all the advantages carry a variety of limitations. Today, drones are used in many different ways to assist farmers in their operations. On top of that, the future of drones in agriculture is looking greatly promising. All in all, more and more farmers today are finding that using drones in their operation is significant to maximizing yields in their fields.

What is Precision Agriculture, and how did Drones get Involved?

Before exploring the use of drones in precision agriculture, It is valuable to understand what precision agriculture is and its advantages to today's generation of farmers. The basic definition of precision farming, as stated by Ivy Wigmore of WhatIs.com is, "an approach to farm management that uses information technology to ensure that crops and soil receive exactly what they need for optimum health and productivity." The overall goal of precision agriculture is to help farmers get the most out of their fields in terms of profitability, sustainability, and the protection of the environment. Precision agriculture allows for farmers to use less to grow more. An example of precision agriculture is the use of GPS for autosteer in tractors. Autosteer

enable the farmer to plant crops more precisely and straighter rather than using a traditional marker on the planter. Autosteer ultimately saves time and fuel, as the farmer can get in and out of each field quicker than ever. Updated technologies like GPS allow precision agriculture to grow and expand to anyone willing to grasp the concept. Technologies utilized by precision agriculture today include:

- Variable-rate technology.
- Global positioning systems (GPS).
- Various maps.
- Guidance software.
- Unmanned aerial vehicles

Unmanned aerial vehicles or UAVs are becoming a prominent part of precision agriculture, but where did they come from? The first unmanned aircraft system involved in agriculture was developed in the 1980s for crop dusting purposes. From there, drones literally and figuratively took off in agriculture. Drones come in all different shapes and sizes. However, the best style of drone for agriculture use is a fixed-wing or rotary-winged helicopter. These are considered low expense, low speed, low ceiling height, lightweight, and have a low payload with a short duration period as a majority of the farming applications require only low-medium endurance capability. Drones, or UAV's, offer countless benefits to the agricultural industry.

Advantages and Limitations of Drone in Agriculture

There are numerous advantages of drones being incorporated into precision agriculture. Farmers are always looking to save money where ever they can. Farm drones can quickly help the farmer save and provide them enhanced efficiency and added profitability, instead of traditional field scouting by physically walking around the area of land looking for certain red flags such as weeds or pests. Drones can take off and survey the farmland within minutes. With the help of intensive software, the drone can even report crop health and even treat certain red-flagged areas. Not only does the drone tell you how to manage the flagged areas, but the farmer can use it to treat that section of the land as well, more accurately than ever. If a farmer plants a field of corn and later notices an excess of weeds in one particular area, rather than the farmer contacting their local cooperative to spray chemicals on the whole area. A drone can easily apply chemicals precisely to that distinct area that needs attention, ultimately saving a significant amount of money. Drones also come in handy for cattle farmers who let their cattle roam through challenging terrain. The farmer can fly their drone to check up on the herd with ease without physically dealing with the rugged terrain. The intelligence to gather and interpret this data in real-time has substantial results for farmers. Results include:

- Better crop yield.

- Fewer resources spent on weed control and other chemicals.

- Overall improved management decisions.

With all the significant advantages of drones in agriculture comes some limitations that might keep the farmer away. These limitations include legal restrictions such as all drones between 0.55 and 55 pounds must be registered with the FAA. The use of drones beyond the line of sight is not permitted. There are also restrictions on speed and height. Any violations can result in imprisonment or financial fines. There are also many flight route limitations. Drones have limited airspace to fly in and around. This prevents interference with other drones or flying objects. For example, a farmer may not fly their drone if their property is near an airport. Airports are in restricted airspace and prohibit drone use. Another limitation would be learning to operate drones. Buying a new tractor is not problematic for a farmer because the controls are similar from model to model. Leading to less time learning how to operate. However, a drone is not a tractor, and the controls are very different. This calls for the farmer to spend time familiarizing themselves with how their drone functions. Some farmers might not have the patience or time for this process. Finally, it is required to have a license to operate a drone for farm use. This means the farmer will have to pass an exam provided by the FAA. Once the exam is passed, the farmer can operate their drone in the farmlands. With all of that said, there is a lot of preparation, consideration, and behind-the-scenes work to operate unmanned aerial vehicles in the agricultural industry.

Real-World Examples of Drones in Agriculture and Future Uses

The capabilities of drones in precision agriculture have grown exponentially over the past decade. Unmanned aircraft can do more than just survey land with a standard

camera. Drones today can utilize specific tools to perform individual tasks. These instruments include RGB cameras, multispectral/NIR cameras, hyperspectral cameras, thermal cameras, depth sensors, spraying equipment, and gripping tools. These tools allow the farmer to perform field mapping, plant stress exposure, field nutrient information, weed management, crop counting, and chemical spraying. Field mapping is when a drone takes pictures of a field and stitches them together to dive deeper into these drone tasks. Each image is typically georeferenced using ground control points so that the data collected is accurate. From there, the field can be reviewed and analyzed. Plant stress detection utilizes thermal, RGB, and multispectral cameras to identify drought, lack of nutrients, and plant diseases. Weed management is done through the use of an RGB camera. Since weeds typically grow to a different height than the crop, the RGB camera can assign a specific color relative to the size of each plant. Ultimately recognizing where the weeds are and what type of weeds are invading the land. From there, drones can be equipped with spraying equipment to treat the weeds with chemicals more accurately than ever. The most popular agricultural drones for sale today include the PrecisionHawk's DJI Matrice 200 v2, senseFly eBee SQ, and the Sentera PHX Complete System. Don't expect the use of drones in precision agriculture to plateau anytime soon. Global Market Insights forecasts that the agricultural drone market size will exceed $5.19 billion by 2025. The company also alleges that technological progressions in farming methods will push demand. Expanded automation deriving from a lack of proficient resources and a labor crisis will reinforce agricultural drone demand. Lastly, GMI anticipates government programs to authorize operations of various sizes to help make farming processes more efficient. All in all, there are so

many uses for drones in the agricultural industry today, and it is only going to continue to grow in the future.

Conclusion

All in all, drones have become an increasingly central part of precision agriculture and farmers looking to get the best out of their land. Drones started in the agriculture industry in the 1980s and only took off from there. They provide the farmer with a handful of benefits, including field mapping, field nutrient information, weed management, crop counting, and chemical spraying, all at the tip of the fingers. Today, there are countless real-world uses for UAVs, and it's only going to expand in the future. Overall, Drones have considerably impacted the agriculture industry, providing the farmer with more and more possibilities to maximize the yield in their field.

References

"Agriculture Technology | Precision Agriculture | Farms.Com." *Farms.Com – Latest Agriculture Information, Farming News, Commentary, Weather, Auctions, Markets & New Products Portal*, https://www.farms.com/precision-agriculture/technology/. Accessed 29 Nov. 2021.

Hassler, Samuel, and Fulya Baysal-Gurel. "Agronomy | Free Full-Text | Unmanned Aircraft System (UAS) Technology and Applications in Agriculture | HTML." *MDPI*, Multidisciplinary Digital Publishing Institute, 9 Oct. 2019, https://www.mdpi.com/2073-4395/9/10/618/htm.

"How Drones Are Used in Agriculture - UAV Training Australia." *UAV Training Australia*, excitemedia, 8 Apr. 2021, https://www.uavtrainingaustralia.com.au/how-drones-are-used-in-agriculture/.

Knight, Renee. "Precision Agriculture: The Trends and Technologies Changing the Industry - Inside Unmanned Systems." *Inside Unmanned Systems*, 2 Apr. 2019, https://insideunmannedsystems.com/precision-agriculture-the-trends-and-technologies-changing-the-industry/.

Meivel, S., and S. Maheswari. "Remote Sensing Analysis of Agricultural Drone | SpringerLink." *Journal of the Indian Society of Remote Sensing*, 24 Nov. 2020, https://link.springer.com/article/10.1007/s12524-020-01244-y.

Meola, Andrew. "Precision Agriculture 2021: Benefits of Farm Drones & UAV Tech." *Business Insider*, Insider, 8 Feb. 2021, https://www.businessinsider.com/agricultural-drones-precision-mapping-spraying#:~:text=Drones%20have%20revolutionized%20agriculture%20by,and%20irrigation%20systems%2C%20and%20more.

"Precision Agriculture 2021: Benefits of Farm Drones & UAV Tech." *Business Insider*, Insider, 8 Feb. 2021, https://www.businessinsider.com/agricultural-drones-precision-mapping-spraying.

Naji, Ibrahim. "The Drones' Impact On Precision Agriculture." *ScholarWorks*, 1 Jan. 2019, https://scholarworks.utep.edu/cgi/viewcontent.cgi?article=3879&context=open_etd#:~:text=The%20first%20UAS%20in%20the,1980s%20for%20crop%20dusting%20purposes.

Pinguet, Ben. "The Role of Drone Technology in Sustainable Agriculture - PrecisionAg." *PrecisionAg*, 25 May 2021, https://www.precisionag.com/in-field-technologies/drones-uavs/the-role-of-drone-technology-in-sustainable-agriculture/.

Wigmore, Ivy. "What Is Precision Agriculture? - Definition from WhatIs.Com." *WhatIs.Com*, TechTarget, 17 Feb. 2016, https://whatis.techtarget.com/definition/precision-agriculture-precision-farming.