

Pigeon River Farm

Home of  Pasture-Raised Eggs

Final Report:

Curriculum introducing drones as cost effective tools for improved efficiency in ecologically and socially responsible management of livestock grazing operations



SNCR-SARE Farmer Rancher Sustainable Agriculture Grant
North Central Region

January 9, 2021

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Abstract:

Traditional ag-tech programs do not currently include curriculum introducing drone technology as an effective farm management tool. The project has developed 6 curriculum modules demonstrating “drone use for livestock grazing operations” curriculum. These modules provide 2-hours of technical curriculum in Wisconsin Standards for Agriculture, Food, and Natural Resources format for ag-tech instructors and other educators. These curriculum modules may be easily inserted into current ag-tech courses at the discretion of the educator. The curriculum modules are also easily adaptable for use in “field day” venues with live drone demonstration.

The multi-media curriculum modules present real-life examples of the ecologically sound, economically viable and socially responsible use of drones on Pigeon River Farm. Examples include research data and footage demonstrating such things as:

- Time money saved using drones in routine grazing livestock monitoring and close inspection activities versus conventional in-person methods;
- Ecological / environmental benefits of using drones versus conventional in-person grazing livestock monitoring methods;
- Stress reduction by drone use when conventional in-person grazing livestock monitoring methods are either dangerous or unattainable.

The finished curriculum has been initially released to local secondary and post-secondary ag-tech programs. Multi-faceted feedback and effectiveness from these ag-tech programs may be used to further refine and expand the curriculum.

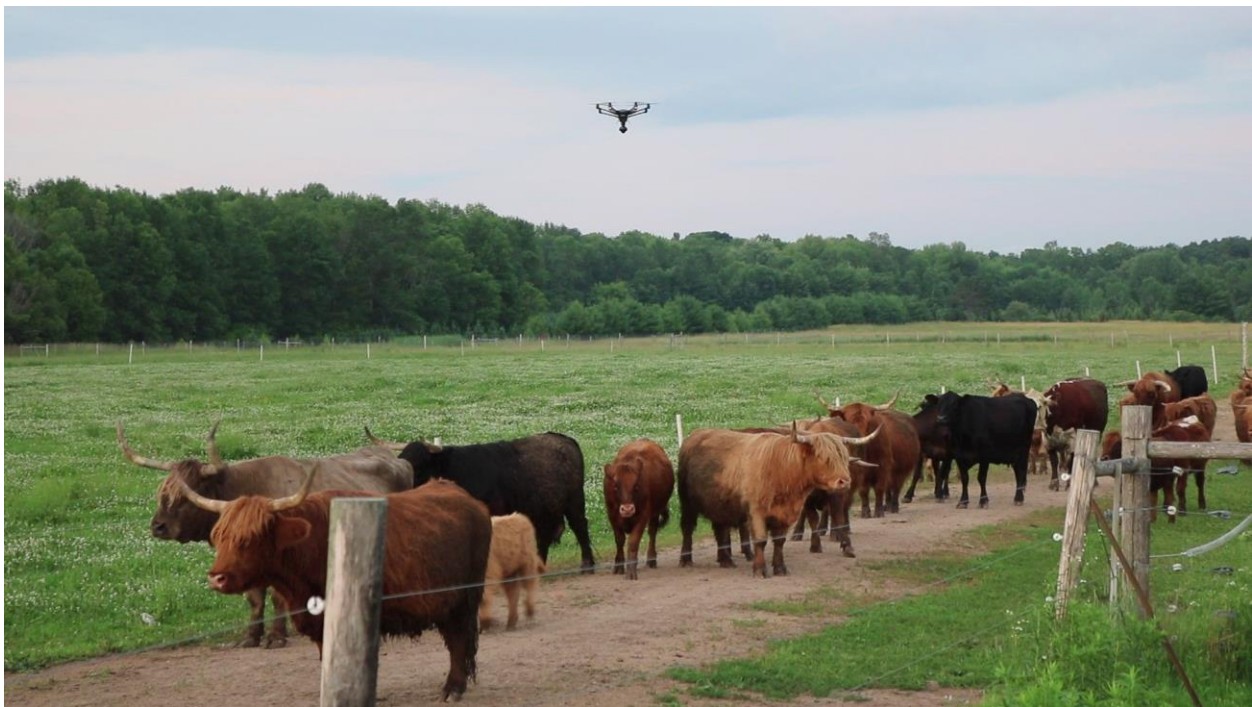
Pigeon River Farm Project Team:

- Robert Braun – Team Leader
- Kim Braun
- Brian Buckta
- Jacob Abrahamson.



Project Objectives:

1. Establish a benchmark by researching and documenting the effects of Drone Technology in pasture management compared to conventional methods.
2. Present the early project concept at June 2020 MREA Energy and Sustainable Agricultural Fair in Custer, Wisconsin (MREA Energy and Sustainable Agricultural Fair was cancelled in 2020 and 2021 due to the COVID-19 pandemic).
3. Present / demonstrate proof of concept in September 2020 field day (field day demonstration was delayed by COVID-19 pandemic until August 2021).
4. Develop a 2-hour multi-media curriculum module in WIDS format for easy integration into ag-tech programs. <https://www.wids.org/> (due to prohibitive program costs Wisconsin Standards for Agriculture, Food, and Natural Resources format was used rather than WIDS).
5. Distribute the finished curriculum module to ag-tech programs through website, social media, and live presentations.
6. Compile feedback and effectiveness data from ag-tech programs into a final project report.



Background:

Established in 2003, Pigeon River Farm is a family owned and farmed 50-acre Organically-Operated facility located on the southern branch of the Pigeon River near Clintonville in Waupaca County, Wisconsin. Pigeon River Farm's AWA certified chickens and livestock are pastured according to free range, rotational grazing practices.

Pigeon River Farm's livestock and chickens are rotated through paddocks of high-quality legumes and grasses. The legumes and grasses are then allowed to rest and re-grow, working with natural relationships and biological processes in order to:

- Keep chickens and livestock healthy and productive,
- Reduce the need for off-farm inputs;
- Preserve and improve natural resources;
- Protect habitat for wildlife;
- Produce high quality meat and eggs for local food systems,
- Secure farm sustainability for current and future generations



Pigeon River Farm currently raises:

- Layer hens housed in proprietary mobile shelters that are moved in the pasture on a 1 to 3-day basis in conjunction with the cattle and goats;
- Scottish Highland Beef Cattle;
- Meat Goats.

Since July 2018 the farm has been using drones daily to monitor the health and well-being of chickens and livestock in the pasture, fence integrity, pasture conditions, and environmental observations. The farm has found drones to be extremely beneficial and cost-effective tools for improved efficiency in the ecologically and socially responsible management of Pigeon River Farm's grazing operations.

Robert Braun, owner and operator of Pigeon River Farm has extensive experience in comprehensive research, design, patenting, prototyping, and testing of solution-based mechanical equipment. Additionally, he has received and administered many grants for research, curriculum development and outreach throughout his career in technical education. An FAA Part 107 Certified drone pilot, Mr. Braun also presented an informal workshop on drones at the June 2019 MREA Energy and Sustainable Agricultural Fair in Custer, Wisconsin.

Research Methodology:

The project initially verified the savings of time, money and resources Pigeon River Farm has experienced by using drones. This was accomplished by establishing the following benchmarks for daily livestock inspections over a 10-day period:

1. Time, money, and resources expended without the use of a drone or an ATV;
2. Time, money, and resources expended using an ATV without the use of a drone;
3. Time, money, and resources expended using a drone.

The tables below contain the benchmark data for comparison, along with comparative data for additional routine farm-management inspections.

<u>BENCHMARK LIVESTOCK INSPECTION</u>			
(East Pasture)			
	Drone Minutes	Walking Minutes	ATV Minutes
Day 1 Summer of 2021	7	36	12
Day 2 Summer of 2021	6	25	13
Day 3 Summer of 2021	6	24	13
Day 4 Summer of 2021	9	29	16
Day 5 Summer of 2021	6	28	14
Day 6 Summer of 2021	13	24	21
Day 7 Summer of 2021	10	32	17
Day 8 Summer of 2021	6	34	18
Day 9 Summer of 2021	7	19	10
Day 10 Summer of 2021	9	26	15
10 Day Total Minutes	79	277	149
Daily Average Minutes	7.9	27.7	14.9
Daily Average Labor Cost*	\$4.35	\$15.24	\$8.20
Daily Average Equipment Operation Cost	\$0.25	N/A	\$3.00
DAILY AVERAGE COST TOTALS	Drone	Walking	ATV
	\$4.60	\$15.24	\$11.20
* Labor Cost of \$0.55 per Minute is based upon the US Bureau of Labor Statistics National Hourly Wage Estimates for Farmers, Ranchers, and Other Agricultural Managers of \$32.73 https://www.bls.gov/oes/current/oes119013.htm			

<u>ADDITIONAL INSPECTION COMPARISONS</u>			
	Drone	Walking	ATV
Fence inspection 1.5 miles	7 min	45 min	15 min
Frequency of Fence inspection per week	7X	1X	2X
Pasture inspection	15 Min	120 min	40 Min

Daily drone flights routinely observed and recorded many factors, including:

- Cattle and goats movement within the paddock and pasture;
- Potential cattle or goat distress, aggression, or agitation;
- Possible cattle or goat breeding or birthing;
- Possible predator activity;
- Fencing infrastructure
- Poultry overwatch of conditions not seen on the ground



Monthly project reports were prepared by compiling and analyzing the month's data. These reports were used to prepare formal multimedia presentations and informational/educational materials, and they were ultimately used in the development of the curriculum modules. This verified drone data from a live case study provides a foundation for introducing the potential benefits of drone technology to the overall agricultural infrastructure.

Project Timeline and Outreach:

- **March 2020** The project began, and the project equipment was acquired & calibrated.
- **April 2020 – January 2022**
Daily drone flights and data collection were performed. During this period we identified and documented best practices for specific drone uses with livestock, poultry and additional uses on the farm.
- **May 2020** Channel 5 Television in Green Bay, Wisconsin aired a segment on the Pigeon River Farm Drone Project on their Saturday morning farm show. Fox Valley Technical College was on-site during the filming to add technical feedback while the drone was being used to manage cattle.
<https://www.youtube.com/watch?v=dVLIJ08--TiQ>
- **June 2020** Night-time drone flights were performed using special lighting equipment for comparison with daytime flights.



- **June 2020 – September 2021**

Between the summer of 2020 and 2021, a total of 28 farmers and 4 Agricultural Professionals visited Pigeon River Farm independently for firsthand observation of a drone interacting with livestock.

- **June 2020 – September 2021**

Between the summer of 2020 and 2021, Robert Braun visited several area farms as requested to demonstrate the viability of using a drone to gather livestock data on the participating farm.

- **July 2020**

Robert Braun participated in a GrassWorks event on July 22 that was geared toward introducing the agricultural industry to K-12 students. This was an excellent opportunity to show students how advanced electronic tools may be utilized in sustainable agriculture.



- **July 2020**

Several Agricultural Educators visited Pigeon River Farm on July 22 to observe a drone interacting with livestock.

- **August 2020**

Agri-View Newspaper featured the Pigeon River Farm Drone Project on August 4.

https://www.agupdate.com/agriview/news/business/graziers-tool-flies-with-ease/article_de72377f-336d-5fc4-b774-6d31c231fb76.html

Pigeon River Farm received excellent feedback from local farmers on this article.

- **September 2020 – January 2021**

During this period daily drone flights and data collection continued. Robert Braun continued building strong working relationships with secondary & post-secondary agricultural instructors and ag-industry leaders. In addition, research and development was performed to select and learn the best media technologies and techniques for our purposes.

- **February 2021**

Robert Braun delivered a Virtual Presentation at the annual Grass Works Conference. This was a large and diverse audience of farmers, agricultural professionals and stakeholders.

- **March 2021 – January 2022** Curriculum Development began in March with team meetings and comprehensive planning for videos, worksheets, instructor notes, and multi-media presentations. during this time it was also determined that shorter curriculum segments were preferred by the end-users.
- **April 2021** Drone footage and data were carefully reviewed, cross-referenced, and evaluated and selected for specific video series subject matter use.
- **May 2021 – July 2021** The initial video and voice-over script templates were created, mixed, evaluated, and adjusted by the Project Team.
- **July 2021** Robert Braun delivered a presentation with a hands-on drone demonstration at the GrassWorks meeting on July 17 in Pulaski, Wisconsin.
- **August 2021** The field demonstration day at Pigeon River Farm on August 19, 2021 was very successful (see Exhibit 1 on Page 15). A total of 15 farmers and educators attended the pasture walk/drone demonstration. A complete tour of the farm was given to familiarize the attendees with the size and scope of the operation. Next, two drones were utilized to show the attendees the efficiency and ease of use. After the drone demonstration the attendees were treated to refreshments and a light meal in Pigeon River Farm’s shop. The curriculum was presented with a projector showing the videos. Great feedback was given and is being utilized as we work toward the final product. The event was promoted by NRCS.



- **September 2021**

A preliminary beta-draft of the curriculum was presented at the local high school agricultural program by Project Team Member, Jacob Abrahamson. The students responded very favorably to the curriculum. (see Exhibit 2 on Page 16)

- **October 2021**

Curriculum development continued. Robert Braun met with the local technical college agricultural curriculum coordinator to validate all components of the curriculum meet or exceed state standards for postsecondary education.

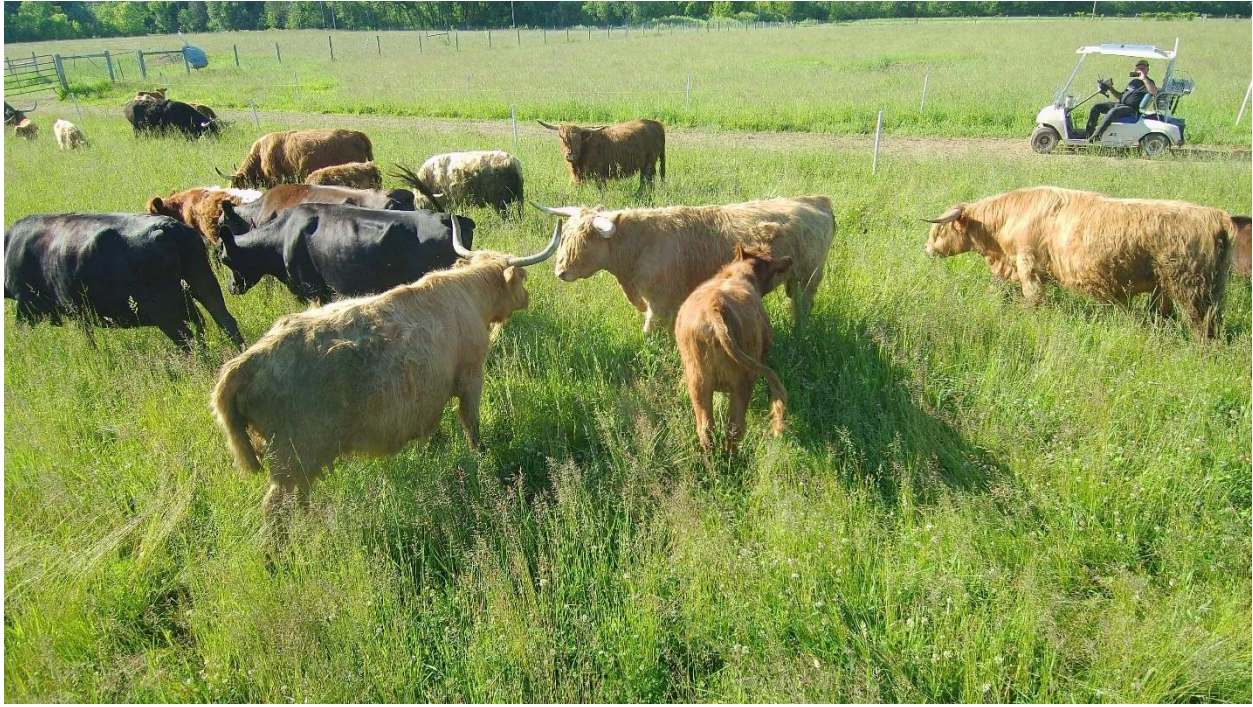
- **November 2021**

4 of the 6 curriculum videos were finished. On Nov 18 Pigeon River Farm hosted a Night Class with 9 FVTC students and 3 educators in attendance to present the curriculum. On November 20, an FVTC agricultural instructor presented the curriculum PowerPoint presentation ([Drone Support info files](#)) with videos and worksheets to a class, with excellent results (see Exhibit 3 on Page 17).



- **December 2021**

The final 2 curriculum videos and worksheets were completed during this time.



- **January 2022**

The finished curriculum modules were distributed to local secondary and post-secondary ag-tech programs and additional farming industry informational networks. The complete curriculum package with support materials was also posted online for stakeholder review and/or distribution at [Drone Support info files.](#)



Tangible Outcomes:

Pigeon River Farm found the project very rewarding and revealing with both tangible and intangible benefits. The tangible outcomes of our research are reflected below. Time is a farmer's most precious and perishable resource. We have calculated the time saved by using drones on our farm, and the corresponding monetary value of that time.

- Compared to our calculated time / cost of walking, drones provide us with a 70% savings.
- Compared to our calculated time / cost of using an ATV, drones provide us with a 41% savings.

Operation & maintenance costs of ATV's or vehicles for on-farm monitoring are skyrocketing. In comparison, emerging drone technology is becoming increasingly affordable. Drone use for routine monitoring can drastically reduce current expenses involved in conventional in-person monitoring methods.

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Intangible Outcomes:

Ecologically and environmentally, our research revealed that drone use can eliminate soil compaction caused by frequent use of conventional vehicles. Practically, our research revealed that drones can also allow on-farm monitoring when flooding, muddy ground or deep snow prohibit conventional in-person methods. Drones also offer more frequent environmental farm observations with a significantly enhanced aerial perspective. This same drone-based perspective can provide a farmer with documentation regarding prevention of soil erosion, soil health, water quality, etc. with video and still pictures unobtainable by any other method. Additionally, drones do not produce harmful emissions through the use of fossil fuels used in conventional vehicles or ATV's.

Physiologically and psychologically, as we grow older we have personally realized a significant reduction in labor and related stress through the use of drones. Additionally, drones can be used in sub-zero temperatures, improving safety conditions for farmers that would otherwise be forced to endure the danger of the extreme cold. Most of in-person farm inspections are also done alone by one person, increasing the inherent risk of a potential injury in the field. Remote inspection by drone eliminates this risk for the farmer.

Practically, our research revealed that drones also provide a unique perspective with potential benefits for livestock. Combined with high-resolution photo and video technology, drone use has allowed us to perform enhanced close inspection and attention to detail previously only achieved by in-person inspection. Robert Braun has monitored cattle activity on the farm by hovering above the herd for as long as 20 minutes. The information he gathered included the aggressive action of one animal towards another. Such behavior is often difficult to observe at ground level. This type of information could lead to better herd management by putting groups of animals together that are least combative.

The introduction of the project concept, demonstrations, and initial release of the curriculum produced by the project have also received excellent feedback from farmers, agricultural leaders, educators and students (see Exhibit 2 and Exhibit 3 beginning on Page 16). The complete curriculum package is posted online for stakeholder review and/or distribution at [Drone Support info files.](#)



Recommendations

It is our recommendation that the curriculum produced by this project continue to be refined, widely promoted, and distributed to secondary and post-secondary agricultural education programs and additional farming industry informational networks such as SARE, NRCS, technical colleges and farming industry informational networks.

We further recommend that feedback and effectiveness data be collected from all curriculum users, and that the data collected be used to enhance the curriculum and develop additional modules in the same manner to maximize the benefits to a wider spectrum of agricultural stakeholders.



Acknowledgements

The Pigeon River Farm Project Team would like to express our special thanks to the following individuals and businesses for their key role in our project's success:

- Rachel Bouressa, Bouressa Family Farm, New London WI
- Eileen Lamm, Lamm Farms, Clintonville WI
- Steve Rosenow, Rosenow Farm, New London WI
- Alvin Miller, Miller Farm, Marion WI
- Justen Seeger, Maple Valley Farm, Marion WI
- Dan Braun, Pine Hill Farm, Marion WI
- Dale Knaack, Knaack Dairy Farm, Marion WI
- Wayne Schmude, Hilltop Dairy Goats, Clintonville WI
- Josh Laatsch, Technical Support, Caroline WI
- Tim Laatsch, Laatsch Dairy Farm "Goats", Tigerton WI
- Dale Muschamp, Technical Support, Clintonville WI
- Dale Johnson, Century Sunflower Oil Farm, Pulaski WI
- Dan Hintz, Hintz Dairy Farm, Marion WI
- DroneU, Technical support, Albuquerque NM
- Tanner Allender, Cattle and Horse Support, Clintonville WI

Exhibit 1 – Field Day Handout August 19, 2021

Pigeon River Farm

Home of  Pasture-Raised Eggs

Efficient & Effective Drones on the Farm Project

Traditional ag-tech programs do not currently include curriculum introducing drone technology as an effective farm management tool. The project will develop 2 classroom hours of “drone use for livestock grazing operations” curriculum. Curriculum modules will be produced in Worldwide Instructional Design System (WIDS) format for ag-tech instructors and other educators. Curriculum modules will be easily inserted into current ag-tech courses at the discretion of the educator. Curriculum modules will also be easily adaptable for use in “field day” venues with live drone demonstration.

The multi-media WIDS-format curriculum modules will present real-life examples of the ecologically sound, economically viable and socially responsible use of drones on Pigeon River Farm. Examples will include research data and footage demonstrating such principles as:

- Time money saved using drones in routine grazing livestock monitoring and close inspection activities versus conventional in-person methods;
- Ecological / environmental benefits of using drones versus conventional in-person grazing livestock monitoring methods;
- Stress reduction by drone use when conventional in-person grazing livestock monitoring methods are either dangerous or unattainable.

Each curriculum module will focus on a specific topic such as:

1. Equipment Selection, Rules & Regulations, Safety
2. Fence Inspection
3. Pasture Inspection
4. Livestock Interaction:
 - Cattle
 - Poultry
 - Horses
 - Sheep & Goats



The finished curriculum will be released to secondary and post-secondary ag-tech programs. Students and educators using the finished curriculum module will be asked to complete a pre-class survey and a post-class survey to provide a full spectrum of effectiveness feedback.

E7148 Neitzke Road, Clintonville, WI 54929 715-754-2425 www.pigeonriverfarm.com

Exhibit 2 – Letter from Marion High School, Marion, WI



MARION JR/SR HIGH SCHOOL

“Our children will achieve their full potential”

January 5, 2022

Robert Braun
Pigeon River Farm
E7148 Neitzke Rd.
Clintonville, WI 54929

Hi Bob,

I showed the Effective use of Drones module to my Intro to Agriculture Students. They were excited to learn and talk about the use of drones. They mentioned that the content was very interesting and relevant to the newer technologies that they are interested in. They said that the videos provided great visuals to the learning process and helped them understand the content. I look forward to using these modules in both my large and small animal science classes. The videos include lots of details and information and the review worksheets provide a chance to check in with students to see what information they have learned.

I am looking forward to working with you more in the future to produce effective curriculum for my students.

Sincerely,

Jacob Abrahamson
Agricultural Instructor
jacob.abrahamson@marion-mustangs.org

105 School St., Marion, WI 54950

Phone 715-754-5273 FAX 715-754-1350

Exhibit 3 – Letter from Fox Valley Technical College



Appleton Campus

1825 N. Bluemound Drive, P.O. Box 2277
Appleton, WI 54912-2277 • www.fvtc.edu

January 4, 2022

Robert Braun
Pigeon River Farm
E7148 Neitzke Rd.
Clintonville, WI 54929

Dear Bob,

Drone technology has been around for several years, but very little research has been done with them on how they could be used to manage animals. Pigeon River Farm has done an outstanding job showcasing how different animal species react to a drone, how drones could be used to help assist in managing the animals, and in pasture/fence management. The videos, slides, and review items, will aid in increasing the knowledge of learners who seek to learn more about drone use among animals and pastures.

Thank You!

Sara F. Maass-Pate
Farm Business & Production Management Instructor
maasspat@fvtc.edu



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