Advancing Precision Agriculture In The Urban Environment

External Evaluation Report – Year 2
June, 2024

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Executive Summary

The Advancing Precision Agriculture in the Urban Environment NSF ATE (National Science Foundation's Advanced Technology Education) project has three project goals. These goals relate to (1) building a Urban Agriculture career pathway for secondary students, (2) developing training and professional development for secondary school educators that increases their knowledge of urban agriculture, precision agriculture and horticulture, and 3) providing continuing education for incumbent agricultural workers. To provide a clear and unbiased picture of the project's progress toward meeting these goals, the project works with an external project evaluator – Sun Associates – to monitor progress. This monitoring produces both formative and summative reporting that the project and its host institution – Northeast Community College (NECC) of Norfolk, NE – use to feed on-going reflection on the project's work. The report in hand is one of the information products of project evaluation. This is the Year 2 annual evaluation report.

Project progress in Year 2 continues to be strong. The project has met and exceeded nearly all of its quantitative benchmarks for Goals 1 and 2. This year, the project has logged well over 500 classroom-based interactions between secondary Agricultural Education students and the project's classroom trainer. Related to these classroom visits, the project has engaged with 17 classroom teachers. These interactions are in addition to other project work with teachers and students that were less intensive than the teaching of precision agriculture classroom activities. Interactions with students at opportunities such as Husker Harvest Days brought the project into contact with even more students. In-depth teacher interactions have occurred via the project's annual Summer Teacher Workshop, work with its Teacher Advisory Board, and via presentations at conferences and meetings such as the NCE conference. In short, the Advancing Precision Agriculture ATE project has had a busy and successful Year 2.

In terms of success, evaluation data shows that during Year 2, students generally connected with the key learning/knowledge objectives around which the project-created lessons were designed. Students utilized science, technology and math skills to conduct short investigations (STEM) related to a variety of topics connected to agriculture. As such, these lessons appeared to have a welcoming audience among those Agriculture Education teachers that the project reached out to and into whose classrooms project trainers visited to pilot the lessons. During Year 2, the project sharpened its message around the actual definition of "precision agriculture" and how STEM is a critical and necessary part of modern agriculture. Evaluation data shows that this message has reached the students and teachers alike who participate in project work.

During Year 2, the project continued to develop its understanding that it likely will not meet the stated objective of offering a secondary teacher micro-credential in precision agriculture. Likewise, it appears that Goal 3 – offering professional development to incumbent agricultural/horticultural workers – will not be met. In both of these cases the reason for not meeting the objective or goal is lack of participant interest. It simply appears that the project misjudged the amount of interest in a micro-credential or incumbent worker professional development. Rather than perseverating on meeting these (apparent)

non-needs, the project has devoted its resources into serving audiences that do have needs and desire to be served; i.e., secondary agricultural education teachers.

Recommendations flowing from Year 2 findings relate to what should be a natural maturation of project work as it passes the half-way point of its funding. The evaluators recommend that the project keep the notion of sustainability in mind as effort should be expended to developing the project's online presence into a resource that offers stand-alone service to teachers as the project prepares to transition from solely in-person service to teachers and students. Related to this would be development of resources that guide teachers' understanding of the best practices around the integration of STEM/precision agriculture into the broader Agricultural Education curriculum. Finally, it would be helpful if the project could support and inform activities that engage teachers in collaboration around developing or "extending" the example lessons and curriculum that the project has developed.

With its highly dedicated and talented staff at work during Year 3, there is every reason to assume that the coming project year will bring further progress toward meeting the Advancing Precision Agriculture project goals and broadening its impact upon teachers and students in Nebraska and nationwide.

1. Introduction

Purpose of this Report

The purpose of this report is to summarize the project Year 2 evaluative findings and recommendations arising the external evaluation of Northeast Community College's Advancing Precision Agriculture in the Urban Environment NSF-funded ATE grant (NSF Proposal Number 2202151). This report does not aim to be an authoritative list or exhaustive examination of each and every project activity. Rather, what this report does do is to present information on those project activities that are representative of the project's work to address its operational goals and then account for how these various strands of activity are helping the program make progress toward its big picture goals. Operationally, the annual evaluation report is intended to provide the project with a reflection point to consider the extent to which its work is serving its target audience and to make on-going (formative) adjustments to that work over the duration of the project. While this formal annual report is summative of approximately one year's worth of work, it is in-fact composed of evaluation data and information that has been shared and discussed with the project formatively throughout the year.

The Advancing Precision Agriculture project's evaluation is focused on an examination of three evaluation questions. These evaluation questions are:

1. To what extent has the project been successful in its efforts to build an expanded pathway and entrance to STEM horticultural careers by working within secondary school partnerships and in facilitating active learning opportunities using horticulture and precision technologies and interactive horticultural experiences?
2. To what extent has the project successfully developed and implemented professional development for Agricultural Educators that supports a guided pathway for secondary school agricultural education?
3. To what extent has the project served the continuing educational needs of incumbent agricultural workers within its partner organizations?

These questions are intended to frame an evaluation of project activities and performance that serve the project's three main goals. These goals are:

- To build an expanded pathway to urban agriculture careers by partnering with secondary schools to develop programing that introduces secondary school students to high-skill career options and provides active learning opportunities using horticulture concepts and precision technologies.
- To develop workshops for Agriculture Educators to develop their knowledge-base and skills on horticulture topics, the use of precision technology, and urban agriculture to enhance their ability to teach relevant courses.
- To Continuing Education workshops for incumbent workers.

Evaluation Activities to Date

Evaluation Plan and Methodology

Sun Associates' evaluation work on behalf of the Advancing Precision Agriculture project is rooted in the concept of collaborative or participatory evaluation. [1] The evaluators' experience indicates that collaborative evaluation methodology is a most cost-effective way of engaging projects in the formative work of reflecting on project progress and the factors that contribute to successful project performance. As an external evaluator, it is always Sun Associates' intention to not only report "what happened" to a project, but to facilitate the development of an understanding about why the project performs as it does. Central to this exploratory approach to evaluation is the creation of descriptive performance indicators related to project goals.

Evaluation Indicators

For the Advancing Precision Agriculture project, the evaluators worked with Northeast Community College's grant leadership team to develop the project performance indicators. This team initially convened in September of 2022 and through a process facilitated by Sun Associates completed its indicators by January, 2023. The descriptive indicators were organized into a matrix with associated data collection strategies that continues to serve and guide the project and its evaluation through the present time (Year 2). The indicators are attached in the Appendix of this report.

Project Activities that Inform this Evaluation

Primary Project Activities Covered by this Evaluation

Year 2 has represented the Advancing Precision Agriculture's first true full year of project work. Year 1 included approximately half a year of planning and organization time. This up-front work in Year 1 benefitted Year 2 in that the project was well under way and fully functional throughout Year 2

The primary project activities that give rise to the evaluation findings detailed in this report are:

- Review of data related to teacher, student, and teacher advisory group review of secondary school lessons/activities
- Project visits to secondary agricultural education classrooms
- Project professional development for secondary school teachers
- On-going project management and meetings

Data Collected for Year 2

Data collection for this study consisted of classroom and professional development session observations, teacher and staff interviews/discussions, a professional development session focus group, and student, teacher, and professional development participant surveys (**Table 1**). Copies of the instruments used for data collection are found in the Appendix of this report. A guiding principle in the evaluators' data

[1] O'Sullivan, Rita. (2012). Collaborative Evaluation within a framework of stakeholder-oriented evaluation approaches. Evaluation and program planning. 35. 518-22. 10.1016/j.evalprogplan.2011.12.005.

collection efforts was to utilize a mixed methods approach (quantitative as well as qualitative data) and to insure that all findings can be rooted in more than one data source.

Focus Groups	
Teachers/Professional Development Participants	6
Observations	
School/Classroom	13
Professional Development Sessions	2 (days)
Online Survey Responses	
Students	529
Participating Classroom Implementation Teachers	17[2]
June, 2024 NCE Workshop Participants	9

Table 1 - n values for focus groups, observations and surveys

Please note that the comments attributed to teachers, staff and students in this report are all actual quotations from interviews and are represented in indented *italics* throughout the report. In some cases quotations have been minimally edited for clarity or confidentiality. Those edits are represented using standard typographic notations.

[2] 14 teachers completed the post-visit survey as well as the pre-visit survey. 3 teachers only completed the pre-visit survey. Therefore a total of 17 unique teachers completed the evaluators' surveys.

2. Findings to Date Related to Indicators

Goal 1 – Secondary Student Activities

Secondary Student Lessons

Over the course of project Year 2, the Advancing Precision Agriculture project continued to field the secondary agricultural education lessons/classroom activities it created in Year 1. These lessons aim to introduce students to basic concepts related to precision agriculture and to provide opportunity to develop some of the STEM skills necessary to engage with a precision agriculture career pathway. By the end of Year 1, there were five lessons altogether that had been developed and piloted by project staff. The website to which these lessons will be posted has been created and exists at northeast.edu/nsf. Additionally, in Year 2, the project worked to improve the lessons by soliciting feedback on them from the project's teacher advisory board of secondary agricultural education teachers and pedagogy specialists from the Northeast Community College faculty.

The project goal under which student activities have been developed is:

> *To build an expanded pathway to urban agriculture careers by partnering with secondary schools to develop programing that introduces secondary school students to high-skill career options and provides active learning opportunities using horticulture concepts and precision technologies.*

The project has defined success in meeting this goal as students being able to:

- *Be able to define the terms "precision agriculture", "horticulture", and to describe drone technology as well as to be able to recognize career opportunities in these areas.*
- *Be able to make informed decisions and apply problem-solving strategies around the use of precision agriculture/horticulture/drone technologies in various decision-making settings/situations.*
- *Apply mathematical principles to a variety of precision agriculture, horticulture and drone technology decision-making scenarios.*

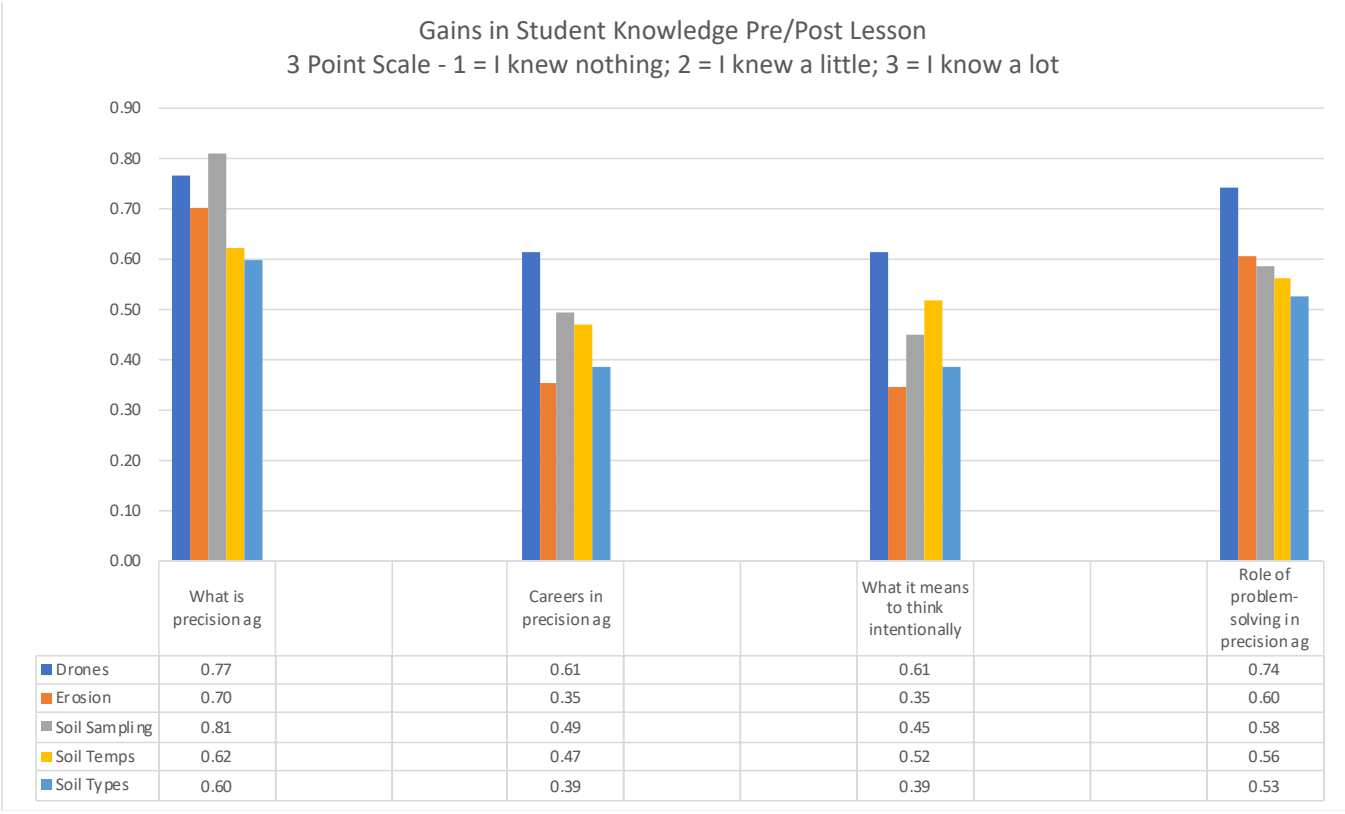
As part of these indicators, there are several quantitative benchmarks set out in relation to Year 2, Goal 1. Specifically, the project aimed to connect with 100 secondary students as well as 100 post-secondary students who would engage with the project-produced lessons. Progress in this regard will be discussed below.

In order to assess progress toward meeting Goal 1 and to measure project performance against its indicator, the evaluators surveyed as well as observed students who participated in three of the project's developed lessons. Survey data was collected from 90 students, and classroom observations were made in three different schools where these lessons were taught by the project's trainer. As was the case in Year 1, the project's Precision Agriculture Trainer traveled to schools throughout NECC's service region to teach the project-developed lessons. The evaluators continued to administer teacher and student surveys (developed by the evaluator) to uniformly assess teacher and student reactions to the lessons. By the end of Year 2, such data had been collected from 14 schools, on five different lessons (Drones, Growing Media, What's the Temp?, Field Microscopes, and Variability).[3]

Student survey data on the degree to which they understood key lesson – and project – learning objectives both before participating in the lesson and then after participation is shown in Figure 1, below.[4]

[3] There were 17 teachers who completed pre-visit surveys, and 14 who completed both pre and post-visit surveys. 529 students completed post-visit student surveys (there is not a pre-visit survey for students) during Year 2. The evaluators associate these Year 2 student surveys with the 14 teachers who completed post-visit surveys. There is room for error in this association, and the evaluators will improve the data collection instruments for Year 3 so as to create a more fool-proof correlation between teachers and their students who complete the student survey. In addition, a small number of the 529 student surveys related to lesson activities that were not among the five discussed above (e.g., a sprayer simulation activity, a class on field scouting, and 17 student surveys that could not be correlated to any known grant activity. Those surveys are not included in any of the statistics reported in this report.

[4] This testing methodology, known as retrospective pre-test or RPT is a statistically valid way of measuring changes in participant knowledge after an event or intervention. See Hwalek, Melanie, Cassandra Solomon-Filer, and Deborah



	What is precision ag			Careers in precision ag			What it means to think intentionally			Role of problem-solving in precision ag
Drones	0.77			0.61			0.61			0.74
Erosion	0.70			0.35			0.35			0.60
Soil Sampling	0.81			0.49			0.45			0.58
Soil Temps	0.62			0.47			0.52			0.56
Soil Types	0.60			0.39			0.39			0.53

Figure 1 – Student knowledge of core objectives before lesson participation and growth after.

Here it can be seen that of the five lessons administered during Year 2 and tested via survey, the Drone lesson seems to consistently have had the greatest impact on students overall across all four measured domains. To reiterate, these domains are:

- A definition of "precision agriculture"
- Careers related to precision agriculture
- What it means to think intentionally
- The role of problem-solving in precision agriculture

Looking at all four domains, it appears that the biggest gains regardless of lesson were in developing a definition of precision agriculture and understanding the role of problem-solving in precision agriculture. When left to use their own words to describe what the lesson they experienced was about, 16% (85 out of 529) explicitly stated "precision agriculture". Figure 2, below is a graphic representation of all of the terms applied to lessons. Here, the evaluators note that many students tended to describe the lessons very literally, using terms like "drones" (20%), "soil" (34%), and erosion (14%) which of course reflected the actual activities or materials the lessons utilized.

Wasserman. 2021. "Retrospective Pretests: Recent Use in Visitor Studies Research and Ways to Make Them More Informative." *Visitor Studies* 25 (1): 1–21. doi:10.1080/10645578.2021.1977084.

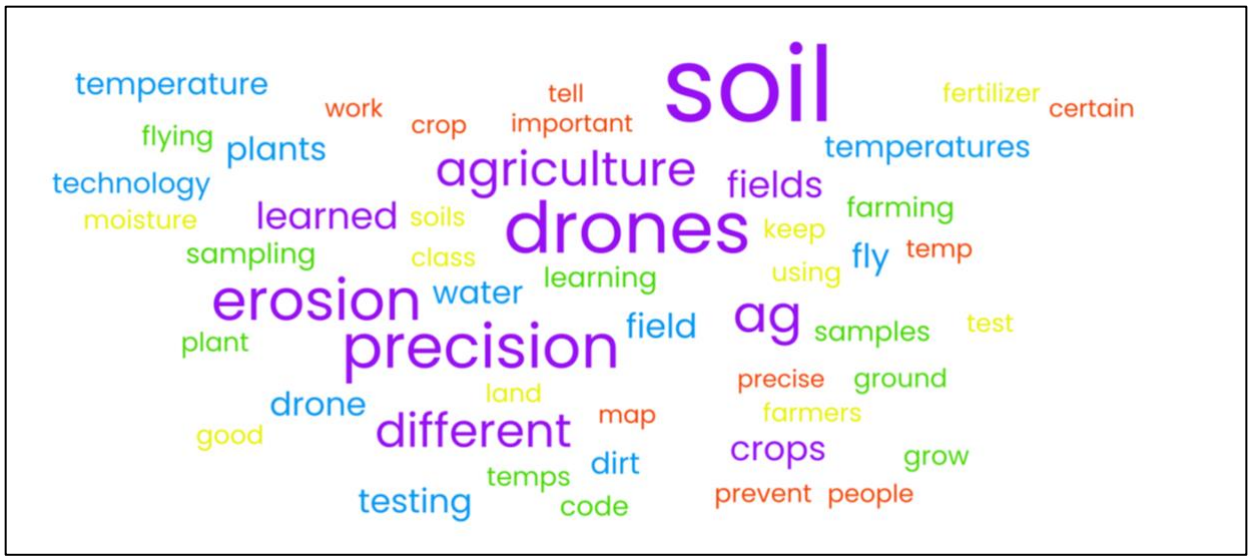


Figure 2 – Visual analysis of the frequency of terms used by Year 2 secondary students when describing what the project lesson they participated in "was about".

In Year 2, the evaluators observed project trainers frequently utilizing a standardized presentation that introduced the chosen lesson to each class. Figures 3 and 4 below show the introductory slides from this presentation.

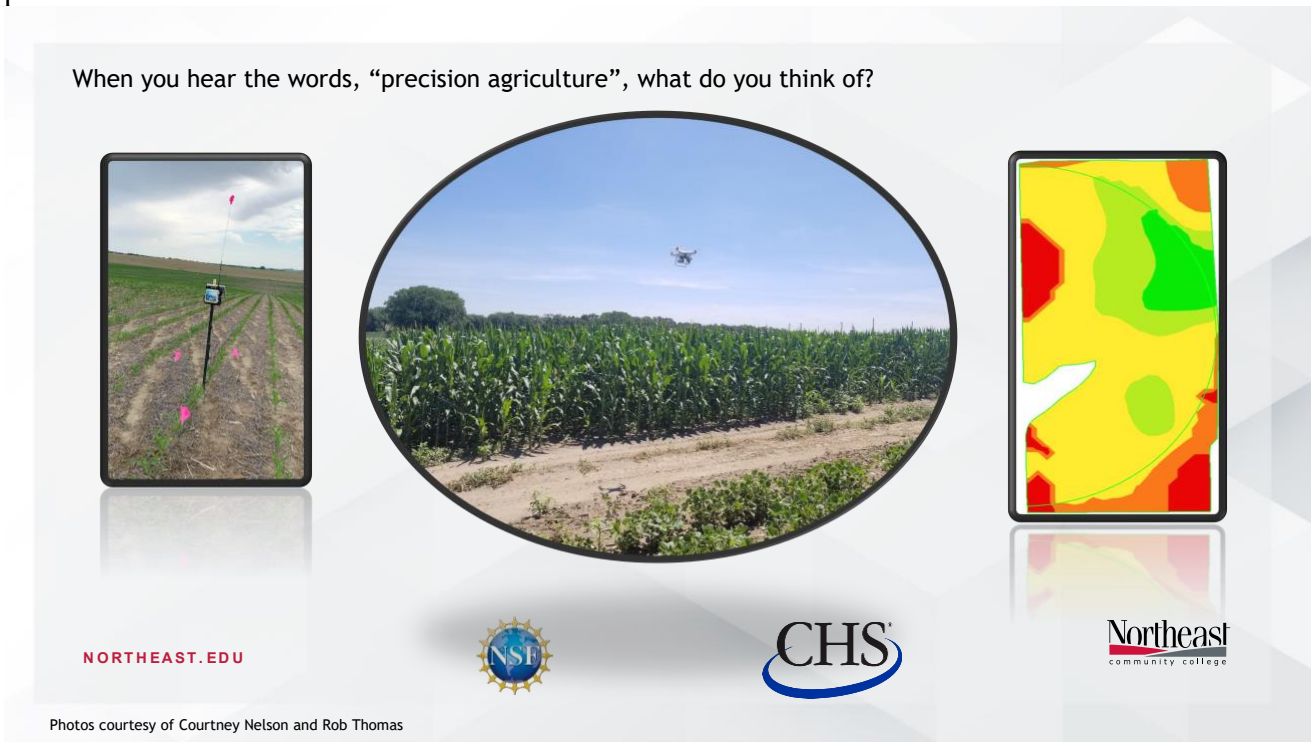


Figure 3 – Project-created visual to spur student conversation about the definition of "precision agriculture".

Figure 4 – Project-created visual for student discussion of the term "precision agriculture".

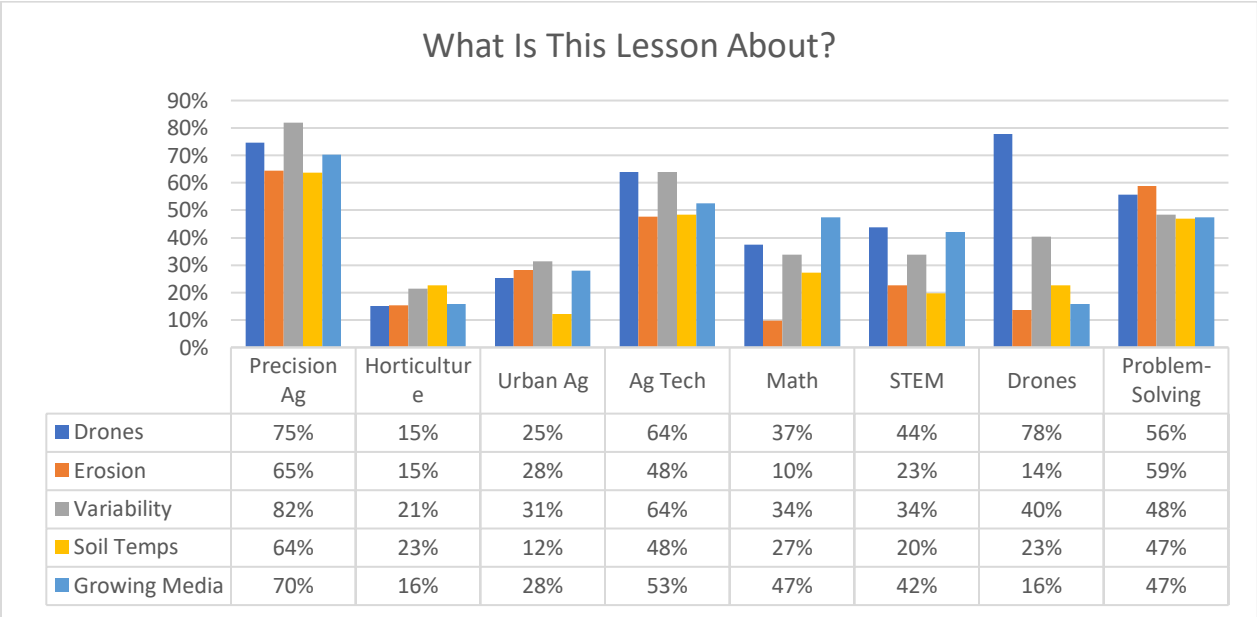
The evaluators find that these slides do an excellent job establishing the basic framework around which the project-created individual lessons are structured. Since these are typically shown to students before any of the hands-on activities commence, student attention is high. The project staff have also been observed doing a good job facilitating a question and answer conversation (interactive direct instruction) to embed the idea of "what is precision agriculture" with students.

The presentations also have recap slides (see Figure 5), although given the logistics of delivering a lesion, it is not always possible for the facilitator to get to these recaps. The evaluators find that this is likely one reason why a number of students end up remembering the actual activity (drones, erosion, use of infrared thermometers) more than the overarching concept that the lesson connects to (precision agriculture).

Figure 5 – Project-created slide recapping the student discussion of precision agriculture.

Identified Student Take-Aways

Figure 6, below, shows how students identified lesson topics when provided with a controlled vocabulary posed by the evaluators. It is very clear that "Precision Agriculture" was most-often chosen by students as a lesson topic regardless of the materials or activities involved in the lesson.[5]



	Precision Ag	Horticulture	Urban Ag	Ag Tech	Math	STEM	Drones	Problem-Solving
Drones	75%	15%	25%	64%	37%	44%	78%	56%
Erosion	65%	15%	28%	48%	10%	23%	14%	59%
Variability	82%	21%	31%	64%	34%	34%	40%	48%
Soil Temps	64%	23%	12%	48%	27%	20%	23%	47%
Growing Media	70%	16%	28%	53%	47%	42%	16%	47%

Figure 6 – Student assessment of whether or not various lessons related to queried topics.

[5] Students were not required to choose just one topic but could assign as many topics as they felt relevant to each of the lessons they experienced.

The evaluators find that the developed lessons have continued to mature since their introduction in Year 1. Some of this maturation and improvement came from teacher feedback (see below), but as a general point, the lessons have simply been iteratively improved as they've been used throughout the year. To date, the project has not yet posted the lessons and other material online (something that the project aims to do), and therefore the materials could potentially continue to undergo minor improvements. More important than revising the physical materials is the fact that the program staff demonstrating the lessons have simply been able to continuously improve the lesson delivery over the course of the year. It is this type of formative improvement that is responsible for the PowerPoint presentations that now introduce the lessons. These were not observed to be in use during Year 1, but their addition in Year 2 seems to have substantially improved delivery and impact.

While students were asked to assess their knowledge of agricultural STEM jobs and careers both before and after interacting with the project's lessons (see Figure 1), and growth of career knowledge was indeed measured for all five lessons, student comments about careers are frequent. For example:

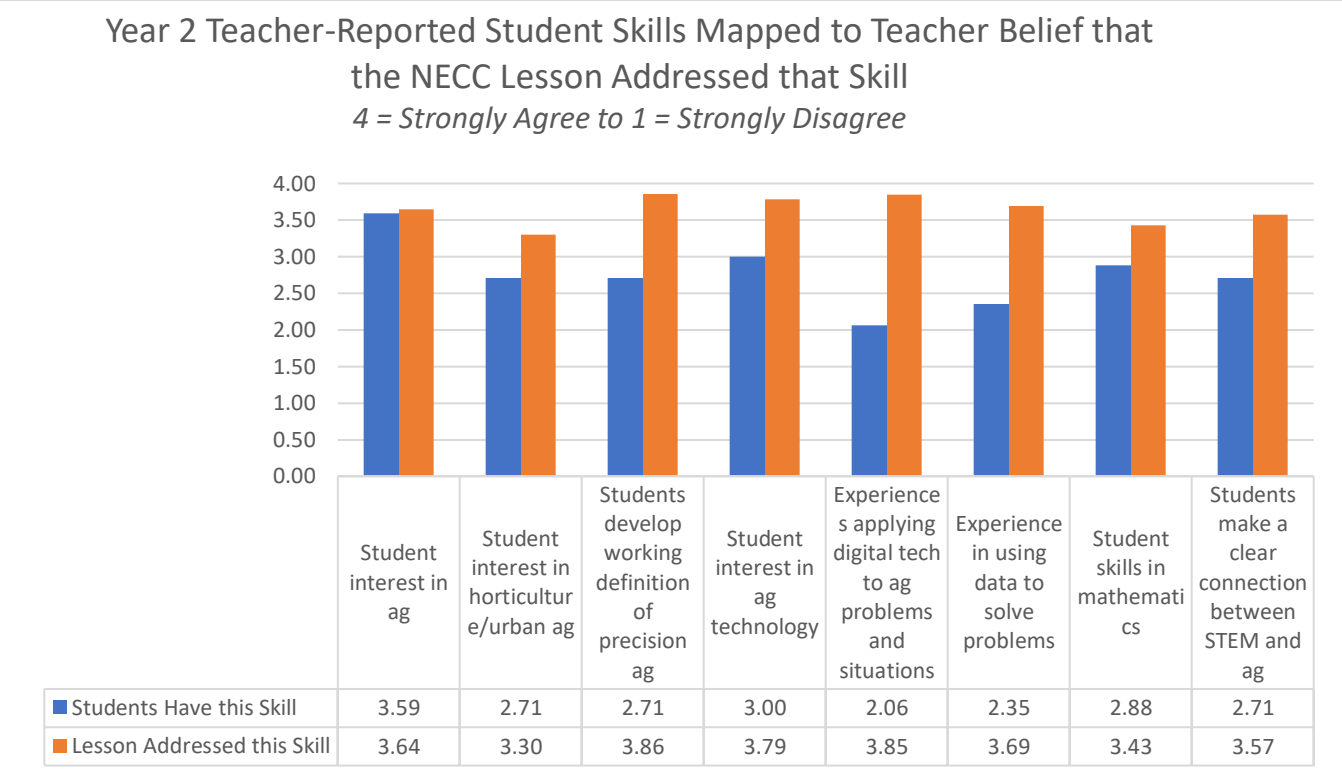
- *I would maybe like to know more about other interesting things that you do in precision agriculture.*
- *It was a very informative and hands on class. I learned a lot about parts of agriculture I didn't even know were a thing.*
- *What jobs use precision agriculture?*
- *What I would like to know especially as a senior is what are some of the jobs and careers in precision agriculture.*
- *I would like to know how many years it would take to accomplish this degree.*
- *Yes I would like to learn more about agronomy more. I might want to do that in the future.*
- *I want to talk more about the careers in precision agriculture.*
- *I enjoyed it because I am considering going into agronomy.*
- *what the people in this career are trained to do.*

Student comments about what their lessons were about are summarized in Figure 2. While many students took the question of "what was this lesson about" very literally and typically answered with just a few words like "Drones", "Erosion" or "Dirt", a number of the comments offered more insight into how students were thinking about this content and placing it within a context of precision agriculture as a STEM-related discipline. For example:

- *It was about drones being used in precision Ag and how they are making agriculture easier and faster for farmers.*
- *Drones and how we are advancing in using these things to use them more to our advantage and in being more accurate*
- *It was a lesson about precision ag that was hands on and allowed us to get some experience and practice by using block coding to program drones to fly a specific pattern.*
- *We did a hands on experiment on how to stop crops from eroding*
- *This lesson was about preventing erosion with and without "chemicals ¨ the best we can, and be as efficient as possible with materials.*
- *It was about precision agriculture and the tools they use for the job along with how it works and some of the thing you need to do to work in that field. and that it is also kind of like the IT of agriculture.*

Another window on student impact is shown in Figure 5, below. This data comes from pre and post teacher surveys where teachers were asked in a pre-visit survey to assess their student skills and knowledge around eight different goal-related/indicator-described domains ranging from "Interest in Agriculture" to their ability to "Make Clear Connections Between STEM and Agriculture". Then, as part of a post-visit survey, these same teachers were asked to assess the degree to which the project-created lesson had an impact on students in each of those same domains. Here it can be seen that overall, teachers felt that the project's lessons did indeed address student interests, knowledge, or need for experiences.[6]

An analysis of participating secondary teacher input shows that the lessons had the student impact that the lesson designers sought to create. It is also notable that for nearly every queried student skill, teachers uniformly agreed that the lessons did in fact address those skills. Defining precision agriculture, addressing student interest in technology, and using technology to solve agriculture-related problems scored highest in teacher agreement, but in fact all queried skills scored high. A positive reflection on the project's curriculum activity development is that the area where teachers felt that students had the weakest skills – using technology to solve agriculture-related problems – is an area that scored among the highest in terms of teachers feeling that the curriculum addressed this topic. Teachers clearly felt that the project's developed lessons were useful to the Ag Ed students.



	Student interest in ag	Student interest in horticultur e/urban ag	Students develop working definition of precision ag	Student interest in ag technology	Experience s applying digital tech to ag problems and situations	Experience in using data to solve problems	Student skills in mathemati cs	Students make a clear connection between STEM and ag
Students Have this Skill	3.59	2.71	2.71	3.00	2.06	2.35	2.88	2.71
Lesson Addressed this Skill	3.64	3.30	3.86	3.79	3.85	3.69	3.43	3.57

Figure 5 – Teacher data on student skills, and the extent to which they believe that the project lesson/activity piloted with their students addressed these student skills.

[6] See the survey instrument, in the appendix, for specifics as to whether teachers were commenting on student interests, knowledge, or experiences. These varied according to each of the domains as in some cases (for example) interest is the desired lesson outcome, whereas in other cases knowledge was the desired outcome.

Additional Teacher Input on Project-Created Lessons

Approximately half way through Year 2, project staff organized a "teacher advisory board" (an evaluator recommendation from Year 1) and solicited feedback about the five lessons that the project had developed at that time.[7] This feedback provided quite detailed input from six teachers on their impressions of lesson content, the likelihood that they would teach the lessons themselves, and the Nebraska Agriculture and Natural Resources standards that each lesson addressed. Particularly useful was the feedback related to whether the teachers would teach the lessons to their classes. Here, the data indicates that by and large, most of the lessons would be taught with the caveat that not all of the advisory board teachers teach classes where various lessons would be appropriate. But when looking at the deeper topics upon which the lessons are built – i.e., use of technology, using data to solve problems, and critical thinking (inherent in the integration of STEM topics, particularly engineering) – teachers clearly resonated with using the project-produced lessons within their agricultural education curriculum and therefore felt that for the most part these lessons would be useful. This advisory board feedback connects to the actual implementation data gathered by the evaluators in that teachers have made similar affirmations in the evaluators' survey and interview data.

For example, teachers were asked by the evaluators to write comments about whether the lessons met their expectations and how they thought that the had impact on their students' knowledge. Teachers were uniform in their positive comments in this regard.

- *I felt like students were able to learn more about precision ag in general as well as careers and what someone would so do as part of those careers.*
- *It very much met my expectations! The students loved it and it gave them an opportunity to learn something different that I don't have the knowledge to teach them about.*
- *I loved that the visit really reiterated what I talk about during land judging unit ever fall. I think it also made some students aware of what different ways to help conserve soil. Rather than just talking about it, they tried it.*
- *The hands-on applications were spot on for precision ag.*
- *I was impressed with Courtney's teaching abilities and how well the activities engaged the students from start to finish. I am confident they can explain what they did and why they did it!*
- *The visit more than met my expectations. The activities were hands-on, engaging and gave my students great real life examples of how precision technology is used in agriculture.*
- *My students were able to have a more hands-on approach to numerous different ag areas. This is something I usually try to do, but I think they appreciated it more coming from someone else*

[7] These are Growing Media, What's the Temp?, Field Microscopes, Soil Moisture, and Variability. Since then, two more lessons have been developed – one about drones and one about soil test analysis.

Quantitative Benchmarks/Achievements Related to Goal 1

In terms of the quantitative benchmarks in the Goal 1 indicator, the evaluators can attest that the project has served at least 529 secondary students in Year 2, more than five times the its target of 100 for Year 2. To date, the project has met its three-year benchmark of serving 20 (16 in Year 2 plus 4 in Year 1) schools by the end of Year 3.[8]

The indicator for Goal 1 also describes that the project will serve 150 undergraduate post-secondary students in Year 2. This objective was indeed met through the project's participation in Ag Field Days in September, 2023. NECC's Ag Field Days activity is a day when NECC business partners host information sessions about how their business or areas of interest provide career opportunities to the College's undergraduate Agricultural students.[9] During the Fall 2023 Field Day, students visited ATE Project staff at the project's Urban Farm and heard about Urban Agriculture careers and installed a plot of permeable pavers at the Farm. As a side note, these pavers are a useful component in the Urban Farm and form the starting/landing area for drone education activities the project hosts at the Farm.

[8] Note that these numbers come from the evaluators' own record-keeping and from counting the number of student post-visit surveys as well as teacher pre and post-visit surveys. So, these are actual evaluation data points. It is likely that even more students and teachers have been touched by the project without completing evaluation surveys. Therefore, actual participation numbers may exceed those reported here.

[9] Northeast's partners include: Sandramere Seed/Pioneer Seed, Unverferth/Orthman, Farmer's Pride Cooperative, Wolken Seed/ Channel Seed. Helena Cooperative, NRCS, QLF Agronomy, John Deere – AKRS, and Claas-Nebraska Harvest Center.

Goal 2 – Professional Development/Educator Knowledge

Operating in parallel with its aim to develop career pathways and programming for secondary students around urban agriculture, precision agriculture and horticulture (Goal 1) the Advancing Precision Agriculture project also intends to develop professional development for Agriculture Educators so that they may teach "relevant courses" to the secondary student population connected to Goal 1. This professional development constitutes project Goal 2.

Project Goal 2 is:

> *To develop workshops for Agriculture Educators to develop their knowledge-base and skills on horticulture topics, the use of precision technology, and urban agriculture to enhance their ability to teach relevant courses.*

The definition of success – that is, the indicator – for Goal 2 is:

> *Secondary teachers participating in the project report that they are able to integrate the project-developed lessons with ease. This includes the ability to interpret the data components of lessons, comfort examining new technologies involved in the lessons, and the integration of existing classroom technologies with confidence. Teachers will demonstrate the ability to develop new precision agriculture/horticulture/drone technology lessons and activities that expand upon those activities introduced by the project's classroom trainer.*

The quantitative benchmarks associated with Goal 2 are:

- A minimum of 20 secondary teachers will be engaged via classroom visits by the mobile learning lab/trainer
- Each teacher participant has access to a minimum of three lesson plans with a minimum of one being taught by the mobile learning trainer
- A minimum of 25 Agricultural Education secondary teachers will enroll in the six provided summer workshops at NECC
- 25 Agricultural Education secondary school educators will receive dual credit certification through demonstrating mastery of lesson plan content and/or completing the micro-credentials for all three courses with developed lesson plans
- Three drone-based workshops will be supplied over three years to Agricultural Education secondary educators

The project's formal teacher professional development work occurs throughout the project year, but is particularly intensive during summer between school years when staff host a Summer ATE Workshop for secondary Agricultural Education teachers and presents at the annual Nebraska Career Education Conference (NCE). During Year 2, the Summer Workshop was held May 28 – 30, 2024 and NCE occurred on June 5, 2024.

NCE and Summer Institute Workshops

Early in the Summer of 2024, project staff delivered professional development workshops in conjunction with Nebraska's Career Education Conference and also via a more intensive engagement with six educators recruited to attend a three-day summer institute (May 28 – 30) on NECC's Norfolk, NE campus. Content for these sessions focused on newly-developed soil lessons as well as two days of

drone training/lessons at the May summer institute. In the case of the NCE workshops, the evaluators collected online survey data from workshop participants. For the summer institute sessions, the evaluators conducted in-person professional development session observations and a participant focus group.

At the 2024 NCE conference, project staff conducted as workshop that piloted two new precision agriculture lessons – Soil Moisture and Soil Data Analysis. A total of nine participants completed post-workshop surveys for this session. Participant demographics were similar to previous year's NCE conferences with the majority of participants being secondary agricultural education teachers who teach a broad band of grades ranging from 7 through 12.

As shown in Figure 6, session participants showed gains in all workshop key concepts (as identified by the evaluators) in a retrospective post-test (RPT) administered at the conclusion of the session. Here it can be seen that the greatest knowledge gains came in the areas of using online resources to acquire data (.78) and interpreting data for agriculture problem solving (.89). The evaluators note that in both cases, these concepts scored initially (pre-test component) lowest of all of the queried skills, with teacher participants indicating that they generally knew nothing to only a little about these things. The other areas generally had teachers reporting that they knew "a little" about the concepts and therefore gains were lower.

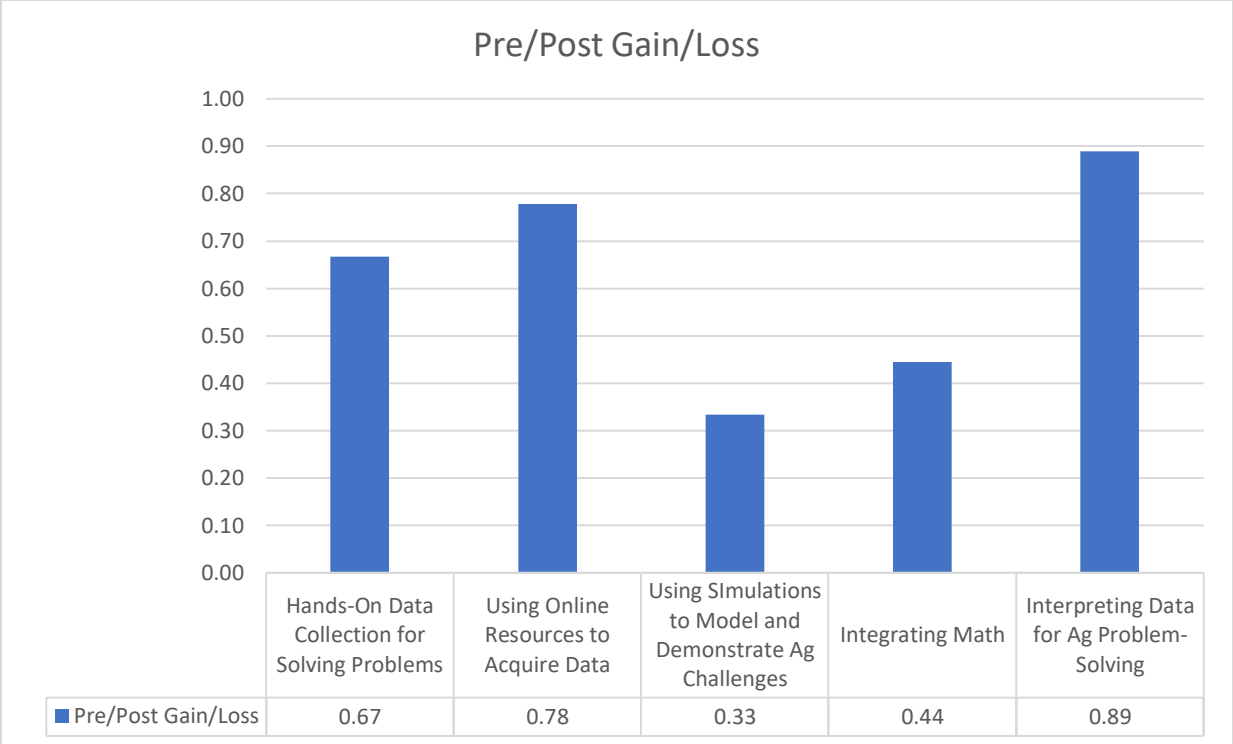


Figure 6 – NCE session participant pre/post gains in knowledge as measured on a three point scale with 1 = I knew nothing about this, 2 = I knew a little about this, and 3 = I knew a lot about this.

NCE session participants were also queried about the likelihood that they would request that the project's trainer come visit their classrooms to model lessons (a process that has been discussed earlier in this chapter). 56% of participants indicated that they would be likely to make such a request and 33% indicated that they would be "very likely" to request. Since the project is in a mode where it encourages

such interactions with the trainer, and is still interested in 1-1 service/modeling, this is a very promising outcome for the project.

Summer 2024 Teacher Workshop

The evaluators observed the project's three-day teacher workshop in May, 2024. While attendance was low, this seemed to be a well-organized and relevant session those teachers who were able to attend. It is noted that this year's workshop was literally squeezed into a narrow window of opportunity between the end of the school year and another three-to-six weeks of professional development opportunities for Nebraska's agricultural education teachers. The evaluators used the opportunity afforded by this teacher focus group to explore not only teacher motivation for attending and satisfaction with the project's professional development event, but also gathered teacher insights into the degree to which the project's main messages resonate with the students these teachers teach. Other topics explored related to general perceptions of agricultural education student need and the degree to which the project might be helping teachers meet those needs.

Teachers felt that while many of their students had some basic understanding of what "precision agriculture" is, this is complicated by the fact that for at least half of these teachers fewer than half of their agriculture education students (all of these teachers are agricultural education teachers) have any firsthand experience with farming. Particularly among younger students, who have had less exposure to agricultural education, their understanding of precision agriculture is limited.

Nevertheless, teachers felt that the "hands on" aspect of precision agriculture and in particular the topics and lessons modeled by the project do a good job of supporting students with learning experiences they need and want. Teachers feel that particularly since COVID, students have lost ground in their ability to communicate in authentic, face-to-face ways. This in turn has given rise to a multitude of student mental health concerns. The evaluators note that while these same concerns are voiced by teachers nationwide in a wide variety of grades and subject areas, the agricultural educators

this project works with believe that they have an advantage over many other teachers in terms of being able to support their students. This advantage lies in the fact that ag education is something that students are taking because they are interested in the topic. Students essentially opt-in to the courses that this project supports. For example:

- *Agriculture is an elective so kids are in our classes because they choose to be there. It makes relationship building better. It's easier for them to see the direct contact between what they do in Ag and the real world. Kids can get first hand exp with ag careers in our class.*

- *[Students] are in our class because they are interested in our subject. So if they want to own their own business, they may want to take my Ag Business class. Or a greenhouse class or a horticulture class if they want to work with their hands. Something in their minds that they can go on to use.*

- *Ag Ed is so diverse. There are so many things. Animals, drones, plants. You can take your curriculum and alter it to whatever kids want to know and need. You change your curriculum to suit their needs and help them be their best self.*

With students who are generally dedicated to being in their classes, the Ag Ed teachers are interested in serving their student needs with experiences that range from hands-on in the classroom (such as the project-produced lessons that have been fielded for the past two project years) to perhaps more activities and engagements with various professionals who work in different precision-agriculture-related fields.

- *One of the main things that we talk about to this day is that now as grownups we weren't given the knowledge or experience with any jobs that we didn't see daily. So you worked at the hospital or the manufacturing plant and those were the jobs you saw. We didn't get the exposure to so many careers and types of jobs. So, [I would like the opportunity to have] more exposure to a variety of options.*

- *The impact on kids is when they actually go to the place. I get speakers all the time, but when you take them somewhere and the students can interact with people that's a game changer. They also learn how to act. If they don't act well, I don' take them places.*

- *I think that since COVID, NECC has had a lot of things that we can do to bring our students to. NECC goes above and beyond providing opportunities.*

In this way, the teacher conversation came back to NECC and the Urban and Precision Agriculture ATE project staff. As one teacher noted:

- *I'm going to take these resources and put them with more resources back at school. I can write grants. So this is more of a resource that I can put with other things and create my own units.*

The evaluators note this this specific point is addressed as evidence of success in the project's indicators where it's stated:

Teachers will demonstrate the ability to develop new precision agriculture/horticulture/drone technology lessons and activities that expand upon those activities introduced by the project's classroom trainer.

Clearly the indicator hinges on the word "demonstrate", and therefore the degree to which this has occurred is something that will be directly explored during Year 3. Still, it is promising that teachers are saying that they want to use project resources as the basis for further curriculum and activity development. Likewise, the general perception from teachers on the Advisory Board (see above) that the project-produced (i.e., models) lessons are things that do serve their curriculum needs is a promising indicator that teachers will find ways to develop their own activities out of these models. This may be particularly the case with the drone activities which are clearly interesting to teachers, but where there exists a wide variation on the availability of drones in schools it may well be that substantial modification of the project-produced lessons is required.[10]

Goal 2 Quantitative Benchmarks

Just as with Goal 1, the Advancing Precision Agriculture project has largely met – and in fact already exceeded – nearly all of its Goal 2 quantitative benchmarks. These benchmarks relate to the number of teachers whose classrooms are visited by the project trainer (20 over 3 years); teacher access to three lesson plans; 25 teachers involved in the summer institute; and three drone workshops provided by the project. As of the end of Year 2, 38 teachers have been visited (exceeding the three year benchmark by 18); seven lesson plans have been developed (exceeding the three year benchmark by four); and 18 teachers have been involved in the summer institutes (on track to meet the three year benchmark by the end of Year 3). As to drone workshops, the project has conducted multiple days of drone workshops at each of the two summer institutes thus far. This is in addition to teaching multiple drone classes during school visits. The drone workshop benchmark has been more than met in spirit, and with next year's summer institute (assuming it has a drone workshop in it) the benchmark will be fully met.

One final benchmark for Goal 2 relates to the provision of "dual credit certification" and micro-credentials for secondary agricultural education teachers. Here the evaluators note that the project is unlikely to meet this benchmark due to a lack of teacher interest in the certification as well as logistical difficulties at NECC in setting up a micro-credential. It is said by project staff that institutional difficulties could be resolved except that thus far no teacher has expressed interest in the credential or certification. The project's statement is that this is due to the fact that Agricultural Education teachers have many options for credentialing and therefore no pressing interest in any additional options.

Connecting Goal 1 and Goal 2 Findings

Goal 2, which focuses on developing the teacher skills and knowledge necessary to develop a urban/precision/horticulture career pathway naturally connects to Goal 1, which is about students developing the skills and interests to progress down this pathway. Therefore, the evaluators naturally consider both of these goals as interconnected pieces of project work.

[10] Data such as that coming from the Advisory Board survey, participating teacher surveys and direct evaluator interview of participating teachers and their classroom implementations indicates that many teachers do not have drones and if they do it is not necessarily the case that they have the droneblocks software and indoor drones used by the project in its training. Nevertheless, teachers are very interested in learning about the integration of drones via the project's professional development and express the fact that they will ultimately develop their own drone-based lessons, inspired by what they have seen from NECC.

At the end of Year 2 it appears that the project is making good progress on both of these goals. The project has demonstrated that the curriculum-based activities it has developed and field-tested are effective ways to address student STEM skill and knowledge development within the context of Agricultural Education. Teachers have reflected on how the lessons have connected with students and have independently affirmed that the lessons are having a positive, desired, impact. Furthermore, teachers as learners have taken the time – both casually (by watching the project's trainer work with their students) and formally (via project-provided professional development) – to examine the lessons as learning activities which aim to engage students around STEM and precision agriculture. Teachers have largely indicated that these sorts of lessons and activities are important additions to their Agricultural Education curricula.

In the Year 1 annual evaluation report, the evaluators forecast that Year 2 would bring some observable measure of awareness on the part of teachers who work with the project around issues of how precision agriculture can be a viable career pathway for their students. In their pre-visit and post-visit surveys, teachers clearly expressed a desire that the project-created lessons would spark student interest in STEM-agricultural/horticultural careers. For example:

- *It's easier for them to see the direct contact between what they do in Ag and the real world. Kids can get first hand exp with ag careers in our class.*

- *[I hope that] Students will learn more about precision ag topics and potential careers.*

- *I hope to make sure my students understand what precision agriculture is and why it's so important to the industry. I want them to see the opportunities in agriculture careers for them. Many are interested in technology but don't always make the connection of technology in agriculture careers.*

- *I felt like students were able to learn more about precision ag in general as well as careers and what someone would so do as part of those careers.*

The evaluators note that the classroom lessons all taught by the project trainer explicitly address the fact that precision agriculture is very much about solving global problems and therefore is a strong basis for future careers.

Figure 7 – Slide from project's introductory and framing presentation for all delivered precision agriculture lessons.

The explanation related to the presentation slide shown in Figure 7 is:

> *It is helpful, as you consider careers, to ponder what problems you enjoy solving. Even when you go to sport events or scroll Tik Tok, you are solving a boredom problem that you are working to fix. You want entertainment, so those are examples of solutions. Let's jump into the "why" of precision ag before we go too much further. On a global scale, we have to feed 9 billion people by 2050. This will continue to be talked about until 2050, so you will hear about this in college, especially if you go into an agriculture degree. How can we work to accomplish this with urban sprawl? Precision ag may be an option to help us be intentional with the land that we have.*

The evaluators find that this is a strong and direct connection to make to students; and the fact that it was made in every classroom lesson is evidenced by the numerous student comments that echoed this statement. For example:

- *I would maybe like to know more about other interesting things that you do in precision agriculture.*
- *I liked being able to know what kind of jobs there are and how they all play a part in the agricultural industry.*
- *I want to talk more about the careers in precision agriculture.*

In short, in the Year 1 evaluation report, the evaluators recommended that the project make explicit the message that precision agriculture is a career that will pay off in its ability to solve global problems. That STEM message absolutely has been stated during Year 2, and there is evidence that it is being heard by students.

Goal 3 – Continuing Education for Incumbent Workers

Advancing Precision Agriculture's Goal 3 is simply to provide continuing education workshops for incumbent workers. These are individuals who work in a variety of horticulture and agricultural fields such as turf management. The workshops for incumbent workers represent a sort of "student" for the project not too conceptually different than the secondary students who are involved in Goals 1 and 2. Many of the skills that the project aims to develop (or help teachers to develop) in secondary students are similar outcomes for incumbent workers.

The project has defined its success in meeting Goal 3 as:

> *Incumbent workers participating in project-developed and implemented activities report that the activities have provided them with greater (than prior to participation) insight into how to interpret data, apply new/novel technologies to their current work settings, and overall more ways to integrate precision agriculture/horticulture/drone technologies into their current work.*

Quantitative benchmarks for Goal 3 are:

- *Three drone-based workshops will be supplied over three years to at least 20 incumbent members of the industry workforce*
- *The project attends at least two industry-based conferences or field days per year where classroom lessons (modified for incumbent workers) are presented.*
- *At least 60 individuals interact with the project (total) as trainees in these industry conference events.*
- *Ten modified lesson plans developed for industry training have been made available for digital download*

The evaluators find that Goal 3 is in a similar situation to the Goal 2 objective around secondary teacher credentialing. The project is willing and able to support this goal, but there simply does not seem to be participant interest in the work of this goal.

Specifically in relation to Goal 3 and its aim to provide professional development to incumbent agricultural workers, over the course of Year 2, the project reached out to all three professional organizations in Nebraska that connect and serve incumbent workers. This means that approximately 1000 individuals working in areas of landscaping and turf management were contacted and asked about interest in working with the project to deliver training during these organization's various conferences. This resulted in near zero interest. Project staff report that while organizational leadership is supportive of training, it is said that such training needs to be offered during times when the workers are not working (i.e., during winter); and for the most part this would mean that the workers need to attend training on their own off-time. This has proven to be an untenable position and likely explains the lack of worker interest. Professional organizations of course have no leverage over the various employers who employ their membership and it seems that employers place a higher priority on serving paying clients than offering useable training opportunities to their employees.

In short, the project has made an informed and strong case for why there will likely be no traction on meeting Goal 3 during the remaining life of the project. Should any Goal 3-related activities be logged in Year 3, the evaluators will gladly report on them.

3. Recommendations

At a point slightly more than half way through its funded life, the evaluators are pleased to report that the Advancing Precision Agriculture in the Urban Environment project has met and substantially exceeded nearly all of its quantitative benchmarks on Goals 1 and 2. Goal 3 has not been met, but this is not for lack of trying but mostly due to the fact that the goal was not practical in the current environment. Year 3 promises to be more productive both in terms of continuing to add to the project's quantitative achievements as well as for making solid additional gains on the qualitative measures that define project progress. In consideration of this very positive situation, the evaluators do still have some recommendations for insuring and solidifying this progress.

Goal 1 – Student Outcomes and Programing

1. Develop and Launch the Project's Online Presence

As a further step toward making the Advancing Precision Agriculture project a self-standing project that is not entirely dependent upon direct service to teachers by project staff, the project must formally launch its online presence. This presence of course will contain the variety of lesson plans, and related resources, that the project has developed for Agricultural Education teachers. While the project has thus far depended upon the in-person relationships between regional teachers and project staff – staff who come and provide direct service to teachers and students throughout the region – it is clear that this type of servicing cannot occur indefinitely. Particularly as NSF funding ultimately ceases, the project needs a self-standing presence. That is the point of the project's website.

The advantage of creating the website now versus waiting until in-person service winds down is multifold. First, the online site can support and make consistent (from one school visit to the next) the in-person experience that the project now offers. Teachers who can download lesson plans, handouts, and resource lists from the website surrounding the trainer's visit will be much more prepared, and participatory than they are when they are dependent (as is now the case) upon the trainer to deliver support for things such as handouts and resources. Second, a project website/online repository – particularly one that is oriented toward stand-alone use – will help build the project's exposure beyond that which can currently only happen with in-person engagements.

In short, actually getting this website up and running (it frankly is something that should have been launched in Year 1 or at latest in Year 2) is not only helpful to the project's on-going funded work, but it will be a strong step toward creating the on-going, sustainable, presence that the project needs as it prepares to complete the NSF-funded portion of its work.

2. Develop a Crosswalk Between "Traditional" Ag Ed and Precision-Agriculture

The evaluators have observed project staff doing an excellent job explaining to students the role of STEM in agriculture – i.e., precision agriculture. As has been discussed in the findings, this explanation seems to resonate with students who in turn seem to be developing an understanding of how skills and interests in STEM constitute an important part of agriculture. Now, it's time for the project to solidify this connection for the Agricultural Education teachers with whom it works. At present, the various

lessons and activities that the project conducts are all good "examples" of how topics in precision agriculture can be taught within secondary Ag Ed courses; but it would still be worthwhile for there to be more of a conceptual framework, or an actual curriculum framework within to place these activities and those which are going to be developed by other teachers over time. This latter point is significant in light of the fact that one of the project's objectives (under Goal 2) is for teachers to "extend" teaching about precision agriculture from the direct experiences (examples) that the project brings to classrooms around the region.

A crosswalk between Ag Ed curriculum and topics such as drones, data analysis, etc. would give teachers concrete information on where and how to integrate these topics within the broader ag ed curriculum that they presently teach. The evaluators believe that teachers would find this to be useful guidance. In addition, a concept document – essentially a sort of practitioner-focused white paper – that could be distributed to teachers (via the project's online resource site as well as being promoted separately) would give ag ed teachers a concise rationale for making the modifications to their curriculum to support the inclusion of precision agriculture experiences. This concept work as well as its resulting tangible products (a document, resources, all linked together on the project's website) would also be a strong promotional tool for NECC's precision agriculture education program around the region.

Goal 2 – Professional Development/Educator Knowledge

1. Focus on Assisting Teachers to Expand Upon Existing Precision Agriculture Activities and Lessons

To utilize the "give a person a fish versus teaching them how to fish" analogy, it is clear that the Advancing Precision Agriculture has done excellent work delivering fish to teachers and students around the region. To extend the analogy, the lessons developed are clearly effective, but it is also clear that five to seven lessons cannot possibly sustain a real push for the integration of precision agriculture within the state/regional Ag Ed curriculum. Rather, as the project goals anticipated, it will ultimately be necessary for teachers to expand on the current lessons and ideas to develop that depth of curriculum on their own. The evaluators believe that there is a role for the Advancing Precision Agriculture project to assist in that development during its third and final years.

One way to do this – and there are no doubt multiple angles of approach to this objective/recommendation – is to shift next year's Summer Workshop to be one that's more about curriculum or lesson writing than it is simply exploring existing lessons or more broadly topics in precision agriculture. The project's Teacher Advisory Board could be brought together during the year to gather ideas for curricula and a roadmap for integration, and then could be engaged to work with other teachers during the Summer Workshop to actually create product. This is a subtle shift in perspective around working with teachers, with the teachers being more of a group of collaborators (with each other and with project staff) versus "participants" in project-produced training, but this would definitely represent "teaching how to fish" and is appropriate for a project in its later stages of implementation.

Summary

Overall, the evaluators find that the project is making excellent progress toward meeting its indicators. Therefore the general sense of the recommendations is that the project should continue on its present course. The recommendations detailed above are intended to clarify, refine, and support already positive project performance. Such refinements will not only benefit the project in its current status, but will likely allow the project to solidify that which it accomplishes into a program of work that could be sustainable by NECC and educators in Northeast and East-Central Nebraska well after project funding ends.

Appendices

URLs for Survey Instruments

The survey instruments used during project Year 2 and referred to in the Year 2 Evaluation Report are linked below.

- Classroom teacher pre-visit survey
- Classroom teacher post-visit survey
- Student feedback survey
- NCE June, 2024 workshop participant survey

A page that contains all of these links online can be found at: www.sun-associates.com/necceval

Please note that these surveys are PDF print versions of interactive online surveys and thus contain the various formatting errors and other artifacts (e.g., item numbers) that are the result of changing an online survey into print form. These errors and artifacts were not present for the teachers and students who used the actual online forms.

Teacher Focus Group Questions

1. How did you hear about this week's sessions, and what attracted you to actually register and come out for the past 3 days?

2. Who here has had prior interaction with NECC's Urban and Precision Ag program? And if you have, what was that interaction?

3. Do you feel that your students – thinking about the student population your traditionally teach in the courses you traditionally teach – have an understanding of what "precision agriculture" is? And what might that be?

4. Thinking generally and broadly, what do your students come to you <u>most needing</u>? This doesn't have to be specifically content knowledge, but it really could be anything.

And how do you address that?

And what additional resources could you imagine getting that would help you with addressing those needs?

5. Who's taught (or had Courtney visit and she taught) any of the activities/lessons such as erosion, sampling, soil temperature, or any of the drone activities? And if so, how did those go?

6. To what extent has the workshop met your expectations?

7. What <u>barriers</u> can you imagine/visualize/know will hinder your being able to do these things with your students in your school?

8. Since these activities all involve the use – by you and your students – of some manner of technology. Can you speak to the technologies you and your students <u>currently</u> use (and in particular, your comfort level with integrating those technologies)?

9. Many of these activities involve math skills, can you speak to your students' ability to work with activities that require this level of mathematics skills?

10. Anything else?

Thank You for Your Time

Indicators

Advancing Precision Agriculture in the Urban Environment
Goals and Evaluation Matrix

Advancing Precision Agriculture Goal	**Evaluation Question**	**Indicators** ***We expect to see (count, hear about, etc.)...***	**Evaluation Data Sources**
Secondary School Programming/ Student Outcomes To build an expanded pathway to urban agriculture careers by partnering with secondary schools to develop programing that introduces secondary school students to high skill career options and provides active learning opportunities using horticulture concepts and precision technologies.	To what extent has the project been successful in its efforts to build an expanded pathway and entrance to STEM horticultural careers by working within secondary school partnerships and in facilitating active learning opportunities using horticulture and precision technologies and interactive horticultural experiences?	Through engagement with project-created lessons and experiences, students will: • Be able to define the terms "precision agriculture", "horticulture", and to describe drone technology as well as to be able to recognize career opportunities in these areas. • Be able to make informed decisions and apply problem-solving strategies around the use of precision agriculture/horticulture/drone technologies in various decision-making settings/situations. • Apply mathematical principles to a variety of precision agriculture, horticulture and drone technology decision-making scenarios. The project makes steady annual progress toward meeting its quantitative objectives around student and school engagement. • 250 secondary students (year 1 – 50, year 2 – 100, year 3 – 100) • 350 undergraduate post-secondary students (year 1 – 75, year 2 – 100, year 3 – 175) • • 20 schools (over 3 years) will be visited by the mobile learning trainer to administer lesson plans • Students from each school will participate in at least one of the project's curriculum activities (lessons) per visit from the project trainer.	• Student and class observation • Teacher logs and interviews • Teacher and administrator interviews/focus groups • Observation and analysis of student work (provided by • teachers) • Review of project • developed lessons and curriculum materials • Annual teacher surveys (pre/post/implementation) • Counts of student participants, schools, units/activities developed, etc.)

Professional Development/ Educator Knowledge To develop workshops for Agriculture Educators to develop their knowledge-base and skills on horticulture topics, the use of precision technology, and urban agriculture to enhance their ability to teach relevant courses.	To what extent has the project successfully developed and implemented professional development for secondary school Agricultural Educators that supports a guided pathway for secondary school agricultural education?	Secondary teachers participating in the project report that they are able to integrate the project-developed lessons with ease. This includes the ability to interpret the data components of lessons, comfort examining new technologies involved in the lessons, and the integration of existing classroom technologies with confidence. Teachers will demonstrate the ability to develop new precision agriculture/horticulture/drone technology lessons and activities that expand upon those activities introduced by the project's classroom trainer. The project makes steady annual progress toward meeting its quantitative objectives related to teacher engagement. • A minimum of 20 secondary teachers will be engaged via classroom visits by the mobile learning lab/trainer • Each teacher participant has access to a minimum of three lesson plans with a minimum of one being taught by the mobile learning trainer • A minimum of 25 Agricultural Education secondary teachers will enroll in the six provided summer workshops at NECC • 25 Agricultural Education secondary school educators will receive dual credit certification through demonstrating mastery of lesson plan content and/or completing the micro-credentials for all three courses with developed lesson plans • • Three drone-based workshops will be supplied over three years to Agricultural Education secondary educators	• Teacher and school administrator interviews/focus groups • Teacher logs and interviews • Class observation • Teacher surveys • Professional development observation • Review of project developed lessons and curriculum materials

Continuing Education/ Workforce Development To provide Continuing Education workshops for incumbent workers	To what extent has the project served the continuing educational needs of incumbent agricultural workers within its partner organizations?	The project makes steady annual progress toward meeting its quantitative objectives related to workforce development. • Three drone-based workshops will be supplied over three years to at least 20 incumbent members of the industry workforce • The project attends at least two industry-based conferences or field days per year where classroom lessons (modified for incumbent workers) are presented. • At least 60 individuals interact with the project (total) as trainees in these industry conference events. • Ten modified lesson plans developed for industry training have been made available for digital download Incumbent workers participating in project-developed and implemented activities report that the activities have provided them with greater (than prior to participation) insight into how to interpret data, apply new/novel technologies to their current work settings, and overall more ways to integrate precision agriculture/horticulture/drone technologies into their current work.	• Worker interviews • Workplace supervisor interviews • Workshop observations • Review of Initiative developed training materials/resources and supporting documentation