Optimizing Human Health and Nutrition: From Soil to Society

Graduate Student Written Interviews Report
June 2024

Background

In 2021, Washington State University (WSU) and its partners received funding from the United States Department of Agriculture's (USDA) National Institute of Food and Agriculture (NIFA) for an Agriculture and Food Research Initiative (AFRI) Sustainable Agricultural Systems (SAS) project, *Optimizing Human Health and Nutrition: From Soil to Society* (the AFRI SAS Soil to Society project). According to the project's proposal, the long-term goals of this project are to create more nutritious, affordable, and accessible whole grain–based foods through 1) the investigation of the contribution of novel, biofortified crop varieties and food products to human health through clinical and epidemiological evaluations and 2) the development and deployment of nutritious food products made from improved crop varieties grown within sustainable cropping systems.

This multi-institutional and transdisciplinary project will employ a Soil to Society (S2S) pipeline strategy that addresses gaps in current knowledge and traces the flow of nutrients from agricultural systems and food production to human consumption. The strategy will culminate in the synthesis of more sustainable agricultural management strategies and healthy and affordable food products to meet the needs of diverse individuals and communities.

To address short-, medium-, and long-term goals, the project's key objectives are to:

1. Understand and apply the roles of environment, soil, and cropping system management on soil health, farm economics, and the nutritional content of the grain for each target crop (Soil Management and Cropping Systems).
2. Develop new varieties of barley, wheat, peas, lentils, quinoa, and buckwheat with enhanced health and nutritive value (Plant Breeding and Genetics).
3. Confirm the impact of nutritionally enhanced varieties on key indicators of human health and assess acceptance using consumer panels (Human Health and Nutrition).
4. Develop a diverse and innovative suite of flavorful, affordable, and nutritious food products that will be accessible to consumers from all income levels (Food Science and Product Development).
5. Conduct population studies to explore impacts on dietary quality by increasing target crop consumption in US diets and assess consumer acceptance and valuation of whole grain– and legume-based foods (Community-based Health and Nutrition).
6. Focus educational capacity on secondary student instruction, teacher professional development, and farmer training (Education).
7. Disseminate knowledge gained and products developed to stakeholders across agriculture, food and health sciences, and communities, schools, and underserved populations through a wide-reaching extension effort (Extension).

Purpose

As part of the project evaluation, the AFRI SAS Soil to Society project leadership contracted with the Office of Educational Innovation and Evaluation (OEIE) to assess the progress, implementation, and impacts of the project. OEIE conducted written interviews with graduate students associated with the project to learn about their perceptions related to progress made toward project objectives, implementation, collaboration within the project, and perceived benefits from being a part of the project. A copy of the survey is provided in Appendix A.

Methods

OEIE collaborated with project leadership to develop the interview questions. Initially, focus groups with graduate students were planned, but because students were unavailable, OEIE and project leadership shifted to written interviews. On January 23, 2024, OEIE sent email invitations to 17 student researchers identified by project management to participate in focus groups. Despite several reminders, only three students showed interest in participating. A focus group was scheduled for three students, but when one student canceled, OEIE canceled the focus group altogether. OEIE and project leadership then discussed possible alternatives to focus groups and decided to send interview questions to each student, asking for written responses. On March 26, 2024, OEIE sent questions to all 17 students. To encourage participation, students were offered optional $10 e-gift cards.

Respondents

OEIE received responses from four of 17 graduate students for a 23.5% response rate.

Analysis

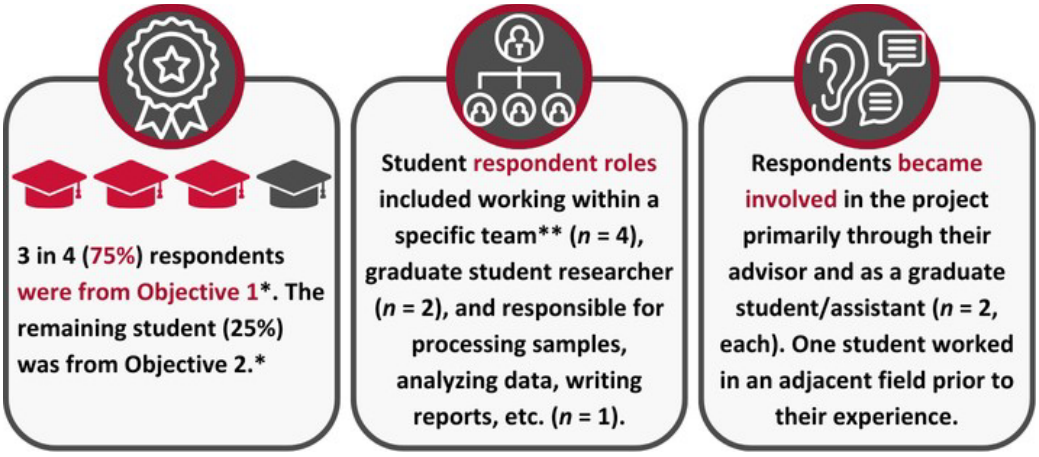
OEIE analyzed the interview data by reviewing responses to each question and identifying key concepts or themes emerging in those responses. Responses were coded to multiple themes as appropriate. Highlights appear in this summary. Appendix B contains a list of key concepts/themes from responses to each interview question.

Highlights

Involvement in the project

Student respondents were initially asked a series of questions to determine what Objective(s) they are a member of, what roles they take, and how they initially became involved in the project (Figure 1).

Figure 1. Student respondent Objective membership, roles, and how they became involved in the Soil to Society project.



*Objective 1 is Soil Management and Cropping Systems and Objective 2 is Plant Breeding and Genetics.
**Respondents had restated which Objective team they were apart of as summarized in the leftmost rectangle.

Students were also asked about their motivations for joining the project and they most frequently highlighted its interdisciplinary and collaborative nature (*n* = 3), followed by the project's alignment with their research interests (*n* = 2), a desire to learn how soil management connects to human nutrition (n= 1), and excitement about working with the project's PI(s) (*n* = 1).

The main reason for my interest in joining the project was its multidisciplinary nature, which brings together researchers from various fields of agriculture, including soil scientists, breeders, food scientists, extension specialists, and health professionals. This collaboration across disciplines is essential for achieving the ultimate goal of promoting healthy food production.

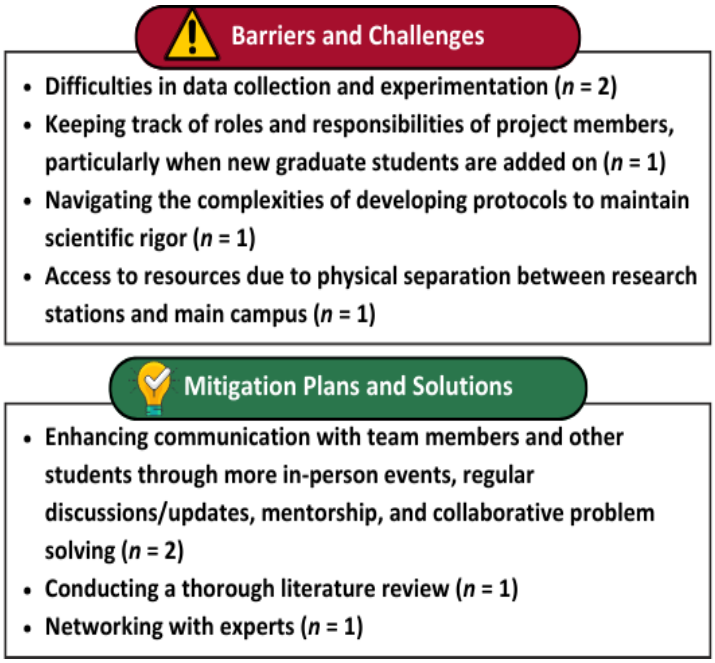
Implementation

Respondents indicated that the project is making progress toward achieving its goals overall since they have been involved. While some noted a slower pace of progress (*n* = 2), others highlighted ongoing efforts directed toward achieving the project goals (e.g., collecting and analyzing data, undergoing training) (*n* = 2). Additionally, one student expressed satisfaction with the considerable progress made, including the completion of a research trial and making plans for the project's next steps (*n* = 1).

Respondents expressed a range of benefits when asked about the desired impacts or benefits of the project. These included fostering collaboration across diverse sectors to ensure the delivery of nutritious food to consumers (*n* = 2), ensuring that the experimental design, data collection, and results are reliable and representative of the real world (*n* = 1), gaining a well-rounded understanding of sustainable

agriculture that can be used by producers (*n* = 1), and identifying strategies to enhance production processes (*n* = 1).

Figure 2. Project barriers, challenges, and the mitigation plans and solutions student respondents suggested.



Regarding the effectiveness of project communications, most students indicated that the information provided and guidance to resources were clear (*n* = 3), although one respondent found them somewhat clear. In terms of improving project communication with students, most respondents mentioned that the communication is adequate (*n* = 2). However, one respondent noted that the physical distance from collaborators has hindered project communication (*n* = 1). Participants also provided some suggestions, including more discussion sessions with students or experts under the same objective (*n* = 1) and providing more discussion sessions across different groups (*n* = 1). When discussing the project's greatest challenges or barriers, respondents highlighted various issues and their potential solutions in Figure 2.

Transdisciplinary research

Respondents unanimously stated that they are comfortable collaborating with colleagues in different disciplines (*n* = 4). They described being involved in frequent collaboration with other faculty and their lab members across different labs and Objective groups (*n* = 3), as well as collaboration within their own team (*n* = 1). Additionally, respondents expected this collaboration to continue after the project concludes (*n* = 3).

When asked if their comfort level for engaging in transdisciplinary research changed throughout the course of working on the Soil to Society project, students indicated yes (*n* = 4), with one respondent mentioning feeling more comfortable (*n* = 1), and another stating they were comfortable until recently and anticipate resolving any discomfort as they gain a greater understanding of the process (*n* = 1). Respondents provided various insights regarding suggestions to improve collaboration broadly and transdisciplinary collaborations. Two participants mentioned that the project is doing well with collaborations, particularly noting that regular meetings have been beneficial (*n* = 2). One respondent suggested organizing informal get-togethers between members for networking and sharing experiences, while another recommended more communication and sharing of work within the same objectives (*n* = 1 each). Two students were unsure and did not provide specific suggestions (*n* = 2).

Project communications have been clear in providing information and guiding me to resources. Initially, I felt a bit lost, but I soon realized that we have timely update meetings, student meetings, and semester-wise meetings. Attending these meetings has helped me stay on track with the project's progress across various fields.

Extension/Outreach

Respondents highlighted the benefits or impacts from the project's education and extension efforts. One student noted that interaction with invested parties has helped in understanding what information is helpful to them (*n* = 1), while another mentioned that a summer internship experience was excellent and that participants were engaged during the annual conference (*n* = 1). Students' suggestions to improve education and outreach efforts included exploring channels beyond traditional methods to reach a wider audience, such as social media, webinars, and informative videos (*n* = 1), as well as increasing collaboration between research and education teams (*n* = 1). Respondents also offered suggestions to raise awareness among specific groups and organizations. These suggestions included collaborating with relevant organizations, associations, or community groups (*n* = 1); conducting field days to show findings (*n* = 1); continuing farmer outreach (*n* = 1); and customizing outreach materials and messages to match the interests, concerns, and language preferences of the target audience (*n* = 1).

I have been able to interact with several local farmers through my research and this is important. It helps us know what information is helpful to local farmers and drives our research decisions.

Sustainability

Respondents were asked about the academic and/or professional benefits they expected to gain or have gained from participating in the project. They mentioned a variety of benefits, including creating connections/networking (*n* = 3), developing large project and field management skills (*n* = 2), gaining experience and benefits from working in transdisciplinary research (*n* = 2), learning new laboratory techniques and data analysis skills (*n* = 2), diversifying/broadening their research (*n* = 1), gaining subject matter expertise (*n* = 1), and learning about science communication and collaboration (*n* = 1). When asked about activities or experiences they wanted to participate in but were not accessible to them, one student mentioned wanting to get more involved in the preparation of samples and learning about the equipment to analyze samples (*n* = 1), while another indicated there were no additional activities they wanted to mention (*n* = 1).

Regarding professional development opportunities, some respondents voiced satisfaction with existing support structures (*n* = 2) while some offered suggestions. These suggestions include opportunities such as help disseminating student products/research findings (*n* = 1), mentorship/support for the research publication process (manuscript writing, peer review, and journal selection) (*n* = 1), and networking events (conferences, seminars to connect students with professionals, researchers, and industry experts) (*n* = 1). When asked for suggestions to support the sustainability of the project and its research/impacts, students' suggestions included continuing to disseminate project findings in accessible formats for a wide audience after the project concludes (i.e., workshops, seminars, outreach events, aimed at farmers, policymakers, public, etc.) (*n* = 2), building strong partnerships with relevant organizations and industrial invested parties (*n* = 1), maintaining contact/relationships between PIs and students regarding manuscripts and presentations (*n* = 1). One respondent had no additional suggestions (*n* = 1).

It's essential to share our research findings widely and make them accessible to various stakeholders… through simple and engaging communication methods, such as workshops, seminars, and outreach events aimed at farmers, policymakers, and the public. Building strong partnerships with relevant organizations and industry stakeholders can provide valuable support and resources.

In response to whether they had any final comments or feedback, students expressed that they are happy to be part of the project (*n* = 2).

Observations and Recommendations

The following section includes observations and recommendations based on those observations for leadership to consider when reviewing their program. Please note that these observations and recommendations are based on a 23.5% response rate, with only two Objectives being represented by the respondents. Leadership should take these limitations into account when making considerations regarding project recommendations.

Observations

OEIE commends project leadership on the progress made toward their goals this past year. While limited by the low response rate, OEIE found evidence of progress toward project goals including the following (evaluation questions 1, 2, and 6; see Appendix C in the Soil to Society External Evaluation Plan):

1) **Project objectives are being completed as proposed**: Students stated that while there are some hurdles, such as the inherent slowness of their research or the physical distance from research materials, they feel that they are making progress toward their project goals. Students are also gaining research skills and knowledge, particularly transdisciplinary collaboration skills, catering research to the real world, and making strategies to enhance processes. At least one student highlighted that extension and outreach efforts enhanced their research and knowledge because of the insights they gained from communicating with producers. Students also noted that project communication has helped facilitate their comfort levels in collaborating with others within and outside their discipline. Overall, students have highlighted that project communication has been clear and very helpful.
2) **Transdisciplinary research collaboration has enhanced the project:** As mentioned previously, students stated unanimously that they are comfortable collaborating with colleagues in different disciplines and are in frequent collaboration with other faculty and lab members, in addition to their own Objective team members. Development of transdisciplinary skills and transdisciplinary collaboration has rendered students more adept at communicating and understanding transdisciplinary research and perspectives. Such progress also highlights the sustainability of the project as students expect such collaborations to continue after the project concludes.
3) **Evidence toward project sustainability**: In addition to the students' continued collaborations after the project ends, project involvement is contributing to student cognitive and technical skills, as well as progress toward educational and career planning in agriscience. Skills they developed included transdisciplinary skills, learning new laboratory techniques, and gaining subject matter expertise. Most student respondents are satisfied with the professional opportunities they have been provided or engaged in.

Recommendations

OEIE recommends that leadership should foremost maintain existing student support, as students have not only made progress toward project goals but have indicated their satisfaction and happiness with the benefits they have gained from the project and the progress they have made. To maintain support, project leadership should consider continuing their efforts to facilitate networking and collaboration, as well as keep meeting, mentoring, and communicating overall with students. Facilitating networking and collaboration is particularly important because students most frequently identified the expansion of

networks and collaborations to be benefits they anticipated or achieved by participating in the project. To *enhance* these great outcomes, OEIE suggests considering the following student recommendations:

Communication and collaboration: Although half the respondents felt that project communication was adequate and had no further recommendations, there were several recommendations for enhancing the existing communications. These include holding more discussion sessions with students or experts under the same Objective, improving communication efforts and accessibility for students who work at a distance, and providing more discussion sessions across different groups. Similarly, when asked for suggestions to enhance collaboration, students recommended more communication. While increasing the frequency and types of meetings may be feasible for leadership, OEIE acknowledges that addressing the physical barriers may be difficult. As such, OEIE suggests that leadership consider revisiting the needs that students may have relative to their location and brainstorm local assets (e.g., subject matter experts, producers, adjacent lab equipment, other students in a similar field) that can be mobilized to help minimize the disadvantages of physical distance. Finding subject matter experts or other students in a similar field or project to create a support group, for example, may be beneficial. Please refer to the asset map OEIE conducted in Year 2. Team leaders could also consider making rounds to meet with their students in person if they are physically distanced.

Mitigating research barriers: Students most frequently suggested enhancing communication with team members and other students, as detailed above. Additional suggestions included networking with experts and conducting a thorough literature review. OEIE suggests that following the communication advice above will help address the communication- and network- related suggestions, but conducting a thorough literature review may be a case-by-case matter. OEIE suggests that leadership work with team leads to identify who or which team may benefit from such efforts.

Improving education and outreach efforts: There was no overall theme found among student suggestions to improve education and outreach efforts. The two actionable suggestions included exploring channels beyond traditional methods to reach a wider audience (e.g., social media, webinars, creating informative videos) and increasing collaboration between research and education teams. While the latter has already been addressed in the previous section on communication and collaboration, the former suggestion may indicate that the student is not aware of the social media efforts already underway. OEIE suggests that leadership consider engaging students in social media more (e.g., asking them to volunteer to contribute to posts and other media) or including social media progress on the Teams updates or newsletters to enhance awareness.

Suggestions to raise awareness of the project among specific groups and organizations were also found to not have an overarching theme. However, students provided several actionable items including collaborating with relevant organizations, associations, or community groups; conducting field days; continuing farmer outreach; and customizing outreach materials and messages to match the interests, concerns, and language preferences of the target audience. OEIE suggests that leadership review education and outreach efforts to see which action items may already be underway and which could be considered for implementation. Several of these items could be addressed together by, for example, conducting field days that incorporate farmers and producers followed by a meeting that facilitates collaboration and discussion with all participating members.

Sustainability (professional development and support): As mentioned previously, the majority of students who responded to a question regarding professional development activities indicated that no additional support was needed. However, some suggestions were left for leadership to consider. These

included help with disseminating student products/research findings, mentorship and support for the publication process, and having more networking events (e.g., conferences, seminars to connect with professionals, researchers, and industry experts). If leadership considers involving students more in social media, the dissemination assistance suggestion may be addressed. The concerns with mentorship and networking events may be resolved by the initial suggestions on communication and collaboration, but with mentoring and meetings or workshops focused on the publication process (e.g., manuscript writing, peer review, journal selection, overall process).

Additionally, when prompted to identify activities or experiences they wanted to participate in that were not accessible to them, only one person provided a request. This request was to be more involved in the preparation of samples and learning about the equipment used to analyze samples. OEIE suggests that leadership could consider meeting with team leads to see if integrating more opportunities for students to gain hands-on experience with equipment is feasible within their projects.

Finally, students most frequently recommended that sustainability of the project could be enhanced by continuing to disseminate project findings in accessible formats for a wider audience (during and after the project concludes). This can be achieved by delivering briefs to workshops, seminars, outreach events aimed at farmers, policy makers, the public, etc. OEIE suggests not only tailoring content to the audience, but also making sure the content is accessible and readable (e.g., reducing jargon, translating into different languages, modifying for sight-impaired individuals). Other suggestions included building a strong partnership with relevant organizations and industrial partners and maintaining relationships between PIs and students regarding manuscripts and presentations after the project ends. Project leadership could consider enhancing the previously suggested outreach and education events with such briefs and flyers and providing them to researchers after the project ends so they can be disseminated to other professional and appropriate venues. Continuing project related meetings and/or hosting a centralized platform for communication after the project ends may help maintain contact and the relationships between all project members, including students and PIs.

Optimizing Human Health and Nutrition: From Soil to Society
Year 3 Graduate Student Written Interviews
Appendix A – Survey Instrument

Involvement

1. Please describe your role on the Soil to Society project.

    a. With what objective(s) are you primarily affiliated?

2. How did you become involved in the project?

    a. What made you become interested in joining the project?

Implementation

1. From your perspective, what are the desired impacts or benefits of the Soil to Society project? (i.e., what would success look like to you?)

2. Please describe the progress made toward the overall project impacts/goals since you have been involved in the project.

3. Do you feel like the project communications were clear in terms of providing information and guiding you to resources?

    a. What could be improved about project communication with students?

4. What would you consider to be one or two of the project's greatest challenges/barriers at the current time?

5. What suggestions do you have to mitigate or eliminate these challenges?

Transdisciplinary research

8. Please describe the collaborations you have been involved in on the Soil to Society project. Please consider with whom you collaborate, frequency of collaborations, and whether these collaborations are expected to continue after the Soil to Society project ends.

9. How comfortable are you collaborating with colleagues in different disciplines? Please select one.
    1. Extremely uncomfortable
    2. Uncomfortable
    3. Neither comfortable nor uncomfortable
    4. Comfortable
    5. Very comfortable

10. Has your comfort level for engaging in transdisciplinary research changed throughout the course of working on the Soil to Society project?

11. Please provide one or two suggestions as to how the project could improve collaboration broadly and transdisciplinary collaborations.

Extension/outreach

12. What benefits or impacts have you observed that you, the extension/education participants, and/or the community gain from education and extension efforts?

13. What are one or two suggestions for improving education and outreach efforts?

    a. What are one or two suggestions to raise awareness amongst specific groups and organizations?

Sustainability

14. What academic and/or professional benefits did you expect to gain or have you gained from participating in the Soil to Society project?

a. Were there any activities or experiences in which you wanted to participate but that were not accessible to you? If so, what were they and why were they not accessible?

15. What types of professional development opportunities, if any, would you like to see the project provide for graduate students?

16. What are one or two recommendations you would give to the Soil to Society project to support the sustainability of the project and its research/impacts?

Final questions

17. Do you have any final comments or feedback you would like to share, or questions that you wish we had asked?

Optimizing Human Health and Nutrition: From Soil to Society
Year 3 Graduate Student Written Interviews
Appendix B - Compiled Results

Note. Frequencies may sum to greater than the number of participants, *n*, because responses can be coded into multiple themes. Quotes have been edited to help protect confidentiality and enhance readability.

Involvement

Table 1. Please describe your role on the Soil to Society project. (n = 4)

Theme	Frequency
Part of the Soil Management and Cropping Systems team	3
Graduate student researcher	2
Responsibility included processing samples, analyzing data, writing reports and publications, and managing projects	1
Working with plant breeding team	1

Table 1a. With what objective (s) are you primarily affiliated? (n = 4)

Theme	Frequency
Objective 1: Soil Management and Cropping Systems	3
Objective 2: Plant Breeding and Genetics	1

Table 2. How did you become involved in the project? (n = 4)

Theme	Frequency
Introduced to the project by an advisor	2
Involved as a graduate student/assistant	2
Started in an adjacent field and continued to graduate studies	1

Table 2a. What made you become interested in joining the project? (n = 4)

Theme	Frequency
Interdisciplinary and collaborative nature of the project	3
Project was interesting and fit research interest	2
Desire to learn how soil management connects to human nutrition	1
Excitement working with the PI(s) on the project	1

Representative quote:

- *The project was interesting to me because it was an interdisciplinary collaborative project. I always wanted to learn how soil management connects to human nutrition and being part of Soil to Society will help understand that connection.*
- *The main reason for my interest in joining the project was its multidisciplinary nature, which brings together researchers from various fields of agriculture, including soil scientists, breeders, food scientists, extension specialists, and health professionals. This collaboration across disciplines is essential for achieving the ultimate goal of promoting healthy food production.*

Implementation

Table 3. From your perspective, what are the desired impacts or benefits of the Soil to Society project (i.e., what would success look like to you?) (n = 4)

Theme	Frequency
Mobilizing diverse sectors towards the common goal of providing nutritious food to consumers	2
Ensuring that the experimental design, data collection, and results are as reliable and representative of the real world	1
Gain a well-rounded understanding of sustainable agriculture that can be used by producers	1
Identifying key strategies to improve the chain of production and ways to apply these strategies	1

Representative quote:

- *From my perspective, the Soil to Society project embodies a comprehensive strategy encompassing soil health, agricultural productivity, environmental sustainability, community engagement, knowledge dissemination, and public health. The ultimate benefit of this project lies in its ability to unite these diverse sectors towards the common goal of providing nutritious food to consumers.*

Table 4. Please describe the progress made toward the overall project impacts/goals since you have been involved in the project. (n = 4)

Theme	Frequency
Progress has been a little slow (e.g., data processing/analysis, slowed by balancing S2S work and other responsibilities, inherently slow work)	2
Working towards achieving the project goals (e.g., collecting and analyzing data, undergoing training)	2
A lot of progress has been made (e.g., concluded trial, collected and analyzed data, making plans for next steps)	1

Representative quote:

- *There has been a lot of progress made. We have…collected and analyzed data and are planning for 2024.*

Table 5. Do you feel like the project communications were clear in terms of providing information and guiding you to resources? What could be improved about project communication with students? (n = 4)

Theme	Frequency
Yes, team does a good/adequate job at clearly communicating (e.g., timely update meetings, student meetings, and semester-wise meetings has helped enhancing project communications)	3
Somewhat clear	1

Representative quote:

- *Yes, the project communications have been clear in providing information and guiding me to resources. Initially, I felt a bit lost, but I soon realized that we have timely update meetings, student*

meetings, and semester-wise meetings. Attending these meetings has helped me stay on track with the project's progress across various fields.

Table 5a. What could be improved about project communication with students? (n = 4)

Theme	Frequency
Nothing (e.g., existing communication is adequate)	2
More discussion sessions with students or experts under the same objective	1
Physical distance with collaborators has hindered the project communication	1
Provide more discussion sessions across different groups (i.e., discussing differences in progress levels may help newcomers and provide other inter-team benefits)	1

Representative quote:

- *I want to see more discussion sessions with students or experts under the same objective. Since we are collectively aiming for a common goal but focusing on different crops, facilitating communication about our work can greatly benefit each other.*

Table 6. What would you consider to be one or two of the project's greatest challenges/barriers at the current time? (n = 4)

Theme	Frequency
Difficulties in collecting data/conducting experiments (e.g., short period of time; inherent difficulty; troubleshooting)	2
Keeping track of roles and responsibilities of project members, specifically when new graduate students are added on	1
Navigating the complexities of developing protocols to maintain scientific rigor	1
Physical separation between research stations and main campus (difficulty readily accessing resources)	1

Representative Quote:

- *I think the physical separation between research stations and main campus is a challenge since there are resources in the main campus that cannot be accessed with ease. However, in my opinion, it is a small challenge that can be overcome.*
- *One of the project's greatest challenges at the current time is the development of protocols…This process requires careful experimentation, troubleshooting, and coordination with other team members, all of which contribute to the current challenge I am facing within the project.*
- *I think it's hard to keep track of "who is who," especially when new graduate students are added on.*

Table 7. What suggestions do you have to mitigate or eliminate these challenges? (n = 4)

Theme	Frequency
Enhanced communication with team members and other students (e.g., more in-person events, regular discussions/updates, mentorship, collaborative problem solving)	2
Conducting a thorough literature review	1
Networking with experts	1
Don't know	1

Representative quote:

- *To mitigate challenges, it's crucial to prioritize enhanced communication within the project team and among fellow students. Regular discussions, updates, and sharing of experiences can provide valuable insights and support, facilitating adaptation to the work.*
- *Conducting a thorough literature review, networking with experts, and actively engaging in collaborative problem-solving sessions can offer guidance, innovative approaches, and potential collaboration opportunities; ultimately aiding in overcoming technical hurdles and advancing the project effectively.*

Transdisciplinary research

Table 8. Please describe the collaborations you have been involved in on the Soil to Society project. (n = 4)

Theme	Frequency
Collaboration is expected to continue after project concludes (e.g., sharing equipment, collaboration with other groups anticipated as project matures, ongoing mentorship)	3
Frequent collaboration with other faculty and their lab members (e.g., with other labs, other objective groups)	3
Collaboration within their own team	1

Table 9. How comfortable are you collaborating with colleagues in different disciplines? (n = 4)

Theme	Frequency
Comfortable	4

Table 10. Has your comfort level for engaging in transdisciplinary research changed throughout the course of working on the Soil to Society project? (n = 4)

Theme	Frequency
Yes	4
More comfortable	1
Was comfortable until recently (e.g., needs time to understand the process)	1

Table 11. Please provide one or two suggestions as to how the project could improve collaboration broadly and transdisciplinary collaborations. (n = 4)

Theme	Frequency
Project is doing well with collaborations (e.g., in general, regular meetings have helped)	2
Informal get-togethers between the members for networking and sharing experiences	1
More communication and sharing of works within the same objectives	1
Unsure	2

Representative quote:

- *I am not sure because we do have constant meetings where problems and needs are brought up and often get resolved with the help of others in the team/project. The meetings are really helpful***.**

Extension/Outreach

Table 12. What benefits or impacts have you observed that you, the extension/education participants, and/or the community gain from education and extension efforts? (n = 3)

Theme	Frequency
Interaction with invested parties (e.g., local farmers) has helped knowing what information is helpful to them	1
Summer internship was great and were engaged during the annual conference	1
N/A	1

Representative quote:

- *I have been able to interact with several local farmers through my research and this is important. It helps us know what information is helpful to local farmers and drives our research decisions***.**

Table 13. What are one or two suggestions for improving education and outreach efforts? (n = 3)

Theme	Frequency
Explore various outreach channels beyond traditional methods to reach a wider audience (e.g., social media, webinars, creating informative videos)	1
Increased collaboration between research and education teams	1
No suggestions	1
N/A	1

Representative quote:

- *Explore various outreach channels beyond traditional methods to reach a wider audience, such as social media platforms, organizing webinars or workshops, creating informative videos, or developing interactive online resources.*

Table 13a. What are one or two suggestions to raise awareness amongst specific groups and organizations? (n = 3)

Theme	Frequency
Collaborating with relevant organizations, associations, or community groups	1
Conduct field days to show findings	1
Continue farmer outreach	1
Customizing outreach materials and messages to match the interests, concerns, and language preferences of the target audience	1
N/A	1

Representative quote:

- *Tailoring messaging and forming partnerships are pivotal strategies for raising awareness among specific groups and organizations. Customizing outreach materials and messages to match the interests, concerns, and language preferences of the target audience ensures the effective communication of research findings within their context. Moreover, collaborating with relevant organizations, associations, or community groups allows for the utilization of existing networks and influences to amplify outreach efforts and facilitate access to the intended audience.*

Sustainability

Table 14. What academic and/or professional benefits did you expect to gain or have you gained from participating in the Soil to Society project? (n = 4)

Theme	Frequency
Creating connections/networking	3
Developed project and field management skills	2
Experience and benefits from working in transdisciplinary research	2
Learned new laboratory techniques and data analysis skills	2
Diversify/broadening their research	1
Gained subject matter expertise	1
Learned about science communication and collaboration	1

Table 14a. Were there any activities or experiences in which you wanted to participate but that were not accessible to you? If so, what were they and why were they not accessible? (n = 3)

Theme	Frequency
Getting more involved in the preparation of samples and learning about the analytical equipment to analyze samples	1
None	1
N/A	1

Representative quote:

- *I would like to be more involved in the preparation of samples and learning about the analytical equipment to analyze samples.*

Table 15. What types of professional development opportunities, if any, would like to see the project provide for graduate students? (n = 3)

Theme	Frequency
Satisfied with the support for professional development (e.g., no additional support needed)	2
Help disseminating student products/research findings	1
Mentorship/support for the research publication process (e.g., manuscript writing, peer review, and journal selection)	1
Networking events (e.g., conferences, seminars to connect students with professionals, researchers, and industry experts)	1

Note. Frequencies sum to greater than n because responses can be coded into multiple themes.

Representative quote:

- *I think overall we have been provided with support to be involved in professional development.*

Table 16. What are one or two recommendations you would give to the Soil to Society project to support the sustainability of the project and its research/impacts? (n = 3)

Theme	Frequency
Continue to disseminate project findings in an accessible format for a wide audience after project concludes (i.e., workshops, seminars, outreach events, aimed at farmers, policymakers, public, etc.)	2
Building strong partnerships with relevant organizations and industrial invested parties	1
Maintain contact/relationships between PIs and students regarding manuscripts and presentations	1
No suggestions	1

Representative quote:

- *I think after the project has concluded there will still be work needed to spread the word about the findings from the project; so, making sure there is still contact between PIs about manuscripts and presentations will be helpful.*
- *It's essential to share our research findings widely and make them accessible to various stakeholders. This can be achieved through simple and engaging communication methods, such as workshops, seminars, and outreach events aimed at farmers, policymakers, and the public. Secondly, building strong partnerships with relevant organizations and industry stakeholders can provide valuable support and resources for our research efforts.*

Final Questions

Table 17. Do you have any final comments or feedback you would like to share, or questions that you wish we had asked? (n = 2)

Theme	Frequency
Happy to be part of the project	2

Representative quote:

- *I am delighted to be a part of the SAS project. I am eager to collaborate and explore further with this dynamic team.*