



Agricultural Marketing Service

U.S. DEPARTMENT OF AGRICULTURE

AWARD YEARS 2022 AND FORWARD

This annual Performance Progress Report (PPR) must illustrate the progress made toward the completion of your project. If this project is completed at the time of the annual PPR submission, the project report should be marked as final. Please note character limits (abbreviated "char.") throughout.

PROJECT INFORMATION

Project Title (250 char.)	EAT SD: Education and Training in Sustainability and Development (Part II)
Organization Name (250 char.)	Western Dakota Technical College
Project Start Date	9/30/2022
Project End Date	9/29/2025

ORGANIZATION POINT OF CONTACT

Full Name	Chandra Calvert
Phone Number	605-718-2419
Email Address	Chandra.Calvert@wdt.edu

BACKGROUND INFORMATION

PROJECT PROGRESS

Please provide the total percentage of work completed on the project.	100%
Is this a final report? Please select the box to the right if the answer is "yes".	☐

PROJECT BACKGROUND (REQUIRED FOR FINAL REPORTS)

Provide enough information for the reader to understand the importance or context of the project and any key findings. This section may draw from the background and justification contained in the accepted project plan. As the project has been completed, write this section in past tense. If this is an annual report, please skip this section. (1200 char.)

For this project, students and faculty at WDTC built modular aquaponics units to test and finalize open source plans that producers can use to build their own aquaponics growing systems. The College has built larger units in the past, but wanted to build smaller units that better fit the needs of producers with limited space. The concept was to design a modular unit so producers could build the number of modules that best fit in the space available. Our project tested yield, water quality, and cost to see if there was a saturation point at which multiple units lessened the yield and/or viable fish population. Due to changing circumstances with facilities our initial partners had access to, we shifted our focus to testing units on campus and focusing on yield and water quality rather than the saturation point. This was in part due to partners having less space than we originally thought, meaning very few producers would start with more than one unit. We also learned that each unit needs a dedicated fish tank, so each module would stand alone anyways. We had great success with growing lettuces, snow peas, and herbs and experimented with pumpkins as well.

OBJECTIVE(S) (REQUIRED)

Please provide the approved project's objectives from the accepted project plan. Use the boxes to indicate if the objective is in progress, has been completed, or is not (and will not be) completed. At the final report, if "no" is selected for any of the listed objectives, you must expand upon this in the Challenges and Developments Section. Additional objectives may be added as needed.

+	#	Objective (2,000 char.)	Objective Completed?
-	1	To design a cost-effective modular aquaponics and/or hydroponic system that can be built using locally-sourced, easily obtained materials. This modular design will allow for construction of a small stand-alone system or for a large commercial operation. Design will be integrated in the curriculum of several programs on campus including Controlled Environment Agriculture, Environmental Engineering, Electrical Trades, Plumbing, and Computer-Aided Design. • System design will benefit WDT students as they will be applying skills necessary for success in their respective careers. This project will be integrated into a minimum of three current classes being taught on campus • Modular systems are necessary for producers to start small, with minimal investment, and grow the system as their business grows • Modular systems will be designed for growing lettuces, micro-greens, berries, and herbs.	Yes
-	2	To create an open-source set of plans, a materials list, and a basic set of operational instructions for potential users. • The designs will be open source, so any specialty producer will have access to the plans, list of materials, optimal specialty crops, and current pricing.	Yes
-	3	To build several prototypes of the designed system for use in education at WDT by placing and studying prototypes at various partner organizations in Rapid City. All prototypes will be used to grow lettuce, micro greens, berries, and herbs.	Yes

OUTCOMES

Please only report on the outcomes and indicators that are selected and approved for this project. Use the check boxes to indicate which outcomes and indicators are selected. Select the "N/A" box for any indicators that are not applicable.

1. INCREASING CONSUMPTION AND CONSUMER PURCHASING OF SPECIALTY CROPS

☐

2. INCREASING ACCESS TO SPECIALTY CROPS AND EXPANDING SPECIALTY CROP PRODUCTION AND DISTRIBUTION

☒

Indicators	Value	N/A
2.1 Number of stakeholders that gained technical knowledge about producing, preparing, procuring, and/or accessing specialty crops		☒
2.2 Number of stakeholders that reported producing, preparing, procuring, and/or accessing more specialty crops	3	☐
2.3 Total number of market access points for specialty crops developed or expanded, and of those:		☒
2.3a Number of new online portals created to sell specialty crops		☒
2.3b Number with expanded seasonal availability		☒
2.3c Number of existing market access points that expanded specialty crop offerings		☒
2.3d Number of new market access points that established specialty crop offerings		☒
2.4 Number of stakeholders that gained knowledge about more efficient and effective distribution systems		☒
2.5 Number of stakeholders that adopted best practices or new technologies to improve distribution systems		☒

Indicators	Value	N/A
2.6 Total number of partnerships established between producers, distributors, and/or other relevant intermediaries related to distribution systems, and of those established:		☐
2.6a Number formalized with written agreements (i.e. MOU's, signed contracts, etc.)		☐
2.6b Number of partnerships with underserved organizations		☐
2.7 Total number of new/improved distribution systems developed, and of those, the number that:		☐
2.7a Stemmed from new partnerships		☐
2.7b Increased efficiency		☐
2.7c Reduced costs		☐
2.7d Increased specialty crop grower participation		☐
2.7e Expanded customer reach		☐
2.7f Increased online presence		☐
2.8 Number of specialty crop-related jobs:		☐
2.8a Created		☐
2.8b Maintained		☐
2.9 Total number of new individuals who went into specialty crop production as a result of marketing, and of those, the number who are:		☐
2.9a Beginning farmers or ranchers		☐
2.9b Socially disadvantaged farmers or ranchers		☐
2.10 Number of market access points that reported increased:		☐
2.10a Revenue		☐
2.10b Sales		☐
2.10c Cost-savings		☐

3. INCREASE FOOD SAFETY KNOWLEDGE AND PROCESSES

☐

4. IMPROVE PEST AND DISEASE CONTROL PROCESSES

☐

5. DEVELOP NEW SEED VARIETIES AND SPECIALTY CROPS

☐

6. EXPAND SPECIALTY CROP RESEARCH AND DEVELOPMENT

☒

Indicators	Value	N/A
6.1 Number of research goals accomplished		☐

Indicators	Value	N/A
6.2 For research conclusions, the number that:		☒
6.2a Yielded findings that supported continued research		☒
6.2b Yielded findings that led to completion of study		☒
6.2c Yielded findings that allow for implementation of new practice, process or technology		☒
6.3 Number of industry representatives and other stakeholders who engaged with research results	70	☐
6.4 Total number of research outputs published to industry publications and/or academic journals, and for each published research output, the:		☒
6.4a Number of views/reads of published research/data		☒
6.4b Number of citations counted		☒

7. IMPROVE ENVIRONMENTAL SUSTAINABILITY OF SPECIALTY CROPS



Indicators	Value	N/A
7.1 Number of stakeholders that gained knowledge about environmental sustainability best practices, tools, or technologies		☒
7.2 Number of stakeholders reported with an intent to adopt environmental sustainability best practices, tools, or technologies		☒
7.3 Number of producers that adopted environmental best practices or tools		☒
7.4 Number of new tools/technologies developed or enhanced to improve sustainability/conservation or other environmental outcomes	8	☐
7.5 Number of additional acres managed with sustainable practices, tools, or technologies that focused on:		☒
7.5a Water quality/ conservation		☒
7.5b Soil health		☒
7.5c Biodiversity		☒
7.5d Reduction in energy use		☒
7.5e Other positive environmental outcomes (optional)		☒
7.6 Number of additional acres established and maintained for the mutual benefit of pollinators/specialty crops		☒

ADDITIONAL APPROVED OUTCOME (IF APPLICABLE)



OUTCOME REMARKS (REQUIRED)

Please explain any quantifiable results, along with an update on their progress and data collection efforts for each of the outcomes and indicators selected in the accepted project plan. It is understood that the results may not yet be final at the time that this report is submitted; however, please provide an update on progress to date. If you do not have any data on the indicator(s) listed above, you must explain why in this section. (2,000 char.)

2.2 The total number of stakeholders who will produce, prepare, procure, and/or access more specialty crops in our project plan are the two partners who will utilize these units at their sites and another who came to learn about the unit to possibly incorporate one at their site. All stakeholders assisted in the production of the units and received education in preparation and the crops that are proving to yield

the best in the units. All partners plan to grow the crops that showed the best yield with the least amount of intervention: lettuce, snow pea, and herbs. All are also considering trying different crops, based on needs. All will access more specialty crops as part of this project and will incorporate them into their feeding programs.

6.3 Data from the units has been collected and analyzed by students in the Electrical Trades and Environmental Engineering programs as well as faculty members and adjunct instructors. Additionally, partners from advisory boards and partner sites were instrumental in advising WDTC on how to use research results in the future as well as what details to include in the open source plans. Faculty and students appreciated the opportunity to incorporate this research project into their curricula. Faculty will use this project as the basis for further aquaponics projects at the College.

7.4 We listed eight technologies in our project plan. At the completion of the project, all eight have been developed or enhanced: 1. controlled environment agriculture; 2. aquaponics; 3. nutrient film technique; 4. deep-water culture hydroponics systems; 5. low-grade geothermal systems; 6. advanced PLC systems; 7. sustainable agriculture; and 8. educational outreach.

NARRATIVE

ACCOMPLISHMENTS (REQUIRED)

If this is an annual report, list your accomplishments for this reporting period. If this is a final report, your accomplishments should be cumulative and include all accomplishments previously reported on and updated to include activities conducted this past reporting period. Indicate how these accomplishments associated with each of your project's objective(s), outcome(s), and/or indicator(s). This listing should identify your project's partners and their contributions. Additional accomplishments can be added as needed.

+	#	Accomplishment (1,200 char.)	Related to (Objective/ Outcome)
-	1	Year 1: Completion of preliminary design work. We constructed a prototype to further inform plans for the modular units. Establishment of faculty team and time spent on design and prototype. Year 2: Designs for the modular aquaponics units are complete. Final open source versions will be developed after proof-of-concept work early in Year 3 to see if any small design changes are needed. Year 3: Completed aquaponics units. Design, building, planting, harvesting and data collection and analysis were done by WDTC students and faculty. This project gave students a real-world, multi-year example of the process of planning and building the type of system they may be expected to work with in their future jobs. The project also gave them research experience that is beyond the traditional curriculum.	Objective 1/Outcomes 2, and 6
-	2	Year 1: Establishment of partnerships with two organizations that will utilize and test the modular aquaponics units. One partner organization hired a position directly related to this project. Year 3: Completed open-source plans so producers can customize and build their own system. Plans themselves were created by students and faculty and refined through the building and growing process, as well as partner input.	Objective 2/Outcome 2
-	3	Year 2: Further development of partnerships and plans for installation of units to test output is ongoing.	Objective 3/Outcome 2

CHALLENGES AND DEVELOPMENTS (REQUIRED)

Provide any challenges to the completion of your project or any positive developments outside of the project's original intent that you experienced during this reporting period. Also, provide the corrective actions you took to address these issues. If you did not attain an approved objective, outcome(s), and/or indicator(s), provide an explanation in the Corrective Actions column. For developments, you may put "N/A" under Corrective Actions. Additional challenges/developments may be added as needed.

+	#	Challenge or Development (1,200 char.)	Corrective Action
-	1	Year 3: We encountered some challenges with water quality, specifically high alkalinity levels in the fish tanks. This is likely due to build-up on the bottom of the tanks.	In the future, we will consider an overflow system or adding calcium bicarbonate to neutralize alkalinity.

-	2	Year 3: One unintended development for the project was discovering the possibility of having two different control systems in the same aquaponics unit (deep water culture and flood-and-drain). This could mean growing crops that respond best to each type, diversifying the variety of crops grown in the system at the same time.	N/A
-	3	Year 2: In the spring, the College made the decision to put the Controlled Environmental Agriculture program on hiatus, meaning students would not longer be able to enroll for the 2024-2025 academic year. One of the co-directors of that program also resigned.	We reassessed the project timeline and team structure, leading to a modification request that was accepted. A new Program Director for the Environmental Engineering program was hired. The project continued with the approved modifications, with the units being installed early in Year 3, allowing for enough time for data collection and dissemination prior to the grant award/project end.
-	4	Year 2: Objective 2 is to create an open-source set of plans, materials list, and a basic set of operational instructions for potential users. Plans have been developed but will not be ready to share until the units are tested, which may lead to small changes to the plans and operational instructions.	This objective would be completed at the end of the project when units have been tested. Testing may lead to small changes in the plans, materials, list, and/or operation instructions.
-	5	In Year 2 USDA approved a budget amendment that included a change to Objective 3 moderating the originally expressed hope that additional sites could be added, given the timing and personnel developments in the subrecipient organization.	Amendment with USDA updated the project PI and adapted the objective to conform with organizational capacity over the second half of the project.

UPCOMING ACTIVITIES (REQUIRED FOR ANNUAL REPORTS)

Provide a description of the activities that you are planning to complete during the next reporting period. Additional activities can be added as needed. Please note, if this is a final report there should be no upcoming activities associated with the project, and this section should be left blank.

+	#	Activity (600 char.)	Anticipated Completion
-			
-			

LESSON LEARNED (REQUIRED FOR FINAL REPORTS)

The recipient or subrecipient is required to provide recommendations or advice that others may use to improve their performance in implementing similar projects. If this is an annual report, please skip this section. (1200 char.)

We have three primary lessons learned through this project: 1. Producers need to be aware of additional steps they may need to take before implementing an aquaponics system, including food safety implications and water source/quality. The circumstances will be different for each producer, so more research should be done prior to starting a system. 2. Producers will need to be aware of non-pollinating varieties of non-lettuce crops. We experimented with growing pumpkins, but unknowingly used a non-pollinating variety. The plant produced several flowers, but no fruit. This system would be great for self-pollinating berries. 3. Our systems were built with programmable pumps and lights. As we monitored water quality, there were always low levels of ammonia in the water. After some experimenting, we determined that this was due to the pumps cycling and not running continuously. If ammonia is an issue in a system, continuous filtration is recommended.
--

CONTINUATION AND DISSEMINATION OF RESULTS (REQUIRED FOR FINAL REPORTS)

Describe your plans for continuing the project (sustainability; capacity building) and/or disseminating the project results. If this is an annual report, please skip this section. (1200 char.)

We have developed a set of open source plans for others to build a similar aquaponics unit. The plans include drawings, photos, and a supply list. We learned that technical information, such as maintaining water quality or which crops to grow, vary greatly by producer. When we are asked for the plans, we will recommend an in-person meeting with a faculty member to go over technical requirements and questions. At this time the plans will be made available to anyone familiar with this project who inquires. WDTC is currently undergoing a project to update the entire website. Once that is completed, we will seek to establish a landing page for this and other projects so people can find the plans on the Internet.

PROJECT BENEFICIARIES (REQUIRED FOR FINAL REPORTS)

Provide the number of project beneficiaries. If this is an annual report, please skip this section. (12 char.)

5,000

FEDERAL PROJECT EXPENDITURE

EXPENDITURE (REQUIRED)

You must respond to at least one cost category. Please note, the subtotal and total rows include formulas to auto-calculate totals. The approved budget should come from the accepted project plan or any approved budget amendments.

Cost Category	Amount Approved in Budget	Actual Federal Expenditures (Federal Funds Only)
Personnel	\$27,120.00	\$27,816.95
Fringe Benefits	\$0.00	\$0.00
Travel	\$0.00	\$0.00
Equipment	\$0.00	\$0.00
Supplies	\$27,150.00	\$26,453.05
Contractual	\$9,000.00	\$9,000.00
Other	\$0.00	\$0.00
Direct Costs Sub-Total	\$63,270.00	\$63,270.00
Indirect Costs	\$0.00	\$0.00
Project Expenditure Total Federal Costs	\$63,270.00	\$63,270.00

DISCUSSION OF EXPENDITURES (REQUIRED)

For 1st Annual Reports, if total project expenditures is less than 30 percent, and for 2nd Annual Reports, if total project expenditures is less than 60 percent, include a statement explaining how the grant funds will be expended and project activities completed as planned by the end date on the grant agreement. Any state approved budget amendments should be included here; include the line item that the funds are coming from and going to, as well as the date that the state approved the budget amendment. (1,200 char.)

All grant funds were expended within the allowed 10% variance for each category.

PROGRAM INCOME (IF APPLICABLE)

If program income was earned on the project, grant recipients are required to report on the source, amount, and how funds were expended. Program income is gross income --earned by a recipient or subrecipient under a grant --directly generated by the grant-supported activity or earned only because of the grant agreement during the grant period of performance. Program income includes, but is not limited to, income from fees for services performed; the sale of commodities or items fabricated under an award (this includes items sold at cost if the cost of producing the item was funded in whole or partially with grant funds); registration fees for conferences, etc.

+	Source/Nature of Program Income (100 char.)	Amount Approved in Budget	Actual Amount Earned
-		\$0.00	\$0.00

USE OF PROGRAM INCOME (IF APPLICABLE)

Describe how the earned program income was used to further the objectives of this project during the performance period. Any income generated must be reinvested back into the project and not set aside or reserved for future expenses after the grant ends. (1,200 char.)

PPR ATTACHMENTS DESCRIPTION (IF APPLICABLE)

Grantors will rely on the data that is submitted in this form when they report to congress. However, if you think additional documents are necessary to support PPR, please attach them and provide a document name and description of document below.

+	Document Name	Document Description
-	Modular Aquaponics System Plans	Open-source plans for producers to customize and build a modular aquaponics system
-	Modular Aquaponics System Drawings	CAD renderings of the modular aquaponics system