

FINAL PERFORMANCE REPORT

AWARD YEARS 2016 FORWARD

A Final Performance Report must be received within 90 days after the end of the grant agreement. You are required to report on the administration of the agreement and each project approved within the agreement. The completed Final Performance Report will be posted to the AMS website.

FINAL PROJECT REPORT TEMPLATE

Final Performance Reports must illustrate the completion of each project within the grant agreement. Each project shall be outlined as separate project profiles. You will report on projects in the same order they were submitted in the approved application and subsequent amendments.

PROJECT INFORMATION

Project Title	EAT, SD: Education and Training in Sustainability and Development			
Recipient Organization Name:	Western Dakota Tech			
Period of Performance:	Start Date:	9/30/2019	End Date:	9/29/2022
Recipient's Project Contact				
Name:	Chandra Calvert			
Phone:	(605) 718-2419			
Email:	Chandra.Calvert@wdt.edu			

PERFORMANCE NARRATIVE

PROJECT BACKGROUND

Provide enough information for the reader to understand the importance or context of the project. This section may draw from the background and justification contained in the approved project proposal.

Project EAT, SD centers on aquaponics, a synergistic food production platform that combines techniques in aquaculture and hydroponics to simultaneously raise edible plants and fish. This forward-thinking technology responds to current sustainability challenges such as limited arable lands, constrained freshwater supplies, soil degradation, and soil nutrient depletion. WDTC programs began work on aquaponics systems and testing in 2017. In 2018, WDTC took first place in the National Science Foundation's Community College Innovation Challenge with a project that integrated hydroponics and aquaculture into technical training in the Electrical Trades program with the overarching goal of solving world hunger. Since that time, the aquaponics project has grown and now includes the additional programs of Environmental Engineering Technician, Farm and Ranch Management, and Computer Aided Design.

In the beginning, WDTC was building and testing aquaponics systems on a small scale. The goal of project EAT, SD was to incorporate aquaponics into more common greenhouse-style facilities to study how this technology can be used on a larger scale: they can be used to feed a single home in the hot desert or an entire community in the cold arctic tundra. The project itself was to build a deep-winter greenhouse (funded by WDTC) that was constructed to house an aquaponics system to grow specialty crops. The greenhouse is a teaching facility, both for WDTC students and the community. Data collected through the project has allowed for the refinement of the aquaponics system so the most recent and best practices in aquaponics can be incorporated into the curriculum and teaching materials.

ACTIVITIES PERFORMED

Address the below sections as they relate to the entire project's period of performance.

OBJECTIVES

Provide the approved project's objectives.

#	Objective	Completed?	
		Yes	No*
1	Objective 1: Construction of a proof-of-concept greenhouse or geodesic dome using sustainable energy sources to house currently existing aquaponics units. Design and construction will be integrated into the curriculum of several programs on campus including Construction Technology, Electrical Trades, Plumbing, Environmental Engineering, and Computer-Aided Design Programs. Though there were delays, construction of the greenhouse is now complete. Current students for the 2022-2023 academic year have worked in the indoor grow spaces and are instrumental in moving started plants into the greenhouse. Instructors and students from the Construction Technology, Electrical Trades, HVAC, Plumbing, Electrical Trades, Computer Aided Design, Controlled Environmental Agriculture, and Environmental Engineering programs continue to collaborate and innovate ways to improve the greenhouse and the functionality of the aquaponics system. Though the delays were frustrating, they actually made way for much more collaboration as we had to find creative solutions to building material shortages.	X	
2	Objective 2: Determination of economic feasibility of installing a commercial controlled environment growing facility for aquaponics. The Environmental Engineering and Farm and Ranch Management Programs will integrate feasibility studies into current curriculum. Costs associated with building the greenhouse have been documented. Preliminary numbers are in. Figures will be complete once all greenhouse systems are operational. Crop yield and energy use data continues to be gathered. We obtained a WIMS data management system to document data related to the project including energy use, crop yield, fish health, etc.). Built an aquaculture lab with 5 tanks.	X	
3	Objective 3: To provide community and farmer/rancher engagement and outreach (through on-campus tours and farmers market education) Multiple tours have been given to farmers, potential students, and community stakeholders. Four courses have been developed for the Controlled Environment Agriculture program (Indoor Growing/Aquaponics; Horticulture; Aquaculture; and CEA Design). We have also developed further seminar topics related to this project for an Environmental Engineering Technicians course called Topics in Environmental Engineering. An Instagram page was developed called WesternDakotaSustainability. This project will be showcased at the Black Hills Home Show in March which draws in thousands of people over the course of the show. The project is also a feature in an Urban X-Change grant project with our sister city in Apolda, Germany. Best practice documents and videos are in progress.	X	
4	Objective 4: To have a positive impact on the local hunger problem We continue to involve local institutions in the project. WDTC faculty and staff continue to be active on the Friends of Food Security committee.	X	

**If no is selected for any of the listed objectives, you must expand upon this in the challenges and lessons learned sections.*

ACCOMPLISHMENTS

List your accomplishments for the project's period of performance, including the impact they had on the project's beneficiaries, and indicate how these accomplishments assist in the fulfillment of your project's objective(s), outcome(s), and/or indicator(s).

#	Accomplishment or Impact	Relevance to Objective, Outcome, and/or Indicator
1	Extensive inter-program collaboration on greenhouse planning, design, and build. In years 1-2, the greenhouse location was determined; geo-technical ground testing was completed with satisfactory results; full set of plans for greenhouse as well as virtual renderings completed, including excavation and retaining wall; bid process has begun; greenhouse ordered. Work with the WDT Foundation to solicit donations of building materials. Weekly planning meetings. The greenhouse itself was purchased. In year 3, the permit process for the greenhouse was completed and a permit was issued. Greenhouse prep-work completed: area surveyed; staking; pre-ground work/site prep; utility planning; trench and brick safety courses provided to students; excavation and trenching for geothermal system; installation of geothermal temperature control system; engineering and installation of retaining wall; backfill; caps installed at the ends with temporary wall (eventually will adjoin to a building); actual greenhouse structure will be erected within the next month (this will only take about a day). Materials obtained for electrical distribution and coordinated with utilities for a new power pole for the greenhouse. Initial HVAC planning complete. Though there were delays, construction of the greenhouse is now complete. Current students for the 2022-2023 academic year have worked in the indoor grow spaces and are instrumental in moving started plants into the greenhouse. Instructors and students from the Construction Technology, Electrical Trades, HVAC, Plumbing, Electrical Trades, Computer Aided Design, Controlled Environmental Agriculture, and Environmental Engineering programs continue to collaborate and innovate ways to improve the greenhouse and the functionality of the aquaponics system. Though the delays were frustrating, they actually made way for much more collaboration as we had to find creative solutions to building material shortages.	Objective 1; Outcome 4, Indicator 2d

#	Accomplishment or Impact	Relevance to Objective, Outcome, and/or Indicator
2	Objective 2 was delayed due to COVID-19. However, throughout the life of the project all costs were documented and continue to be. Actual figures are not available in time for this final report, as the greenhouse is not yet operational. In years 1-2, students in participating programs completed initial plans for the greenhouse, including cost estimates and planning for plants/planting. Specifically, costs associated with building the greenhouse have been documented. Preliminary numbers are in. Figures will be complete once all greenhouse systems are operational. Crop yield and energy use data continues to be gathered. We obtained a WIMS data management system to document data related to the project including energy use, crop yield, fish health, etc.). In years 1-2, we built an aquaculture lab with 5 tanks.	Objective 2
3	This project set us up well for part II- ongoing education for local farmers and food security organizations.	Objective 3
4	This project set us up well for part II- ongoing education for local farmers and food security organizations. In year 2, students demonstrated the aquaponics unit at the Farmer's Market (Winter 2019) Tours. In years 2-3, multiple tours were given to farmers, potential students, and community stakeholders. Four courses were developed for the Controlled Environment Agriculture program (Indoor Growing/Aquaponics; Horticulture; Aquaculture; and CEA Design). We have also developed further seminar topics related to this project for an Environmental Engineering Technicians course called Topics in Environmental Engineering. An Instagram page was developed called WesternDakotaSustainability. This project will be showcased at the Black Hills Home Show in March 2023 which draws in thousands of people over the course of the show. The project is also a feature in an Urban X-Change grant project with our sister city in Apolda, Germany. Best practice documents and videos are in progress.	Objective 3
5	In years 1-2, 30 heads of lettuce were donated to Fork Real Café and the WDTC on-campus food bank. Faculty presented at the annual meeting of the Friends of Food Security committee.	Objective 4

#	Accomplishment or Impact	Relevance to Objective, Outcome, and/or Indicator
	In year 3, 70 more heads of lettuce were donated to Fork Real Café. We continue to involve local institutions in the project. WDTF faculty and staff continue to be active on the Friends of Food Security committee.	

CHALLENGES AND DEVELOPMENTS

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 project. Also, provide the corrective actions you took to address these issues. If you did not attain an approved objectives, outcome(s), and/or indicator(s), provide an explanation in the Corrective Actions column.

#	Challenge or Development	Corrective Action or Project Change
1	COVID-19 presented major supply chain issues which impacted greenhouse building and the hydroponics and aquaponics lab.	Supply chain issues with the greenhouse were overcome. We hired 8 Federal Work Study students to assist with construction of the greenhouse and indoor labs to start growing and testing. Those students also worked to gather project data.
2	The City of Rapid City had never approved a project like this before, so the building permit process took a lot longer than expected as they worked to establish processes that will be fair and thorough in the future.	This was overcome and a permit was issued in September 2021. A team of dedicated faculty, students, and WDT staff members worked hard to expedite construction of the greenhouse.
3		
4		

LESSONS LEARNED

Provide recommendations or advice that others may use to improve their performance in implementing similar projects.

We learned that unexpected events can complicate a project, but a firm and shared vision of the end results can keep you focused and enthusiastic about the project. Expect problems but have a strong team that can collaborate to overcome them.

CONTINUATION AND DISSEMINATION OF RESULTS (IF APPLICABLE)

Describe your plans for continuing the project (sustainability; capacity building) and/or disseminating the project results.

Since the greenhouse itself was delayed, so too is the production data and best practices. We will continue to study the unit and output and share the findings with our community, particularly those looking to use aquaponics and/or deep winter greenhouses to grow specialty crops.

BENEFICIARIES

Number of project beneficiaries:.....Estimated 2250

OUTCOME(S) AND INDICATOR(S)/SUB-INDICATOR(S)

Provide the results of the project outcome(s) and indicator(s) as approved in your application and project proposal. The results of the outcome(s) and indicator(s) will be used to evaluate the performance of the Program on a national level.

OUTCOME MEASURE(S)

Select the Outcome Measure(s) that were approved for your project.

- ☐ **Outcome 1:** Enhance the competitiveness of specialty crops through increased sales
- ☒ **Outcome 2:** Enhance the competitiveness of specialty crops through increased consumption
- ☒ **Outcome 3:** Enhance the competitiveness of specialty crops through increased access
- ☒ **Outcome 4:** Enhance the competitiveness of specialty crops through greater capacity of sustainable practices of specialty crop production resulting in increased yield, reduced inputs, increased efficiency, increased economic return, and/or conservation of resources
- ☒ **Outcome 5:** Enhance the competitiveness of specialty crops through more sustainable, diverse, and resilient specialty crop systems
- ☐ **Outcome 6:** Enhance the competitiveness of specialty crops through increasing the number of viable technologies to improve food safety
- ☐ **Outcome 7:** Enhance the competitiveness of specialty crops through increased understanding of the ecology of threats to food safety from microbial and chemical sources
- ☒ **Outcome 8:** Enhance the competitiveness of specialty crops through enhancing or improving the economy as a result of specialty crop development

OUTCOME INDICATOR(S)

Provide the indicator approved for your project and the related quantifiable result. If you have multiple outcomes and/or indicators, repeat this for each outcome/indicator (add more rows as needed).

#	Outcome and Indicator	Quantifiable Results
1	Outcome 2 (Indicator 2a, b) & 4 (Indicator 2d) Of the 750 total adults reached through greenhouse tours, it is expected at least 75% will gain new knowledge about eating more specialty crops. It is expected that 50-60% of adults reached through this project will report an intention to eat more specialty crops. Outcome 4 Indicator 2d: Number of habitat acres established and maintained for the mutual benefit of pollinators and specialty crops is approximately 25, based on our physical property	Many of these outcomes are dependent on the greenhouse being and operational, which it very recently has become. However, completion of indoor hydroponics and aquaponics labs have allowed us to begin growing produce that is being distributed for consumption on a smaller scale. We have also been able to share this project with the public through tours of the labs and at the Farmers Market. 2a We did give tours of existing spaces to 250 adults, all of whom gained knowledge about eating more specialty crops. These are tracked in our internal planning software so are totaled at the end of each academic year. 2b Of the total number of adults reached, the number that reported an intention to eat more specialty crops is <u>188</u>. 4 2d Number of new specialty crops and/or specialty crop products introduced to consumers: <u>10</u>
2	Outcome 3, Indicator 1a In addition to the 1250 people (both youth and adults) who are anticipated to tour the greenhouse, we anticipate reaching approximately 500 people at the farmers market and 500 people through hunger-relief organizations. Of the 1000 total consumers reached, 90% will gain knowledge on how to access/produce/prepare/preserve specialty crops	Of the total number of consumers or wholesale buyers reached, the number that gained knowledge on how to access, produce, prepare, preserve specialty crops will be determined if we become a wholesaler. We have worked with our local Farmer's Market to be a wholesaler. There are approximately 35 vendors at the farmer's market that we could potentially be a wholesaler for. Farmer's Market has said demand for lettuce is very high in the area but supply is low, so this is a niche we will help fill.
3	Outcome 5, Indicator 2a The number of innovations adopted as a result of this project is at least 8: including controlled	Number of innovations adopted to date: <u>9</u>

	environment agriculture, aquaponics, including nutrient film technique and deep-water culture hydroponics systems, low-grade geothermal systems, advanced PLC systems.	Innovations adopted to date: controlled environment agriculture, aquaponics (including nutrient film technique, deep-water culture hydroponics systems and vertical grow systems); advanced PLC systems; de-coupled aquaponics systems; small-scale sustainable agriculture is currently being produced; personal aquaponics systems have been designed
4	Outcome 8, Indicator 1 Number of new rural/urban careers created: 1.	Number of new rural careers created: <u>1</u> based on our new Controlled Environment Agriculture (CEA) program. Over the course of the grant, the CEA program has enrolled 10 students. More than 100 students are enrolled across all 4 related programs. We have also converted a classroom into a hydroponics (vertical grow) lab and have outfitted an aquaculture lab.
5	Outcome 8, Indicator 6 In addition to Western Dakota Tech qualifying as a new beginning farmer, the number of students, particularly Farm and Ranch and Controlled Environment Agriculture who would potentially adopt specialty crop production techniques is approximately 30 over the course of the three years of the project period.	WDTC has had <u>2</u> graduates between the programs.
6	Outcome 8, Indicator 7 Based on the WDT student population, approximately 60% of the 30 new beginning farmers would be considered socially disadvantaged.	There were 30 graduates in Environmental Engineering Technician and Controlled Environment Agriculture over the 3 years of the project. 18 of those students are considered socially disadvantaged (60%) based on their financial aid offerings,

DATA COLLECTION

Explain what data was collected, how it was collected, the evaluation methods used, and how the data was analyzed to derive the quantifiable indicator.

We have collected data on cost of greenhouse construction, preliminary feasibility studies, preliminary crop and production studies. The project had a lot of challenges with delays in materials which will delay heavy data collection until after the grant expires. However, the project will continue both in WDTC program and as part of the phase II project funded under the 2022 Specialty Crop Block Grant Program.

FEDERAL PROJECT EXPENDITURES

EXPENDITURES

Cost Category	Amount Approved in Budget	Actual Federal Expenditures (Federal Funds ONLY)
Personnel	\$35,000	\$35,000.10
Fringe Benefits	\$11,055	\$11,044
Travel		
Equipment		
Supplies	\$3,945	\$3503
Contractual		

Cost Category	Amount Approved in Budget	Actual Federal Expenditures (Federal Funds ONLY)
Other		
Direct Costs Sub-Total	\$50,000	\$49,547.10
Indirect Costs		
Total Federal Costs	\$50,000	\$49,547.10

PROGRAM INCOME (IF APPLICABLE)

Source/Nature (i.e., registration fees)	Amount Approved in Budget	Actual Amount Earned
1.		
2.		
3.		
Total Program Income Earned		

Use of Program Income

Describe how the earned program income was used to further the objectives of this project.

Given project delays, no produce was available for purchase by the conclusion of the project. Therefore, we have no program income to report.

ADDITIONAL INFORMATION

Provide additional information available (i.e., publications, websites, photographs) that is not applicable to any of the prior sections.

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