IGEM Grant Report

Final (due August 31)

IGEM Grant # IGEM25-006 Principal Investigator Mary Everett

Submission Date: 8/18/25 Primary Institution University of Idaho

Section 1:
Project Accomplishments

- LoRaWAN gateway and sensors were developed for the system. 11 sensors (leaf wetness, CO2, and more) could report every 5 minutes up to 0.6 miles away. The longest range on one sensor was 3.5 miles.
- Additionally, a LoRaWAN gateway was developed to forward information to main SCARECRO gateway. Dendrometer sensors were added to the system.
- The Data Gator is now dynamically configurable via a web-based user interface. The Data Gator sensor documentation was maintained and the build has stayed under $120 per unit.
- Tempest weather stations were added to Laurel Grove Wine Farm (LGWF). TreeTag point dendrometers were added to 20 trees (apple, pear, and cherry) at Sandpoint Organic Agriculture Center (SOAC).
- A Microclimate comparison study was conducted using AI (k-means clustering and dynamic time warping) at LGWF to determine possible varietal plantings in growing area. (Presented on at European Conference on Precision Agriculture).
- Quantitative Association Rule Mining (QARM) via Genetic Algorithms (another AI-based tool) was conducted to determine driving factors of downy mildew and frost events at LGWF.
- Climate comparison research was conducted (using dynamic time warping) for drivers of climate similarity between LGWF and 4 other wine producing regions.
- A custom Degree Day Modeling App was developed and documented for SOAC.
- Downy mildew forecasting graphs (using Syngenta prediction model) were developed for LGWF.
- Climate prediction to outcome research conducted via the program was published in an ACM journal during the project period.

Upcoming Plans

- There is planning deployment of LoRaWAN sensors in the UI Experimental Forest (ideal environment for long-range sensing), and long-term sensor collection and monitoring for SOAC, LGWF.
- There is a planned changeover to Grafana as the integration framework for variety of farm tasks, including degree day model visualization and farm mapping

Section 2:
A total of $119,800 was budgeted ($106,360.54 spent, $13,439.46 left). $5,049.55 was budgeted and spent on agricultural sensors, $1,500 was budgeted and spent on an AI journal publication, and $13,166 was budgeted and spent on tuition for the graduate student. $13,439.46 was left of the $100,134.54 budgeted for personnel costs due to a flu season impacting the number of hours worked by several of the student participants. It was our impression that this cannot be expended outside the project period. If this is

not the case, this money would be put toward student work on farmer-directed analytics.

Section 3:

Industry Involvement

- The NSF I-Corps training program was one of the main industry engagement projects undertaken (16 zoom and phone interviews with farmers, precision agriculture researchers, and environmental mangers).
- The microclimate comparison research was presented at the 2025 European Conference on Precision Agriculture. There was significant interest in the SCARECRO system and contacts were made with companies (WeLASER and SAF Water Sampling) and members of WSU's precision agriculture group.

Private Sector Involvement

- LGWF has continued to be our industry, research, and technology development partner throughout the endeavor. They provided the data collected through the system and feedback about use, and served as the test bed for AI modeling.
- At the ECPA, a contact was made with an Idaho company interested in a potential collaboration on the SCARECRO system for farming in Southern Idaho.

External Funding

- NASA Idaho Space Grant Consortium (ISGC) funded a student for Summer 2025 to develop an optimal gateway build for lakeshore monitoring.
- Idaho INBRE (Idea Network of Biomedical Research Excellence) funded a student for Summer 2025 to assist in developing the climate comparison AI.

Section 4:

- 1 faculty member (plus 1 research scientist) participated in the program by developing software and proving environmental/farming feedback
- 5 undergraduate students and 4 graduate students participated in the project. The undergraduate students primarily worked on the dashboard, some sensor integrations, and the AI components to a lesser extent. The graduate students worked on the Data Gator improvements as well as the AI integrations.

Section 5 :

Long-Term Sustainability

- We aim to conduct a long-term sustainability test in the coming year.
- Some of the biggest takeaways from this project year were (1) the system needs to be easier to setup, and (2) farmers have existing metrics that the data needs implement before AI projects are developed.

Future Plans

- The follow-on grant will stress test and commercialize the SCARECRO system.
- We plan to write 2 USDA NIFA grants for using SCARECRO system data. We plan to put in for an NSF VINES and an NSF Cyber-Physical Systems grant on the entire network in the upcoming year. We will continue seeking NASA ISGC, Idaho INBRE, and UI Office of Undergraduate Research funding for individual students on the project.

Section 6: Please see attached report.

IGEM Expenditure Report

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Expenditure Report

Personnel:
Budgeted: 84,1480.90
Rebudgeted: 100,134.45
Spent: 86,694.99
Remaining: 13,439.46
Description: The personnel category was spent on 5 undergraduate students and 4 graduate students over the project course (part time during the school year and full-time over the summer). These students conducted the bulk of the Data Gator software improvements, dashboard development, and artificial intelligence model development. This category also included time for the research scientist (PI) who worked on the gateway software and documentation, as well as the I-Corps participant and industry partner coordinator. Finally, this category included time from one faculty member who assisted with project directing, student and industry connections, and technological expertise on all parts of system development. This category was underspent, even after the rebudget. This was in part due to a particularly difficult illness season this year which prevented many of the students from working full allotted hours.

Equipment:
Budgeted: 5,049.55
Spent: 5,049.55
Remaining: 0
Description: The money for equipment was spent primarily on agricultural sensors, including Tempest Weather Stations and S6 temperature/humidity sensors. Funding from another source also provided a variety of LoRa and dendrometer sensors to use in project sensing. This category also bought some basic materials and supplies for gateway and Data Gator maintenance, installs, and continued operations.

Travel:
Budgeted: 0
Spent: 0

Participant Support:
Budgeted: 0
Spent: 0

Other Direct Costs:
Publication Charges Budget: 1,500
Publication Charges Spent: 1,500
Tuition Budgeted: 29,069.55
Tuition Rebudgeted: 13,116

Spent: 13,116
Remaining: 0
Description: The publication charges went toward publishing results on the climate prediction AI research (applied in this case to Valley Fever data, which impacts agricultural workers) in the Journal of Biomedical Informatics with a study titled: "*Valley-Forecast: Forecasting Coccidioidomycosis incidence via enhanced LSTM models trained on comprehensive meteorological data*" (DOI: 10.1016/j.jbi.2025.104774). The Tuition category was spent on the yearlong tuition charges for the graduate student working on the Data Gator improvements.

Total Budget: 119,800
Total Spent Budget: 106,360.54
Total Underspent Budget: 13,439.46
A total of 13,439.46 was underspent during the budget part. This is in part because we rebudgeted in order to fit the project into a year-long grant cycle, which aligned better with the follow-on grant and was more in line with the current grant year's progress. We did conduct a rebudget midway through the project which allowed better expenditures for the year cycle. However, some unexpected illnesses from student workers resulted in less than full hours worked from those allotted on the project, resulting in a surplus budget.

Plans for Expenditure:
It is our understanding that the surplus is not permitted to be spent outside of the project period. However, if that is not the case, we would put the surplus towards graduate and undergraduate student work on the project for the next grant cycle, especially in industry-focused technology integration aspects (creating more farmer-based visualizations and analytics packages).