



Environment and Natural Resources Trust Fund

M.L. 2026 Final Work Plan

General Information

ID Number: 2026-464

Staff Lead: Lisa Bigaouette

Date this document submitted to LCCMR: May 27, 2026

Project Title: Advancing Dehydration Technologies for Resilient Minnesota Food Systems

Project Budget: \$300,000

Project Manager Information

Name: Natasha Wright

Organization: U of MN - College of Science and Engineering

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Project Reporting

Reporting Schedule: December 1 / June 1 of each year.

Project Completion: June 30, 2029

Final Report Due Date: August 14, 2029

Legal Information

Legal Citation: M.L. 2026, Chp. 104, Sec. 2, Subd. 03g

Appropriation Language: \$300,000 the second year is from the trust fund to the Board of Regents of the University of Minnesota to: (1) assess opportunities and develop technology for solar dehydration and curing of produce that reduces climatic impact of food loss and waste; and (2) develop and distribute findings to farmers, farming organizations, community partners, and other supply chain and market players in Minnesota.

Appropriation End Date: June 30, 2029

Narrative

Project Summary: We will enable resilient food systems by defining opportunities and developing technology for solar drying and curing in Minnesota with three distinct farmer groups.

Describe the opportunity or problem your proposal seeks to address. Include any relevant background information.

Food loss and waste (FLW) accounts for roughly 5.9-trillion gallons of freshwater in the U.S. annually (EPA, 2021), enough to supply all Minnesotan residents with water for over 53 years. Beyond water, FLW leads to immense waste in land, fertilizer, energy, and greenhouse gas emissions. Fruits and vegetables contribute significantly to this issue. An estimated 40% of wasted food could have been consumed before spoiling (MPCA, 2022).

As FLW intensifies climate change, climate change intensifies the volatility of agricultural markets. Extreme weather events like floods and droughts result in seasons of poor yields. For example, in Spring 2024, June floods followed by an exceptionally warm and dry fall caused significant disruptions across Minnesota (MinnPost, 2024). Other years, extended growing seasons lead to overproduction, exceeding consumer and market demand. The impact of these fluctuations depends on the agricultural system's resilience. Current adaptation strategies are often costly, energy-intensive, and resource-heavy.

Just as resilient renewable energy systems require both energy generation and storage, a resilient Minnesota food system will rely on our ability to both cultivate and store produce. Dehydrating surplus produce could offer a solution, extending access to locally sourced, shelf-stable food during low-production seasons and diversifying economic potential.

What is your proposed solution to the problem or opportunity discussed above? Introduce us to the work you are seeking funding to do. You will be asked to expand on this proposed solution in Activities & Milestones.

Dehydration and curing extend the shelf life of produce by removing water and preventing spoilage. These processes are energy-intensive on industrial scale and time-consuming for individual consumers. This project explores farm-level solar greenhouse drying and other dehydration technologies to achieve the Minnesota Pollution Control Agency's goal of reducing FLW by 50% by 2030.

Farmers use Controlled Environment Agriculture (CEA), such as greenhouses, to improve climate resilience and extend growing seasons. Dehydration offers a way to use CEA systems beyond food production, especially during periods when temperatures are too high for growing. Dehydration is less energy-intensive than other preservation methods like canning or freezing. Other benefits include diversifying local food systems, providing culturally relevant foods, increasing farmers' incomes, and reducing transportation emissions through lighter shipments.

Our team is made up of University of Minnesota (UMN) researchers, extension educators, and external farming partners. We will assess farm-level food loss in Minnesota and explore the feasibility of greenhouse dehydration as a solution. Initial findings will quantify the impact and later stages will provide recommendations for system operation and future implementation. Results will be shared with farmers through educational materials, training sessions, and an interactive tool to tailor recommendations for improving food preservation.

What are the specific project outcomes as they relate to the public purpose of protection, conservation, preservation, and enhancement of the state's natural resources?

We will define the role of dehydration for Minnesota farmers and provide preliminary solar dryer designs. These outcomes align with Goals and Strategies in LCCMR's 6-Year Strategic Plan. We will:

(i) Develop new dehydration processes on agricultural land, providing long-term environmental and economic benefits (Goal 1- Land).

(ii) Leverage passive solar and renewable energy systems to promote the agricultural sector transition toward innovative energy systems and management strategies (Goal 6 - Energy).

(iii) Foster resilient food systems that reduce climatic impact of food loss, withstand extreme and changing climates, and are collaboratively developed with impacted communities (Goal 4 - Resiliency).

Project Location

What is the best scale for describing where your work will take place?

Statewide

What is the best scale to describe the area impacted by your work?

Statewide

When will the work impact occur?

During the Project and In the Future

Activities and Milestones

Activity 1: Analyze the opportunity for dried and cured produce in Minnesota in three distinct farmer contexts.

Activity Budget: \$157,985

Activity Description:

We will analyze the current and future role of dehydrating and curing in Minnesota. Value propositions are hypothesized to include dehydration as a resilience strategy and to provide culturally relevant foods (e.g. indigenous African greens), cure winter produce (e.g. squash), and reduce unharvested and postharvest losses (e.g. apples). However, there is limited data quantifying the extent of the existing losses. Additionally, it is unclear how the hypothesized value propositions translate to technical requirements for solar drying technologies and systems in which they operate.

We will study three farmers groups: (i) recent-immigrant farmers from East Africa, commonly farming <1 acre and currently producing culturally relevant produce with high demand, (ii) current and past farmers involved in the Land Stewardship Project “climate cohorts” who have received climate adaptation training and are anticipated early adopters of shelf-life extending technologies, and (iii) apple growers, frequently experiencing overproduction.

We will use a combination of surveys (n=100), qualitative interviews (n=30), and focus groups (n=6) to define the economic, community-based, and environmental tradeoffs of dehydration and curing. Our team includes three UMN Agricultural Extension Educators who have existing relationships with these farmer groups; they have identified community experts to guide engagements.

Activity Milestones:

Description	Approximate Completion Date
Surveys design completed; facilitation guides for stakeholder interviews and focus groups completed; IRB approval obtained.	December 31, 2026
Surveys (early season) disseminated to farmers through community partners, target response rate achieved.	May 31, 2027
Surveys (late season) disseminated to farmers through community partners, target response rate achieved.	September 30, 2027
All focus groups and stakeholder interviews completed.	October 31, 2027
Summary report finalized including solution pathway and requirements for proposed drying technology.	December 31, 2027

Activity 2: Theoretically evaluate technology performance for drying in Minnesota.

Activity Budget: \$99,130

Activity Description:

The UMN Wright Lab has previously developed and validated thermal and energy models for MN Deep Winter Greenhouses and Kenyan hybrid solar greenhouse dryers. These models will be leveraged to develop and validate a model to predict, analyze, and optimize the performance of a relevant MN solar dehydration or curing technology. The exact technology and contextual scope (i.e., product type, location, farm size, capacity) will be informed by results from Activity 1. The solution pathways and system requirements will be continuously and collaboratively assessed alongside community partners.

Using the developed model, an energy analysis will be conducted with consideration for variable climate conditions and available renewable energy sources (e.g., biomass, solar, wind) throughout MN. System leverage points will be identified

to develop innovative renewable energy systems and efficient energy management schemes. Optimization strategies will prioritize system and operation parameters for energy sources, cost, time, and resources identified findings from Activity 1. Continued discussions and collaborations with community partners throughout Activity 2, and predicted energy model and analyses results, we aim to (i) quantify estimated impact of the identified technology, (ii) assess system resilience by quantifying environmental and economic impact, and (iii) recommend optimized operating strategies.

Activity Milestones:

Description	Approximate Completion Date
Construction of bench-scale experimental setup for model validation.	June 30, 2028
Model for dehydration or curing technology developed and validated.	August 31, 2028
Energy analysis with recommendations for technology operation completed.	December 31, 2028

Activity 3: Disseminate findings through targeted engagement with stakeholders.

Activity Budget: \$42,885

Activity Description:

Knowledge dissemination and technology transfer will be completed through targeted engagement with stakeholders, such as farmers, farming organizations, community partners, and other supply chain and market players. Accessible public-facing reports (e.g., food dehydration manual), workshops, webinar, and community events (e.g., sharing findings during existing community partner events) will be developed to disseminate findings from Activity 1 and technology and operational recommendations from Activity 2.

Findings and the developed materials will be distributed through existing communication networks as well as through new networks and connections established during the duration of the project. Existing communication networks include UMN Extension’s “Fruit and Vegetable News” newsletter (~1,700 subscribers), annual climate resilient vegetable production retreats (~30 farmers per year), climate cohorts (10-12 farms per year), at least one presentation at a regional conference, and affiliated YouTube channels (+100,000 viewers).

Activity Milestones:

Description	Approximate Completion Date
Drafted educational materials (report and presentation) based on findings from Activities 1 and 2	March 31, 2029
Public-facing report disseminated via UMN Extension’s “Fruit and Vegetable News” newsletter.	May 31, 2029
Presentation provided at a minimum of two workshops, one online seminar, and one conference.	June 30, 2029

Project Partners and Collaborators

Name	Organization	Role	Receiving Funds
Amy Johnston, Natalie Hoidal, Madeline Wimmer	University of Minnesota Extension	Three extension workers with specialization in food safety, vegetables, and fruits (respectively), will develop survey protocols and leverage their existing relationships to recruit MN farmers for the proposed study.	Yes
Nick Olson	Land Stewardship Project	Nick Olson will support the extension educators on the work outlined in Activity 1, including recruiting local farmers for conducting interviews and focus groups, and facilitating continued engagement opportunities with farmers for the University of Minnesota team. LSP will support the research team in disseminating the results of the study.	Yes

Dissemination

Describe your plans for dissemination, presentation, documentation, or sharing of data, results, samples, physical collections, and other products and how they will follow ENRTF Acknowledgement Requirements and Guidelines.

Dissemination efforts are the focus of Activity 3.

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The Environment and Natural Resources Trust Fund will be acknowledged through use of the trust fund logo or attribution language on project print and electronic media, publications, signage, and other communications per the ENRTF Acknowledgment Guidelines.

Long-Term Implementation and Funding

Describe how the results will be implemented and how any ongoing effort will be funded. If not already addressed as part of the project, how will findings, results, and products developed be implemented after project completion? If additional work is needed, how will this work be funded?

We will pursue National-scale funding for this project through the U.S. Department of Energy and Department of Agriculture, federal agencies that have demonstrated their support and investment for sustainable agriculture and food loss reduction technologies in the past. The Department of Energy has previously supported Prof. Wright’s work in decentralized resource recovery technology. Activity 3 is focused on dissemination efforts, including the development of educational materials and web-based platforms for farmers to explore the potential for drying in their region.

Other ENRTF Appropriations Awarded in the Last Six Years

Name	Appropriation	Amount Awarded
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Managing Highly Saline Waste From Municipal Water Treatment	M.L. 2021, First Special Session, Chp. 6, Art. 5, Sec. 2, Subd. 04a	\$250,000
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Budget Summary

Category / Name	Subcategory or Type	Description	Purpose	Gen. Ineligible	% Benefits	# FTE	Classified Staff?	\$ Amount
Personnel								
Principal Investigator (Natasha Wright)		Overall program management and oversight; direct mentorship of graduate student researcher. 2 weeks/year, 3 years, including UMN rate of 36.6% benefits.			26.8%	0.21		\$26,794
Graduate Researcher		Primary researcher. Analytical model extension, conduct data collection and experimental validation. 50% FTE in Years 1 and 2, 25% FTE in Year 3. Includes UMN rate of 23.2% benefits plus tuition.			43%	1.26		\$154,684
Extension Researcher and Coordinator (Amy Johnston)		Design survey for relevant farmer group; administer survey with associated community expert; facilitate connections with relevant stakeholders (Activity 1). Develop education materials to disseminate to community partners (Activity 3). Include UMN Fringe Rate of 36.6%			26.8%	0.12		\$13,999
Extension Researcher and Coordinator (Natalie Hoidal)		Design survey for relevant farmer group; administer survey with associated community expert; facilitate connections with relevant stakeholders (Activity 1). Develop education materials to disseminate to community partners (Activity 3). Include UMN Fringe Rate of 36.6%			26.8%	0.12		\$15,998
Extension Researcher and Coordinator (Madeline Wimmer)		Design survey for relevant farmer group; administer survey with associated community expert; facilitate connections with relevant stakeholders (Activity 1). Develop education materials to disseminate to community partners (Activity 3). Include UMN Fringe Rate of 36.6%			26.8%	0.12		\$13,999
Field Coordinator (Greg Schweser)		Coordinate Farm Scale Deep Winter Greenhouse outreach events. Meet monthly with research team to provide insight on farmer contextual factors relevant to design direction. 2 weeks/year, 3 years, including UMN rate of 36.6% benefits.			26.8%	0.12		\$14,286
Field technology specialist (Daniel Handeen)		Sustainable building and materials specialist. Meets regularly with PI and graduate student researcher to review design directions. 1 week/year in Year 1, 3 weeks/year in Years 2 and 3, including UMN rate of 36.6% benefits.			26.8%	0.12		\$17,821

							Sub Total	\$257,581
Contracts and Services								
TBD	Service Contract	One consultant from farmer group (i) "recent-immigrant farmers." 80 hours over the 3 year project period to recruit participants for Activity 1, facilitate engagements with local farmers, and collaborate for results dissemination. \$50/hr.				0.03		\$4,000
TBD	Service Contract	One consultant from farmer group (iii) "apple growers." 80 hours over the 3 year project period to recruit participants for Activity 1, facilitate engagements with local farmers, and collaborate for results dissemination. \$50/hr.				0.03		\$4,000
Land Stewardship Project	Subaward	Personnel time (80 hours, \$50/hr) over the 3 year project period to recruit participants for Activity 1 from farmer group (ii) "climate cohorts", facilitate engagements, and collaborate for results dissemination.				0.03		\$4,000
							Sub Total	\$12,000
Equipment, Tools, and Supplies								
	Tools and Supplies	Weather station, temperature/humidity/airflow/state sensors, and data acquisition equipment	Needed to fully outfit one experimental dryer for model validation.					\$11,919
							Sub Total	\$11,919
Capital Equipment								
							Sub Total	-
Acquisitions and Stewardship								
							Sub Total	-
Travel In Minnesota								
	Miles/ Meals/ Lodging	Miles: 16 trips to MN-based farms and cooperatives for PI and graduate researcher, extension staff.	To conduct focus groups, interviews, and knowledge dissemination efforts					\$5,000

			throughout the state. Activities 1 and 3.					
							Sub Total	\$5,000
Travel Outside Minnesota								
	Conference Registration Miles/ Meals/ Lodging	1 person (program manager or graduate student); flight, 3 nights hotel, conference registration.	Attendance at 1 US-based professional conference to present the findings of this research	X				\$3,000
							Sub Total	\$3,000
Printing and Publication								
	Publication	Journal publication fees (x2)	To make published journal articles immediately available via open access to maximize data availability and dissemination.					\$6,000
							Sub Total	\$6,000
Other Expenses								
		Stipends	Human Research Participant Stipends: A series of focus groups and interviews are proposed as part of Activity 1. 90 total participants at \$50/session.	X				\$4,500
							Sub Total	\$4,500
							Grand Total	\$300,000

Classified Staff or Generally Ineligible Expenses

Category/Name	Subcategory or Type	Description	Justification Ineligible Expense or Classified Staff Request
Travel Outside Minnesota	Conference Registration Miles/Meals/Lodging	1 person (program manager or graduate student); flight, 3 nights hotel, conference registration.	Formal presentation of project findings at a water treatment conference outside of MN. Combined academic and industry conferences are critical to student learning, networking, and building future collaborations toward technology development.
Other Expenses		Stipends	Stipends in human subjects work greatly aids in recruiting and retaining participants. Stipends also ensure that participants are fairly compensated for their time participating in the interview or focus group and for their travel.

Non ENRTF Funds

Category	Specific Source	Use	Status	\$ Amount
State				
			State Sub Total	-
Non-State				
In-Kind	University of Minnesota	Because the project is overhead free, laboratory space, electricity, and other facilities/administrative costs (54% of direct costs excluding permanent equipment and graduate student tuition benefits) are provided in-kind.	Secured	\$134,679
			Non State Sub Total	\$134,679
			Funds Total	\$134,679

Total Project Cost: \$434,679

This amount accurately reflects total project cost?

Yes

Attachments

Required Attachments

Visual Component

File: [0e16bee7-6fe.pdf](#)

Alternate Text for Visual Component

The visual shows the impact of food loss on water resources, and presents a graphic that demonstrates the overall concept of dehydration as a method of fostering a resilient food system in Minnesota....

Supplemental Attachments

Capital Project Questionnaire, Budget Supplements, Support Letter, Photos, Media, Other

Title	File
University of Minnesota Letter of Intent	58435fa3-7ee.pdf
Letter of Support - Land Stewardship Project	b265e00e-7cc.pdf

Difference between Proposal and Work Plan

Describe changes from Proposal to Work Plan Stage

The budget as updated to reflect the recommended funding amount of \$300k (a reduction of \$68k). The reduced budget was achieved by reducing the effort of the project manager (Wright) in all years, and the graduate student researcher in Year 3. Prize drawing for survey participants and refreshments for focus groups were removed. Community consultants were added as Service Contracts.

The original Milestone 2 under Activity 3 which focused on the development of an interactive tool was removed to align with the reduced effort of the graduate student researcher. Activity 3 was updated to include 3 Milestones.

Additional Acknowledgements and Conditions:

The following are acknowledgements and conditions beyond those already included in the above workplan:

Do you understand and acknowledge the ENRTF repayment requirements if the use of capital equipment changes?

N/A

Do you understand that travel expenses are only approved if they follow the "Commissioner's Plan" promulgated by the Commissioner of Management of Budget or, for University of Minnesota projects, the University of Minnesota plan?

Yes, I understand the UMN Policy on travel applies.

Does your project have potential for royalties, copyrights, patents, sale of products and assets, or revenue generation?

Yes

Do you understand and acknowledge IP and revenue-return and sharing requirements in 116P.10?

Yes

Do you wish to request reinvestment of any revenues into your project instead of returning revenue to the ENRTF?

No

Does your project include original, hypothesis-driven research?

No

Does the organization have a fiscal agent for this project?

No

Does your project include the pre-design, design, construction, or renovation of a building, trail, campground, or other fixed capital asset costing \$10,000 or more or large-scale stream or wetland restoration?

No

Do you propose using an appropriation from the Environment and Natural Resources Trust Fund to conduct a project that provides children's services (as defined in Minnesota Statutes section 299C.61 Subd.7 as "the provision of care, treatment, education, training, instruction, or recreation to children")?

No

Provide the name(s) and organization(s) of additional individuals assisting in the completion of this project:

All named personnel in the budget, all from the University of Minnesota, assisted in preparing and reviewing the proposal text.

Do you understand that a named service contract does not constitute a funder-designated subrecipient or approval of a sole-source contract? In other words, a service contract entity is only approved if it has been selected according to the contracting rules identified in state law and policy for organizations that receive ENRTF funds through direct appropriations, or in the DNR's reimbursement manual for non-state organizations. These rules may include competitive bidding and prevailing wage requirements

Yes, I understand