

Environment and Natural Resources Trust Fund

2026 Request for Proposal

General Information

Proposal ID: 2026-464

Proposal Title: Advancing Dehydration Technologies for Resilient Minnesota Food Systems

Project Manager Information

Name: Natasha Wright Organization: U of MN - College of Science and Engineering Office Telephone: (612) 219-3540 Email: natasha@umn.edu

Project Basic Information

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.

ENRTF Funds Requested: \$368,000

Proposed Project Completion: June 30, 2029

LCCMR Funding Category: Resiliency (A)

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

Narrative

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).

Activities and Milestones

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

Activity Budget: \$173,306

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

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

Activity Budget: \$130,420

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: \$64,274

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), training sessions and workshops, webinar series, 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. To provide tailored recommendations for technology design and operation under specific contexts, an accessible and interactive tool (e.g., flyer, web-based tool) will be developed and shared with farmers and interested target audiences.

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
Develop and disseminate educational materials based on findings from Activity 1 and Activity 2.	April 30, 2029
Develop interactive tool to convey technical design or operation information based on local environmental context.	April 30, 2029
Findings summarized with assessment of real world application for the proposed technology.	June 30, 2029

Project Partners and Collaborators

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

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

Project Manager and Organization Qualifications

Project Manager Name: Natasha Wright

Job Title: Assistant Professor

Provide description of the project manager's qualifications to manage the proposed project.

B.S., Mechanical Engineering, University of St. Thomas, St. Paul, MN

M.S., Mechanical Engineering, Massachusetts Institute of Technology, Cambridge, MA.

Ph.D., Mechanical Engineering, Massachusetts Institute of Technology, Cambridge, MA.

Post-Doctoral Associate, Environmental Engineering, 2019, University of Minnesota

Natasha Wright (Assistant Professor, Mechanical Engineering) will be responsible for the overall project coordination. Her research group at the UMN focuses on the design and system optimization of decentralized energy and water systems. She successfully completed an LCCMR-funded project on the design and real-time optimization of convection enhanced evaporation processes in June 2024. That project has led to one granted patent and four journal publications. Dehydration/drying technology is a convection enhanced evaporation process - therefore her lab's expertise in thermal modeling of such systems will directly translate to this work. Over the last 10 years, she has piloted energy-water systems in the United States, India, and Gaza. Wright teaches the "Solar Technologies" course and the "Research and Methods for Sustainability Impact" course on UMN Twin Cities campus; the latter trains an interdisciplinary cohort of graduate students in stakeholder analysis, life cycle assessment, and semi-structured qualitative interviewing techniques.

Organization: U of MN - College of Science and Engineering

Organization Description:

The University of Minnesota is one of the largest, most comprehensive, and most prestigious public universities in the United States (https://twin-cities.umn.edu/about-us). The laboratories and offices of the PI and co-PIs contain all of the necessary fixed and moveable equipment and facilities needed for the proposed studies.

Budget Summary

Category / Name	Subcategory or Type	Description	Purpose	Gen. Ineli	% Bene	# FTE	Class ified	\$ Amount
				gible	fits		Staff?	
Personnel								
Principal		Overall program management and oversight; direct			26.8%	0.24		\$58,053
Investigator		mentorship of graduate student researcher. 1						
(Natasha		month/year, 3 years, including UMN rate of 36.6%						
Wright)		benefits.						
Graduate		Primary researcher. Analytical model extension,			43%	1.5		\$186,730
Researcher		conduct data collection and experimental validation.						
		Includes UMN rate of 23.2% benefits plus tuition.						
Extension		Design survey for relevant farmer group; administer			26.8%	0.12		\$13,999
Researcher		survey with associated community expert; facilitate						
and		connections with relevant stakeholders (Activity 1).						
Coordinator		Develop education materials to disseminate to						
(Amy		community partners (Activity 3). Include UMN Fringe						
Johnston)		Rate of 36.6%						
Extension		Design survey for relevant farmer group; administer			26.8%	0.12		\$15,998
Researcher		survey with associated community expert; facilitate						
and		connections with relevant stakeholders (Activity 1).						
Coordinator		Develop education materials to disseminate to						
(Natalie		community partners (Activity 3). Include UMN Fringe						
Hoidal)		Rate of 36.6%						
Extension Design survey for relevant farmer group; administer				26.8%	0.12		\$13,999	
Researcher		survey with associated community expert; facilitate						
and		connections with relevant stakeholders (Activity 1).						
Coordinator		Develop education materials to disseminate to						
(Madeline		community partners (Activity 3). Include UMN Fringe						
Wimmer)		Rate of 36.6%						
Field Coordinate Farm Scale Deep Winter Greenhouse				26.8%	0.12		\$14,286	
Coordinator		outreach events. Meet monthly with research team to						
(Greg		provide insight on farmer contextual factors relevant to						
Schweser)		design direction. 2 weeks/year, 3 years, including UMN						
		rate of 36.6% benefits.						
Field	Field Sustainable building and materials specialist. Meets				26.8%	0.12		\$17,821
technology		regularly with PI and graduate student researcher to						
specialist		review design directions. 1 week/year in Year 1, 3						
(Daniel		weeks/year in Years 2 and 3, including UMN rate of						
Handeen)		36.6% benefits.		1				

					Sub Total	\$320,886
Contracts and Services						
					Sub Total	-
Equipment, Tools, and Supplies						
	Tools and Supplies	Life-cycle inventory database procurement.	Necessary to conduct environmental assessment as part of Activity 2.			\$4,300
	Tools and Supplies	Weather station, temperature/humidity/airflow/state sensors, and data acquisition equipment	Needed to fully outfit one experimental dryer for model validation.			\$11,414
					Sub Total	\$15,714
Capital Expenditures						
					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 throughout the state. Activities 1 and 3.			\$5,000
					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	Х		\$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						
		Expert Consultant	One consultant from each of the three farmers groups will be hired for 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.			\$12,000
		Human Research Participant Payments	A series of focus groups and interviews are proposed as part of Activity 1. 90 total participants at \$50/session.			\$4,500
		Survey Participant Prize Drawings	Two prize drawings (e.g. \$50 gift cards) will be made for those who fill out the survey within each of the three farmer group.	х		\$300
		Refreshments	Provision of light snacks and refreshments at each of the six focus group events (\$100/each).			\$600
					Sub Total	\$17,400
					Grand Total	\$368,000

Classified Staff or Generally Ineligible Expenses

Category/Name	Subcategory or Type	Description	Justification Ineligible Expense or Classified Staff Request
Travel Outside Conference 1 person (program manager or Formal prese		1 person (program manager or	Formal presentation of project findings at a water treatment conference outside of MN.
Minnesota Registration graduate student); flight, 3 nights Combined academic and industry conferences are of		Combined academic and industry conferences are critical to student learning,	
	Miles/Meals/Lodging	hotel, conference registration.	networking, and building future collaborations toward technology development.
Other Expenses		Survey Participant Prize Drawings	Necessary to achieve high survey response rate.

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	\$166,242
			Non State	\$166,242
			Sub Total	
			Funds	\$166,242
			Total	

Total Project Cost: \$534,242

This amount accurately reflects total project cost?

Yes

Attachments

Required Attachments

Visual Component File: <u>0e16bee7-6fe.pdf</u>

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
Letter of Support - Land Stewardship Project	b265e00e-7cc.pdf
University of Minnesota Letter of Intent	<u>58435fa3-7ee.pdf</u>

Administrative Use

Does your project include restoration or acquisition of land rights?

No

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 proposal:

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

N/A