Environment and Natural Resources Trust Fund

2026 Request for Proposal

General Information

Proposal ID: 2026-194

Proposal Title: Spatially Targeting Perennial Grains for Maximum Environmental Value

Project Manager Information

Name: Jacob Jungers

Organization: U of MN - College of Food, Agricultural and Natural Resource Sciences

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Project Basic Information

Project Summary: Kernza is a deep-rooted perennial crop that yields nutritious grains under drought conditions. We'll create tools to identify ideal locations for Kernza production in Minnesota under various climate change scenarios.

ENRTF Funds Requested: $299,000

Proposed Project Completion: June 30, 2029

LCCMR Funding Category: Small Projects (G)
  Secondary 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

Narrative

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

Kernza is the first commercially viable perennial grain crop. Developed by The Land Institute and University of Minnesota's Forever Green Initiative, The Minnesota Star Tribune has called it "the environmental wonder grain" (Vondracek, 2023). Kernza's deep roots prevent nitrate leaching to groundwater, sequester carbon, and improve soil health (DeHaan et al., 2023). However, land managers have been slow to adopt Kernza because they lack information on where to plant it, how to grow it, and where to sell it (Lanker et al., 2020). Moreover, the crop is early in development and more information on its genetics would help expedite new variety releases.

This project will leverage a decade of field research data, cutting-edge genomic tools, and agro-environmental modeling to identify the most suitable fields in MN for Kernza production under current and future climate conditions. By integrating landscape-scale suitability analysis with breeding-to-market decision support, we aim to align Kernza genetics with optimal environments, maximizing both environmental benefits and farmer profitability. Through data-driven education and outreach, we will connect farmers in high-suitability areas with the latest research and market development resources.

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.

We will develop a decision support system that integrates hundreds of Kernza experimental datapoints from across Minnesota, advanced genomic prediction methods, and agro-environmental modeling to optimize strategic landscape deployment of Kernza. The system will help farmers, land managers, and businesses identify the most suitable land and production practices for Kernza cultivation while improving the crop's performance under future climates.

We will use genome-environment association analyses to identify key genetic regions associated with climate resilience in Kernza's wild relatives. Genetic markers will be used to fast-track breeding of new, high-performing varieties with improved drought and heat tolerance. Unlike traditional breeding methods that require years of field trials, this approach allows us to use global climate and genomic datasets to rapidly identify parents with the most promising adaptive traits.

In parallel, we will develop a suitability model to map the best locations for Kernza production in Minnesota, both now and under projected 2050 and 2070 climate conditions. This will allow growers and policymakers to decide where Kernza can thrive while generating environmental benefits such as water quality improvement and carbon sequestration.

Results will be developed into an interactive spatial decision support system that will provide customized dashboard views tailored to different users.

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?

This project will enhance Minnesota's natural resources by expanding Kernza adoption, a perennial grain that's been shown to improve soil health and water quality. By mapping suitability for Kernza under current and future climate conditions, we will help farmers optimize land use, reducing soil erosion and nutrient runoff while increasing carbon sequestration. This project aligns with Minnesota's commitment to conservation by advancing sustainable agriculture practices that protect and enhance the state's ecosystems while supporting economic viability for farmers. The outcomes will serve as a model for integrating perennial crops into working landscapes to mitigate climate change and improve environmental health.

Activities and Milestones

Activity 1: Map the suitability of all Minnesota farm fields for Kernza production potential today, in 2050, and 2070 given climate change.

Activity Budget: $99,165

Activity Description:

For more than 10 years, this team has conducted numerous experiments on Kernza at sites across Minnesota. These experiments tested a range of agronomic treatments like fertilizer rates, row spacing, and planting dates. Each experiment includes data from multiple sites and multiple years, which has resulted in thousands of Kernza yield observations from a broad range of soil types, precipitation conditions, and temperature regimes. For milestone 1, these data will be aggregated from their original datasets into a synthetic dataset with key variables needed for the next milestone.

To determine the most suitable locations for Kernza cultivation in Minnesota, we will develop a high-resolution suitability map for the present, 2050, and 2070 using a MAXENT species distribution model. This model will integrate WorldClim climate projections and 30-meter spatial resolution soil and environmental data to predict where Kernza is most likely to thrive under current and future climate conditions. In addition to suitability mapping, we will perform an environmental clustering analysis to identify distinct zones of drought and temperature stress across Minnesota. By analyzing key climate variables such as precipitation patterns, heat stress, soil moisture retention, and waterlogging risk, we will classify regions across Minnesota.

Activity Milestones:

Description	Approximate Completion Date
Develop a synthesized dataset of past Kernza experiments from across Minnesota to inform modeling.	June 30, 2028
Finish habitat suitability model	June 30, 2029

Activity 2: Use wild relatives of Kernza to search for and enhance genetic regions of Kernza that impart climate resilience

Activity Budget: $121,736

Activity Description:

The UMN Kernza breeding program is over a decade old and has developed improved populations with two formally released as varieties. Although successful, the program is based on only 14 effective parents and thus lacks genetic diversity to maximize the crop's potential for resilience and yield stability.

We will acquire seed from 380 unique wild populations of Kernza collected from areas around the world and available in the USDA-ARS Germplasm Resources Information Network (GRIN) collection. We will grow those populations at two locations over two years and identify areas of their genomes that correlate to traits relevant to climate adaptation and productivity. This genome-environment association analysis will identify genetic regions linked to plant productivity in relation to key climate resilience traits such as drought and temperature tolerance. This approach will allow us to pinpoint the best potential parents for breeding improved Kernza varieties that are better adapted to Minnesota's environmental conditions.

Unlike traditional genome-wide association studies, which require multi-year field trials for phenotypic data, GEA leverages existing global climate datasets to infer ecological adaptations of wild populations. This will allow us to rapidly identify adaptive genes and parents that can be incorporated into breeding programs through marker-assisted selection.

Activity Milestones:

Description	Approximate Completion Date
Establish field plots and collect data from 380 diverse populations of Kernza relatives.	November 30, 2028
Conduct GEA analysis and report results on genes associated with climate resiliency.	June 30, 2029

Activity 3: Build a spatial decision-support system that informs growers, breeders, and businesses on how to expand Kernza production and use.

Activity Budget: $78,099

Activity Description:

To ensure that Kernza adoption is strategic, scalable, and informed by the best available data, we will develop a spatial decision-support system that integrates the outputs from Activities 1 and 2. This system will be designed to serve Kernza growers, breeders and businesses to advance commercialization, providing tailored insights that support Kernza expansion in Minnesota.

The system will be built through an iterative, co-design process, incorporating feedback from key stakeholders to refine its usability and functionality. We will develop data integration pipelines to seamlessly merge genomic, environmental, and suitability data, ensuring accessibility for users in research, farming, and market development. A centralized database will house raw environmental, genetic, and modeled response data, with an API allowing flexible access for advanced analyses and integration with external systems.

A user-friendly front-end interface, developed in collaboration with growers, breeders, and commercialization experts, will provide interactive dashboards for different user groups, enabling customized decision-making. This tool will also be used for targeted outreach, allowing commercialization specialists to identify and connect with high-suitability growers. Ultimately, this system will accelerate Kernza adoption, breeding improvements, and market development while maximizing environmental and economic benefits by allowing all Kernza stakeholders to use data to drive their decisions.

Activity Milestones:

Description	Approximate Completion Date
Finish version 1 of the decision-support system	December 31, 2027
Beta test system, received user feedback, and create version 2	December 31, 2028
Complete and disseminate final version of decision-support system	June 30, 2029

Project Partners and Collaborators

Name	Organization	Role	Receiving Funds
Bryan Runck	University of Minnesota - GEMS	Lead activities 1&3, supervise the data engineer, analyze data, and co-author publications related to the research findings	Yes
James Anderson	University of Minnesota	Lead the plant breeding components of the project	No

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?

The spatial decision-support system will have an API to enable integration with external tools, ensuring long-term utility. The operational costs are expected to be roughly $10,000 per year for hosting and software updates. Ongoing funding will be pursued through federal grants, industry partnerships, and state-level programs. State investment through the Forever Green Initiative was critical to providing the background data for this project. Forever Green is designed to support the basic breeding and environmental research of new crops that improve water quality and soil health. This project extends that mission by applying research findings into tools for Minnesota citizens.

Other ENRTF Appropriations Awarded in the Last Six Years

Name	Appropriation	Amount Awarded
Long-Term Nitrate Mitigation By Maintaining Profitable Kernza Production	M.L. 2021, First Special Session, Chp. 6, Art. 6, Sec. 2, Subd. 04i	$485,000

Project Manager and Organization Qualifications

Project Manager Name: Jacob Jungers

Job Title: Associate Professor

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

Dr. Jacob Jungers is an Associate Professor and agroecologist in the Department of Agronomy and Plant Genetics at the University of Minnesota (UMN). Dr. Jungers received his PhD from the Conservation Biology Program at UMN while working on an LCCMR project. Since then, he has collaborated on three other successful LCCMR grants but has not yet led one. As an agroecologist, Dr. Jungers focuses on the intersections between natural resource conservation and agriculture. Specifically, his goal is to design new farming systems that limit the negative impacts of agriculture on water, soil, and biodiversity. His projects have involved monitoring duck nest success in grasslands managed for bioenergy, the role of crop roots on soil carbon cycling, and nitrate leaching reductions from perennial grains like Kernza. In his work on Kernza, Dr. Jungers has partnered with farmers, Soil Water Conservation District managers, AURI, high schools, and non-profit organizations across Minnesota to evaluate the water quality benefits of this new crop.

Over the last 10 years, Dr. Jungers has successfully led state- and national-scale projects with funding from the Minnesota Dept. of Agriculture, the Forever Green Initiative, multiple USDA programs, and grants from various non-profit and philanthropic organizations. He has been identified as a national and international leader around Kernza and is the director of a $10 million USDA project that involves 10 large research institutions and over 40 collaborating entities. His expertise is in facilitating the translation of research to applied contexts in partnership with interdisciplinary stakeholder teams.

Dr. Jungers is among the most productive faculty members in the College of Food and Natural Resource Sciences, which

has earned him University-level awards like the McKnight Presidential Fellowship. He has published 70 papers in peer-reviewed journals, advised 15 graduate students, and has mentored more than 25 other graduate and undergraduate students.

Organization: U of MN - College of Food, Agricultural and Natural Resource Sciences

Organization Description:
The University of Minnesota College of Food, Agricultural and Natural Resource Sciences (CFANS) is a leader in research, education, and outreach dedicated to conserving natural resources. With a strong emphasis on sustainability, CFANS integrates cutting-edge science, policy, and practical solutions to address environmental challenges such as climate change, water quality, biodiversity loss, and sustainable land management. CFANS develops innovative strategies to protect ecosystems, manage wildlife populations, and restore habitats. Faculty and researchers collaborate with government agencies, nonprofits, and industry to develop science-based conservation policies and resource management practices that ensure the long-term health of forests, wetlands, and agricultural landscapes. CFANS also provides students with hands-on learning opportunities, from fieldwork in Minnesota's diverse ecosystems to internships with environmental organizations. Programs such as sustainable agriculture, ecological restoration, and environmental sciences prepare future leaders to tackle pressing conservation issues. By integrating education, research, and community engagement, CFANS plays a critical role in conserving natural resources while promoting sustainable practices that balance environmental, economic, and social needs for future generations.

Budget Summary

Category / Name	Subcategory or Type	Description	Purpose	Gen. Ineli gible	% Bene fits	# FTE	Class ified Staff?	$ Amount
Personnel								
Project Director		Oversee all project reporting activities, lead Activity 2, supervise research staff, provide data and field equipment and materials, assist with data analysis and co-author publications related to the research findings.			36.6%	0.12		$25,817
Scientist		Lead Activity 1 and 3, supervise the data engineer, analyze data, and co-author publications related to the research findings.			36.6%	0.21		$33,511
Data Engineer		The Data Engineer will execute tasks related to Activity 3 to build spatial decision support system.			36.6%	0.3		$54,889
Plant Breeding Researcher 4		Collect phenotypic data from field trials and organize genomic data for Activity 2.			32.3%	0.3		$26,580
Agronomy Researcher 4		Aggregate past field trial data that will feed into the spatial decision support tool and prepare genomic data for the landscape suitability map in Activity 1.			32.3%	0.6		$49,071
Undergraduate interns		Assist with field data collection, harvest grain and biomass samples, process grain and biomass samples, weigh samples, and enter data.			0%	0.39		$15,043
							Sub Total	**$204,911**
Contracts and Services								
TBD	Service Contract	Funds for an Agricultural Landscape Geneticist to achieve Activity 1 goals on how to use climatological/environmental data to identify climate resilience in crop species.				0.58		$90,000
							Sub Total	**$90,000**
Equipment, Tools, and Supplies								
	Tools and Supplies	Field supplies - plot stakes, greenhouse pots, nitrogen, phosphorus, and potassium fertilizers, irrigation hose, plot flags, paper bags for biomass samples, vials for storing ground biomass.	These basic field supplies are used to start seedlings in a greenhouse, clone them for transplanting, grow them for three years, and collect					$1,047

			data from them including harvested seed and aboveground biomass.					
							Sub Total	$1,047
Capital Expenditures								
							Sub Total	-
Acquisitions and Stewardship								
							Sub Total	-
Travel In Minnesota								
	Miles/ Meals/ Lodging	Funds are requested for mileage expenses at $0.70 per mile to travel 1000 miles per year for trips from St. Paul, MN to Lamberton, MN, and Rosemount, MN to collect field trial data in each year ($700 per year). Funds for two nights lodging ($98/day) and two days per diem ($59/day) are requested per year in years 1-2, $314 per year.	Trips to Lamberton and Rosemount are required to plant seedlings, maintain plots, and collect data.					$3,042
							Sub Total	$3,042
Travel Outside Minnesota								
							Sub Total	-
Printing and Publication								
							Sub Total	-
Other Expenses								
							Sub Total	-
							Grand Total	$299,000

Classified Staff or Generally Ineligible Expenses

Category/Name	Subcategory or Type	Description	Justification Ineligible Expense or Classified Staff Request

Non ENRTF Funds

Category	Specific Source	Use	Status	Amount
State				
-			State Sub Total	-
Non-State				
-			Non State Sub Total	-
-			Funds Total	-

Total Project Cost: $299,000

This amount accurately reflects total project cost?

Yes

Attachments

Required Attachments

Visual Component

File: 7e2dc634-add.pdf

Alternate Text for Visual Component

Maps showing where field data have been collected, how they will be combined with environmental data, and examples of suitability maps as outcome. A diagram with global maps of sources of Kernza wild relatives, a photo of field selection, and a photo of a Kernza product - Climate Smart Cereal...

Supplemental Attachments

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

Title	File
Letter of Support - Perennial Promise Growers Coop	00349fc9-225.pdf
UMN SPA Approval Letter	e2862214-1e0.pdf

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?

    No

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

    N/A

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

    N/A

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:

Kelsey Grachek, Senior Grants and Contracts Officer, University of Minnesota Sponsored Projects Administration

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