Environment and Natural Resources Trust Fund
2019 Request for Proposals (RFP)

Project Title: **ENRTF ID: 072-B**

Accelerating Perennial Crop Production to Prevent Nitrate Leaching

Category: B. Water Resources

Sub-Category:

Total Project Budget: $ 448,905

Proposed Project Time Period for the Funding Requested: June 30, 2021 (2 yrs)

Summary:

Reducing nitrate leaching on sandy soils of central Minnesota by developing water-efficient production methods, supply chains, and end-use markets for thee profitable perennial crops: Kernza, prairie, and alfalfa.

Name: Dennis Fuchs

Sponsoring Organization: Stearns County Soil and Water Conservation District

Title:

Department:

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Waite Park MN 56387

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Email dennis.fuchs@mn.nacdnet.net

Web Address

Location

Region: Central

County Name: Pope, Stearns

City / Township:

Alternate Text for Visual:

Map of Minnesota DWSMAs and project locations in Pope and Stearns counties. List of project participants, activities, and activity descriptions. Images and rationale for three perennial crops in study.

_____ Funding Priorities	_____ Multiple Benefits	_____ Outcomes	_____ Knowledge Base
_____ Extent of Impact	_____ Innovation	_____ Scientific/Tech Basis	_____ Urgency
_____ Capacity Readiness	_____ Leverage	_____ TOTAL	_____%
____ If under $200,000, waive presentation?			

PROJECT TITLE: Accelerating perennial crop production to prevent nitrate leaching

I. PROJECT STATEMENT

The sandy soil cropland in Central Minnesota is prone to nitrate leaching; an environmental concern that degrades groundwater and poses human health risks for communities relying on groundwater for drinking water. Nutrient laded water flows quickly through these sandy soils. As a result, farmers need to irrigate crops, which further exacerbates nitrate leaching. Perennial plants are more effective at accessing nitrogen and water deep in the soil where annuals cannot, which means that perennial crops can be particularly effective at reducing nitrate leaching in sandy soils.

Our objective is to 1) measure nitrate leaching and 2) identify and develop commercialization opportunities for seed, forage, and grain from three perennial crops grown on sandy soil:

- **Native prairie** because it's known to provide ecosystem services and retain nitrogen on sandy soil but requires value chain research to improve the economics of seed production (for prairie restorations).
- **Intermediate wheatgrass (Kernza)** because it's a deep rooted perennial grain that has potential to be profitable if supply chain work is conducted to align growers and end-users.
- **Alfalfa** because it's Minnesota's most common perennial crop but has limited nitrate retention benefits because it fixes nitrogen.

Native prairie and Kernza provide valuable seed, and all three perennials also provide biomass as a non-food co-product that can enhance profitability from sales as forage, straw, or biofuel. **This project will compare total net revenues from seed and biomass within each perennial cropping system with and without irrigation to determine economic viability on sandy soil while reducing nitrate leaching.**

The expansion of perennial crops in Central Minnesota is possible only if a market for their seed and biomass exists. Furthermore, identifying markets for their co-products will accelerate the adoption of these nitrogen-conserving crops. Currently, demand for Kernza exceeds supply because of supply chain challenges related to grain cleaning, processing, storage, and transportation. Minnesota's agricultural communities likely possess the technology and innovation to overcome the Kernza supply chain challenges, and this project will identify those assets and facilitate the supply chain resources necessary for rural Minnesota to capitalize on this unique economic opportunity. **This project will also conduct supply-chain research to identify markets for Kernza grain, native prairie seed, and perennial crop biomass.** This project will empower a unique team to study and implement Kernza so that it can reduce groundwater nitrate pollution and stimulate rural economies.

II. PROJECT ACTIVITIES AND OUTCOMES

Activity 1: *Quantify and compare nitrate leaching and yields of prairie, alfalfa, and Kernza grown with and without irrigation on sandy soils of Central Minnesota.* **Budget: $260,513**

We will test the hypothesis that Kernza and native prairie seed production are more effective at reducing nitrate leaching than alfalfa on sandy soils of Central Minnesota under irrigated and rain-fed conditions by measuring soil water nitrate content using lysimeters. We will test the hypothesis that Kernza and native prairie seed and biomass yields will result in equal profitability with and without irrigation by measuring seed/grain and biomass yield annually. Economic assessments will be conducted using results from value chain research in Activity 3. This research will be conducted at the Rosholt Research Farm, a public research facility owned and operated by the Pope Soil Water Conservation District and within the Bonanza Valley Groundwater Management Area.

Outcome	Completion Date
1. A report comparing soil water nitrate beneath Kernza, native prairie, and alfalfa managed with and without irrigation	*June 30, 2021*
2. A report comparing grain, seed, and biomass yield from Kernza, prairie, and alfalfa growth with and without irrigation	*June 30, 2021*

Activity 2: *Kernza demonstration field in a Drinking Water Source Management Area* **Budget: $23,112**

Establish two Kernza demonstration fields totaling 36 acres on privately owned, row-crop agricultural fields within the City of Cold Spring Drinking Water Source Management Area in Stearns County. These fields will be

monitored for nitrate leaching and demonstrate field scale production. They will be the sites of two field days and outreach events. Grain from these fields will be used for supply chain research described in Activity 3.

Outcome	Completion Date
1. Establish 36 acres of Kernza on two farms in Drinking Water Source Management Areas	*June 30, 2021*
2. Produce 12,000 pounds of Kernza grain for testing processing techniques and research	*June 30, 2021*
4. Demonstrate nitrate leaching reductions beneath Kernza fields	*June 30, 2021*
5. Host two field days and education events at the Kernza demonstration fields	*June 30, 2021*

Activity 3: *Develop value chains for food and non-food applications of Kernza and native prairie seed and biomass* **Budget: $165,280**

For food applications, examine Kernza as a food ingredient (bread, cereal, pasta, beer, etc.) with MN companies and map local processor capabilities, opportunities and barriers. Characterize and provide technical information on handling (clean and de-hull), storage, formulation and shelf life of selected Kernza product development concepts. Supply nutritional profiles for food/beverage containing Kernza and conduct sensory analysis. For non-food applications, characterize Kernza and native prairie straw for feed value and identify potential markets; evaluate straw as pelleted fuel or biomass blend for heating and as composite for plastic/fiberglass/pressed wood applications and identify the companies that process the fiber. Examine the use of straw for poultry litter.

Outcome	Completion Date
1. Value chain summary report on Central MN value chains utilizing Kernza grain, native prairie seed, and co-products (straw, chaff) in food/beverage and non-food applications	*June 30, 2021*
3. Summarize limitations of Kernza and native prairie co-products and propose possible solutions (e.g. blending with other fibers to enhance properties of end products)	*June 30, 2021*

III. PROJECT STRATEGY

A. Project Team/Partners:

No ENRTF Funding:

Stearns County Soil & Water Conservation District: Mr. Dennis Fuchs will serve as project manager.
Minnesota Department of Agriculture: Mrs. Margaret Wagner will advise on project objectives.
Minnesota Department of Health: Mr. Mark Wettlaufer will advise on project objectives.
Minnesota Rural Water Association: Mr. Aaron Meyer will advise on project objectives.

ENRTF Funded Partners:

Pope County Soil & Water Conservation District: Ms. Holly Kovarik manages the Rosholt Research Farm.
University of Minnesota, St. Paul: Dr. Jacob Jungers will oversee the experiments including crop agronomics, plant and soil nitrate sampling, and data analysis.
Agricultural Utilization Research Initiative: Dr. Goutham Vemuri will manage a team to conduct supply chain development activities and outreach events.

B. Project Impact and Long-Term Strategy:

The long-term strategy is to develop perennial crops with high economic value and environmental benefits including improved groundwater quality. This project complements the 2018 LCCMR project 057-B related to Kernza production in wellhead protection areas, which has been recommended for funding at 33% of the original project budget. This proposed project is unique in that it compares water quality benefits among other perennial crops, and that the research tests the effects of irrigation. Another differentiating feature that this project includes the supply chain aspects of marketing perennial crop seed, grain and biomass. This project will further expand the application portfolio for Kernza and perennial crops.

C. Timeline Requirements: This is a two year study that will establish instrumented research plots at a new location (Rosholt Farm) to be used in future studies beyond the timeline of this study. We will also establish a demonstration Kernza production field during the two-year timeframe of this study, which will also be available for future projects.

2019 Proposal Budget Spreadsheet

Project Title: Accelerating perennial crop production to prevent nitrate leaching

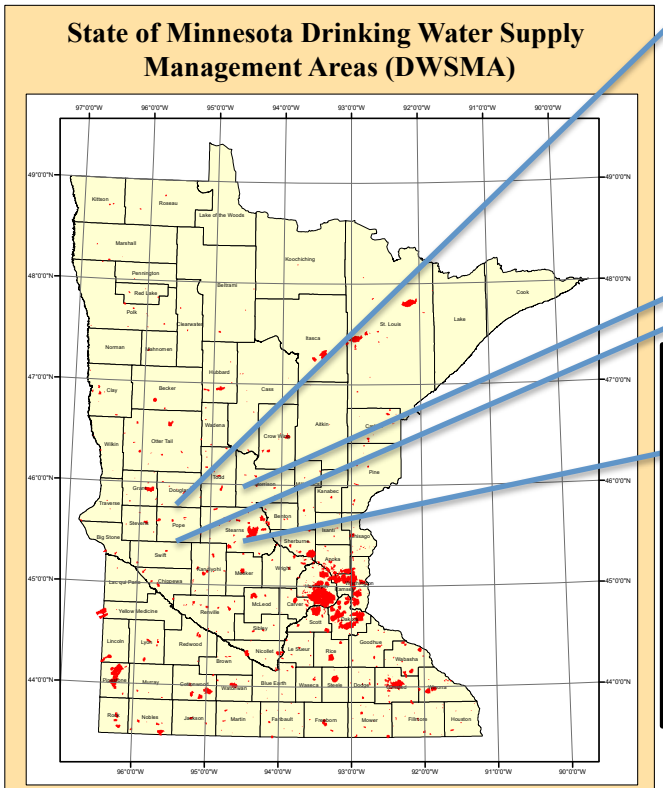
IV. TOTAL ENRTF REQUEST BUDGET *2* **years**

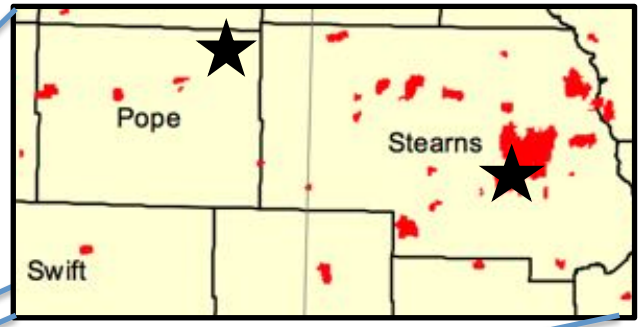
BUDGET ITEM (See "Guidance on Allowable Expenses")	**AMOUNT**
Personnel:	$ -
Professional/Technical/Service Contracts: University of Minnesota - Postdoc researcher (50% FTE per year for two years + 21.4% fringe) = $61,307; Technician (20% FTE per year for two years + 27.2% fringe) = $24,666. Supplies (112 lysimeters @ $80 per lysimeter and 240 soil moisture sensors @ $150 per sensor) = $44,960. Analysis (Plant C/N, soil C/N, soil nitrate, soil physical characteristics, lysimeter soil water nitrate) = $54,016. Travel ($8,000 per year for mileage and per diem from St. Paul, MN to Staples, MN) = $16,000. Land rental fees (2 acres per year @ $225 per acre for Rosholt Farm plot fees) = $1,000.	$ 201,949
Professional/Technical/Service Contracts: Pope County - Rosholt Farm Administration (208 hours per year for 2 years at $64.67 per hour [including fringe and travel]) = $26,903. Hourly undergraduate intern (50% FTE per year for 2 years + 7.65% fringe) = $31,661,	$ 58,564
Professional/Technical/Service Contracts: Kernza production fee for services - Fee for services to operators to prepare fields, plant seed, apply fertilizer, harvest grain, and harvest biomass residue for Kernza production fields. Estimates of inputs and labor costs come from farm economic spreadsheet models developed by Bill Lazarus (http://wlazarus.cfans.umn.edu/william-f-lazarus-farm-machinery-management) = 36 acres @ $321 per acre per year for two years = $23,112	$ 23,112
Professional/Technical/Service Contracts: Agricultural Utilization Research Institute - The project commercialization (supply chain and value-add) team (25% FTE) will work on the project to map, develop and report perennial grain utilization in various applications. The technical team (25% FTE) will work on grain processing and food application developmement. The personnel time also include time for project management (10% FTE). The total AURI personnel time allocated for these tasks is equivalent to that of 60% FTE/year at $55/h (includes base+fringe) for 2 years ($55/h x 60% x 2080 h/yr x 2 yrs) = $137, 280. Expenses for sub-contracting market research firms, and analytical technical services over two years = $19,000. Travel to collaborator sites, meetings with growers, end-users for 2 years = $4,000. Organizing targeted forums, dissemination, and outreach activities for two years = $5,000.	$ 165,280
Equipment/Tools/Supplies:	$ -
Acquisition (Fee Title or Permanent Easements):	$ -
Travel:	$ -
Additional Budget Items:	$ -
TOTAL ENVIRONMENT AND NATURAL RESOURCES TRUST FUND $ REQUEST =	$ 448,905

V. OTHER FUNDS *(This entire section must be filled out. Do not delete rows. Indicate "N/A" if row is not applicable.)*

SOURCE OF FUNDS	**AMOUNT**	**Status**
Other Non-State $ To Be Applied To Project During Project Period:	$ -	
Other State $ To Be Applied To Project During Project Period:	$ -	
In-kind Services To Be Applied To Project During Project Period: Stearns County SWCD time. 100 hour per year at $65 per hour (salary + fringe) for two years.	$ 13,000	
Past and Current ENRTF Appropriation:	$ -	
Other Funding History:	$ -	

Accelerating perennial crop production to prevent nitrate leaching





Project leader: Dennis Fuchs, Stearns County SWCD
Partners: University of Minnesota, Pope County SWCD, Agricultural Research Utilization Institute (AURI)

Activity 1: Measure nitrate leaching and economic outputs of three perennial crops on vulnerable sandy soil grown with and without irrigation at Rosholt Research Farm.
Activity 2: Establish 36 acres of Kernza on two farms within the Cold Spring Drinking Water Supply Management Area to reduce groundwater nitrate and provide field-scale demonstration sites for outreach and education events.
Activity 3: Conduct value chain assessment of grain, seed, biomass, and other products from perennial crops to provide economic opportunities.

Perennial crops to prevent nitrate leaching

Alfalfa – A nitrogen fixer with marginal nitrate retention attributes. Provides high-value forage for a developed market.

Native prairie – The gold standard for nitrate retention. Provides valuable seed and biomass for emerging markets.

Kernza – A deep rooted perennial grain with great potential for nitrate retention. Demand is high for this valuable grain, but supply chain work is needed to realize its economic potential.

Project Manager Qualifications & Organization Description

Dennis J. Fuchs
Administrator, Stearns County Soil and Water Conservation District
110 Second St. S. Suite 128
Waite Park, MN 56387
Direct: 320-345-6477, Cell: 320-290-3854, Office: 320-251-7800 x3

Work Experience:
STEARNS COUNTY SOIL AND WATER CONSERVATION DISTRICT
(website: http://www.stearnscountyswcd.net/)
Waite Park, MN. District Administrator, 1996-present.

MINNESOTA DEPARTMENT OF AGRICULTURE St. Paul, MN. Soil Scientist, 1994-1996. Assisted local and state units of government in evaluating agricultural nutrient management practices on water quality Designed and coordinated a variety of "Best Management Practices" implementation programs with organizations such as the Minnesota Extension Service, Soil and Water Conservation District, and Clean Water Partnership staff. Worked on LCMR funded demonstration projects, such as, field-scale paired-watershed comparison between Variable Rate Technology (VRT) and conventional technology

Education
UNIVERSITY OF MINNESOTA, St. Paul, MN. 1986-1988
Master of Agriculture, Soil Science; Hydrology Minor
Master project; extensive study of earthworm distribution in MN and effect on soil properties

UNIVERSITY OF MINNESOTA, St. Paul, MN. 1983-1986
B.S. degree, Agronomy; Applied Agricultural Economics Minor

Memberships/Licensures
- Certified Crop Adviser
- Licensed Professional Soil Scientist
- Soil and Water Conservation Society member
- American Society of Agronomy & Soil Science member
- MN Agriculture Rural Leadership alumni member

Organization Description

SWCDs are local units of government that manage and direct natural resource management programs at the local level. Districts work in both urban and rural settings, with landowners and with other units of government, to carry out a program for the conservation, use, and development of soil, water, and related resources.

One crucial niche districts fill is that of providing soil and water conservation services to owners of private lands. Privately owned lands make up 78 percent of the land surface in Minnesota. Managing these private lands, whether agriculture, forest, lakes, or urban, is key to Minnesota's quality of life.

Minnesotans trust SWCDs to provide needed technology, funding and educational services because they are established in each community, governed by local leaders and focused on conservation of local soil and water resources. The Stearns County SWCD is a recognized national leader in conservation delivery.