



# Environment and Natural Resources Trust Fund (ENRTF) M.L. 2019 ENRTF Work Plan (Main Document)

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**Today's Date:** 08/20/2018

**Date of Next Status Update Report:** 03/01/2020

**Date of Work Plan Approval:**

**Project Completion Date:** 06/30/2021

**Does this submission include an amendment request?** No

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**PROJECT TITLE:** Accelerating perennial crop production to prevent nitrate leaching

**Project Manager:** Dennis Fuchs

**Organization:** Stearns County Soil and Water Conservation District

**College/Department/Division:**

**Mailing Address:** 110 Second Street S. Suite 128

**City/State/Zip Code:** Waite Park, MN 56387

**Telephone Number:** 320-345-6477

**Email Address:** Dennis.Fuchs@mn.nacdnet.net

**Web Address:**

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**Location:** Pope County, Stearns County

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**Total Project Budget:** \$440,000

**Amount Spent:** \$0

**Balance:** \$440,000

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**Legal Citation:** M.L. 2019, Chp. xx, Sec. xx, Subd. xx

**Appropriation Language:**

Any income generated as part of this appropriation may be used to expand the project through additional planting of Kernza in wellhead protection areas.

## 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. OVERALL PROJECT STATUS UPDATES:

**First Update March 1, 2020**

**Second Update September 1, 2020**

**Third Update March 1, 2021**

**Final Report between project end (June 30) and August 15, 2021**

## III. PROJECT ACTIVITIES AND OUTCOMES:

**ACTIVITY 1 Title: *Quantify and compare nitrate leaching and yields of prairie, alfalfa, and Kernza grown with and without irrigation on sandy soils of Central Minnesota.***

**Description:** 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.

**ACTIVITY 1 ENRTF BUDGET: \$251,608**

<b>Outcome</b>	<b>Completion Date</b>
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

**First Update March 1, 2020**

**Second Update September 1, 2020**

**Third Update March 1, 2021**

**Final Report between project end (June 30) and August 15, 2021**

**ACTIVITY 2 Title: Kernza demonstration field in a Drinking Water Source Management Area**

**Description:** 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.

**ACTIVITY 2 ENRTF BUDGET: \$23,112**

<b>Outcome</b>	<b>Completion Date</b>
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
3. Demonstrate nitrate leaching reductions beneath Kernza fields	June 30, 2021
4. Host two field days and education events at the Kernza demonstration fields	June 30, 2021

**First Update March 1, 2020**

**Second Update September 1, 2020**

**Third Update March 1, 2021**

**Final Report between project end (June 30) and August 15, 2021**

**ACTIVITY 3 Title: Develop value chains for food and non-food applications of Kernza and native prairie seed and biomass**

**Description:** 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.

**ACTIVITY 3 ENRTF BUDGET: \$165,280**

<b>Outcome</b>	<b>Completion Date</b>
<i>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</i>	<i>June 30, 2021</i>
<i>2. 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)</i>	<i>June 30, 2021</i>

**First Update March 1, 2020**

**Second Update September 1, 2020**

**Third Update March 1, 2021**

**Final Report between project end (June 30) and August 15, 2021**

**IV. DISSEMINATION:**

**Description:** Research results will be summarized and presented in the LCCMR final report document. In additions, research results from the Activity 1 will be published in a peer-reviewed manuscript, presented at the Minnesota Water Resources Conference, and summarized in a two-page handout designed for a broad range of audiences including farmers, policy-makers, business leaders, and others. This handout will be made available to attendees of a Kernza water quality field day that will be held in 2020 and 2021. Information from activity 3 will be disseminated at the field days, as well as in a value-chain summary report. This report will be made available online on multiple high-visitation websites.

The Minnesota Environment and Natural Resources Trust Fund (ENRTF) 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 Acknowledgement Guidelines](#).

**First Update March 1, 2020**

**Second Update September 1, 2020**

**Third Update March 1, 2021**

**Final Report between project end (June 30) and August 15, 2021**

**V. ADDITIONAL BUDGET INFORMATION:**

**A. Personnel and Capital Expenditures**

**Explanation of Capital Expenditures Greater Than \$5,000:**

**Explanation of Use of Classified Staff:**

**Total Number of Full-time Equivalents (FTE) Directly Funded with this ENRTF Appropriation:**

Enter Total Estimated Personnel Hours for entire duration of project: NA, all in-kind	Divide total personnel hours by 2,080 hours in 1 yr = TOTAL FTE: None
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**Total Number of Full-time Equivalents (FTE) Estimated to Be Funded through Contracts with this ENRTF Appropriation:**

Enter Total Estimated Contract Personnel Hours for entire duration of project: 5824	Divide total contract hours by 2,080 hours in 1 yr = TOTAL FTE: 2.8
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**VI. PROJECT PARTNERS:**

**A. Partners outside of project manager’s organization receiving ENRTF funding**

Name	Title	Affiliation	Role
Dr. Jacob Jungers	Research Assistant Professor	University of Minnesota	Oversee the experiments including crop agronomics, plant and soil sampling, and data analysis
Dr. Goutham Vermuri	Research Scientists	Agricultural Utilization Research Initiative (AURI)	Manage team to conduct supply chain development activities and outreach events
Ms. Holly Kovarik	District Manager	Pope County Soil and Water Conservation District	Manages the Rosholt Research Farm

**B. Partners outside of project manager’s organization NOT receiving ENRTF funding**

Name	Title	Affiliation	Role
Margaret Wagner	Supervisor, Clean Water Technical Assistance Unit	Minnesota Department of Agriculture (MDA)	Advise on project outcomes and deliverables
Mark Wettlaufer	Planning Supervisor	Minnesota Department of Health (MDH)	Advise on project objectives and deliverables, review reports
Aaron Meyer	Source Water Specialists	Minnesota Rural Water Association (MRWA)	Advise on project objectives and deliverables, review reports and outreach materials

**VII. LONG-TERM- IMPLEMENTATION AND FUNDING:**

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.

**VIII. REPORTING REQUIREMENTS:**

- Project status update reports will be submitted March 1 and September 1 each year of the project
- A final report and associated products will be submitted between June 30 and August 15, 2021

**IX. SEE ADDITIONAL WORK PLAN COMPONENTS:**

- A. Budget Spreadsheet**
- B. Visual Component or Map**
- C. Parcel List Spreadsheet - NA**
- D. Acquisition, Easements, and Restoration Requirements - NA**
- E. Research Addendum - NA**

Attachment A:

Environment and Natural Resources Trust Fund

M.L. 2019 Budget Spreadsheet

Legal Citation:

Project Manager: Dennis Fuchs

Project Title: Accelerating perennial crop production to prevent nitrate leaching

Organization: Stearns County Soil and Water Conservation District

Project Budget: \$440,000

Project Length and Completion Date: Two years, 6/30/2021

Today's Date: 08/27/2018



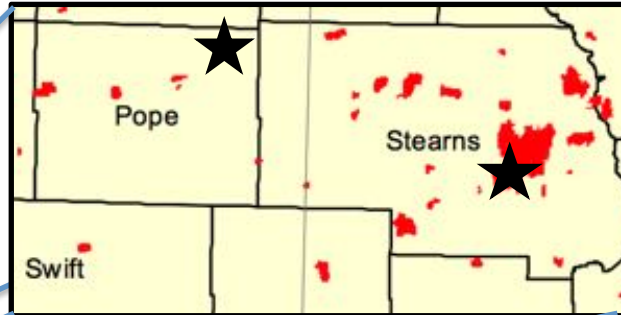
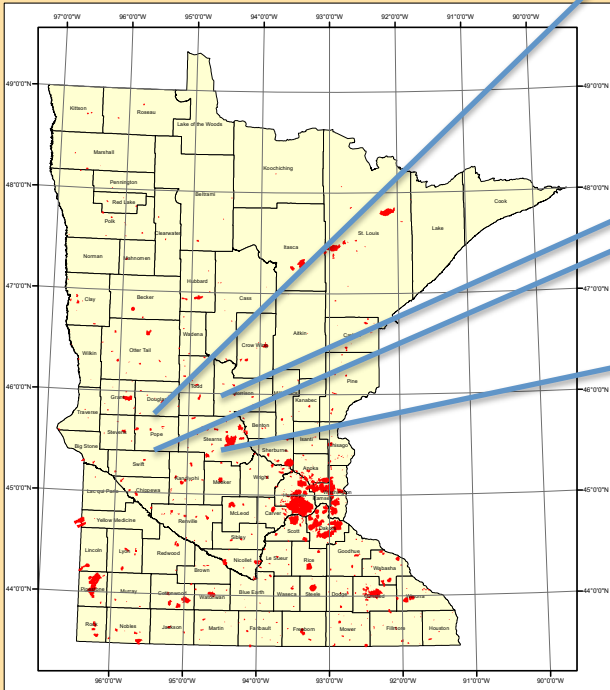
ENVIRONMENT AND NATURAL RESOURCES TRUST FUND BUDGET	Budget	Amount Spent	Balance
<b>BUDGET ITEM</b>			
<b>Professional/Technical/Service Contracts: University of Minnesota</b>	\$ 193,044	\$ -	\$ 193,044
<b>Personnel: Postdoctoral Researcher</b> - 50% FTE per year for 2 years, 78.6% salary and 21.4% fringe to oversee field and lab research and produce deliverables. (Total = \$61,307)			
<b>Personnel: Technician</b> - 20% FTE per year for 2 years, 73.8% salary and 27.2% fringe conduct field research tasks such as planting, weeding, and harvesting research plots. Oversee processing of research samples. (Total = \$24,666)			
<b>Equipment/Tools/Supplies</b> - 64 lysimeters @ \$80 per lysimeter and 120 soil moisture sensors @ \$150 per sensor. (Total = \$38,055)			
<b>Analysis</b> - Plant C/N, soil C/N, soil nitrate, soil physical characteristics, lysimeter soil water nitrate. (Total = \$54,016)			
<b>Travel expenses in Minnesota:</b> Funds for 2 UMN personnel to make 12 trips per year from St. Paul to Rosholt Research Farm (245 miles round trip) to collect soil water samples. Expenses include M&IE each day and lodging for 10 nights. Travel expenses for 2 UMN personnel to make 12 trips per year from St. Paul to Cold Spring (160 miles roundtrip) to collect soil water samples. Expenses include M&IE each day and no lodging. (Total = \$14,000)			
<b>Research Plot Fees:</b> 2 acres per year @ \$225 per acre for Rosholt Farm Research plot fee. (Total = \$1,000)			
<b>Professional/Technical/Service Contracts: Pope County Soil Water Conservation District</b>	\$ 58,564	\$ -	\$ 58,564
<b>Personnel: Rosholt Farm Administrator</b> - 10% FTE per year for 2 years, \$64.67 per hour (including fringe and travel) to oversee Rosholt Research Farm tasks specific to this project. (Total = \$26,903)			
<b>Personnel: Undergraduate Intern</b> - 50% FTE per year for 2 years plus 7.65% fringe to collect and process lysimeter samples. (Total = \$31,661)			
<b>Professional/Technical/Service Contracts: Kernza production fee for services</b> - 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 ( <a href="http://wlazarus.cfans.umn.edu/william-f-lazarus-farm-machinery-management">http://wlazarus.cfans.umn.edu/william-f-lazarus-farm-machinery-management</a> ) = 36 acres @ \$321 per acre per year for two years. Total = \$23,112	\$ 23,112	\$ -	\$ 23,112
<b>Professional/Technical/Service Contracts: Agricultural Utilization Research Institute</b>	\$ 165,280	\$ -	\$ 165,280
<b>Personnel: Supply Chain</b> - 25% FTE per year for 2 years at \$55 per hour (including fringe) to map, develop, and report perennial grain utilization in various applications. Total = \$57,200			
<b>Personnel: Technical</b> - 25% FTE per year for 2 years at \$55 per hour (including fringe) to work on grain processing and food application development. Total = \$57,200			
<b>Personnel: Management</b> - 10% FTE per year for 2 years at \$55 per hour (including fringe) to work on grain processing and food application development. Total = \$22,880			
<b>Subcontract</b> - Expenses for sub-contracting market research firms and analytical services over two years. Total = \$19,000			
<b>Travel expenses in Minnesota:</b> Travel to collaborator sites, meetings with growers, end-users for 2 years. Total = \$4,000			
<b>Other:</b> Expenses related to targeted forums, research dissemination and outreach activities for 2 years. Total = \$5,000			
	\$ -	\$ -	\$ -
<b>COLUMN TOTAL</b>	\$ 440,000	\$ -	\$ 440,000

OTHER FUNDS CONTRIBUTED TO THE PROJECT	Status (secured or pending)	Budget	Spent	Balance
<b>Non-State:</b>		\$ -	\$ -	\$ -
<b>State:</b>		\$ -	\$ -	\$ -
<b>In kind:</b> Stearns County SWCD time. 100 hour per year at \$65 per hour (salary + fringe) for two years (\$13,000). Kernza seed for Activity 2 - 36 acre demonstration field (\$2.00 per pound, 15 pounds per acre at 36 acres = \$1080)	secured	\$ 14,080	\$ -	\$ 14,080

PAST AND CURRENT ENRTF APPROPRIATIONS	Amount legally obligated but not yet spent	Budget	Spent	Balance
<b>Current appropriation:</b>		\$ -	\$ -	\$ -
<b>Past appropriations:</b>		\$ -	\$ -	\$ -

# Accelerating perennial crop production to prevent nitrate leaching

State of Minnesota Drinking Water Supply Management Areas (DWSMA)



**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.