

**Environment and Natural Resources Trust Fund
2020 Request for Proposals (RFP)**

Project Title:

ENRTF ID: 216-F

Implementing Hemp Crop Rotation to Improve Water Quality

Category: F. Methods to Protect, Restore, and Enhance Land, Water, and Habitat

Sub-Category:

Total Project Budget: \$ 740,000

Proposed Project Time Period for the Funding Requested: June 30, 2024 (4 yrs)

Summary:

We will evaluate how hemp crops may reduce nitrogen contamination of surface and groundwater in conventional crop rotations while demonstrating the environmental and economic benefits of hemp grain production.

Name: Keith Olander

Sponsoring Organization: Central Lakes College

Job Title: _____

Department: Aq & Energy Center

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Staples MN 56479

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Web Address: http://www.clcmn.edu/aq-energy-center/

Location:

Region: Central, Metro, Southwest

County Name: Carver, Redwood, Stevens, Todd, Wadena

City / Township: Staples, Morris, Waconia, Lamberton

Alternate Text for Visual:

Five panes: Question – hemp planting, seedlings, combining; Experiment– corn and hemp crop and grain and 3-year rotation tables, Outcomes – hemp grain and plant with bee with pollen. Site location map.

_____ Funding Priorities	_____ Multiple Benefits	_____ Outcomes	_____ Knowledge Base
_____ Extent of Impact	_____ Innovation	_____ Scientific/Tech Basis	_____ Urgency
_____ Capacity Readiness	_____ Leverage	_____ TOTAL	_____ %

PROJECT TITLE: Implementing hemp crop rotation to improve water quality

I. PROJECT STATEMENT

Establishing industrial hemp (*Cannabis sativa*) as an oilseed grain crop has potential to improve surface and ground water quality and restore soil integrity within the conventional crop rotation systems that are major environmental concern in Minnesota. Deep rooted hemp has the potential to scavenge, prevent runoff and reduce leaching of agricultural nutrient inputs, especially nitrogen, while further contributing organic matter to the soil horizon. We will experimentally test the effectiveness of hemp grain crops to scavenge excess nitrogen and prevent leaching in crop rotation systems. In parallel, we will demonstrate on a production scale how the incorporation of hemp grain into conventional crop rotation systems can achieve desired water quality and soil health outcomes. Finally, we will communicate the viable economic potential of hemp oilseed/grain cropping as discovered, refined and facilitated by market pathway and supply-chain development analyses. Communication of study results and best practices through field days, farm demonstrations, and presentations will support adoption of hemp crops to achieve water quality, soil improvement and other environmental benefits in Minnesota.

II. PROJECT ACTIVITIES AND OUTCOMES

Activity 1: *Corn vs. hemp comparison of nitrogen movement & corn-soybean-hemp integration*

Description: Changes to the 2014 and 2018 federal Farm Bills have piqued the interest of growers in adding industrial hemp to their crop rotations. Unlike corn, hemp produces a robust tap root that has the potential to recover nitrate leached deep into the soil profile before it enters the water table. This three-year experiment will quantify fertilizer and mineralized nitrogen recovery by hemp compared to corn and thereby assess the potential for hemp to mitigate nitrate contamination of water resources if included in typical crop rotations. We will also conduct production scale trials to demonstrate the integration of hemp into conventional corn-soybean rotations and to assess leaching and scavenging of nitrogen.

ENRTF BUDGET: \$435,000

Outcome	Completion Date
1. Investigate the potential of hemp to mitigate groundwater contamination.	October 31, 2022
2. Demonstrate production-scale benefits of hemp in rotation to farmers.	October 31, 2021

Activity 2: *Economic impact with business development for industrial hemp in Minnesota.*

Description: Ameliorating the impact of agriculture on water quality requires economically viable alternatives to current crop rotation systems. We will provide information on crop yield and economic data to deliver economic benefits that are aligned with environmental quality. This activity will examine the economics of adding industrial hemp to a conventional crop rotation and identify the market potential for feed, food, fuel, and fiber from industrial hemp. Due to public safety concerns as well as market volatility, we will not investigate the economics of cannabidiol (CBD) production in hemp.

ENRTF BUDGET: \$166,000

Outcome	Completion Date
1. Produce environmental benefits and provide advice for a profitable production of industrial hemp in corn-soybean rotation.	June 30, 2022
2. Communicate economic findings on implementing industrial hemp in a corn-soybean rotation.	June 30, 2022
3. Identify and relay market opportunities for industrial hemp by reviewing supply chain availability.	August 31, 2022

Activity 3: Education and outreach on growing hemp in a conventional cropping systems.

Description: We will host annual field days and demonstrations to showcase the production of industrial hemp in a rotation to farmers, government officials, local businesses, educators, and students. This activity will showcase a farmer with industrial hemp as part of a crop rotation. We will also communicate the results obtained from Activities 1 and 2 so farmers can be informed on requirements to implement hemp in a rotation, economic considerations, and water quality improvement.

ENRTF BUDGET: \$139,000

Outcome	Completion Date
1. Educate stakeholders, citizens and students about growing industrial hemp.	December 31, 2023
2. Demonstrate the variable markets of industrial hemp from a cropping rotation.	December 31, 2023

III. PROJECT PARTNERS AND COLLABORATORS:

Central Lakes College (CLC) conducts production scale hemp crop demonstration and field day events at CLC (Staples) and Southwest Research and Outreach Center (ROC) (Lamberton); collaborates with local landowners, producers and regional soil and water conservation districts. University of Minnesota (UMN) conducts nitrogen scavenging/leaching/uptake experiments comparing hemp at SWROC (Lamberton), West Central ROC (Morris), CLC (Staples) and Hemp Acres (Waconia). Agricultural Utilization Research Institute (AURI) contributes to education and outreach events, conducts value-added analysis of grains and biomass, and conducts market analysis to identify market opportunities for industrial hemp.

IV. LONG-TERM IMPLEMENTATION AND FUNDING:

The three year span of this project coincides with the initial licensing of and expansion of commercial industrial hemp production in Minnesota as authorized under the 2018 Federal Farm Bill. Evidence-based guidance from this study on how hemp crops can mitigate water quality impacts of conventional corn-soybean agriculture by reducing excess input nitrogen runoff and leaching will help maximize environmental benefits through farmer adoption of this emerging agricultural economic opportunity.

Attachment A: Project Budget Spreadsheet
Environment and Natural Resources Trust Fund
M.L. 2020 Budget Spreadsheet



Legal Citation:

Project Manager: Keith Olander, Central Lakes College

Project Title: Implementing hemp crop rotation to improve water quality

Organization: Central Lakes College, University of Minnesota, Agricultural Utilization Research Institute

Project Budget: \$740,000

Project Length and Completion Date: 3 years; Dec 31, 2023

Today's Date: April 15, 2019

ENVIRONMENT AND NATURAL RESOURCES TRUST FUND BUDGET	Budget	Amount Spent	Balance
BUDGET ITEM			
Personnel (Wages and Benefits)	\$ 670,000	\$ -	\$ 670,000
Ron Nelson, CLC farm operations manager, \$27,994, 70.4% salary/29.6% fringe, 0.15% FTE, years 1-3 (Total: 45% FTE)			
Hannah Barrett, CLC research coordinator, \$44,712, 70.4% salary/29.6% fringe, 25% FTE, years 1-3 (Total: 75% FTE)			
Todd Pollema, CLC ag technician, \$20,995, 70.4% salary/29.6% fringe, 15% FTE, years 1-3 (Total: 45% FTE)			
CLC student intern, \$23,040, 100% FTE, years 1-3, (Total: 300% FTE)			
Keith Olander, CLC center director, \$118,973, 70.4% salary/29.6% fringe, 30% FTE, years 1-3, (Total: 90% FTE)			
Jonathan Wenger, UMN project manager, \$97,252, 64% salary/36% fringe, 30% FTE years 1-3 (Total: 90% FTE)			
UMN nitrate experiment technical manager, \$139,577, 70.5% salary/29.5% fringe, 50% FTE year 1 + 100% FTE years 2&3 (Total: 250% FTE)			
UMN undergraduate nitrate experiment technician, \$26,800, Base wage \$14/hr. Half time summer (14 weeks) Year 1. Full time summer plus 8h/wk F&S semester Yr 2&3.			
UMN graduate student, \$17,136, 83.9% salary/16.1% fringe, Full time summer (14 weeks) Year 1, Half time fall semester (14 weeks), Year 1.			
Technicians: water sample collection fees, \$7500, \$500 x 5 nitrogen-scavenging experiment blocks x 3 years.			
AURI Business Development team, \$51,480, Total Team effort is 15% FTE/yr at \$55/hr (\$40/hr salary & \$15/hr fringe), all years, will establish supply chain opportunities and investigate new markets with private businesses with industrial hemp products.			
AURI Technical team (comprising of Process Engineer, food scientist, and analytical scientist), \$68,640, Total Team effort is 20% FTE/year at \$55/hr (\$40/hr salary & \$15/hr fringe), all years, will work on assessing grains for proximate analysis, nitrogen, and provide economic impact of hemp compared to other grains.			
AURI Outreach and Innovation Network, \$25,740, Total team effort is 7.5% of FTE/yr at \$55/hr (\$40/hr salary & \$15/hr fringe), all years, will organize 2 hemp field days over the grant period to assist in education and awareness of growing industrial hemp in a crop rotation. AURI program/grant manager.			
Equipment/Tools/Supplies			
Land costs: Activity 1: Six acres/yr for production-scale demonstration (\$4950) + five acres/yr for nitrogen scavenging experiment (\$4125) = 11 acres/yr x 3yrs x \$275/acre = \$9075.	\$ 9,000		\$ 9,000
Machinery operations: \$165/acre x 6 acres x 3 years = \$2970	\$ 3,000		\$ 3,000
Field day costs (material and supplies): (5 days total over 3 yrs), 900 total attendance x \$10/participant = \$9000), On-site demonstration and immersion of farmers to foster adoption of emerging practices.	\$ 9,000		\$ 9,000
Experiment and sample analysis material costs: \$6000: reagents and lab consumable supplies/chemicals all years; \$1000: consumable plot supplies; \$1440: soil testing; \$12,000: 120 soil water samplers x \$100 each; \$10,875: soil water analysis lab supplies @ \$725/location/year x 5 locations x 3 years; \$2200: seed, \$600 yr 1, \$800 yrs 2,3; Subtotal = \$33,515	\$ 34,000		\$ 34,000
Travel expenses in Minnesota			

UMN: Plot management: St. Paul to Waconia, Lambertson, Morris, Staples, St. Paul 500 mi Minivan rental \$56/day x 2 days = \$112. Hotel \$120/night. Total \$232/trip Year 1 - 2 trips = \$464 (minivan rental + hotel) Year 2 – 6 trips = \$1392 (minivan rental + hotel) year 3 - 6 trips = \$1392 (minivan rental + hotel) total = \$3248 plot management travel Presentation of results: (e.g. Annual Conference of American Society for Horticultural Science) \$2000 year 2 and \$2000 year 3 = \$4000 UMN travel subtotal: \$7248 AURI: Travel by the technical team, business development team, and outreach team. Travel from Marshall by Technical team to collect samples and field days, to partner labs, various locations (Mileage: 3 trips to Morris @~184 per trip @\$0.58 per mile = \$320.16; 3 trips to Staples @ ~334 miles per trip @ \$0.58 per mile= \$581.16; 3 trips to Waconia @242 miles per trip @ \$0.58 per trip+ \$421.08, 3 trips to Lambertson @ 80 miles per trip @ \$0.58 per mile=\$139.2; M&IE @\$50 per day=\$600; Travel by Innovation and Commercialization Team to private businesses and investors, various MN locations (\$0.58 per mile; M&IE@ \$71 per day in Minneapolis/St. Paul)= \$3,200; Travel by the Outreach and Communications team to Field Days (Morris and Staples from various locations @ \$0.58 per mile; M&IE @ \$50 per day), costs of hosting speakers = \$2,000. AURI travel subtotal=\$7300 Combined=\$14,548		\$ 15,000	\$ -	\$ 15,000	
COLUMN TOTAL		\$ 740,000	\$ -	\$ 740,000	
SOURCE AND USE OF OTHER FUNDS CONTRIBUTED TO THE PROJECT		Status (secured or pending)	Budget	Spent	Balance
Non-State:			\$ -	\$ -	\$ -
State:			\$ -	\$ -	\$ -
In kind:UMN In-kind cost share of unrecovered ICR (54% of UMN costs)		pending	\$ 176,000	\$ -	\$ 176,000
In kind:CLC In-kind cost share of unrecovered ICR (29.4% of salary+fringe)		pending	\$ 69,000	\$ -	\$ 69,000
Other ENRTF APPROPRIATIONS AWARDED IN THE LAST SIX YEARS		Amount legally obligated but not yet spent	Budget	Spent	Balance
04I 076-B Farm-Ready Cover Crops for Protecting Water Quality		\$741,000	\$741,000	\$ -	\$ 741,000

Implementing Hemp Crop Rotation to Improve Water Quality

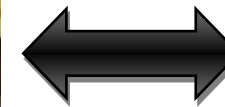


Question: Does hemp affect water quality?

- Seeding
- Best Management Practices
- Fertilizer requirements
- Harvest



Experiment: Crop rotation and water quality comparisons



Year	2021	2022	2023
Crop Rotation	Corn	Soybeans	Small Grain
	Hemp	Corn	Soybeans
	Small Grain	Hemp	Corn
	Soybeans	Small Grain	Hemp

Year	2021	2022	2023
Crop Comparisons	Corn	Hemp	Corn
	Hemp	Corn	Hemp

Outcomes

- Determine water quality impacts
- Maximize nitrogen scavenging in clay soils
- Minimize nitrogen leaching in sandy soils
- Yield production for both seed and fiber



***Project Manager:
Keith Olander***

Dean of Agricultural Studies, Central Lakes College
Supervise 13 faculty in Agriculture, Food, & Natural Resources Education

Director of AgCentric, Minnesota State Center of Excellence in Agriculture
Coordinate Professional Development of Statewide Farm Business Management
Facilitate Database Construction, over 2100 farms
Eight Colleges within Minnesota State, 66 faculty

Director of Central Lakes College Ag & Energy Center, Central Lakes College
Facilitate over 40 public & private research partnerships
1800 acre research & demonstration in the following areas:

- Alternative Energy
- Cover Crops
- Soil Water Quality
- Irrigation Technology Management
- Local Foods Systems Catalyst
- Agronomic Crop Production

Owner & Operator, crop farm

350 acres of row crops – 30 year practitioner, rural Staples, MN

Demonstrating balance in environmental impact with financial sustainability

**As a practitioner, a large amount of credibility is extended when presenting to local farmers as they give credence to listening to “another farmer”.

Organization Description:

The Central Lakes College Ag and Energy Center is a catalyst for agriculture research and demonstration in the coarse, sandy plains of Minnesota. The **mission** of the Central Lakes College Ag and Energy Center is to build futures; as it delivers valuable products, services, and education, which contribute to the economic vitality of the region.

The Ag and Energy Center has built a network of farmers and agricultural partners in the region. The Center is guided by an advisory council that includes area farmers and will provide expertise on increasing the adoption of new crops by the farm community. Leading teams to meet grant and research objectives is integral to the mission of serving our region’s farmers. Aside from involving farmers in guiding farm demonstration, the Ag & Energy Center Director is the education liaison for local farm groups offering annual programming with an emphasis in water quality, monitoring, and “forever green” concepts like cover crops. The Ag & Energy Center has the capacity to handle full agronomic cycle of the crops in this project and the human resources to facilitate the administration of all aspects of the project. These relationships make the Ag & Energy Center uniquely positioned to effectively lead the effort to increase alternative crop adoption on the central sandplains to protect valuable groundwater.



