**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**

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| **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**

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| **Outcome** | **Completion Date** |
| 1. 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**

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| **Outcome** | **Completion Date** |
| 1. 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.