Environment and Natural Resources Trust Fund
2016 Request for Proposals (RFP)

Project Title: **ENRTF ID: 146-E**

Modified Terrace System for Climate Adaptive Agricultural Landscapes

Category: E. Air Quality, Climate Change, and Renewable Energy

Total Project Budget: $ 665,037

Proposed Project Time Period for the Funding Requested: 3 years, July 2016 to June 2019

Summary:

Incorporate modified terraces with woody perennials and native prairies into agricultural systems. Test responsiveness to climate change (flood, drought, weather extremes) and improvements to water quality, soil, and pollinator habitat.

Name: Greg Schweser

Sponsoring Organization: U of MN

Address: 1991 Upper Buford Circle

St. Paul MN 55108

Telephone Number: (612) 625-9706

Email schwe233@umn.edu

Web Address http://www.extension.umn.edu/rsdp/

Location

Region: Central, Metro, NE

County Name: Dakota, St. Louis, Todd

City / Township:

Alternate Text for Visual:

Pictorial explanation and examples of modified terrace system; locations of test sites.

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

I. PROJECT STATEMENT

This project will demonstrate the effectiveness of a modified terrace system for agricultural landscapes, in response to recent climate trends of heavy rainfall, frequent drought, and temperature extremes. The modified terrace system is designed to collect, store, and distribute storm water on site and can be used as a climate change adaptation strategy to sustain food production and protect delicate ecosystems through extreme and unpredictable weather.

The system consists of digging narrow, shallow trenches along the contour of a field and mounding the displaced soil along the edge of the trenches, then reinforcing the mounds with perennial woody hazelnut bushes because their roots form dense understories to prevent erosion and improve soil quality. Strips of 12-18 native deep-rooted prairie species are planted between the mounds to mitigate the effects of extreme precipitation, drought, soil erosion and nutrient runoff into Minnesota lakes, streams and rivers, and to provide pollinator habitat. (See attached photos). Modified terrace construction can also be combined with the principles of STRIPS (developed at Iowa State University) by planting linear strips of perennial crops between the terraces.

Farmers and landowners are experimenting with similar systems in response to extreme weather in order to maintain the usability and productivity of their land. This project will provide the needed research to demonstrate the benefits and assess the impacts on Minnesota's ecosystems of the modified terrace system.

Research plots will be constructed in three disparate Minnesota ecoregions (NE, Central, and Metro/Southeast) to demonstrate how the system performs in different soil types and climatic zones. Researchers will observe and record changes in soil fertility, soil organic matter, rainfall, water infiltration, soil runoff, plant growth, prairie mass, and prairie species diversity over three years. Data collected from the research sites will be used as baseline data in a computer simulation of system performance for more than a 1000 possible climate, weather, and soil variables. Extension will share the results with its statewide network of farmers, conservation professionals, and land managers so they have the information needed to effectively construct and manage a modified terrace system.

II. PROJECT ACTIVITIES AND OUTCOMES

Activity 1: Construct modified terrace systems and collect and analyze performance data **Budget: $394,603**

Design, layout and construct modified terrace and control systems on three test sites: 1) Sustainable Agriculture Project; UMN Duluth; 2) Rosemont Research and Outreach Center; and 3) Camphill Village, Sauk Centre). Soil testing, collection of baseline data and planting of perennial woody plants (hazelnuts) along terraces. Establish native prairie in strips between terraces. Conduct regular tests to determine soil fertility, soil organic matter, temperature, rainfall, infiltration, runoff, prairie mass, woody plant growth.

Outcomes	Completion Date
1. Three modified terrace and three control systems established on test sites	October 2016
2. Native woody plants and native prairie established	October 2016
3. Baseline and performance data collected over three-year project period (i.e. soil quality, precipitation, water infiltration and runoff)	July 2016 – June 2019

Activity 2: *Design and build simulation framework to incorporate observed data and simulate system performance for 1000 possible climate, weather, and soil variables* **Budget: $161,735**

Download climate data from statewide datasets and organize into usable format. Program software to conduct simulation analysis and load system with observed data from test sites. Conduct sensitivity analysis to refine data accuracy. Conduct analyses of performance scenarios of varying climate and weather events.

Outcomes	Completion Date
1. Publishable results of data simulations	2019
2. Results incorporated into Extension program materials	2018
3. White paper on climate adaptability of modified terrace systems	2019

Budget: $108,699

Activity 3: *Extension Education and Outreach*
University of Minnesota Extension will conduct outreach and education to promote the project and demonstrate the performance results of the modified terrace system. Outreach will be targeted to farmers, Extension educators, and conservation professionals.

Outcome	Completion Date
1. One field day held on each experimental site in years 2 and 3. Post field day evaluation will gauge participant interest, knowledge, and potential to adopt system. (6 field days total)	2017, 2018
2. Extension materials and activities to explain system, installation techniques, management, and results of experiments and simulations	2018
3. Presentations at Extension conferences and sustainable agriculture conferences	2017, 2018
4. Final report written and distributed via University of Minnesota Extension websites	2019

III. PROJECT STRATEGY

A. Project Team/Partners

The University of Minnesota Extension will partner with Camphill Village. Staff involved will include Greg Schweser (Associate Director Sustainable Agriculture, RSDP), project management; Diomy Zamora (Associate Extension Professor), Rosemount site oversight, research design implementation; Stephen Briggs (Camphill Village, land manager), Sauk Center site design, oversight, and management; Bruce Wilson (Professor, Bioproducts and Biosystems Engineering), modified terrace engineering and design, modeling system performance, oversight of graduate student; Jose Hernandez (Associate Extension Professor) soil testing, water infiltration research and analysis; Lois Braun (Research Associate, Agronomy and Plant Genetics) woody hazelnut installation, analysis, and research; Randel Hansen, (UMD Environment and Sustainability); Duluth site oversight, research design and implementation; Craig Sheaffer, (Professor, Agronomy and Plant Genetics) UMN Agronomy and Plant Genetics; native prairie design, installation, and analysis.

B. Project Impacts and Long-Term Strategies

Project Impacts

- Increased understanding and knowledge of the benefits of the modified terrace system.
- Increased adoption of modified terrace systems as a climate change adaptation strategy.
- Reduced soil erosion and storm water runoff into Minnesota lakes, streams and rivers.
- Increase in pollinator habitats.
- Conservation programs like NRCS EQIP program use the research results to protect Minnesota ecosystems.

Long-term Strategy

- University of Minnesota Extension will include results in its outreach and education efforts to demonstrate the benefits of the modified terrace system.
- Outreach will be targeted to Extension's statewide network of farmers, Extension educators, and conservation professionals.
- Modified terrace systems established during this research will be available for future research on grazing impacts and product and forage yield, as well as outreach/demonstration.

C. Timeline Requirements

The three-year project period is necessary to ensure the modified terrace systems are fully established and to ensure that enough data is observed over time to conduct the climate variability simulation. The modified terraces will be constructed on the research sites in the fall. Native prairie and hazelnut plantings will follow terrace construction the same year. Data collection will begin in the pre-construction phase and continue after planting and throughout the three-year project period.

2016 Detailed Project Budget

Project Title: Modified Terrace System for Climate Adaptive Agricultural Landscapes

IV. TOTAL ENRTF REQUEST BUDGET 3 years

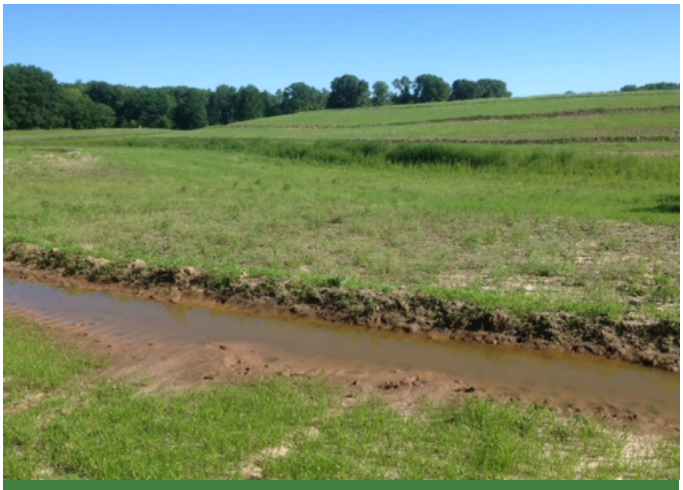
BUDGET ITEM *(See "Guidance on Allowable Expenses", p. 13)*	**AMOUNT**
Personnel:	**$ 479,430**
Greg Schweser, project manager, (75% salary, 25% fringe) 40% FTE year 1,2,3	$ 84425
Diomy Zamora, oversight of installation; design and outreach; (75% salary, 25% fringe) 15% FTE year 1,2,3	$ 37378
Bruce Wilson, engineering, design, simulation (75% salary, 25% fringe) 1% FTE year 1,2,3 (COST SHARED)	$ 0
Lois Braun, hazelnut installation, analysis (75% salary, 25% fringe) 5% FTE year 1, 3% years 2,3	$ 6628
Randel Hanson, Duluth oversight, research (75% salary, 25% fringe) 5% FTE year 1, 3% years 2,3	$ 9090
Jose Hernandez, soil research, testing (75% salary, 25% fringe) 10% FTE years 1,2,3	$ 27187
Craig Sheaffer, prairie management and analysis (75% salary, 25% fringe) 5% FTE year 1,2,3 (COST SHARED)	$ 0
Undergraduate student (2), terrace ssytem labor, analysis (100% salary) 50% FTE year 1,2,3	$ 38384
Graduate student (academic year) (64% salary, 36% fringe) simulation modeling 50% FTE year 1,2,3	$ 88427
Graduate student (summer) (85% salary, 15% fringe) simulation modeling 50% FTE year 1,2,3	$ 22270
Post doctoral research fellow (82% salary, 18% fringe) terrace systsem research 1FTE year 1,2,3	$ 165641
Professional/Technical/Service Contracts:	**$ 53,356**
Camphill Village; Sauk Center site usage, system oversight	4500
Prairie installation contractor	9856
Professional contract to plant Hazelnuts ($2000/site x 3 sites)	6000
Terrace installation contractor	15000
Natural resource/land management maintenance contractor	18000
Equipment/Tools/Supplies:	**$ 30,256**
Pressure transducers installed to measure ponded water depth (3)	7500
precipitation gauges (3)	300
hazelnut seedlings	9072
tree tubes and stakes (1600)	6884
mulch	3000
cattle fencing to protect Sauk Centre site	2500
Dell computer for simulation modeling	1000
Acquisition (Fee Title or Permanent Easements):	**$ -**
Travel:	**$ 49,258**
56,030 total project team miles x .575	32218
Hotel and perdiem (40/year @ $142 x 3 yrs)	17040
Additional Budget Items:	**$ 52,737**
Yearly soil testing (N-NO3, N-NH4; P,K,OM,pH; CEC; Total N,C; Soil texture)	15237
Water quality analysis ($1500 per year)	4500
Prairie mass analysis ($1000 per year)	3000
Printing and publications	6000
Video production	3000
Visual Field Tour	4000
Terrace grazing Conference	5000
Terrace grazing Summer Tour/Camp	4000
Field Days (1 per site yrs 2, 3; bus rental, equipment rental)	8,000
TOTAL ENVIRONMENT AND NATURAL RESOURCES TRUST FUND $ REQUEST =	**$ 665,037**

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

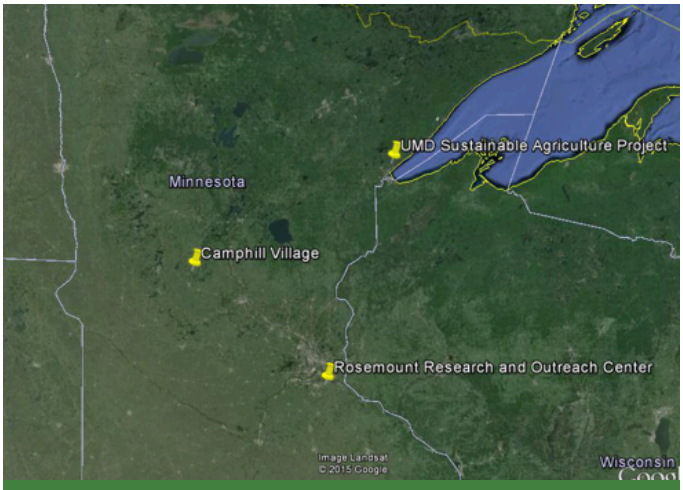
SOURCE OF FUNDS	**AMOUNT**	**Status**
Other Non-State $ To Be Applied To Project During Project Period:	na	
Other State $ To Be Applied To Project During Project Period:	na	
In-kind Services To Be Applied To Project During Project Period: (salary and fringe for B. Wilson and C. Sheaffer)	$ 14,810	*approved*
Funding History:	na	
Remaining $ From Current ENRTF Appropriation:	na	

Woody perennials (hazelnuts) located below the modified terrace.

Established modified terrace with mature hazelnut bushes and growing native pasture.



Newly constructed modified terrace holding water from recent storm that will percolate into the soil profile instead of running off site.



Locations of test sites in Minnesota

Project Manager Qualifications and Organization Description

Greg Schweser is the U of MN Extension's Regional Sustainable Development Partnership associate program director of sustainable agriculture and food systems. He works to build the capacity of community-led innovation in sustainable agriculture by connecting community innovators to education, research, and outreach resources available at the University of Minnesota. Schweser manages many projects to increase sustainable agriculture and local food capacity among Minnesota's environmentally conscious farmers and consumers. In August, 2013, Schweser participated in the Restoration Agriculture Workshop in Iowa City, Iowa where he was trained in design and installation of modified terrace systems. Since that time he has participated in the design and installation of two modified terrace system in Iowa and Wisconsin. Schweser organized and directed a tour of interested farmers, community members and Extension educators from Southeastern Minnesota to New Forest Farm in Viola, Wisconsin to a lecture/tour of Mark Shepard's hazelnut and chestnut farm that pioneered the incorporation of the modified terrace system in the Upper Midwest of the United States. This current LCCMR proposal is a response to requests for assistance, outreach, and information from UMN RSDP stakeholders on the modified terrace system for developing climate resilient sustainable agriculture in Greater Minnesota.

University of Minnesota Regional Sustainable Development Partnerships

The Regional Sustainable Development Partnerships (RSDP) is a program of the University of Minnesota Extension that connects Greater Minnesota communities to the University in order to identify new opportunities and solve problems in sustainability. The Partnerships leverage University knowledge and seed funding with local talent and resources in four areas: agriculture and food systems, tourism and resilient communities, natural resources, and clean energy. RSDP is composed of a statewide office and five partnerships working in Greater Minnesota.