Environment and Natural Resources Trust Fund

2021 Request for Proposal

General Information

Proposal ID: 2021-265

Proposal Title: Farming for Phosphorus Control at the Field Edge

Project Manager Information

Name: Christian Lenhart

Organization: U of MN - College of Food, Agricultural and Natural Resource Sciences

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Project Basic Information

Project Summary: Through watershed analysis and field collected data, we will identify opportunities to reduce phosphorus losses to water through management of the interface between land and streams in agricultural landscapes.

Funds Requested: $577,000

Proposed Project Completion: 2024-06-30

LCCMR Funding Category: Water Resources (B)

Project Location

What is the best scale for describing where your work will take place?

Region(s): SW, SE, Central,

What is the best scale to describe the area impacted by your work?

Statewide

When will the work impact occur?

During the Project and In the Future

Narrative

Describe the opportunity or problem your proposal seeks to address. Include any relevant background information.

Nutrient pollution is the most widespread and important driver of poor water quality in Minnesota. Management to improve water quality near waterways can reduce nitrogen, sediment and phosphorus losses from agriculture. Over time, phosphorus builds up in soils, however, leading to losses of dissolved phosphorus from buffers, wetlands, and other vegetated BMPs. Today, dissolved phosphorus is the largest source to rivers and lakes. Our proposal seeks to develop strategies for managing phosphorus in BMPs through vegetation harvest to reduce dissolved losses, providing key knowledge and practical approaches to more effectively manage farmland for water quality. We will examine how edge-of-field practices affect phosphorus cycling and evaluate strategies to reduce dissolved phosphorus losses from them through biomass harvest. Edge of field practices represent the best opportunity to manage phosphorus without adversely impacting farm production. Without actions to control phosphorus accumulation at the soil surface, however, buffers, wetland restorations and other BMPs will only temporarily reduce phosphorus levels in rivers and lakes. If vegetation harvest and recycling of removed nutrients is effective for phosphorus control, this strategy could maximize the benefits from riparian buffers, help control invasive species and woody plant encroachment, leading to more sustainable farm and agro-ecosystem management.

What is your proposed solution to the problem or opportunity discussed above? i.e. What are you seeking funding to do? You will be asked to expand on this in Activities and Milestones.

We propose documenting how harvesting plants in edge-of-field BMPs such as wetlands and buffer strips can help reduce dissolved phosphorus concentrations in soils which reduces leakage to waterways. While plant harvest is known to reduce soil nutrient levels in other regions, the practice has not been documented at a large scale in Minnesota. We well test and confirm the benefits of the practice through field data collection and modeling studies at three to four sites in rural parts of southern and western Minnesota. The project will also establish three to four demonstration sites in Minnesota where landowners and local government staff can observe plant harvest in practice and determine how to best implement it in their own watershed or property. Outreach efforts such as field trips with local partners will be done to help scale-up application of phosphorus harvest practices.

What are the specific project outcomes as they relate to the public purpose of protection, conservation, preservation, and enhancement of the state's natural resources?

To assess and develop approaches that will help to protect downstream water bodies from eutrophication and algal blooms by reducing phosphorus loading using edge -of-field management practices which are largely compatible with existing farm systems. Near-stream practices are highly effective for control of nitrogen and sediment, but much less for for dissolved phosphorus. However management of near stream areas to reduce phosphorus runoff is critical for the control of toxic algal blooms and reductions in surface water impairment. The project will provide a plant harvest approach that is cost-effective and beneficial both for phosphorus abatement and invasive species.

Activities and Milestones

Activity 1: Evaluating phosphorus control using biomass removal in edge-of-field BMPs including riparian buffers and wetlands.

Activity Budget: $400,000

Activity Description:
Four research sites will be used in agricultural watersheds: the University of Minnesota's Southwestern research station plus farms in Martin, Washington and Dakota Counties. Hydrologic monitoring of flow-through will be setup in 2021 and carried out 2022-2023 with completion by 2024. Soil test phosphorus data will be collected as an indicator of potential for phosphorus leakage. Plant harvesting will be done using small-scale weed cutters and tractor attachments to document removal rates of phosphorus by measuring phosphorus content in the removed plant material. The data will show how plant harvest changes soil P over time reducing outflow from the BMPs. Relationships between soil test P, vegetation harvest, and aquatic losses in near channel BMPs will be developed. These relationships will be established so that they can be applied to the range of conditions found in BMPs as indicated by soil P levels . Using phosphorus budgets within the BMPs, the removal rate relative to the inflow, criteria will be established that can be efficiently integrated with BMP tools and models. Other metrics developed from the study, such as the inflow to outflow ratio will be used to prioritize sites for phosphorus removal .

Activity Milestones:

Description	Completion Date
Preliminary data collection at the research sties	2021-12-31
Establish X 4 research plots to monitor hydrology and plant harvest effects	2021-12-31
Assess relationship between soil and plant P in 2 buffers and 2 wetlands..	2022-12-31
Hydrologic, soil and plant monitoring	2023-12-31
Data summary and report	2024-06-30

Activity 2: Synthesis of data and modeling to scale-up phosphorus benefit from site-scale edge-of-field harvesting to small watershed scale.

Activity Budget: $120,000

Activity Description:
Since individual BMPs are limited in scope and have conditions unique to each place, modeling is necessary to understand the benefit of edge-of=field practices for the entire field and small watershed in which the practices are located. SWAT watershed models will provide data on background phosphorus load at the watersheds of interest. The Agricultural Conservation Planning Framework (ACPF) model will inform the location of different edge-of-field BMPs in the riparian zone. It will be used to identify locations install wetlands and buffers. At the scale of individual buffers and wetlands, a wetland nutrient removal model developed by John Nieber will be utilized to assess benefits of wetlands under different scenarios. The model can be used to assess and predict nutrient removal rates in wetlands with varying characteristics under different hydrologic conditions. Lastly the Vegetated Filter Strip (VFS) model will be used to scale-up results of the buffer study across the local small watershed where each study site is located.

Activity Milestones:

Description	Completion Date
GIS and data collection	2021-12-31
Modeling assessment with SWAT for hydrology, nutrient load at watershed scale	2022-06-30

Draft interim report	2022-12-31
Model with ACPF to identify site locations for phosphorus harvest BMPs	2023-06-30

Activity 3: Development of management recommendations for edge-of-field phosphorus harvest BMPs in different rural landscape settings based on topography, geology and hydrology

Activity Budget: $57,000

Activity Description:

We will take results from the field studies and modeling work and apply to existing buffer and edge-of-field BMP policies. Determine where plant harvesting can be most helpful and effective. Meet with landowners and SWCD staff to get feedback on logistics and practicality of plant harvest practices. We will work with LGUs to determine an ideal timing for plant harvest that will maximize phosphorus removal that is also compatible with locally available equipment and beneficial for invasive species control. This will be accomplished by doing landowner meetings with the LGUs and hosting field trips to one or two of the sites. Lastly we'll develop a list of plant species, working with appropriate experts, that is optimal for establishment and nutrient uptake in buffers and treatment wetlands. This will include development of a recommended method for seeding and a protocol for observation and maintenance of the BMPs in future years after the study is over.

Activity Milestones:

Description	Completion Date
Assess management option and recommendations	2023-12-31
Do field days and meetings with LGUs and landowners	2024-06-30

Project Partners and Collaborators

Name	Organization	Role	Receiving Funds
Mike Kinney	Comfort Lake-Forest Lake Watershed District	They are working with landowners to help us find another suitable research site for plant harvest. They would also use the results to inform their management and for educational efforts with farmers and landowners.	No
Jeff Strock	University of Minnesota, Southwest Research and Outreach Center SWROC	Dr. Jeff Strock a professor in Soil, Climate & Water at the SouthWest Research and Outreach Center will advise on the project and supervise technicians' sampling work at the experimental ditch and wetland facility located onsite, ideally setup for this study.	Yes
John Nieber	University of Minnesota, BBE Department	Dr. Nieber is a professor in BBE with over 30 years experience in researching, modeling and designing agricultural BMPs including treatment wetlands. He has been involved in treatment weltand studies for a decade. He will help staff with the modeling component including ACPF and his wetland hydrology/nutrient dynamic model.	No

Long-Term Implementation and Funding

Describe how the results will be implemented and how any ongoing effort will be funded. If not already addressed as part of the project, how will findings, results, and products developed be implemented after project completion? If additional work is needed, how will this be funded?

We will work with partners including watershed districts, SWCDs and The Nature Conservancy to implement the practices at selected sites. Some are long-term research sites already, primarily the University of Minnesota Southwest Research and Outreach Center (SWROC) with Dr. Jeff Strock. The farm near Granada has had ongoing university studies since about 2010 through a combination of university support and grants. It is expected that once the value of plant harvest in BMPs is recognized it will spread among landowners and local government units. No additional funding is anticipated for this phase.

Project Manager and Organization Qualifications

Project Manager Name: Christian Lenhart

Job Title: Research Assistant Professor

Provide description of the project manager's qualifications to manage the proposed project.

Chris Lenhart has over ten years experience managing research projects as a research professor at the University of Minnesota with an additional ten years' of experience in consulting and non-profit water resources management and restoration project work. He has been leading studies involving treatment wetlands, riparian buffers and plant harvest since 2013. His research has been focusing on phosphorus issues in rural Minnesota the past seven years in treatment wetlands and riparian buffers using field monitoring, modeling and a wetland mesocosm facility at the University of MN, St. Paul campus. In 2017 he led the writing and editing of the second edition of the Agricultural BMP Handbook for Minnesota which documents the effectiveness of agricultural management practices in Minnesota. He has also been involved in similar work in other Midwestern and Great Plains states including research in Ohio to address the algal blooms in Lake Erie. Dr. Lenhart also is affiliated with The Nature Conservancy where he leads wetland restoration studies and contributes to planning and scientific investigations involving freshwater ecosystem restoration and management around Minnesota and the Dakotas. He has over twenty peer-reviewed scientific articles and is co-author of the popular press book: Ecological Restoration in the Midwest: Past, Present and Future. Currently is serving as president of the Society for Ecological Restoration, Midwest-Great Lakes Chapter.

Organization: U of MN - College of Food, Agriculture and Natural Resource Sciences

Organization Description:
boilerplate language from UMN

Budget Summary

Category / Name	Subcategory or Type	Description	Purpose	Gen. Ineligible	% Benefits	# FTE	Classified Staff?	$ Amount
Personnel								
Christian Lenhart		Principal Investigator			36.5%	0.6		$68,349
Jaques Finlay		Co-Principal Investigator			36.5%	0.15		$25,314
Andry Ranaivoson		Field Staff			36.5%	0.45		$33,887
Post-Doctoral Research Scientist		Researcher			36.5%	2		$127,281
Graduate Research Assistant		Research Assistant			45%	1.5		$149,334
Undergraduate Research Assistant		Research Assistant			0%	0.6		$15,000
Kerry Holmberg		Science Technician			31.8%	0.36		$40,738
Mark Coulter		Field Staff			31.8%	0.45		$33,752
							Sub Total	**$493,655**
Contracts and Services								
							Sub Total	-
Equipment, Tools, and Supplies								
	Equipment	water level recorders	water chemistry probe for testing water quality in wells and 3-4 area-velocity flow meters for measuring discharge					$15,000
	Tools and Supplies	General Operating Supplies	computer supplies, printed materials, notebooks, etc. for data collection, field notes and handouts for field trips					$3,000

	Tools and Supplies	Lab Supplies	lab supplies for Finlay lab for phosphorus analysis in water samples taken from research sites					$3,639
	Tools and Supplies	Non-Capitalized Computer Hardware/Software	one heavy duty laptop and carrying case for field work for checking data outdoors at field study sites					$4,000
	Tools and Supplies	Non-Capitalized Lab Scientific or Field Equip	water level recorders and barometric loggers for measuring flow in and out of buffers or wetlands					$14,000
	Tools and Supplies	Non-Capitalized Lab Scientific or Field Equip	OTT bubble sensors (six @ $3751 ea) for measuring flow in and out of buffers or wetlands at the SWROC					$22,506
							Sub Total	**$62,145**
Capital Expenditures								
							Sub Total	**-**
Acquisitions and Stewardship								
							Sub Total	**-**
Travel In Minnesota								
	Miles/ Meals/ Lodging	Travel to and from research sites	Travel to research sites to collect data on hydrology, plants and soil for study					$14,500
	Conference Registration Miles/ Meals/ Lodging	travel to conference and registration	To present research at a state meeting					$500
							Sub Total	**$15,000**
Travel Outside Minnesota								
							Sub Total	**-**
Printing and Publication								

							Sub Total	**-**
Other Expenses								
		General Operating Services	Supplies needed for general operation services					$200
		Lab Services	Lab services for phosphorus soil analyses and other parameters					$5,000
		Repairs and Maintenance	Repairs and Maintenance					$1,000
							Sub Total	**$6,200**
							Grand Total	**$577,000**

Classified Staff or Generally Ineligible Expenses

Category/Name	Subcategory or Type	Description	Justification Ineligible Expense or Classified Staff Request

Non ENRTF Funds

Category	Specific Source	Use	Status	Amount
State				
			State Sub Total	**-**
Non-State				
			Non State Sub Total	**-**
			Funds Total	**-**

Attachments

Required Attachments

Visual Component

File: d2a0f2ba-571.pdf

Alternate Text for Visual Component

A riparian buffer is shown that captures particulate phosphorus. Dissolved phosphorus is shown cycling out of the buffer, moving downstream. A picture of wetlands plants being harvested by a large tractor is shown in the lower right demonstrating that phosphorus can be controlled through plant harvest in edge-of-field BMPs.

Optional Attachments

Support Letter or Other

Title	File
FLCLWD support letter	1e72d822-0a3.pdf

Administrative Use

Does your project include restoration or acquisition of land rights?

No

Does your project have patent, royalties, or revenue potential?

No

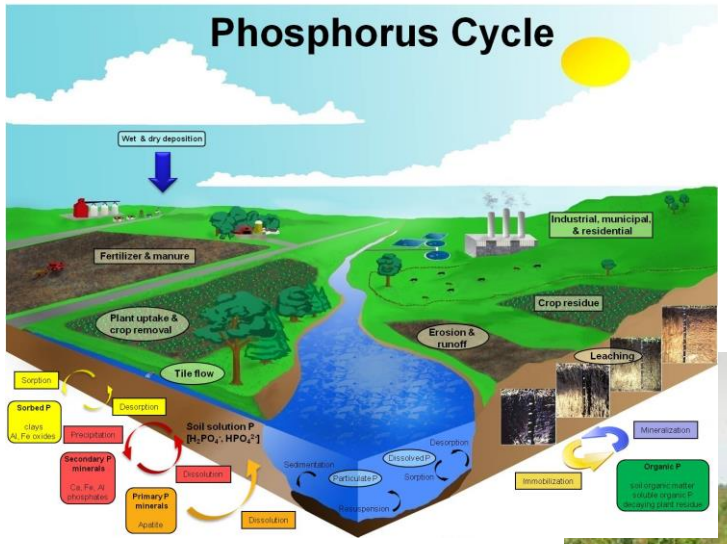
Does your project include research?

Yes

Does the organization have a fiscal agent for this project?

Yes, Sponsored Projects Administration

Farming for phosphorus control at the edge of field



Phosphorus (P) moves around the landscape, mostly in solid form

In buffers, most solid phosphorus (P) settles out but dissolved P may leach out to streams

Plant harvest in wetlands and buffers can remove P from the system so it doesn't leak out