Environment and Natural Resources Trust Fund
2018 Request for Proposals (RFP)

Project Title: **ENRTF ID: 168-E**

Optimizing Food Waste Reduction throughout Minnesota

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

Total Project Budget: $ 999,000

Proposed Project Time Period for the Funding Requested: 3 years, July 2018 to June 2021

Summary:

This project will develop tools to optimize food waste reduction in specific contexts (size of cities, location, etc.) throughout Minnesota, reducing environmental impacts while gaining economic benefits.

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Sponsoring Organization: U of MN

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Location

Region: Statewide

County Name: Statewide

City / Township:

Alternate Text for Visual:

The map (left) shows quantities of food wastes produced by grocery stores throughout Minnesota, in calories per year. The figure at right shows various ways to utilize food waste, including composting, production of animal feedstocks, production of biofuels, waste-to-energy, and anaerobic digestion.

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

I. PROJECT STATEMENT

About 40% of food produced in the U.S. is wasted, mostly at the retail and consumer levels (e.g. grocery stores, restaurants, and households). Recognizing the extent of the problem, the U.S. government has set a goal to reduce food waste going to landfills by 50% by 2030; Minnesota has set overall recycling goals of 35% (non-metro) and 75% (metro region) by 2030, goals that will require recycling of food as well as other materials.

Our project seeks to find the best (optimal) ways to both *prevent food waste* (“upstream” strategies) and to *utilize unavoidable food waste as a resource* (“downstream” strategies”) in various contexts throughout Minnesota. Central to our approach is the recognition that the optimal solutions for food waste management will vary among specific contexts – the size of a city, its location, and its economic activities. Hence, optimal solutions for Hibbing, Albert Lea, Pipestone, and St. Paul will likely be very different. It is unlikely that there will be a single “silver bullet” solution but rather, a mix of management strategies that include both food waste reduction (such as inventory control and household food management) and downstream utilization, such as composting, conversion to animal feed, production of biofuels, “high solids” anaerobic digestion, and incineration, with the optimal mix depending on the local context.

Food waste reduction would have a wide range of *environmental benefits.* Not producing food that is then wasted would result in less use of fertilizer and the conversion of marginal farmland (often the most polluting) to non-farmed land, reducing water pollution (LCCMR Priority B). Utilizing food wastes for energy production (biofuels or incineration) would conserve use of fossil fuels (LCCMR Priority E); converting food waste to animal feed would also reduce the amount of corn and soybeans needed to feed farm animals, further reducing fertilizer use. Reducing the amount of food wastes going to landfills would conserve land that might otherwise have been used for landfills (LCCMR Priority F), reduce contamination of landfill leachate, and reduce methane emissions. Our educational products address LCCMR Priority C. *Economic benefits* would come from conservation of resources (fertilizer, water, etc.) upstream, reduction of landfill tipping fees, and the value of products (e.g., food waste-derived animal feedstocks, worth an estimated $200-$300/dry ton).

II. PROJECT ACTIVITIES AND OUTCOMES

Activity 1: Mapping food waste sources and processors throughout Minnesota Budget: $361,000

We will develop an extensive “benchmark” database of food wastes from restaurants, grocery stores, various types of institutions (e.g., schools; nursing homes), various types of food producers, and households, including total mass, energy, and nutrient profiles scaled to easily acquired data (e.g., per pupil for schools; per employee for restaurants, etc.), using data from our studies, published data from other studies, and new analysis for sources that have not been well characterized.

Outcome	Completion Date
1. Public database of food wastes, by source, energy, and nutrient content.	May 2020
2. Map of “food waste density” throughout Minnesota, by weight and nutrient composition.	May 2020

Activity 2. Determine the effectiveness of different levels of educational information on household food waste behavior. **Budget: $ 212,000**

This activity will provide various levels of information to households about reducing food waste and then measure the impact of this information on the amount and types of food waste produced, compared to households with no information provided. One part of this activity will involve collection and analysis of household food waste samples to determine what types of foods people are discarding.

Outcome	Completion Date
1. Guide to household education for food waste reduction.	May 2021
2. Data base on characteristics of household food waste.	May 2021

Activity 3: Analysis of net economic and environmental impacts of a suite of food waste utilization technologies. **Budget: $180,000**

We will analyze a suite of food waste utilization technologies, including anaerobic digestion, animal feed production, biofuel production, composting, and incineration with respect to economic and environmental impacts. We will use findings from our own prior research, literature review, site visits to operational scale facilities, and our household study to collect information.

Outcome	Completion Date
Report that compares economic (value of products, avoided disposal costs, costs of production and transportation of products) and environmental impacts (air and water pollution, net energy production, avoided water pollution) among food waste technologies.	May 2011

Activity 4: Optimization of food waste management in specific Minnesota contexts. **Budget: $195,000**

This activity will use output from activities 1-3 to quantify net environmental and economic benefits in various contexts (size of cities, location in the state, economic activities, etc.) throughout Minnesota.

Outcome	Completion Date
1. Quantification of net environmental and economic benefits of various food waste reduction/utilization scenarios in specific Minnesota contexts.	May 2021

Activity 5: Outreach and education. **Budget: $51,000**

We will develop outreach and education tools for specific audiences of interest, including informational videos, articles in professional magazines, presentations at conferences and workshops

Outcomes	Completion Date
1. User-friendly spreadsheet tool to support food waste decision makers.	May 2021
2. Online video presentations for both professional and public audiences.	May 2021

III. PROJECT STRATEGY

A. Project Team/Partners

U of M Waste Not Project Team: Our interdisciplinary research group (see “Project Manager qualifications) would do most of the research. Most were also part of our previous Waste Not project. **Russick Group:** We are collaborating with the Russick Group on a USDA Small Business Innovation Research project that has produced food waste-derived animal for an ongoing swine feeding (metabolic) trial; findings from this and new trials will be incorporated into our proposed analysis. **Technical Advisory Group (TAG):** We will convene a TAG, comprising stakeholders from the food waste community, to advise our project as it evolves. Most TAG members will be from our recent Waste Not project.

B. Project Impact and Long-Term Strategy

The proposed research could help Minnesota move towards its food waste reduction goals efficiently, while quantifying environmental benefits – decreased water pollution, reduced need for landfill space, potential reduction of marginal farmland. We anticipate the project outputs will have high impact because Minnesota has set ambitious recycling goals to be met by 2030. We intend to continue food waste research beyond the LCCMR project period, using findings from the LCCMR and Waste Not projects to seek future funding from foundation or the federal government.

C. Timeline Requirements.

We have planned this as a three-year project.

2017 Detailed Project Budget

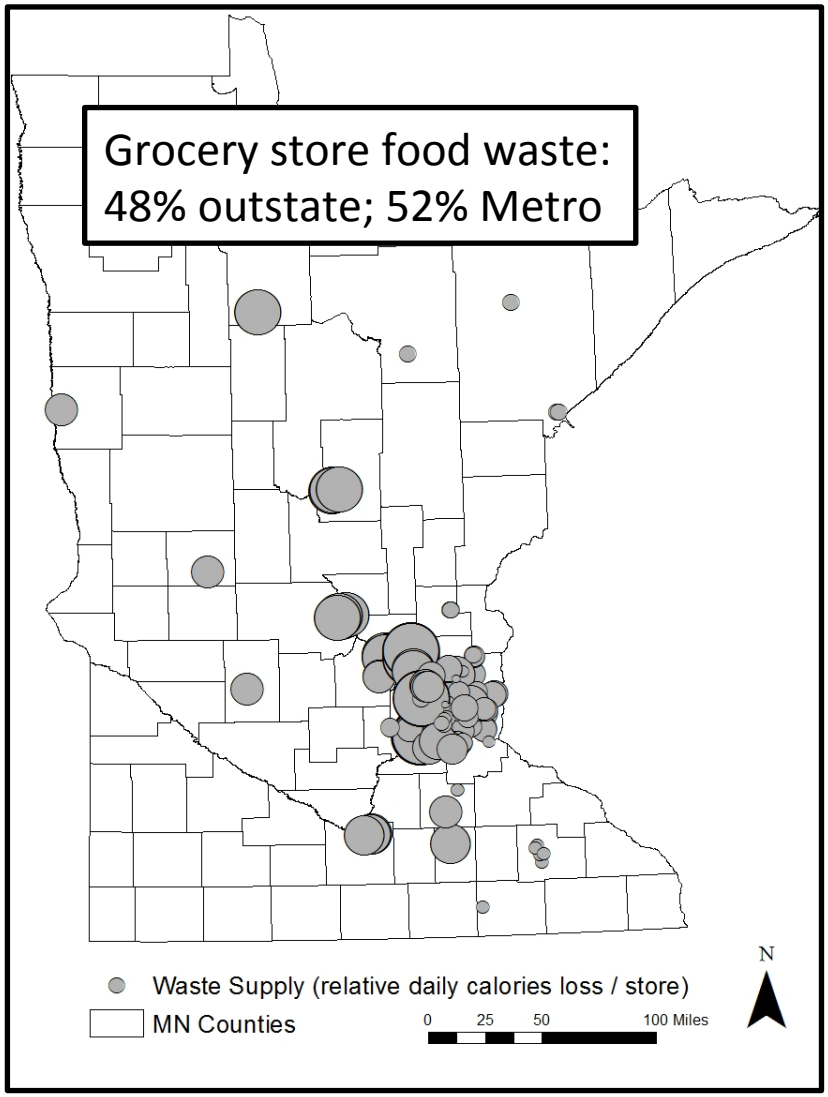
Project Title: Optimizing food waste reduction efforts throughout Minnesota

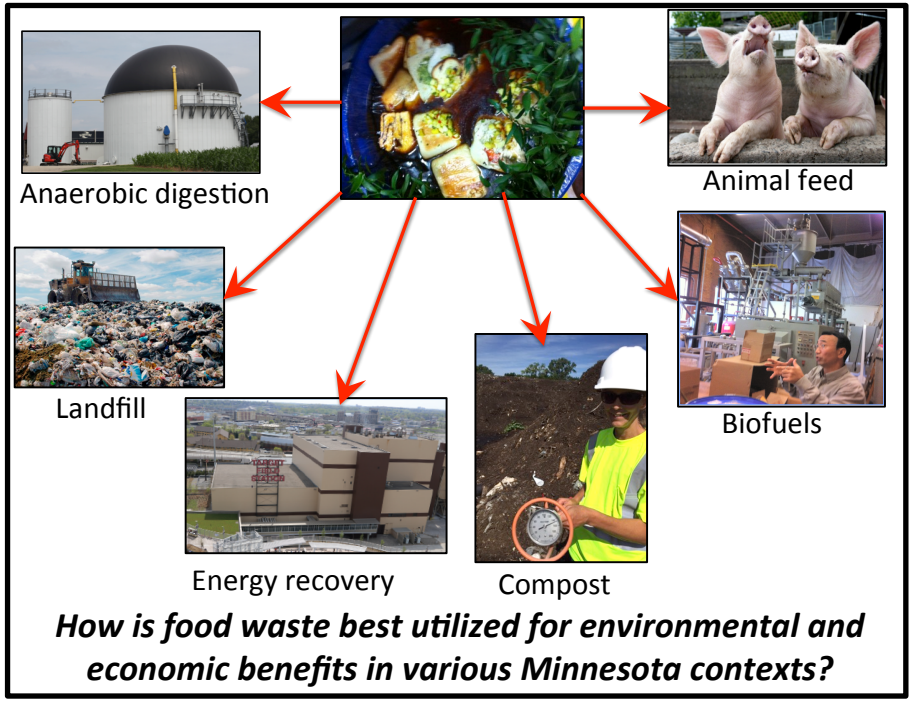
IV. TOTAL ENRTF REQUEST BUDGET 3 year

BUDGET ITEM	AMOUNT	
U of Minnesota personnel:	**$**	**867,146**
Baker (Research Prof., soft money): 25% for 3 years to supervise project; supervise grad students (75% salary/25% benefits)	$ 133,038	
Urriola (Research Asst. Prof., 9 month): 15% for 2 years to work on waste-to-animal feed) (75% salary/25% benefits)	$ 39,514	
Hikaru Peterson, Professor, 1 month per year for 3 years to work on household food waste composition and strategies. (75% salary/25% fringe)	$ 56,308	
Ruan (Professor, 9 month): 4% for 2 years to work on biofuels aspect. (75% salary/25% benefits)	$ 36,798	
T. Smith (Professor, 9 month): 4% for 3 years to lead LCA. (75% salary/25% benefits)	$ 23,229	
S. Kelley (Senior Fellow, soft money): 8% AY for 3 years to lead policy issues. (75% salary/25% benefits)	$ 50,154	
J. Schmitt (Research scientist, soft money): 25% for 3 years to conduct spatial analysis of food waste distribution and food waste benchmark study. (75% salary/25% benefits)	$ 83,151	
Graduate student in BBE (2 years) to compile operational and economic data on each food waste utilization technology,and one in Applied Econ (3 year) (58.4% salary /41.6%)benefits)	$ 229,682	
Post-doc, BBE, to develop life cycle analysis component of food waste conversion technologies in context-specific applications. (82% salary/18% benefits)	$ 191,042	
Undergraduates (1700 hours), to assist in data collection.	$ 24,230	
Professional/Technical/Service Contracts:	**$**	**50,000**
We will develop a contract with one or more waste haulers to obtain food waste samples at several locations (restaurants, grocery stores, etc.) throughout Minnesota.	$ 50,000	
Equipment/Tools/Supplies:	**$**	**23,000**
Lab supplies to collect, prepare, and analyze food wastes	$ 20,000	
Statisical software licenses ($1,500) for 2 years	$ 3,000	
In-state travel:	**$**	**6,200**
Travel to food waste production sites(restaurants, grocery stored, and households), within metro region and state-wide, plus travel to conferences . Lodging and per diem - plus 10 nights of lodging for 2 travelers, plus per 2 days per diem per trip, 4 overnight trips each in years 1 and 2 and 2 in year 3. (Hotel $2,000 + per diem = $4,400 We also request registration fees ($300/conference) for 6 projecct participants to attend in-state conferences to present findings from the study, 1,800 total	$ 6,200	
Out-of-state travel.	$	-
Additional Budget Items:	**$**	**52,654**
Equipment rental: truck rental and mileage for 6 months	$ 19,654	
Lab services: propose $30 K in year 1 for nutrient composition analysis of various food wastes.	$ 30,000	
Publication charges: This research will lead to peer-reviewed publications, we request publication fees, which are typically $1,000 per article, for 3 articles.	$ 3,000	
TOTAL ENVIRONMENT AND NATURAL RESOURCES TRUST FUND $ REQUEST =	$	999,000

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	*NA*
Other State $ To Be Applied To Project During Project Period:	NA	*NA*
In-kind Services To Be Applied To Project During Project Period: *Unrecovered F&A (U of M indirect).*	$ 335,937	
Funding History: Waste Not: Closing the Loop on Organic Wastes (2014-2016)	$600,000	Completed
Remaining $ From Current ENRTF Appropriation: Not applicable.	$ -	*0*





Map (at left) is an initial assessment of food wastes (national grocery stores only). More stores, restaurants, and households will be mapped in the proposed project to enable analysis of "upstream "food waste strategies. The figure on the right illustrates various ways food wastes might be utilized "downstream".

Project Manager Description – Dr. Lawrence Baker

Background: I have conducted many studies of nutrient cycling in cities and farms. Over the past 15 years my research has included numerous studies of nutrients (embedded in food, sewage, fertilizers, etc.) at scales from households to urban regions, as well as agricultural watersheds. I have led 11 projects at the U of M (since 2001) mostly highly involving interdisciplinary research teams, totaling $3.9 million in expenditures.

Food waste research. Some of my previous research has examined movement of nitrogen and phosphorus *between* cities and farms. This research motivated me to develop our two-year MN Drive-funded project ***Waste Not: Closing the Loop or Organic Wastes*** (wastenot.umn.edu). Some accomplishments on this project include (1) analysis of nutrient contents of several major food waste sources; (2) shadow pricing analysis of several feedstocks produced from food wastes; (3) a swine feed trial utilizing feedstock derived from food wastes; (4) a parallel analysis of the biofuels potential of several food wastes; (5) a survey of households in Minneapolis' pilot source-separated organics (SSO) project (both participants and non-participants); (6) initial mapping of food waste density (primarily in the Twin Cities region); (7) a policy analysis of barriers to food waste utilization; and (8) an optimization analysis of biosolids application on farms.

I also recently co-organized a NSF-funded Food Waste Research Workshop (April 17-20, 2017) that included participants from seven universities, including participants from at least five U of M departments. One outcome from this workshop has been a commitment by participants to develop a food waste research agenda. It is also very likely that informal collaborations formed during this workshop will enhance U of M food waste research by data sharing, shared analytical approaches, etc.

Two other qualifications are relevant to the proposed LCCMR project. First, most of my projects in recent years develop very practical tools (simple models, databases, etc.), enabling stakeholders to utilize project findings easily. As an example, a "planning calculator" developed from a project on enhanced street sweeping for water quality improvement was judged to be "helpful" or "very helpful" by 91% of workshop participants (mostly public works staff); several cities are now planning or implementing enhanced sweeping programs based on this research. Second, I frequently communicate outside academia, through articles in professional magazines, newsletters, and newspaper commentaries; and through talks to stakeholder groups such as watershed districts, public works departments, and professional associations.

LCCMR project team. Our project team, mostly from our Waste Not project, includes experts in animal science (Gerry Shurson and Pedro Urriola, food waste→ animal feed), mechanical engineering (Roger Ruan, biofuels), Jennifer Schmitt (spatial analysis) applied economics (Bill Lazarus and Hikaru Peterson), law (Steve Kelley, policy implications), and business sustainability (Tim Smith).

Institutional. The University of Minnesota is one of the top universities in the country. We have all of the necessary lab space, equipment, financial infrastructure, etc. to carry out this the proposed research.