Title: "Urban Food Forests for Healthy Soils"

Project Description:

Cities across the globe are leading the way on climate change action with the development and implementation of policies to make urban areas more resilient and sustainable (Rosenzweig et al. 2010). Frequently, these policies include the creation of different types of green infrastructure, defined as intentional planning for urban spaces dominated by plants and soils rather than built infrastructure (e.g., buildings, pavements, etc.; Matsler et al. 2021). These spaces can help to mitigate the negative impacts of climate change and urbanization including uptake and retention of atmospheric carbon dioxide (CO_2), mitigation of stormwater and nutrient pollution, cool local air temperatures, and mitigation of criteria air pollutants (e.g., particulate matter, ozone (Pataki et al. 2011). The COVID-19 pandemic has also left many urban dwellers seeking urban greenspaces for food security, connection, and solace (Kingsley et al. 2022). Urban food forests are increasingly being proposed as a type of green infrastructure with the potential to address the environmental, social, and economic concerns facing many urban dwellers (Albrecht and Wiek 2021; Spiller and Kashwan 2023). Cities are in need of tools that can help them understand the full life cycle assessment of establishing different types of greenspaces, and the impacts of different approaches on the desired ecosystem services from those spaces. Central to these green infrastructure goals is an improved understanding of urban soils and how to improve soil health which is lacking. For example, in the NRCS soil survey urban areas are classified simply as 'urban' with no further descriptions to help municipalities and community members.

In Massachusetts, the creation of urban food forests is increasing in popularity in recent years. The City of Boston, MA, for example, is planning to expand from currently having nine food forests to thirty by 2030 ("Urban Forest Plan" 2022), and a network of food forests is emerging in Lowell, MA. These food forests are being established on a variety of different soil types with different land use histories, including vacant lots or old agricultural lands often overgrown by invasive species and grasses. In many cases soils are highly degraded due to past land use activities There is limited empirical evidence on the ecosystem services provided by food forests in urban areas nor a framework for evaluating the full life cycle assessment on soil health development in urban areas using common urban agroforestry practices. Here we propose to establish a food forest at UMass Lowell's campus and monitor key metrics of indicators of soil health, that will be used to develop a novel life cycle assessment (LCA) framework for soil health. The food forest objective is to regreen under-used or abandoned impervious surfaces and regenerate soil health on already developed lands. Our proposed project will act as a demonstration site and help provide the tools and datasets needed to help municipalities and community groups begin to successfully implement food forests in their communities.

1.1. Goals and Objectives

Our overarching goal of this project is to develop a framework that can be used by other organizations (community or governmental) when making decisions about the types of greenspaces to create in their locales. To achieve this overarching goal, we have the following four objectives for the proposed project.

- **Objective 1**: Develop a novel framework for urban soil health life cycle assessment when establishing a food forest from vacant lots.
- **Objective 2:** Validate the modified LCA framework with novel empirical field datasets.
- **Objective 3:** Integrate empirical findings into the newly developed LCA framework and apply it to other food forest developments in the Greater Boston Area.
- **Objective 4:** Outreach and community engagement to translate findings and tools to the community.

1.2. Specific areas where this Project will align with or advance the objectives of the HSAP

Our proposed project addresses all four of the objectives specified by the healthy soils challenge grant program.

- **Promote Soil Health:** In our proposed project we are converting a vacant lot dominated by grasses and invasive species into a food forest. We will document the trajectory of soil health metrics and other features of biogeochemical cycles of water, energy, carbon, and nutrients as the food forest is established, and compare these to a nearby lawn with intensive management practices common in urban areas (irrigation, fertilization, herbicides, mowing, etc.).
- **Sustainable Land Management:** Food forests are emerging as an innovative solution to many of the challenges faced by urban areas helping to minimize environmental degradation, enhance biodiversity, restore soil health in urban areas, and provide important ecosystem services helping with improving heat resiliency and protection from negative effects of stormwater events. As a less common type of green infrastructure in urban areas, our project will help to advance our understanding of these systems and provide guidance on effective development in urban settings.
- **Community Engagement:** Central to our proposed project is the engagement of the local community in the development of the site. We work closely with the local community to co-design the site to include plants of interest to the community. We will be hosting annual workshops each year to engage the community and teach them practices for developing healthy soils.
- **Refine Tools for Municipal soil mapping, assessment + planning:** A key tool that will emerge from our proposed project is the development of a novel framework for conducting full LCA on soil health development in urban areas with the establishment of a food forest. Further, we will begin to develop with UML students soil mapping of urban soils in Lowell, MA.

1.3.Methodology

1.3.1. Measuring biogeochemical cycles

A central hypothesis of our proposed research is that urban food forests have unique biogeochemistry (Kaye et al. 2006) compared to other types of urban greenspaces. Advancing our understanding of urban biogeochemistry across different types of greenspaces will be essential to developing an accurate framework for determining the full life cycle assessment of net benefits to society and the environment. Thus, at each site we will make a suite of measurements to capture changes in the biogeochemical cycles across each type of greenspace and over the course of the development of each food forest site. We will focus our measurements on five categories, mapping to each of our study hypotheses and ES we evaluate in the ES-LCA. An overarching goal of this project will focus on five categories of ES representing those most commonly cited by urban areas as particular concerns (Babí Almenar et al. 2021). This will include: (1) urban heat resiliency, (2) greenhouse gas regulation, (3) nutrient cycling/retention, (4) reduced resource consumption (water, pesticides, land, and fertilizer), and (5) enhanced biodiversity. Establishment of healthy resilient soils in urban areas is central to all of these key ecosystem services we will track over the long-term trajectory of this project. In the short term, for this proposal we will focus our analysis on greenhouse gas regulation and nutrient cycling/retention as pertains to development of healthy soils.

1.3.2. Life cycle assessment

Life cycle assessments (LCA) is a field of study that seeks to calculate the environmental, economic, and social impacts of products, services, or environmental systems. Despite a shared environmental sustainability objective, there is little interaction between the field of LCA and evaluation and quantification of ES (i.e., ES-LCA; VanderWilde and Newell 2021). Our proposed research seeks to bridge this gap with a focus on the ES provided in urban areas by bringing together PI Winbourne's expertise in urban biogeochemistry and ecosystem ecology with COPI expertise in industrial ecology and LCA method development.

The main objective is to develop the LCA method to assess the impacts of conventional and agroforestry practices on soil health and their role in the provision of ecosystem services. We will focus on measuring soil organic carbon and the provision of ecosystem services (i.e., greenhouse gas regulation) and their on-site (same soil) and off-site (life cycle perspective) effects. Beyond this grant our research includes urban heat resiliency, nutrient cycling/retention, reduced resource consumption (water, pesticides, land, and fertilizer), and enhanced biodiversity.

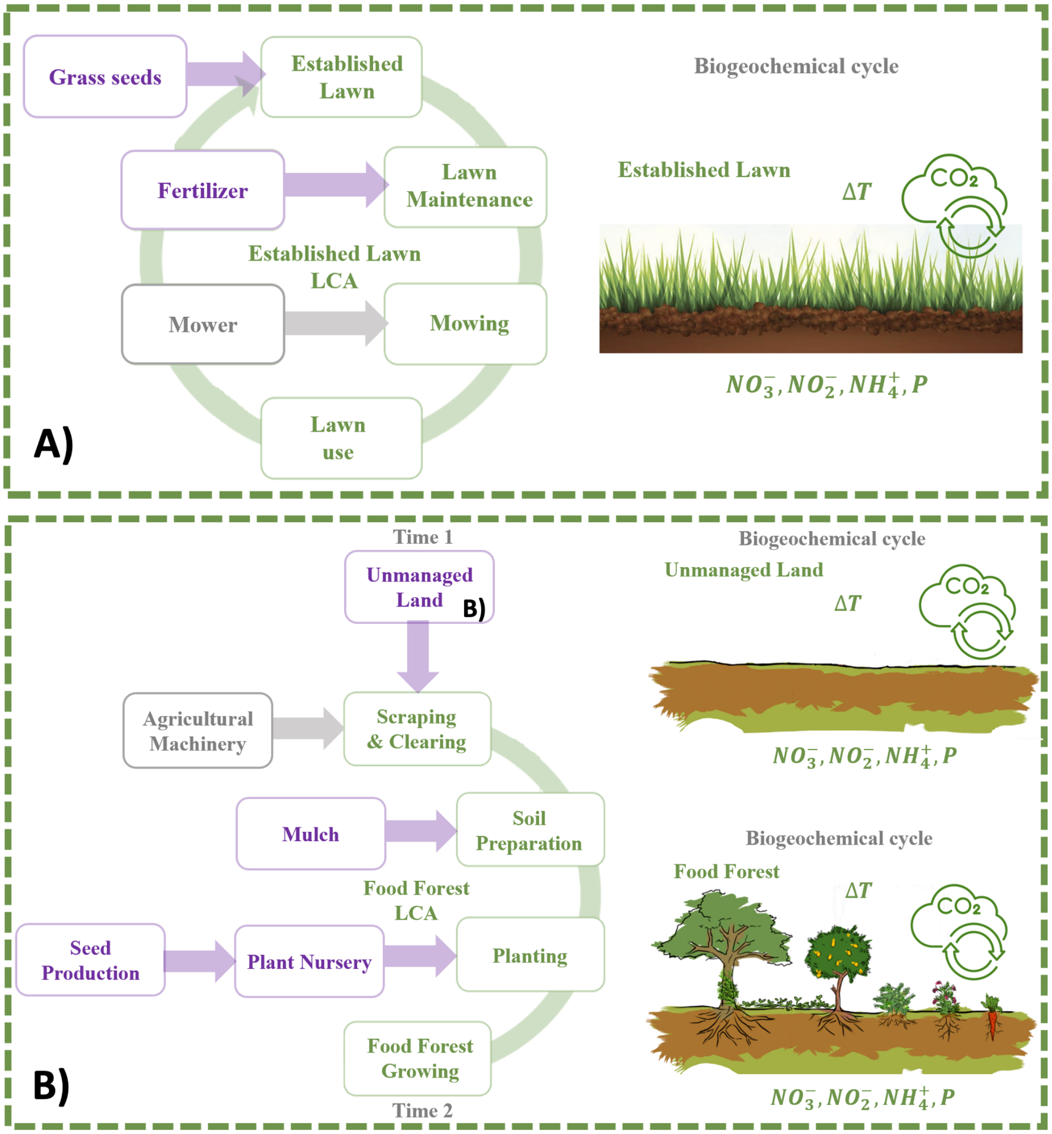

Figure 3. Life cycle of established lawn (A) and food forest (B).

1.4. Expected Outcomes and/or deliverables

There are many benefits to the Food Forest. It will contribute to all aspects of sustainability: environmentally, socially, and economically. Here are some of the benefits of the project: increased biodiversity, drought resistant, resilient food system, supporting local food production, promotes pollinators, regenerates the soil, carbon capturing, community building, social sustainability, a space to relax, food education, accessible, and educating on sustainability. Overall, the food forest will serve as much more than a resilient food system. It will foster sustainable education, promote community building, and transform the previously unused land into a positive impact that serves as a role model. The positive impact of the change will result in a) growing more food on less land, b) increased biodiversity, c) using less conventional fertilizer harmful to water sources, d) offsetting conventional produce, which travels far to get to grocery stores and thus reduce transportation emissions, e) reduce human health impacts of chemicals in food compared to conventionally grown produce, d) educating on sustainability. The results will be shared with university students, faculty, and stuff and other communities, which is a handprint effort.

We propose to have annual workshops at which we will survey community partners managing/stewarding our food forest field sites to gain this knowledge.

2. Budget

In the first phase of the food forest project on UML campus, we acquired permission from UML Space Committee to use one of the barren land locations on campus. Cardboard was obtained from UML Dining without cost and local companies donated their wood chips. Also, we used funding from the UML S.E.E.D Grant for site preparation including scrapping, mulch spreading, and removal of invasive plants. Another UML SEED Grant was used to establish baseline measurements for baren land and nearby lawn.

In the next phase, we will be focusing on establishing a food forest. The food forest costs included:

- cost of 14 guilds with one mature tree each with branching at $219.99 each, 2 shrub bushes each at $35.99 and the remaining plants comprising the herbaceous, root, soil surface, and vertical layers for a total of $6,000. For the planting day, we will have student volunteers.
- We will develop the soils using sheet mulching technique commonly used by people developing food forests in urban areas. We have obtained mulch from region for free and budget $2,000 to obtain organic compost.
- We will purchase 2 rain barrels at $400 each to water plants as they are establishing and for continued maintenance of the garden.
- We will be installing an ADA compliant gravel pathway for members of the community to enjoy the food forest. A labyrinth path will be added as a meditative and reflective artistic feature to enhance well-being. The total cost will be $5,000.
- Park benches will be added throughout the food forest to create a welcoming environment. We will include 4 benches at $850 each for a total of $3,400. A landscaping company will be contracted to install the paths, benches, and rain barrels on the site for a total of $2,000.

The PhD student Alana Smith will work as a full time Student Research Assistant (RA) on activities in support of the project work, which includes 2 semesters and summer. This amounts to $50,200. The funding breakdown details for the entire project including estimated EEA Grant Funding, In-kind contributions, and other funding is shown in Table 1.

Table 1. Funding breakdown details for entire project

	EEA Grant funding	**In-kind contributions**	**Other funding**
Planting: Cost of Food Forest Plants	$6,000		
Landscaping	$2,000		
Compost (20 yards)	$2,000		
Rain barrels	$800		
Labyrinth trail	$5,000		
Benches	$3,400		
Equipment		Provided by Winbourne lab	
Consumables for soil tests and biogeochemical analyzes	$10,000		
Summer Student Research Assistant (RA) ($30/hour for one year for one student)	$50,200		
Undergraduate students		UML fellowship program	
Area for the Food Forest		UML Space Committee	
Volunteers		UML students	
Cardboard		UML Dining	
Wood chips		Donated by local company	
Site preparation: scrapping, mulch spreading and removal of invasive plants			$ 10,000 UML S.E.E.D Grant
Establishing Baseline Measurements on the baren land and nearby lawn			UML SEED Grant $15,000
TOTAL	**$79,400**		

3. Organizational Capacity: List and details of previous achievements. Other information or letters of support that demonstrate the capacity of the organization to successfully implement the project.

3.1.Previous Achievements

Agreement Title: RCR: NRT: Sustainable Water Innovations in Materials: Mentoring, Education, and Research (SWIMMER)

Year Awarded: 2021

Total Award Amount: $ $2,998,922

Funding Agency: National Science Foundation

Using funds from this agreement awarded in 2021, researchers created a National Science Foundation Research Traineeship program at UMass Lowell centered around Sustainable Water Innovations in Materials – Mentoring, Education, & Research (SWIMMER). Ten graduate students have entered the SWIMMER program as trainees, mentored by ten participating faculty members. Trainees are currently engaged in the SWIMMER program, which features bias and inclusion training, communication skills training, immersion experiences in industrial history, a two-semester interdisciplinary core course, team capstone projects, and a seminar speaker series.

UMass Lowell has a consistent track record of meeting reporting requirements for previous assistance agreements, such as the example projects listed above. UML's Office of Research Administration (ORA) is responsible for ensuring timely reporting and the completion of deliverable requirements for funded assistance agreements. The ORA Award Management Team consists of seven Grants and Contracts Administrators, seven Financial Research Administrators, and four College Research Administrators to support university researchers with the administrative and financial reporting for awards, including technical, progress, patent, and property reports or financial invoices. Specifically, the Financial Research Administrators complete all financial reporting requirements and have experience with this for all sizes of grants.

UML also maintains multiple online tools, SUMMIT and PeopleSoft, to support financial reporting by ORA and faculty researchers. UML's SUMMIT Enterprise Reporting System is a dashboard-designed reporting system that provides users with a single reporting application to access data across multiple areas, including financial reporting. Data is displayed in table or graphs formats in dashboards that track key performance indicators and provide updates. UML's PeopleSoft reporting environment updates financial information every 24 hours and can be accessed 24/7. This tool allows the end user access to monthly reports as well as access to ad-hoc reporting to view transaction detail, budgets, and fund balances.

3.2.Qualifications

PI Winbourne's research focuses on measurement and modeling of urban biogeochemical cycles and ecosystem services. PI Winbourne currently is partnered with the City of Lowell, Lowell High School, Harvard Forest Schoolyard program, Mass Audubon, and non-profit Lowell Parks & Conservation Trust, working to develop a new curriculum for High School students to provide experiential learning opportunities on quantification of urban tree evapotranspiration. Additionally, PI Winbourne works closely with the City of Worcester on the development of their Master Urban Forestry Plan as chair of the Worcester Urban Forestry Commission.

CO-PI Jasmina Burek's research focuses on sustainability and resilience engineering. Burek develops decision-making models to measure and minimize environmental, social, and economic impacts (footprint assessment) of agri-food systems, products, materials, buildings using life cycle assessment (LCA). Burek has expertise on whole building whole LCA for residential and commercial buildings including embodied carbon. Burek has also contributed to LCA method development, including assessment of positive sustainability (handprint assessment) for organizations' decarbonization, for example, handprint assessment of eco-innovation. She has integrated swine growth model and LCA to increase sustainability of swine diets and production systems in the Global South working with researchers from Brazil including UNESP, UFRGS, EMBRAPA, and Elanco, Nigeria (FutuX Agri-consult LTD), and Kenya (Ministry of Livestock Development). Also, she was a contributing author to "Life Cycle Assessment of Corn Production Practices in the United States," a report prepared for the National Corn Growers' Association in which she integrated crop growth model with LCA. At UML, Burek wants to intensify its positive impact (handprint) through on-campus projects, including evaluating the handprint of this research project Food Forest which will include interdisciplinary research to integrate LCA and ecosystem services assessment.

PI Winbourne and COPI Burek have currently funded research for "Developing a framework for assessing the net benefits and costs of urban food forests on environmental systems" and "Handprint Assessment Framework of Hands-on Climate-Related University Projects".

We plan to monitor the project deliverables progress towards the specified measurable objectives. This includes evaluation of the project success. For example, in the case of data collection, we will develop data collection tools. Finally, after data analysis and interpretation, we will prepare it for publication in a journal.

The Office of Research Administration ("ORA") at UML is fully capable of administering (managing, expending, and accounting for) this grant on behalf of UML team. ORA has experience handling hundreds of federal grant projects and has well supported all past EPA projects awarded to UML, providing financial reports as needed for each quarterly and final report submitted to EPA.

3.3.Key personnel and their roles in the project

1. **Principal Investigator: Dr. Joy Winbourne, PhD.**
   A. **Expertise:** Assistant Professor of Urban Ecology and Biogeochemistry at the University of Massachusetts Lowell with extensive experience in measurement and modeling of urban biogeochemical cycles and ecosystem services. Dr. Winbourne has over a decade of experience leading environmental outreach activities and engaging local communities in co-production of research. Dr. Winbourne currently is partnered with the City of Lowell, Lowell High School, Harvard Forest Schoolyard program, Mass Audubon, and non-profit Lowell Parks & Conservation Trust, working to develop a new curriculum for High School students to provide experiential learning opportunities on quantification of urban tree evapotranspiration. Additionally, Dr. Winbourne works closely with the City of Worcester on the development of their Master Urban Forestry Plan as chair of the Worcester Urban Forestry Commission.
2. **Tasks:** Dr. Winbourne will be responsible for the overall coordination of the project. Specifically, Dr. Winbourne will oversee the execution of field studies quantifying ecosystem services from different types of greenspaces under consideration (Obj. 2). Working closely with COPI Burek, Dr. Winbourne will help to advance the production of the Ecosystem Services Life Cycle Assessment Framework (ES-LCA; Obj.

1) and integration of empirical findings into the newly developed framework for predicting net benefits of different proposed food forest sites in the Boston Food Forest Coalition (Obj. 3). Dr. Winbourne has university fellowships available for several undergraduate assistants (to be hired) to assist in field and laboratory work. Dr. Winbourne will provide cross-disciplinary training in biogeochemistry methodologies to mechanical and industrial engineering students working with COPI Burek.

Co-Investigator, Dr. Jasmina Burek, PhD.

A. **Expertise:** Assistant Professor of Mechanical and Industrial Engineering and Principal Investigator at BUilding REsilience through Knowledge (BUREK) Lab located at the University of Massachusetts Lowell. Dr. Burek has expertise in mathematical and computer modeling of complex socio-environmental systems, environmental process design, and LCA. Dr. Burek is committed to interdisciplinary collaboration and providing an industrial engineering perspective. Dr. Burek's unique combination of mechanical, industrial, and environmental engineering, quantitative modeling, and the ability to understand and combine research across disciplines will contribute to the success of the proposed research. Her current research focuses broadly on sustainability and resilience engineering using systems thinking approaches and the development of decision-making models to measure and minimize environmental, social, and economic impacts (footprint assessment) of agri-food systems, products, materials, and buildings. Dr. Burek has been teaching the LCA Sustainability course at UML, serves as chair and panelist on multiple Critical Reviews for agricultural LCA studies, and is on the Early-Career Editorial Board for Sustainable Production and Consumption Journal. She has been COPI on the ASEE Grant to Infuse Sustainability in Engineering Education pursuing new methods in sustainability curriculum development.

B. **Tasks:** Dr. Burek will be responsible for leading the development of the ES-LCA framework (Obj. 1) and will work closely with Dr. Winbourne in co-production of integrating empirical findings into the advancement of ES-LCA framework (Obj. 3). Dr. Burek will advise and mentor graduate student Alana Smith that will assist with the execution of the ES-LCA. Dr. Burek will provide cross-disciplinary training to Environmental sustainability students working with PI Winbourne.

3. **Graduate Student in Mechanical and Industrial Engineering, Alana Smith.**

A. **Expertise:** Graduate research assistant in the Department of Mechanical and Industrial Engineering at UMass Lowell. Smith created the initial vision for the project, formed the core team, and gained preliminary University support through RIST Institute seed funding. Smith has expertise in LCA, and sustainable systems. Finally, Alana is a fellow within the NSF NRT The Sustainable Water Innovations in Materials—Mentoring, Education & Research (SWIMMER) program, which will additionally equip her with technical development skills necessary to address the multi-faceted problems. Smith is also involved in community outreach educating the community in food forest education and food system resilience.

B. **Tasks**: Smith will lead the establishing the food forest on UML campus including planting, landscaping, etc and and assist Dr. Burek in development and implementation of the ES-LCA. Additionally, Smith will be provided with training in biogeochemistry and help with some of the field studies proposed in Obj. 2 and contribute to community workshops.

4. Project timeline

Table 2: Project Timeline

		2024							**2025**						
	Month	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
1	Deploy sensor network & site survey	X	X												
	Weekly flux measurements	X	X	X	X	X	X				X	X	X	X	X
	Soil sampling	X		X										X	
2	Installation of food forest	X													
3	Re-establish sensor network in new Food Forest													X	
4	Develop network for testing framework	X	X	X	X										

Table 1. Project timeline and specific tasks.

Tasks	Months after award											
	1	2	3	4	5	6	7	8	9	10	11	12
1. Setting up measuring equipment												
1.1.Collect measurements												
1.2.Analyze data												
2. Data collection for LCA of lawn and food forest												
2.1.Primary data from measurements and project documentation												
2.2.Existing databases												
2.3.Literature												
3. Modeling framework for university carbon footprint												
3.1.Calculate University footprint using O-LCA												
4. Modeling framework for handprint assessment												
4.1.Define the goal and scope of the assessment												
4.2.Conduct a comprehensive LCA of the Food Forest and Lawn												
4.3.Calculate project handprint												
5. Validate handprint results using experimental results												
6. Publication												

5. Project evaluation, monitoring, and reporting

Twice a year we will have an annual team workshop where we will evaluate our success towards reaching goals, write a bi-annual report on findings, discuss challenges and solutions for mitigation of any issues that come up during the course of the project. For educational outreach and workshop activities we will work with UML experts in project evaluation to maximize our success in reaching desired educational goals with community members and students.

Tracking key metrics of ES in the unmanaged forested natural area will serve as a reference for testing the extent to which food forests are mimicking natural forested areas. This will be achieved by comparing the magnitude of services observed among these two forested sites.

6. Sustainability Plan

6.1.Post grant project sustainability assessment.

Universities have always been producers of knowledge, but more recently their role has become also to inform action for the most urgent sustainability problems. Universities are using hands-on learning to educate on sustainability. While the impact on student learning and skills of hands-on projects has been broadly studied, its positive impact on climate and/or sustainability is unknown. Quantifying contributions of university to society is becoming increasingly important. Measuring positive impacts of hands-on projects on sustainability is difficult because there is no universal method to quantify their impact. With the funding from this grant and UML S.E.E.D grant we will develop a methodological framework that will allow the Rist Institute for Sustainability and Energy and UMass Lowell to quantify campus initiatives and projects which have positive impacts on sustainability, for example, measure the impact of on-campus projects such as the Food Forest project. The expected results are that UMass Lowell S.E.E.D. is improving sustainability on campus which will inspire transferability to other universities and communities. The Food Forest project will serve as a handprint effort for UMass Lowell, which can be extended externally, i.e., external handprint.

6.2.Partners involved and role.

The RIST Institute for Sustainability has partnered with the local non-profit, Mill City Grows, to establish an urban farm and greenhouse on UML campus, that provides crops to the community that are otherwise difficult to obtain from local groceries. In the proposed research, we would engage in co-production of the UML food forest with the non-profit Mill City Grows and local community groups. This partnership will be key to selecting plants of particular interest to the community to plant at the proposed site, and in the long-term these partnerships will be leveraged to evaluate the feedback between the environmental system (i.e., the food forest) and social system (outcomes in the community as pertains to site use and food harvesting). To facilitate these activities, we will host an annual workshop for community members to share with them the research we are doing and key concerns and questions from the community.

There will be a student urban agriculture program where a team of students will be stewards of the food forest, and participate in the maintenance and growth of it. Students will work under the mentorship of Mill City Grows. The food forest will be located at the UMass Lowell. The student and local community will have an opportunity to participate in the garden, as well as enjoy the space in their backyard that was previously unused grass. They also have several connections to organizations in Lowell that we could collaborate with in the future. The community building aspect of the forest, as well as the forests potential contributions to environmental, economic, and social welfare, connect directly to the mission and work of UML.

6.3.Community engagement

UML is an urban campus embedded in an environmental justice community with the second largest Cambodian refugee population in the United States. UML works closely with the local community to help address food security concerns. Since UML is very interconnected to the city of Lowell, the food forest should also be a place where neighbors can participate. It will be a place for students, faculty, and the community.

At UML the RIST Institute has been working closely with the community and City of Lowell to help achieve collective sustainability goals. This research will provide a full picture of the net benefits of food forests compared to other greenspace options and help develop a method that cities can use when making greenspace investment decisions. The results will directly affect the quality of life for urban dwellers by evaluating mitigation potential of food forests on threats like urban heat island effects. The proposed research project will act as an outdoor classroom and living laboratory; PI Winbourne and PhD student Alana Smith have already given tours of the site and worked with professors in environmental science, biology, and architecture to educate their students providing hands-on experiences in taking soil samples and conducting plant biodiversity inventories. Also, the PhD student gave a seminar in UMass Lowell's Climate Change Initiative speaker series on this project that is available to the campus and broader community.

We have established partnerships with the City of Lowell, and with the non-profit organization, Mill City Grows. Lowell is an Environmental Justice (EJ) community of both high minority and low-income. EJ cities disproportionately face the effects of climate change and are the ones who need these nature-based solutions the most but have less resources for implementing and determining their net benefits. We will continue our work in the City of Lowell, as well as help other EJ communities find economic solutions to combat climate change as we expand my datasets on ES of different types of greenspaces and LCA assessment tools. We propose to have annual workshops at which we will survey community partners managing/stewarding our food forest field sites to gain this knowledge.

By combining practices and theory in agronomy, forestry, and agroforestry disciplines, food forests aim to develop multiple vertical plant layers that mimic processes observed in unmanaged natural forest systems. In doing so, we hypothesized these systems to require less management (irrigation, fertilizers, or use of pesticides) than more traditional urban greenspaces. There is limited empirical evidence, however, to support this claim. Given the unique impacts of urbanization on unmanaged forest systems, it is possible that food forests could outperform urban forest patches regarding key ES of interest to urban populations. Our understanding of the biogeochemical cycles of urban greenspaces, in general, is lacking. Collectively, this limits our ability to develop data-driven tools to help municipalities consider the place-based tradeoffs when designing and planning urban greenspaces.

7. Risk Assessment for Project, partners, and timeline

   Prior to establishment of the site, we will assess it for major concerns that would prevent it from being used as a food forests which will be done with extensive soil surveys and laboratory analyzes for the chemical composition of those soils. This will also provide information on the extent to which the soils are degraded.

   Additional risks could include having difficulty in finding plant stocks for edible native species that are suitable for an urban environment. We have partnered with Mill City

Grows to grow our own plants in their greenhouse to help mitigate this potential risk. We have also identified several potential nurseries with target plant species.

Urban ecological research often has to consider what to do in the case of vandalism. We have been instrumenting the site with micrometerological equipment for the past year and have had no issues with vandalism of our research equipment, however, we will continue to use low-cost sensors that are discreetly located to minimize the impact of potential vandalism, and have budgeted for equipment to potentially get broken or vandalized.

7.1. Identification of risk considerations

A primary risk in the implementation of our project is if in conducting site assessments we discover obstructions or pollutants that would prevent the site from being used as a food forest. This is unlikely since the site history was not for industrial purposes but is always a potential concern in urban areas. In this case we have selected and worked with UML RIST Institute and ground manager to identify alternative locations to explore as potential sites for the food forest. These sites are similar in that they have no known history of industrial activities and are currently dominated by grasses.

RIST INSTITUTE FOR
SUSTAINABILITY & ENERGY

820 Broadway Street
Lowell, Massachusetts 01854
P: 978.934.1866
E: Ruairi_OMahony@uml.edu

February 1st, 2024

To: Office of Energy and Environmental Affairs (EEA) Challenge
Grants Implementing the Commonwealth's Healthy Soils Action
Plan
Re: Dr. Joy Winbourne and Dr. Jasmina Burek, Letter of Collaboration

Dear Program Director and Reviewers,

If the proposal submitted by Dr. Joy Winbourne entitled "Urban Food Forests for Healthy Soils" is selected for funding by the Office of Energy and Environmental Affairs (EEA), it is my intent to collaborate and/or commit resources as detailed in the Project Description/Research Plan.

Ruairi O'Mahony
Executive Director, Rist Institute for Sustainability and Energy
University of Massachusetts Lowell