UNIVERSITY OF MARYLAND FEARLESSLY FORWARD

Global FEWture ALLIANCE

Conference Proceedings
of the Global FEWture Alliance Annual Symposium

January 18, 2024

University of Maryland
College Park, Maryland

Our inaugural symposium attracted a wide range of contributors, including UMD students and faculty, local community partners, and international guests from Israel, Nepal, and Tanzania.

Purpose, highlights, and takeaways

Purpose: Our annual symposium offered a communal platform for professionals and students to exchange ideas, foster collaboration, and build a community around shared interests involving food, energy, water, climate, and health systems. This dynamic and multifaceted initiative cultivates new forms of collaboration by exploring innovative systems thinking and while nurturing international communities with shared interests. We support interdisciplinary and applied research insights, community-driven capacity building, experiential education, and professional growth. These overarching objectives ultimately address the broad challenges at the intersection of food-energy-water (FEW) resources in the context of climate change and public health.

Highlights: We welcomed UMD faculty members from five different colleges, undergraduate and graduate students, local community partners who work in urban food systems, policymakers from MD state and federal agencies, and partners from our international locations in Israel, Nepal, and Tanzania.

The day kicked off with welcoming remarks from UMD President Darryll Pines, Provost Jennifer King Rice, SPH Dean Boris Lushniak, and Global FEWture Alliance PI Dr. Amy Sapkota. These leaders discussed the vision of the Grand Challenges grants and how they support UMD's Strategic Plan goals. They also noted how the interconnected objectives of the Global FEWture Alliance help us address food-energy-water insecurities by implementing our unique model that breaks down disciplinary barriers, and pursues integrated research-to-action, community-driven capacity building, and experiential education. We also heard from Mr. Ganesh Shah, Ex Minister of Environment of the Government of Nepal and the current Chief Scientific Advisor to the Prime Minister of Nepal, who highlighted the valuable collaboration that UMD is building with the government and communities in Nepal.

Key Takeaways: UMD Campus citizens and our local and international collaborators are excited about our unique approach to addressing global FEW insecurity using integrated methods. While many researchers think about environmental problems from a tight disciplinary framing, our symposium supported the resolve that we must break down silos and work together. There is no food without water and energy; energy generation is often water-dependent; water supply and quality are highly affected by food and energy systems; and climate change will further stress all three resources.

While we integrate many UMD schools and colleges, we also blend a variety of complementary skill sets: outreach and consensus-building; technical modeling of climate change; field-based research that impacts community well-being; and experiential education that trains the next generation of changemakers, not just to be excellent researchers, but also to be partners, mentors, integrators, and diplomats for the FEW nexus.

Our international speakers provided a global perspective, sharing their own unique experiences, case studies, and lessons learned from their diverse regions, emphasizing cross-cultural collaboration to tackle grand challenges from local to global scales.

The lightning talk session from early career scientists and the poster session provided an opportunity for junior researchers to exhibit their work alongside more established professionals, contributing to a diverse and inclusive research community that nurtures the ideas and initiatives of the next generation.

Our solutions-based approach is realistic without falling into fatalism. We are rationally hopeful that with a concerted effort, technical skills, and compelling communication, we can solve these interdependent challenges at local scales, replicate the model in new communities, and brighten the horizon of future generations across the world.

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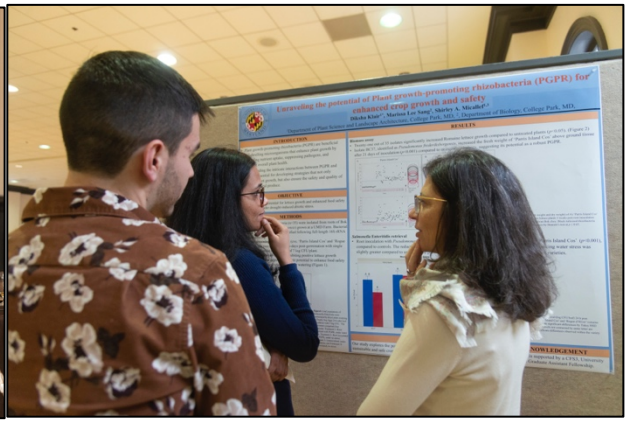
Unraveling the potential of Plant growth-promoting rhizobacteria (PGPR) for enhanced crop growth and safety
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Session 1: Integrating Food-Energy-Water (FEW) Nexus Research-to-Action and Community-Driven Capacity Building

Techno-Social Solutions for Off Grid Food-Energy-Water (FEW) Challenges – Dr. Clive Lipchin (Israel FEWture Team, Arava Institute for Environmental Studies)

Speaker Bio: Dr. Clive Lipchin is the director of the Arava Institute for Environmental Studies' Center for Transboundary Water Management, specializing in water resources management and policy. He conducts research for international water agencies and is involved in projects like the European Union's Water Initiative and USAID programs. Additionally, Clive serves as the CEO of Laguna Innovation, a company focused on off-grid wastewater treatment technology, operating successfully in Israel, the West Bank, Jordan, and South Africa.

Abstract: The response to increasing strains on water, energy and food resources and their inter-connections, has led to an analysis of the Food-Energy-Water (FEW) nexus and its role in development approaches for communities. The FEW nexus concept developed because food, energy, and water, are inextricably linked and constitute essential human rights. A Nexus approach is a systematic analysis of interactions between human activities and the environment, with the purpose of working towards coordinated management on local, national, and international levels. Addressing the FEW nexus in an integrated approach is crucial for off-grid communities that lack access to centralized infrastructure such as water, electricity and sewage grids. It is estimated that 70% of the world's population is not connected to sewage grids. The outcome is that sewage is poorly managed or not managed at all, and is discharged directly or indirectly into the environment. The result is pollution of surface and groundwater and exposure risks to water borne diseases. In this talk I will present on the work of the Arava Institute for Environmental Studies (a partner in the Global FEWture program) that is pioneering an onsite and off-grid FEW technology park for the validation of off-grid FEW technologies such as wastewater treatment and reuse, atmospheric water generation, biogas, and solar energies. The uniqueness of this initiative is that the park is located within a Bedouin community in Israel that is off-grid. The park not only serves to validate these FEW technologies in situ and in an integrated fashion, but also directly serves the community via a partnership, whereby we realize improved sanitation, food security and energy benefits for the socioeconomic development of the community.

A Barrel Full of Benefits? Determining If Harvested Rainwater Can Be Safely Used for Food Crop Irrigation in Urban Agriculture – Rachel Rosenberg Goldstein (Maryland FEWture Team, UMD School of Public Health)

Bio: Dr. Rachel Rosenberg Goldstein is an Assistant Professor at the University of Maryland's School of Public Health, specializing in applied environmental health. She directs the WOW Lab, focusing on community-engaged research and outreach to enhance water quality. Her diverse projects include assessing microbial safety in harvested rainwater, studying on-farm well water quality, and investigating health risks associated with sewer overflows and septic failures due to sea-level rise.

Abstract: Rainwater harvesting could provide an additional water source for farmers, especially in urban agriculture, yet there is currently low adoption in part because of water quality concerns. Between 2021-2022 we collected water samples from 16 Baltimore City farms and gardens from a total of 23 water sources (16 harvested rainwater, 7 municipal water). Four gardens using harvested rainwater were private homes. Participants completed surveys on site characteristics, irrigation methods, and water concerns. Water samples (n = 52) were analyzed to determine the presence and concentration of generic E. coli and heavy metals. The average E. coli concentration for municipal water samples (0.0008 CFU/100mL) and harvested rainwater samples (47 CFU/100mL) met the Good Agricultural Practices (GAPs) irrigation water guideline (126 CFU/100mL), yet five harvested rainwater samples (10%) from two private home gardens exceeded the guideline. There was no difference in E. coli concentrations between municipal water and harvested rainwater used at urban farms and community gardens. Additional treatment might be needed for harvested rainwater before use on produce. Through a USDA AFRI Critical Agriculture Research and Extension grant, we have expanded our work to: 1) field-test an integrated rainwater harvesting, ZVI sand filtration, and irrigation system and confirm water quality and produce safety; 2) evaluate environmental, social, and economic costs and benefits of rainwater harvesting for produce irrigation in urban communities; and 3) develop innovative Extension programming on rainwater harvesting. With additional input from Global FEWture Alliance collaborators, we will incorporation evaluating sustainable energy options and impacts of different water sources on produce nutritional content and rhizosphere microbiome. Our project will provide needed information to urban farmers and policymakers about rainwater harvesting quality and benefits and improve our nation's agricultural and food systems.

MUST and Its Collaborators Towards FEW Nexus Opportunities and Achievements – Eliezer Mwakalapa (Tanzania FEWture Team, Mbeya University of Science and Technology)

Bio: Eliezer Mwakalapa is the Acting Principal – College of Agricultural Sciences and Technology from Mbeya University of Science and Technology (MUST) in Mbeya Tanzania. Eliezer is a Veterinary Scientist in the field of ecotoxicology specialized on the fate and effect of contaminants in the environment, aquatic animal health, and public health.

Abstract: The challenges of Food, Energy, and Water have drawn the attention of the public, institutions, and government worldwide. Rapid population increases with associated anthropogenic activities have intensified the pressure on the environment and the resources affected by climate change impacts. These impacts have led to food insecurity and water scarcity and limited access to clean energy, causing environmental degradation and risk to public health. In Tanzania, like other low-income countries, these challenges are more severe due to lack of technologies, financial capacity, insufficient knowledge, and lack of technical personnel. The Southern Highlands Regions of Tanzania (SHT) is termed as a food basket of the country. Despite its high agricultural potential, the region is challenged by high malnutrition, low agricultural production, inadequate use and access to clean energy and water. As the strategy to solve these challenges, Mbeya University of Science and Technology (MUST) is collaborating with various private and public institutions around the world to address the challenges through training for students, agricultural communities, and other stakeholders on good agricultural practices and technologies such as clean energy use and water reuse; conducting community driven research and outreach programs on water pollution, malnutrition and climate change resilience. Therefore, participation of MUST in Global FEWture alliance programs will help to achieve most of the established programs in areas of energy, water and food security helping to improve public health, food production, reduce the impacts of climate change, improve livelihood, and enhance the use of clean energy by SHT residents and Tanzanians at large.

Advancing Nepal`s Future with the FEWture Initiative – Shree Krishna Dhital (Nepal FEWture team, Sanskriti Farms and Research Center)

Bio: Shree Dhital is the Co-founder and Director of Sanskriti Farms & Research Centre in Dhulikhel, Nepal. He holds a Masters degree in Mechanical Engineering specializing in Renewable Energy, from Kathmandu University. He plays a key role in leading research and community engagement projects on food and water security, climate change, renewable energy, and the environment, collaborating with academics, INGOs, local government, and communities. With extensive experience in working with government organizations and local stakeholders, his research primarily focuses on the Food, Energy, Water (FEW) nexus.

Session 2: FEW Systems Modeling and Decision Support Systems

Early Warning System for Food- and Water-borne Diseases in a Changing Climate – Amir Sapkota (Nepal FEWture Team, UMD School of Public Health)

Bio: Dr. Amir Sapkota is a Professor and Chair of the Department of Epidemiology and Biostatistics at the University of Maryland School of Public Health. His research focuses on the impacts of climate change on human health, with an emphasis on enhancing community resilience. He is leading an international consortium to develop an early warning system for diarrheal diseases in the Asia Pacific Region.

Climate Change Impacts on Regional Food-Energy-Water Security and Coordinated Development Solutions – Xin-Zhong Liang (Global FEWture Team, UMD College of Computer, Mathematical, and Natural Sciences)

Bio: Dr. Xin-Zhong Liang is a Professor of Atmospheric and Oceanic Sciences at the University of Maryland. He serves as the Project Director of DAWN- Dashboard for Agricultural Water-Use and Nutrient Management. His research focuses on enhancing representations of physical processes in global and regional models to advance climate system simulations and applying these models to improve climate prediction on seasonal-interannual and long-term scales.

Integrated Energy-Water-Land Nexus Modeling to Guide Strategic National Planning: Examples from Latin America - Thomas B. Wild (Pacific Northwest National Laboratory, Joint Global Change Research Institute, UMD)

Bio: Dr. Tom Wild is a senior research scientist at the Pacific Northwest National Laboratory's Joint Global Change Research Institute in College Park, MD. He is jointly appointed as an assistant research professor at UMD, where he holds appointments at the Earth System Science Interdisciplinary Center and Center for Global Sustainability. Dr. Wild's research seeks to improve our understanding of how water resources and environmental systems shape, and are shaped by, broader interactions with human (e.g., energy and land) and natural (e.g., climate) systems across scales.

Abstract: Regional energy, water, and land (EWL) resource planning has commonly been conducted in relative isolation by institutions focused on individual sectors (e.g., water resources planning, or electricity system planning). The effectiveness of this traditional planning paradigm is increasingly being strained by rapid integration among sectors; as well as by a range of regional and global forces, such as climate change, technological change, socioeconomic change, etc. An opportunity exists to enhance the traditional approach to national and regional EWL planning. The Latin America and Caribbean (LAC) region provides a rich context for exploring this opportunity, given its abundant but often unevenly distributed resources, strong connection to the global economy through agricultural trade, and potential for climate impacts across energy-water-land systems. This presentation will summarize key insights from three stakeholder-driven EWL planning studies in Colombia, Argentina, and Uruguay. These studies use a novel multi-model EWL accounting framework that couples EWL systems together at the regional level and connects them to national and global socioeconomic and climatic forces in an internally consistent, computationally efficient, and decision-relevant manner. Each study identifies EWL constraints and synergies relevant to infrastructure planning that warrant more detailed consideration. In particular, the studies reveal the unanticipated multi-sector planning consequences of complex interacting and often conflicting policies and forces, such as regional irrigation initiatives, national climate policy, and climate change.

Overcoming Barriers: Leveraging AI and Satellite Data to Support Smallholder Farmers – Catherine Nakalembe (UMD College of Behavioral and Social Sciences)

Bio: Dr. Nakalembe is an Assistant Professor at the University of Maryland and serves as the Africa Program Director under NASA Harvest. Additionally, she is a member of the NASA SERVIR Applied Sciences Team, where she holds the role of Agriculture and Food Security Thematic Lead. Catherine's extensive research interests span projects involving the application of satellite remote sensing and machine learning to agriculture and food security, land use and land-use change mapping, humanitarian mapping, and climate change. She is also actively involved in supporting capacity-building initiatives for the use of remote sensing in agriculture monitoring and research.

Abstract: Global food security relies on sustainable farming practices adapting to climate change. Smallholder farms in Africa are vulnerable. AI/ML and Earth observation advances enable scalable agricultural monitoring to quantify climate risks and inform resilient policies. However, open problems still need to be solved using AI/ML and Earth observation to support smallholders fully. Her presentation shows examples and the impact of work on the cutting edge - summarizing impacts, open problems, and impact pathways. This includes investment in systems over several years and projects, including NASA-funded work, developing scalable models to assess climate threats to food security globally.

Session 3: FEW Nexus Case Studies from Maryland and Around the World

Soil Survey of Israel – Brian Needelman (UMD College of Agriculture and Natural Resources)

Bio: Dr. Brian Needelman, an associate professor at the UMD College of Agriculture and Natural Resources, specializes in soil science, pedology, coastal wetlands, and coastal resiliency. His work involves applying pedology concepts to address environmental and social issues, utilizing soil survey data for precision sustainable agriculture tools, and focusing on blue carbon dynamics in coastal wetlands. Additionally, he integrates environmental and social science approaches to enhance the resilience of coastal socio-ecological systems to climate change, and collaborates on Israel's first national soil survey.

Abstract: A soil survey provides detailed information about the diversity of soils across the landscape that is critical for managing and protecting soils and making a wide range of land use decisions. Unlike most industrialized nations, Israel does not have a modern soil survey. Israel's old soil maps are outdated and are not usable for public awareness or international communication. In this presentation, we will briefly discuss the current project to create a modern soil survey in Israel including: 1) updating the two outdated Israeli methods of soil classification and mapping to the U.S. soil survey methodology; 2) developing GIS layers of soil polygons and climate models, 3) data verification in the field and lab, and 4) development of a relational database that can accommodate traditional soil survey data with modern data layers such as those derived from remote sensing. We will discuss the potential benefits this survey will have for a range of applications including agriculture, public health, water resources, real estate development, and education. We will also discuss opportunities for collaboration with this project including integrating a wide range of data sources into the evolving soil survey database.

Creating Public Urban Food Forests in the Washington D.C. Region – Lincoln Smith (Forested, LLC)

Bio: Lincoln Smith is the Founder, Designer, and Instructor at Forested, a 10-acre experimental forest garden site in Bowie, Maryland. He is a passionate forest gardener who views people as integral components of the forest ecosystem. Lincoln and his team explore and implement forest gardening methods to yield nutritious food and restore ecosystems.

Abstract
Public urban food forests are providing local kids and grownups the chance to forage in their own neighborhood and connect with their food and their ecosystem. Food forests are modeled on the forest but designed with equal emphasis on ecology and productivity. Besides cleaning water, building soil, and providing wildlife habitat, food forests produce an abundance of fruit and nuts, salad and herbs, mushrooms, medicines, and materials. Forest Gardens strive to integrate stewardship of the land with stewardship of healthful human communities. These gardens are increasingly recognized as an important and widespread historical land use amongst traditional cultures throughout the forested ecosystems of the world. In the medium to long term, edible forest gardens could grow in every neighborhood, providing food, nature connection, education, health and enjoyment for residents. Lincoln will speak from his experience creating eight public urban food forests in different jurisdictions around the DC metro area, including public engagement and design practices.

The Holy Triangle of Agricultural Development: Experts, Research and Market Development, CultivAid's Innovative Approach to the Grape Value Chain in Dodoma Tanzania – Tomer Malchi and David Zukerman (Tanzania FEWture Team, CultivAid)

Bio: Dr. Tomer Malchi, a co-founder and the CEO of CultivAid. He has a PhD in soil and water science from Hebrew university. For the past decade Tomer has been leading innovative agricultural initiatives in East Africa.

David Zukerman is CultivAid's country director in Tanzania. David had been on the ground for 3 years and establish farms, training programs and new projects. He is an expert agronomist with a passion for sustainable development.

What is the government's role for creating markets for reclaimed water? – Jonathan Leiman (State of Maryland Department of the Environment)

Bio: Jonathan Leiman works for the Maryland Department of the Environment's Water Quality Modeling Division. He provides assistance to Maryland's jurisdictions on environmental rules that govern total maximum daily load model implementation.

Abstract: Stormwater management costs for Maryland's counties, municipalities, and State agencies like the State Highway Administration are financially burdensome. The stormwater management economy in Maryland needs support to continue to push forward with Chesapeake Bay restoration goals and to meet local Total Maximum Daily Load model requirements. The Maryland Department of the Environment (MDE) is currently working within the context of the U.S. EPA Water Reuse Action Plan to research regulations and innovative water reuse technologies in Maryland. Methodologies for reusing stormwater are being viewed by the MDE as potential pathways to reduce stormwater driven pollution, and recuperate some of the cost burden of stormwater management. In particular, MDE is seeking to develop a stormwater reuse pilot to investigate methods to stabilize the stormwater management economy among Maryland's NPDES Municipal Separate Storm Sewer System (MS4) permittees.

The Water System Network for Reliable Operations & Maintenance: Sharing Experience and Lessons from WaterComms' Pilot in Kenya and Presenting Key Hebrew University FEWture Projects – Yuval Ziv (Israel FEWture Team, WaterComms)

Bio: Yuval Ziv serves as the Project Manager at Ran Wolf Urban Planning, overseeing strategic planning and coordination for the Jerusalem Innovation District project. Additionally, he is the Founder and CEO of WaterComms, a social-impact startup dedicated to enhancing water system functionality in Kenya by a minimum of 50 days per year. In his dual roles, Yuval combines expertise in urban planning and a commitment to addressing water-related challenges in Kenya.

Session 4: FEW Nexus Experiential Education

Overview of the New Graduate and Undergraduate UMD Global STEWARDS Programs within the Global FEWture Alliance – Suhana Chattopadhyay (Education FEWture Team, UMD School of Public Health)

Bio: Dr. Suhana Chattopadhyay is a Postdoctoral fellow at the Maryland Institute of Applied Environmental Health, where she serves as the Program Manager for Global FEWture Alliance and the UMD Global STEWARDS program. She is a trained environmental microbiologist with expertise in the detection and tracking of bacterial pathogens in environmental samples that are of significant public health importance.

"Winter Amp" Study Abroad Trip to Nepal – UMD Global STEWARDS Fellows (UMD, Multiple Schools and Colleges)

Bio: UMD Global STEWARDS Fellows traveled to Nepal for a short-term faculty-led study abroad program during the first two weeks of January 2024. The trip was led by Dr. Leena Malayil and Dr. Rianna Murray. The program focused on how the country is implementing food-energy-water-climate-health solutions to ensure future food and water security. The trip included visiting our collaborators at partner sites at Kathmandu University (KU), Sanskriti Farms and Research Center, and Dhulekhil Hospital in Nepal to learn about FEW nexus issues in these areas.

The Global Classroom Model: Project-Based Learning for Global Change – Anna Glenn and Taryn Devereux (UMD College of Agriculture and Natural Resources)

Bio: Anna Mae Glenn is currently serving as the 4-H Educator in Frederick County where she coordinates positive youth development programming for 600+ youth related to leadership, agricultural literacy, and global citizenship. Before this role, she lived and worked in Liberia, West Africa for 7 years teaching agriculture at a small rural university where she partnered with UMD on various projects such as virtual classrooms, study abroad, community outreach, and farmer training.

Taryn Devereux is a global education specialist focused on the environment, climate change, food security, and gender. Taryn was a UMD faculty member from 2015 through 2023, working across the Department of Agricultural and Resource Economics, UMD-Extension, and in the Department of Geography as Technical Manager with the NASA Harvest Program. She maintains affiliations with UMD and is currently supporting the International Programs unit in the College of Agriculture.

Abstract: Project-based learning empowers students to pursue knowledge through active engagement with real world challenges, including pressing issues like food security and climate change. Increasingly, educators are called upon to produce curriculum that centers these complex topics and that utilizes diverse information delivery modalities to reflect this generation of learners. Globally, students at higher education institutions are passionate about issues related to water, food, energy, and climate. The Global Classroom Model (GCM) allows students at different universities around the world to virtually engage and collaborate on projects through cross- cultural learning and doing. The GCM creates a transformative learning space for students to connect cutting edge research on climate change and the human dimensions of its impact to real-world solutions that take place within their own communities.

This session will present lessons learned from a Global Agriculture Global Classroom taught between the University of Maryland and the Liberia International Christian College between 2019 and 2022. We will focus particularly on the ethical dimensions of global partnerships for complex issues like climate change, and provide resources for educators and researchers on how to develop culturally-responsive and meaningful curriculum and projects that can lead to long-term impacts on students and their communities. We will also showcase some of the projects developed by our students and discuss the impact of these activities on the students and their local partners based on a longitudinal research project around the course itself.

Panel Discussion: Community, State and Business Perspectives on FEW Nexus Challenges

Panelist #1: Margaret Morgan-Hubbard – ECO City Farms

Bio: Margaret Morgan-Hubbard, Founder and CEO of ECO City Farms, is an organizer, educator, activist and life-long environmentalist. Morgan–Hubbard's professional experience includes: directing the Engaged University at the University of Maryland; leading the Office of Communications at the US Environmental Protection Agency; heading a national environmental organization and managing DC's Low Income Weatherization and related Block Grant housing programs. ECO City Farms and other projects like ours are “on the ground think tanks”. We need to create an ethic where every person values being both a thinker and a doer. Divisions between the intellectual class and working class cannot exist if we are to restore our environment and our democracy.

Abstract: Engaged Community Offshoots, Inc. (better known as ECO City Farms or simply ECO) is a nonprofit urban teaching and learning farm in Prince George's County whose mission is to grow great food, farms and farmers in ways that protect, restore and sustain the natural environment and the health of local communities. Working with area children, youth and adults, ECO educates and trains the next generation of urban farmers, eaters and environmental activists. ECO’s long-term goal is the creation of an equitable, diverse, viable, local and enduring alternative to the existing unsustainable industrial food system. More than 14 years ago, ECO first brought the concept and the reality of urban agriculture to Prince George’s County, and the DC metropolitan area. We transformed two blighted sites in lower-income food insecure neighborhoods in the County’s Port Towns into places of nutrition, beauty, opportunity and collegial community.

We pioneered urban farming to:

- show its potential to enhance local food security
- remediate polluted soils
- reconnect area residents to nature
- provide new livelihoods for those in need
- overcome the stigma that equated farming with enslavement
- grow the next generation of environmental leaders and entrepreneurs

We work to demonstrate sustainability through:

- instituting conservation practices that preserve the ecosystem and support the local community
- creating ecological health, social equity, economic viability, including livable wages for food workers.

Our talk will discuss challenges of each of these forms of sustainability.

Panelist #2: Dominic Uccellini – Alluvion Aeroponics
Bio: Owner of Alluvion Aeroponics, which designed and operates a 4000 sq ft Controlled Environment Agriculture facility in Baltimore City. The proprietary aeroponic system uses LED lights to grow 5000 heads of 'Living Lettuce' per month, as well as herbs and microgreens, which are sold at local farmers markets, grocery stores, and to restaurants throughout Baltimore and Washington DC.

Panelist #3: Dr. Ching Tien – Maryland Department of Environment

Bio: Ching Tien is a contractual employee at the Maryland Department of the Environment (MDE). He works on Indirect Potable Reuse (IPR) projects for MDE including the Westminster Purewater Facility and the Anne Arundel County Managed Aquifer Recharge proposal.

Abstract: Town of Centreville, Maryland owns and operates a spray irrigation system to irrigate treated wastewater onto an agriculture farm for beneficial use. Wastewater with a flow rate of approximately 400,000 gallons per day from the town is treated at a wastewater treatment plant. The plant is equipped with two sequential batch reactors, a cartridge filter and a UV/chlorination process for disinfection prior to delivering to a 6-acre storage pond. The irrigation water is pumped from the storage pond and irrigated onto 173 acres spray field seeded with corn and soybean. Irrigation occurred mostly in a 7-month growing season from April through October, with production yields of 180-200 bushels/acre/season corn and 60-80 bushels/acre/season soybeans. There is a 6.5-acre solar panel field adjacent to the spray field and storage pond area which produces electricity and used as a power source for the center pivot irrigation system, pumps, and other equipment. The Centreville Spray Irrigation System is a self-sufficient operation with onsite power generation and efficient reclaimed water irrigation in producing food crops for human and animal consumption.

Trainee and early career scientist lighting rounds

The Impact of Extreme Heat Events on Occupational Heat-Related Illnesses 2000-2019 – Jeff Dalhoff (UMD School of Public Health)

Bio: Jeff Dalhoff is a PhD candidate in Epidemiology at the University of Maryland, School of Public Health. His research involves occupational exposure to environmental heat and heat-related illness. He is a certified industrial hygienist at NASA Goddard Space Flight Center in Greenbelt, MD.

Abstract: With the recent proposed federal regulation of occupational heat exposure and the lack of risk estimates of the relationship between occupational heat-related illness (HRI) and extreme heat events (EHE), there is a critical need to characterize the temporal relationship between HRI and EHE among a broad spectrum of workers in different climate zones. The most recent National Climate Assessment suggests that the frequency, duration, and intensity of EHE has been increasing in the United States and that this trend will continue due to ongoing climate change. Millions of U.S. workers are at additional risk of increased morbidity and mortality and the resulting loss of productivity. This preventable illness burden results from inattention to a new era of work conducted in a climate featuring more frequent and intense EHE. Workers' compensation claims from Florida and New York, daily meteorological data from the National Climatic Data Center, and employment data from the U.S. Census Bureau and Bureau of Labor Statistics were used with case-crossover analysis to determine the risk of EHE on HRI and illness not typically categorized as HRI. Analysis was conducted from 2000 to 2019 in 5-year intervals for workers in Florida and New York observing rates over the study period, between climate zones, and among outdoor and indoor industry sectors. This research indicated that EHEs in Florida were associated with 1.61 (1.55, 1.68) times the rate of occupational heat prostration compared with non-EHEs within the same year, month, day of week, and county strata. A trend of increasing risk during the study period was not indicated. The experience among New York's workforce was generally similar to that of Florida's in that EHEs were associated with an increased risk of heat prostration. Within industry sectors, the outdoor industry sectors of Agriculture and Mining, Construction, and Transportation and Warehousing were among the industry sectors with the greatest rate ratios. EHEs were not indicated to be significantly associated with an increased risk of myocardial infarction (1.01 (0.96, 1.05)) or respiratory disorder (0.98 (0.94, 1.03)) in Florida. This study involving workers' compensation claims covering a broad spectrum of workers and illness and injury types over a 20-year period in two U.S. states in different climate zones, an increased risk of HRI associated with EHE was demonstrated in both the southern and northern U.S. climate zone states. The association between HRI and EHE was greater in Florida than New York though past studies have shown increased climate change effects in northern states. This study provides valuable information to regulatory bodies proposing occupational heat exposure regulation.

Chemical Cocktails from Coast to Coast: Is there a Universal Water Quality Signature of Urbanization in Streams? – Sydney Shelton (UMD College of Computer, Mathematical, and Natural Sciences)

Bio: Sydney Shelton is a PhD candidate in the Geology Department at UMD and is an ORISE fellow with the U.S. Environmental Protection Agency. Her work focuses on how urbanization impacts water quality.

Abstract: In urban systems, a wide variety of processes, including increasing impervious surface cover, road salt application, sewage leaks, and weathering of the built environment, contribute to novel chemical cocktails that are made up of metals, salts, nutrients, and organic matter. Due to heterogeneous land use and myriad pollution sources, water quality is highly variable as streams flow through urban areas. National sensor data sets reveal that water quality in many U.S. streams in different metropolitan areas is influenced by the urban environment; however, these datasets lack concurrent measurements of multiple contaminants over local spatial scales. To investigate if urban streams in different U.S. cities have similar water quality characteristics, we conducted synoptic-style sampling campaigns for nine rivers in five major metropolitan areas (i.e., Baltimore, Maryland; Washington, DC; Cincinnati, Ohio; Denver, Colorado; and Portland, Oregon). We collected 10-65 samples along the flowpath of each stream as the water flows through progressively more urban areas and analyzed for base cation, trace element, carbon, and nitrogen concentrations, and organic matter optical properties. Results demonstrate an urban water quality signal in many of the sampled streams where salts/weathering ions, such as Ca2+, Mg2+, Na+, Sr, and K+, increased along rural to urban flowpaths. These ions are often significantly correlated to one another and drive much of the overall dataset variability. Some streams with wide riparian buffer zones and stream restorations did not demonstrate these systematic increases in salt ions, suggesting that green spaces may disrupt this urban signal.

Systemic Characterization and Utilization of Municipal Solid Waste Streams as Feedstock for Bioenergy Production via Solid State Anaerobic Digestion – Maureen Nabulime (UMD College of Agricultura and Natural Resources)

Bio: Maureen, a doctoral student at the University of Maryland's Department of Environmental Science and Technology, holds both a Master's and Bachelor of Science degree in Agricultural Engineering from Makerere University, Uganda. Her research passion lies in sustainable environmental systems, specifically converting solid waste into bioenergy through anaerobic digestion and conducting life cycle assessments for sustainability. Under the guidance of Prof. Stephanie Lansing, Maureen's innovative work targets the transformation of waste into valuable resources tailored for the aviation sector, with a focus on sustainable aviation fuel to contribute to a circular and sustainable economy.

Abstract: Managing municipal solid waste (MSW) poses a global challenge but holds promise for green energy. Reports indicate 50-75% of industrial resources become yearly waste. MSW, rich in organics like paper, wood, and food waste, is a significant global resource. Converting its organic content into bioenergy faces hurdles such as heterogeneity, low energy density, moisture, contaminants, logistics, and lack of innovation in characterization.

This study aims to assess MSW across locations and times to understand factors affecting biogas production. It aims to overcome barriers, facilitating efficient preprocessing and using the SS-AD energy conversion pathway. Detailed analysis may cut feedstock costs, promote circularity, produce renewable fuels, reduce landfill usage, and foster a circular carbon economy. Findings reveal MSW comprises 93% organic matter, divided into high moisture (48.5% food and yard waste), low moisture (28.7% plastics, paper, Styrofoam), and recyclables (15.8% heavy plastics, cardboard, rubber, fibers, textiles). High moisture MSW shows a pH range of 4.3-5.8, 24- 33.9% total solids, 21.9-38.6% volatile solids, COD of 255-572g/L, and bulky density of 172.2- 1021g/L. Methane yields (404-429 mL CH_4/g VS) suggest SS-AD as a viable MSW biological energy conversion pathway.

Drinking and Irrigation Water Quality in Nepal: A Scoping Review – Alexander Choiniere (UMD School of Public Health)

Bio: Alex Choiniere is a senior music performance and sustainability student at the University of Maryland. This past summer he was an intern with the CONSERVE Center and worked closely with the Global FEWture Alliance

Abstract: With climate change, urbanization, and increasing population, the Southeast Asian country of Nepal is facing water quality and quantity challenges. The presence of microbial and chemical contaminants specifically in drinking and irrigation water poses significant public health risks. This study aimed to assess the current state and concerns related to the water quality for both drinking and irrigation purposes in Nepal. Adhering to the JBI Manual for Evidence Synthesis and the PRISMA-ScP extension, a scoping review was conducted. After designing inclusion-exclusion criteria, peer-reviewed literature on the water quality in Nepal was systematically searched on July 5, 2023, across seven databases: EBSCO databases (Academic Search Ultimate, Agricola, GreenFILE, GeoRef, MEDLINE), Scopus (Elsevier), and Web of Science Core Collection (Clarivate). This systematic search yielded a total of 1,668 unique records, of which 204 full texts were reviewed and 132 studies were included in this scoping review. This review exposed certain contamination patterns, such as the prevalence of *E. coli* contamination in waters from urban areas and the presence of arsenic in the Terai regions. Mitigation efforts and additional research on the topic are needed to help improve the overall water quality of Nepal.

Poster Presentations

Title: *Can Enhanced Rock Weathering Keep Its Promise to Sequester Carbon, Improve Soil Properties, and Increase Crop Yields?*

Authors:
1. Eni Baballari (Lecturer and PhD student, Department of Environmental Science and Technology, College of Agriculture and Natural Resources, University of Maryland)
2. Ray Weil (Professor, Department of Environmental Science and Technology, College of Agriculture and Natural Resources, University of Maryland)

Abstract: This research project delves into the innovative approach of Enhanced Rock Weathering (ERW) as a transformative solution to address climate change and its cascading impacts on essential resources. ERW involves the accelerated weathering of certain minerals, such as basalt, to sequester atmospheric carbon dioxide (CO2) while simultaneously enhancing soil fertility. Our study will investigate the efficacy of ERW in mitigating climate change by sequestering CO2, fortifying agricultural soils with essential nutrients, and mitigating the adverse effects of acidification on water bodies. Specifically, we will compare powdered basalt to traditionally used powdered limestone for neutralizing agricultural soil acidity, measure the rate of pH change over time and space, and measure any effects of soil physical conditions and crop growth. Currently, lack of research data on the efficacy of powdered basalt as a liming material or its effects on regional soils and crops may be slowing the adoption of the ERW practice. Our project will serve as proof-of-concept research in a Frederick County farm and seeks to answer the question: Can enhanced rock weathering sequester carbon, improve soil properties, and affect crop yields?

Title: *The City of Hyattsville's FEWture Food Forests*

Author: Jen Cotting, Director, University of Maryland Environmental Finance Center

Abstract: To address local food insecurity, enhance community engagement, and support mental health, the City of Hyattsville has established two food forests. These forests at Emerson Street (near the Anacostia bike trail) and McClanahan (behind the Hyattsville Crossing metro) are open year-round for community members to harvest seasonally-available fruits and greens. The pesticide-free, permaculture gardens incorporate a variety of edible shrubs, herbs, greens, berries, and fruit and nut trees safe for human consumption. Through site visits and coordination with City staff, the Maryland Team of the Global FEWture Alliance will assess water and energy use at the sites, provide recommendations for improving efficiencies or overcoming existing barriers related to the food-water-energy nexus, and work to identify implementation funding for any recommendations the City would be interested in pursuing.

Title: *Establishing a Permaculture Garden*

Author: Marissa Frick, University of Maryland

Abstract: This senior integrative experience project was an investigation into applying the principles of Permaculture and Hügelkultur gardening within a restored garden area in Lot GG1 on the University of Maryland Campus. Using nine treatment plots, featuring three repetitions of three different organic amendments, we cultivated huckleberries, blueberries, and fig trees. These particular species were chosen due to their native status and demonstrated ability to thrive amidst the high organic matter environment in the restored area. The project encompassed detailed planning, strategic planting, and a unique insulation process meant to protect and nurture the biotic community during the challenging winter months. Our design and execution aimed to emulate natural ecosystems, including creating a welcoming environment for pollinators and other wildlife that is abundant in the local forests.

Title: *Planting green: climate smart cover crop management*

Author: Cassandra Gabalis, University of Maryland

Abstract: Cover crops (CCs) are commonly used in the Mid-Atlantic for provisioning of ecosystem services, but are frequently terminated well before cash crop planting. Longer growing periods of CCs can allow for increased provisioning of services, as conferred by more CC biomass. Planting cash crops into living, green, CCs allows for maximum CC biomass accumulation. However, stakeholders are concerned about the effects of planting green on cash crop dynamics, such as stand establishment and slug damages. This Masters of Science project examines the implications of planting green on soil carbon and agricultural management. This project is within the Environmental Science and Technology department at UMD, and funded by the Northeast Sustainable Agriculture Research and Education (NESARE). Experimental plots at the Central Maryland Research and Education Center will examine three cover crop and termination treatments each, on corn and soy rotation in coastal plain soils. Uniform fertilization application and rolled cover termination will be applied. Elsewhere, farmer-researcher collaborative experiments will occur throughout the Mid-Atlantic in collaboration with the NESARE grant committee. These experiments will be defined by field-scale plots, and under diverse soils and cropping systems.

Title: *Evaluating the Risk of Residential Exposure to Antibiotic-Resistant Bacteria from Sanitary Sewer Overflows (SSOs) and Basement Backups in Baltimore, Maryland*

Authors: Emily M. Healey 1, Dr. Priscila B. R. Alves 2, Dr. Marccus D. Hendricks 2, Dr. Rachel Rosenberg Goldstein 1.
1 Maryland Institute for Applied Environmental Health, School of Public Health, University of Maryland
2 Stormwater Infrastructure Resilience and Justice (SIRJ) Lab, School of Architecture, Planning and Preservation, University of Maryland.

Abstract: Infections from antibiotic resistant (AR) bacteria are an increasingly common public health threat. Once thought to have healthcare origins, studies have shown that wastewater is an environmental source of AR bacteria. AR bacteria, such as methicillin-resistant Staphylococcus aureus (MRSA), can enter the wastewater stream when colonized humans shed bacteria from the nose, skin, and feces. Individuals may be exposed to AR bacteria in wastewater when untreated sewage enters their homes due to sanitary sewers overflow (SSO) events and basement backups. To understand the risk of AR exposure due to backups in homes, we evaluated the presence of E. coli, methicillin-resistant Staphylococcus aureus (MRSA), methicillin-susceptible Staphylococcus aureus (MSSA), coagulase-negative staphylococci (CoNS), and methicillin-resistant coagulase-negative staphylococci (MR-CoNS) in impacted homes. We collected surface swabs (n=40) and standing water (n=6) from 39 homes in Baltimore City, MD where backups occurred. Samples were processed using modified standard membrane filtration and confirmed with biochemical and molecular techniques. Eight homes (20%) had E. coli on surfaces impacted by SSOs and backups. No MRSA was found on surfaces, but 3 homes (7%) had MSSA on surfaces. Additionally, 3 homes (7%) had CoNS and 1 (2%) had MR-CoNS on surfaces. Of the 6 homes with standing water, 3 (50%) had E. coli, 1 (16%) had MRSA, and 1 (16%) had CoNS present in water samples. Neither MSSA nor MR- CoNs were isolated from any water samples. Results suggest that SSOs and backups could expose communities to AR bacteria. Additional sampling is needed to further assess these risks.

Title: *Rain splash-mediated dispersal of Escherichia coli from fecal deposits in field-grown lettuce affected by mulches*

Authors: Adam Hopper 1, Claire Hudson 1, Diksha Klair 1, Qiao Ding 1, Zhujun Gao 2, Aprajeeta Jha 2, Timothy Coolong 5, Rohan Tikekar 2, Laurel Dunn 3, Shirley A. Micallef 1,4
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2 Department of Nutrition and Food Science, University of Maryland
3 Department of Food Science and Technology, University of Georgia
4 Center for Food Safety and Security Systems, University of Maryland
5 Department of Horticulture, University of Georgia

Abstract: Mulch is used to maximize crop yield by modulating soil temperature and moisture levels and suppress weeds. However, various mulches may differentially impact rain- mediated dispersal of bacteria from a fecal point source. The purpose of this study is to assess E. coli dissemination from a fecal point source to a lettuce crop grown on different mulches. Loose-leaf lettuce 'Magenta' seedlings were transplanted into raised beds with black plastic, biodegradable plastic, straw, or left bare. Eleven days post-transplant, 10 g of rabbit manure spiked with 8 logCFU/g E. coli TVS353 were deposited in each bed at the 0 m mark. One and three days after rain, lettuce was collected along 1.5 m transects from either side of fecal deposits and lettuce-associated E. coli semi-quantified with an MPN assay. A Weibull Model was fitted to the data to predict distances at which E. coli would diminish up to 7 log from level in feces.

Both distance ($p<0.001$) and mulch ($p<0.001$) were factors for E. coli transfer from point source to lettuce. E. coli recovery differed by mulch type, with biodegradable plastic and straw yielding the largest difference (2 log, $p<0.001$). Mulch and distance were also significant factors in E. coli recovery 3-days post-rain (both $p<0.001$). In this trial, both plastic mulches differed from bare ground and straw ($p<0.01$). For every mulch, less E. coli was retrieved from lettuce at 0.3 m, 3 days post-rain compared to 1-day ($p<0.01$; all four mulches). Weibull modeling predicated a 7-log reduction in E. coli from fecal levels would be achieved at 1.2-1.4 m from point source on plastic mulch, 0.75 m on bare ground ($p<0.05$) and 0.43 m on straw ($p<0.01$). Straw mulch and bare ground limited rain-mediated E. coli dispersal to lettuce compared to plastic mulches 1- and 3-days post-rain. These findings can inform recommendations for measures related to animal intrusion in vegetable production areas.

Title: *Oxygen Nanobubble Treatment in Stagnant and Recirculating Water Systems*

Authors:
Hibba Hussain 1, Dr. Jose-Luis Izursa 2
1 Environmental Science and Technology & Cellular Biology and Molecular Genetics
2 Environmental Science and Technology

Nanobubbles (NBs) retain a diverse range of applications in various fields across disciplines such as agriculture, engineering, medicine, and wastewater treatment due to their unique characteristics. Apart from standing out due to their property of small size, they differ from Microbubbles (MiBs) and Macrobubbles (MaBs) with regard to their stability and longevity, negative surface charge, high gas solubility and ability to generate free radicals. On the other hand, Aquaponic Systems (AP) emerged as an innovative agriculture and food production approach to make use of the natural biological cycles of ammonification and nitrification to supply nutrients to plants in a soilless setup from affluent water recirculating from the fish tank to the plant bed. This study investigated the immediate and short-term stability and behavior of pure oxygen nanobubbles in recirculating aquaponic and stagnant water systems with only dechlorinated tap water over the course of seven days. Nanobubbles accumulated in higher concentrations in stagnant water systems as compared to recirculating aquaponic systems. This first set of preliminary experiments will allow to set parameters of oxygen nanobubble treatments for future experiments.

Title: *Grand Challenges for Water Quality around the University of Maryland Campus*

Authors: Bennett Kellmayer, Daniel Ding, Ashley Mon, Nicholas Salanitri, Ashley Ireland, Sydney Shelton, Sujay Kaushal: University of Maryland, Department of Geology, Biogeochemistry Laboratory

Abstract: The University of Maryland Biogeochemistry Lab plays a key role in monitoring the health of the streams around campus as well as around the Chesapeake Bay watershed. The lab analyzes key parameters to stream health such as dissolved oxygen, conductivity, temperature, pH, and more in situ measurements when collecting stream water samples. Water samples are brought back to the lab and analyzed for concentrations of 15-20 different elements. In addition, organic chemical compounds dissolved in water are characterized by fluorescence spectroscopy data. One of the core missions of the lab is to involve UMD undergraduate students in the research process and give them experience conducting hydrology research. In the lab, undergraduate students routinely perform in situ measurements with probes and sensors in streams and rivers, collect water samples, and analyze fluorescence data on water samples using an Aqualog spectrofluorometer. Over the course of over a decade of routine monitoring, the lab has observed several key changes in the stream health around campus, specifically elevated salt pollution from road deicers and increased oxidizing-reducing potential in the stream water in response to stream restoration practices involving construction of wetlands and ponded features along Campus Creek. The Aqualog fluorometer aids in understanding the organic components of the collected water samples through the use of absorbance spectra and excitation emission matrices (EEMs), which can be compared to industry standards to analyze the source of the organic matter found in the stream. This optical technique along with continued sampling and elemental analysis of the samples allows the lab to better elucidate both the levels of urban contamination in the stream, as well as the origin of these contaminants. Ultimately, the data from the lab allows for evaluating restoration efforts along Campus Creek and Paint Branch, and it is crucial for engaging UMD student researchers and the sustainability of freshwater resources on the UMD campus and beyond.

Title: *Unraveling the potential of PGPR for enhanced crop growth and safety*

Authors:
Diksha Klair 1, Marissa Lee-Sang 2, Shirley A. Micallef 1, 3
1 Department of Plant Science and Landscape Architecture, College Park, MD
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3 Center for Food Safety and Security Systems, College Park, MD

Abstract: Understanding the intricate interactions between plant growth promoting rhizobacteria (PGPR) and plants is essential for developing strategies that not only promote plant growth, but also ensure the safety and quality of our agricultural produce. The main objective of this research is to explore the food safety potential of PGPR when crops are under abiotic stress conditions induced by drought. To this end, a library of PGPR were screened for lettuce growth promotion and lettuce tolerance to water restriction. Rhizobacteria (n=35) were isolated from the roots of bok choy (*Brassica rapa subsp. chinensis*) grown at the University of Maryland TerpFarm (Central Maryland Research and Education Centre, Upper Marlboro). Bacterial isolates were assigned a presumptive taxonomic classification based on sequencing of the full length 16S rRNA gene using the Basic Local Alignment Search Tool (BLAST) database (NCBI). Lettuce seed (cv. 'Parris Island Cos' and 'Rogue d'Hiver) were sowed in pots and inoculated 3- and 6-days post germination with single strain suspensions of each bacterial isolate at a concentration of 8 log CFU/ml. Plants were screened for growth promotion by fresh and dry biomass analysis. Isolates exhibiting positive lettuce growth effects were further screened for their potential to enhance food safety under water restriction or regular water conditions. Leaf populations of Salmonella Enteritidis were enumerated by direct plate counting on Tryptic Soy Agar 24 h after leaf inoculation with 5 log CFU of this pathogen. Twenty-one out of 35 isolates exhibited growth promotion properties on Romaine lettuce when compared to plants not receiving PGPR ($p<0.05$). Isolate BC37, identified as *Pseudomonas frederiksbergensis*, increased the fresh weight of 'Parris Island Cos' above ground tissue after 21 days of inoculation ($p<0.001$) compared to uninoculated plants, suggesting its potential as a robust PGPR. *P. frederiksbergensis* was further evaluated for modulatory effects on lettuce-Salmonella Enteritidis association with leaves of two Romaine lettuce varieties – 'Parris Island Cos' and 'Rogue d'Hiver'. Root inoculation with Pseudomonas BC37 restricted Salmonella population inoculated on leaves of 'Parris Island Cos' ($p<0.001$), compared to controls, 24 h post Salmonella inoculation. The reduction in Salmonella populations on Pseudomonas-treated plants experiencing water stress was slightly greater compared to non-inoculated control plants after 24 hours, with differences of 1 log or less observed in both plant varieties. These findings contribute new and valuable insights into the agricultural application of PGPR for food security and food safety. Our study emphasizes the potential of harnessing microbial interactions for sustainable and safe crop production in the face of environmental challenges.

Title: *Assess the Impacts of Temperature and pH on Free Nitrous Acid Pretreatment for Stabilizing Organic Wastes*

Authors: Camila A. Proano, Emily Liu, Guangbin Li: University of Maryland, College Park

Abstract: Free nitrous acid (FNA) pretreatment has been reported to enhance the anaerobic digestibility of organic wastes. This work evaluates the effects of pH and temperature on the solubilization of FW or thickened activated sewage sludge (TASS) when pretreated with a FNA concentration of 2.13 mg-N/L. The goal is to elucidate the role of temperature (25, 35, 55, and 70), and pH (5.5) in effectiveness of FNA pretreatment for stabilizing organic wastes. Results demonstrate that temperature impacted on the solubilization of sCOD for FW and TASS. For FW, at 24 hours 70 provided the greatest % change in solubilization of FW 72 20%, vs 49 11 for FW-G and FW-H respectively. In FW, across the different temperatures the addition of FNA pretreatment did not provide further enhancement of sCOD solubilization (p>0.05). For TASS, FNA treatment provided significant improvement to the solubilization at 35 (p=0.0015), 223 2% increase for TASS-C and 277 16 % increase for TASS-D. Other tested temperatures (55 and 70) may promote significant damage to hard degrade components. Final results will include results of nitrite consumption during the pretreatments. Expected results will benefit the field of solid waste management. More specifically how temperature and pH can be used to reach a more stable FNA concentration throughout the duration of the pretreatment of organic wastes.

Title: *Prevalence of Escherichia coli O157:H7 and Salmonella serovars in microgreens grown from contaminated seeds*

Authors: Aishwarya Pradeep Rao 1,2, Jitendra Patel 2, Abani K. Pradhan 1, 3
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3 Center for Food Safety and Security Systems, University of Maryland

Abstract: The consumption of salad vegetables such as sprouts and microgreens has increased tremendously around the globe as consumers are becoming aware of the health benefits of the bioactive compounds they harbor. Recently, microgreen extracts have been used in personal care products for anti-ageing benefits. However, there are food safety concerns and recalls associated with these commodities. Because of the humid environment they are grown in, they can sustain the growth of several foodborne pathogens such as Salmonella and Escherichia coli. The objective of the study was to establish the prevalence of Salmonella and E. coli in daikon, mustard, broccoli, and red cabbage microgreens grown from contaminated seeds. The seeds were inoculated with a cocktail of two strains of each of the pathogens and allowed to germinate on compost-soil substrate. The growth conditions were maintained throughout the 14-day period. At day 7 and 14, microgreen samples were harvested, pummeled in TSB (5X volume), and spiral-plated on SMAC and XLT4. The seeds were sampled similarly on day 0 to establish an initial prevalence level.Red cabbage, daikon and broccoli showed a decrease by 1 log over 14 days when inoculated with low levels of Salmonella compared to 2 log decrease in mustard microgreens. With high inoculum, daikon and mustard decreased from 5 to 3 log but remained at 4 log in red cabbage and broccoli. Microgreens inoculated with E. coli at low levels decreased from 3 to 1 log over 14 days. These pathogens decreased by 1 log at in daikon, red cabbage, and broccoli when seeds were inoculated at high level (~4.5 log CFU/seed) and by 2 log in mustard. Controlled environment agriculture is helping to manage the uncertainties brought about by climate change, wherein resources and environmental conditions can be monitored. The constant recycling of resources allows for pathogens to be recirculated once they enter the controlled environment agricultural continuum and these commodities need a thorough risk assessment to be carried out before they can be sent to retail for human consumption.

Title: *Determining the Impact of Well Maintenance, Condition, Type, and Location Factors on E. coli and Total Coliforms in Maryland Farm Private Drinking Water Wells*

Authors: Cameron Smith 1, Andrew Lazur 2, Alan Leslie 2, Benjamin Beale 2, Kelly Nichols 2, Shannon Dill 2 , Sarah Hirsh 2, Jeff Semler 2, Andrew Kness 2, Emily Healey 1, Jack Keane 1, Raul Cruz-Cano 3, Rachel Goldstein 1
1 University of Maryland, School of Public Health, Maryland Institute of Applied Environmental Health
2 University of Maryland Extension
3 Indiana University School of Public Health

Abstract: In 1974 the Safe Drinking Water Act was passed to improve drinking water quality and set a limit for acceptable contaminant levels as provided by the U.S. Environmental Protection Agency (EPA). However, the EPA does not regulate or monitor the drinking water quality of private wells. EPA estimates that over 23 million households in the U.S. obtain drinking water from private wells. The possible presence of contaminants in private wells poses a public health risk. The team collected 67 water samples from Maryland farms with private wells located in seven regions and 19 counties of Maryland. We evaluated water samples for Escherichia coli and total coliform bacteria to understand the risk of contamination for Maryland private well owners. We also determined the impact of well conditions, maintenance, and location on the presence of E. coli and total coliforms in well water. Our preliminary results found that 10% (7/67) of wells were positive for E. coli and 39% (26/67) were positive for total coliforms. Fisher's Exact Test shows that region was the only significant factor impacting E. coli levels ($p=0.001$). These findings emphasize the importance of well water testing and maintenance for private well owners.

Title: *Feeding Practices and Mycotoxin Contamination of Complementary Food Ingredients in Kongwa District, Tanzania*

Authors: Francis Ngure 1, Neema Kassim 2, Erica L. Phillips 3,4, Paul C. Turner 5
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Abstract: Inadequate infant practices in low-income countries contributes to poor growth and development. Aflatoxin contamination of complementary food ingredients may exacerbate the effects of diet. This pilot survey is designed to capture both early feeding practices and aflatoxin contamination of complementary food. Early feeding practices were assessed in 115 rural households from 25 villages in Kongwa District, Tanzania. The primary caregiver for the index child (6–18 months) was interviewed using a structured dietary questionnaire at recruitment (Oct/Nov), and revisited 6 months later. The questionnaire included typical food consumption in the past 24 hours and captures the minimum dietary diversity (MDD) score. Aflatoxins were additionally analyzed in complementary food from pooled household samples, to broadly establish patterns of contamination.

The MDD was not met for 80% of infants at recruitment as compared with 56% in survey 2 ($p<0.05$). Maize was consumed by >90% of households in both surveys, whereas groundnut was consumed by 44% and 64% of households in surveys 1 and 2, respectively. Aflatoxin concentrations in maize and groundnuts were higher in survey-1 than 2. Overall, AF exceeded the legal limit in 18% of maize and 61% of groundnut samples.Poor diets were common and reliance on maize and groundnuts exposes this vulnerable population to Aflatoxins. Drought stress and poor soil quality can impact aflatoxin levels of crops, and impact food security in general, and thus improved irrigation and soil quality may have a dual impact on public health.

Title: *Provision of low-aflatoxin local complementary porridge flour reduced urinary aflatoxin biomarker in infants in rural Tanzania*

Authors: Neema Kassim 1, Francis Ngure 2, Laura Smith 3, Rebecca Stoltzfus 4,5, Edna Makule 1, Nyabasi Makori 2, Erica Phillips 4,6, Paul C. Turner 7
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Abstract: Aflatoxins are toxic secondary metabolites of fungi that colonize dietary staples, such as maize and groundnut; crops frequently used in complementary feeding in sub-Saharan Africa. In preparation for a large trial, this pilot study examined if provision of a low-aflatoxin infant porridge flour made from local maize and groundnuts, could reduce the prevalence of a urinary aflatoxins in infants. Thirty-six infants aged 6–18 months were included from four villages in Kongwa District, Tanzania. The study was conducted over 12 days with a three-day baseline period and a 10-days where low-aflatoxin porridge flour was provided. Porridge intake of infants was assessed using quantitative 24-hr recalls. Household food ingredients used in infant porridge preparation and urine samples were collected on Days 1–3 (baseline) and 10–12 (follow-up). Aflatoxins were measured in household foods, and AFM1 was measured in urine.

At baseline and follow-up, 78% and 97%, respectively, of the infants consumed porridge in the previous 24hrs (median volume of 220 mL (IQR: 201, 318) and 460 mL (IQR: 430, 563), respectively ($p<0.001$). All 47 samples of homemade flour/ingredients were contaminated with aflatoxin (0.3–723 ng/g). The prevalence of individuals with detectable urinary AFM1 was reduced by 81%, from 15/36 (42%) at baseline to 3/36 (8%) at follow-up ($p = 0.003$). Provision of low-aflatoxin porridge flour was acceptable to caregivers and their infants and successfully reduced the prevalence of detectable urinary AFM1 in infants, thus, confirming its potential to be tested in future large-scale health outcomes trial.

Title: *Does 12 a month provision of low-aflatoxin local complementary porridge flour improve linear growth of children aged 6–18 months in rural Tanzania?*

Authors: Neema Kassim 1, Francis Ngure 2, Laura Smith 3, Rebecca Stoltzfus 4,5, Edna Makule 1, Nyabasi Makori 2, Erica Phillips 4,6, Paul C. Turner 7
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7 MIAEH, School of Public Health, University of Maryland

Abstract: Aflatoxins are produced by the fungi Aspergillus flavus and A. parasiticus that colonize maize and groundnuts under stress conditions. Aflatoxin exposure is associated with infant growth faltering in sub-Saharan Africa. This study examined if an intervention to reduce aflatoxin consumption throughout 6-18 months of age, would increase mean Length-for-Age – Z-score (LAZ) at 18 months. The trial was a cluster-randomized community-based two group trial conducted in the Kongwa District of Tanzania between 2018-2020. An infant and young child feeding education intervention was delivered equally to both groups, while in the intervention group, low-AF pre-blended porridge flour and separate groundnut flour were provided monthly. Data were collected at recruitment, and when infants were 6, 12, and 18-months old. LAZ and secondary anthropometric outcomes were tested.

2,842 maternal-infant dyads were recruited, 88.9% of whom were retained at 18-months. Between study entry and 18-month time point, the proportion of stunted infants doubled (20.2% to 45.5%). Mean LAZ at 18-months was -1.89 (95%CI -1.94; 1.80) with no difference between groups. There were no significant differences in mean Weight-for-Age Z-scores, Weight-for-Length Z-scores, or Head Circumference Z-scores at 12 or 18-months, but Mid Upper Arm Circumference Z-scores were greater in the intervention group. An intervention to reduce aflatoxin exposure from 6 to 18 months did not increase mean LAZ scores in a low-resource, predominantly rural setting. Stunting was profound, with limited recovery once stunted. AF biomarkers will be assessed to better understand exposure patterns in both groups.

Title: *Lightning Climatology, Casualties and Impacts in the U.S. and Africa*

Authors: Daile Zhang 1,2,3, Scott Rudlosky 1,4,5, Mary Ann Cooper 2,3,6, and Ron Holle 2,3,7
1 Cooperative Institute for Satellite Earth System Studies (CISESS), University of Maryland
2 African Centres for Lightning and Electromagnetics Network (ACLENet)
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5 Department of Geography, Kent State University
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Abstract: Lightning has broad impacts on many aspects of everyday lives including outdoor activities, air traffic, and power grid operations. Lightning also triggers wildfires and produces NOx in the atmosphere and soil. Lightning is one of the leading contributors to storm-based weather fatalities. Annually, lightning kills 20-30 people in the U.S., whereas people in developing countries are much more vulnerable, with as many as 6,000-24,000 global annual lightning fatalities (Holle, 2016). In some developing countries, parents are afraid to send children to school due to lack of lightning protection. This talk highlights our work towards understanding and applying lightning data to better understand vulnerabilities to a changing climate, improve operational forecast and warning operations, and better characterize lightning-ignited wildfires. Collaborative efforts underway with the African Centres for Lightning and Electromagnetics Network (ACLENet) and Ugandan government agencies are working towards decreasing deaths, injuries, and property damage from lightning. Project advisors include ACLENet, a U.S. based non-profit organization centered on Uganda, along with experience from the U.S. National Lightning Safety Council and other lightning researchers. To support education access, ACLENet has installed lightning protection systems in seven schools in Uganda and two more schools are underway. Broadening access to lightning observations, including new geostationary lightning observations over Europe and Africa, presents many opportunities. Continuously observing thunderstorm and lightning activity from both ground- and satellite-based sensors should provide lightning early warnings and detections that can be used to promote public safety in Africa.

Title: *Chemical Composition of Mineral-associated Organic Carbon*

Authors: Mengqiang Zhu and Ruifang Hu
Department of Geology, University of Maryland

Abstract: Mineral-associated organic carbon (MAOC) is the major stabile organic C pool in global soils. However, its chemical composition remains poorly known, limiting our understanding of its source and formation and preventing development of effective approaches to manage MAOC for C storage in soils. Here, we separated mineral-associated organic matter (MAOM) using the density/size fractionation protocol from soils collected from a diverse set of ecosystems. The MAOM material was then extracted by hydrogen fluoride (HF) solution to remove minerals, and the extract subsequently was characterized using FT-ICR MS. Results show that a large portion of organic C in MAOM was dissolved in HF solution, particularly for B horizons. FT-ICR MS data indicated that most of the soluble OC can be attributed to plant sources while microbial sources became increasingly important with increasing aridity of the ecosystem. Our study suggests that adsorption of plant-derived soluble organic carbon on mineral surfaces is the primary formation pathway of MAOM. The importance of microbial sources to MAOM might have been overemphasized in the current understanding of the dynamics of MAOM, particularly for the ecosystem not limited by water.

Title: *Source tracking bacterial communities from irrigation water to produce*

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Abstract: As water scarcity increases around the world, rainwater and stormwater harvesting systems are gaining popularity as a resource for crop irrigation. However, several studies have reported the transmission of foodborne pathogens from irrigation water to farm produce. It is currently unknown whether pathogens or beneficial bacteria can travel from irrigation water to soil and end up on crops metabolically active. Therefore, this study aims to track and characterize metabolically active bacteria along irrigation pathways from the water source, soil, and produce from two different irrigation water sources (rooftop-harvested rainwater and harvested stormwater) to irrigated soil and produce. The study utilized 16S rRNA coupled with 5-bromo-2'-deoxyuridine (BrdU) labeling to track metabolically active bacteria from irrigation water, soil, and irrigated produce. *Proteobacteria* was the predominant phylum in the bacteria community in terms of relative abundance. Pathogenic viable bacteria species identified across samples (water, soil, and produce) include members of *Campylobacter ureolyticus, Clostrium perfringens, Vibrio cholerae, Enterococcus cecorum,* and *E. coli*. Our study found viable beneficial human gut microbes: *Bacteroides uniformis, Collinsella aerofaciens, Faecalibacterium prausnitzii, Prevotella copri*, and *Dorea formicigenerans* across water, produce and soil samples. Overall, the rainwater-irrigated produce had more consistently diverse beneficial bacteria over the municipal-irrigated produce. We postulate that the similar bacterial profiles on the soil and the produce may have been due to rain droplets creating a bioaerosol transferring the soil bacteria to the produce. It was observed that metabolically active bacteria species observed in water samples do not necessarily end up on the produce, and certain metabolically active bacteria observed on produce are absent in water and soil samples. This indicates that the flush tanks of the rainwater harvesting systems may have effectively sequestrated some pathogenic bacteria. We did not find any pathogenic bacteria in the cistern that housed filtered stormwater, which leads us to believe that is an optimal storage condition and filtration of stormwater. Our study provides evidence that utilizing BrdU-labeling with 16S rRNA sequencing allows the detection of metabolically active bacteria communities that could be present in water or soil and produce samples in a viable but non-culturable state.

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