**Lindsey Kemmerling**
Biosystems Engineering/Michigan State University
Bacteria, sunlight, and dirt: Making the most of human waste water

Much of the biodiversity on Earth is at risk due to human destruction of natural ecosystems. One such cause of this destruction is a lack of effective wastewater treatment systems, particularly in developing countries. Michigan State University joined with the Gender Equity Office of the Costa Rica Institute of Technology in their work with the Shuabb Aborigine Women’s Association to develop an ecotourism site in Talamanca, Costa Rica. A water treatment system was needed to provide for guests and to prevent negative human impacts.

Our team has designed a wastewater treatment and energy production system utilizing basic mechanical and biological processes. First, water is directed from a nearby creek to a small settling tank. It is then distributed to the kitchen (where it is filtered), showers, and latrines. The black water is piped downhill to a solar-assisted anaerobic digester where bacterial colonies remove pathogens and produce usable biogas. As water exits anaerobic treatment, it enters a constructed wetland where bacteria and plants work to further purify the water output of the digester. This water then flows through a drainage ditch and safely returns to the watershed.

Not only is clean water necessary for a balanced and functioning ecosystem, but for human health as well. Our ecosystems engineering team believes such integrated design can promote ecotourism while protecting natural ecosystems. Such a water purification system can combat larger global issues and promote sustainable development.

**Jelili Adebiyi**
Community Sustainability/Natural Resources
Organic Agriculture: A Climate-Resilient Livelihood Adaptation Strategy for sub-Saharan African Smallholders

Climate change induced stressors like changes in rainfall patterns, increase in temperature, prolonged droughts and extreme weather events are projected to aggravate sub-Saharan Africa’s (SSA) low agricultural productivity challenge. Accordingly, the Intergovernmental Panel on Climate Change 2007 report estimated that SSA may experience about 50% reduction in crop yield by 2020, and a 90% drop in net crop revenue by 2100. Expectedly, this will undermine SSA’s agriculture-dependent economies, worsen the African food security situations, and degrade smallholders’ livelihood conditions, the majority of whom are living below the $1.00 a day poverty line. This implicates a need for climate resilient agricultural systems such as organic agriculture (OA), which smallholders can adopt as livelihood adaptation strategy. OA can contribute to climate adaptation through improving soil fertility and structure, helping to build soil organic matter, and by increasing soil water retention capacity. Through the exclusion of synthetic farm inputs and increase in carbon sequestration, OA presents opportunities for climate mitigation in agriculture. Studies have also
shown that OA can contribute to yield and smallholders’ livelihood improvements in SSA. Drawing on such potential, and using a livelihood analytical frame, this poster contextualizes how the opportunities presented by OA can be leveraged by SSA smallholder farmers as a climate change and livelihood adaption strategy. The poster also illustrates the potential impacts of OA on different aspects of smallholders’ livelihood in SSA, including on natural capital, socio-economic, and emotional wellbeing. Also, the poster highlights how risk and institutional environment intersects with OA to shape its anticipated livelihood outcomes.

Paul Botch
Entomology
Ecological Factors that Lower Risk for a Potential Classical Biological Agent for the Brown Marmorated Stink Bug

The brown marmorated stink bug (BMSB) is an invasive insect from Asia that causes severe damage to a wide variety of agricultural crops, is an urban nuisance, and potentially damages ecosystems. BMSB was introduced to North America without coevolved parasitoids and predators that naturally help to control populations in the native range. Classical biological control, using a coevolved natural enemy against an invasive pest, is the only sustainable, long-term management strategy capable of controlling BMSB at the landscape-level. The Asian egg parasitoid wasp, Trissolcus japonicus, is currently under evaluation as a potential biological control agent to determine if it will attack non-target North American stink bugs. Host-specificity testing has shown that T. japonicus can develop on >10 genera of native non-target stink bugs, and therefore poses a potential risk if it were released. There may be ecological factors that reduce the risk to native stink bugs in nature, however. Individually, we investigated the effects of habitat partitioning, habitat complexity, chemical cues, and host egg characteristics, which may lower the risk of T. japonicus to non-target stink bugs. We hypothesize that habitat partitioning and host egg characteristics will have the greatest effect of reducing risk. This research will contribute to an overall risk analysis of T. japonicus prior to applying for a USDA-APHIS release permit, and will be important to post-release monitoring and sustainable management of BMSB in the future.

Sayli Devdas Bote
Chemical Engineering & Material Science
Synthesis of biobased polyols from soymeal and its application in polyurethane (PU) rigid foam

The polyurethane market is constantly growing and there is a considerable interest in the manufacture of biobased polyurethanes using plant-biomass. At present, biobased PUs are derived from plant oil polyol. Since, multiple steps are involved in the manufacturing of polyols from plant oil, their cost is relatively high. Polyols derived from plant oils have been introduced into the urethane market but most of them have low hydroxyl value and secondary hydroxyl structure which is less reactive.

In this work, soymeal (residue remaining after extraction of oil from soybean) was directly used without any pre-treatment for the synthesis of polyols using transamidation process. This
is two-step process where soymeal is reacted with ethanolamine to give amine derivatives which are then reacted with propylene carbonate to give polyols. The soymeal polyol was characterized for hydroxyl value, amine value, viscosity and percent insoluble. The soymeal polyol has primary as well as secondary hydroxyl groups and the hydroxyl value is suitable for making rigid polyurethane foam. These polyurethane rigid foams have many applications in insulation, appliances, packaging and construction. 

There is no pre-treatment of soymeal before using it or there is no generation of waste during synthesis of polyols. The soymeal polyol has primary as well as secondary amines which reduces amount of catalyst used for making polyurethanes and by reducing amount of catalyst we reduce amount of volatile organic carbon in polyurethanes.

The above process can be used for any protein biomass residues (e.g. algae protein, DDGS). Thus, the polyols derived from these protein biomass residues can be used with or without petroleum based polyols to make polyurethanes. These biobased materials offer the value proposition of a reduced carbon footprint as well as decreasing our dependence on non-renewable fossil resources.

**Tinqiao Chen**  
Department of Counseling, Educational Psychology and Special Education  
The Study of Diffusion of Climate Change Information (Lake Levels and Freeze Thaw Cycles) in Great Lakes Region

In this research project, we study how information about lake levels and freeze thaw cycles diffuse in Great Lakes region with methods in social network analysis. Lake levels and freeze thaw cycles are two important topics related to climate change in Great Lakes region. Once some new research results come out, it is interesting to know the process of new outcomes being known by other scientists, NGOs, stakeholders, etc. In particular, we are interested in studying the relationship between social structure (i.e. the location of the person relative to other people in the sociogram, e.g. a person could be a bridger connecting two clusters) and how their opinion about lake levels and freeze thaw cycles change. We collected two-mode network data and longitudinal survey data. The two-mode data are attendance data of people attending conferences, meetings, workshops, etc. related to lake levels and freeze thaw cycles. Surveys were used to collect peopleâ€™s opinion about lake levels, freeze thaw cycles and other demographic data. We were about to finish collecting the 2nd-round of survey data next week. In addition, sensitivity analysis is also incorporated in the research to address the external validity issue in 2-mode network analysis, for example we might miss some 2-mode network data in our research; there might an important climate change event that we donâ€™t know about. In particular, we will calculate an index indicating what proportion of cases we will add from the unobserved population to the current sample to invalidate the inference from the currently observed data.
Lauren Costatini
Biosystems and Agricultural Engineering
Age of Italian Ryegrass Effect on Phosphorus Release in Freeze-Thaw Cycles

Eutrophication occurs when an overabundance of the nutrients phosphorus and nitrogen enters water sources and stimulates an excessive amount of algae growth, leading to oxygen depletion and decreased water quality. A major source of nonpoint phosphorus pollution is farms, which apply phosphorus-rich fertilizers and manure to the land. The use of cover crops is widely advocated as a way to decrease nutrient runoff and soil erosion, but recent research has suggested that despite its success in decreasing particulate phosphorus loss, cover crops such as Italian ryegrass (Lolium multiflorum) increase the concentration of soluble phosphorus being discharged, which can directly enter tile drains. This release of soluble phosphorus is heightened during winter freeze-thaw cycles when the changing temperatures damages cell membranes. This project sought to examine the risks of planting Italian ryegrass later in the season, by comparing its age with its level of phosphorus release after undergoing a freeze-thaw event. The ryegrass was examined during a period of vigorous growth and after becoming well-established (approximately five and nine weeks after seeding, respectively). The intent of this experiment was to provide information to assist farmers in understanding the environmental impacts of planting cover crops later in the season.

Mahlet Garedew
Biosystems and Agricultural Engineering
Biomass Conversion to Fuels and Biochar to Displace Fossil Fuels and Provide Carbon Sequestration Strategies

With current energy crisis and the implication of burning fossil fuels as one of the major contributors to climate change, the production of fuels from biomass has become a very important current topic. Biomass fast pyrolysis (BFP), which uses heat (400-600°C) without oxygen to convert biomass to bio-oil, biochar and combustible gas, offers an alternative to fossil fuels and a means to alleviate the environmental impact of fossil fuel use. The biochar co-product can be used for the removal of pollutants in the environment and has potential for use in soil amendment and carbon sequestration. The combustible gas co-product is typically burned for process heat needed by the pyrolysis system. The major product, bio-oil, has the potential to displace liquid hydrocarbon fuels; however, bio-oil is highly oxygenated, corrosive, low in energy content and unstable during storage. Electrocatalytic hydrogenation (ECH) is employed to reduce and deoxygenate reactive compounds and improve bio-oil properties. The mild nature of electrocatalysis makes it more attractive than current catalytic hydrogenation schemes that require relatively high temperature and pressure. Additionally, electrocatalysis has the potential for utilizing other alternative sources of energy to provide the electricity needed for upgrading bio-oil to fuel intermediates. With the combination of pyrolysis and electrocatalysis, this process will maximize the yields of biomass conversion to fuels and value-added products while sequestering carbon and reducing environmental impacts of burning fossil fuels.
Excess levels of phosphorous have been cited as the highest source of environmental pollution in freshwater systems. This is primarily from point sources such as wastewater and industrial facilities and nonpoint sources such as agricultural runoff. These levels of phosphorous lead to high levels of eutrophication damaging natural ecosystems and increasing the risk of health hazards from cyanobacteria. The analyses of phosphorous has separated them into multiple species distinguished by factors such as water solubility, reactivity, and organic/inorganic state. Those that are soluble nonreactive phosphorus species (SNRP) have been shown to have a high Biologically Available Phosphorus (BAP) ratings. And are resistant to traditional wastewater treatment methods. Research was conducted to determine the possibility of SNRP removal using a porous, iron-based ceramic containing nanomaterials that has proven effective in soluble reactive phosphorous removal and recovery. Preliminary results show significant removal rates.

The Southern High Plains is one of the most productive agricultural areas in the country, but is threatened by the depletion of groundwater resources that are key to its high yields. Coupled land-use and surface water models indicate that land management decisions impact groundwater depletion and recharge, affecting the health of the aquifer and the future of agriculture in the region.

Groundwater plays an important role in improving the resilience of agriculture practices by mitigating the risk associated with unreliable and seasonal rainfalls. This has been an important driver in satisfying the food demand for an ever increasing population across the world. However, the inability to manage this large but limited freshwater reserve has resulted in a sharp decline in water table levels, with India being at the forefront of this problem. This study looks at the temporal trajectory of groundwater extraction in India over a 40 year time span during which well irrigation has evolved to become a central component of agriculture there. Using a systems approach, we identify the regional hot-spots of unsustainable groundwater extraction and then analyze its relationship with the environmental, economic and social components of the region. Early results indicate that the state of Punjab has been over-exploiting its groundwater resources since the early 1980’s with a 22% jump in groundwater extraction after the introduction of a free electricity policy, with a concomitant reduction in the number of marginal farmers by 36%. This is in contrast with the state of Tamil
Nadu, in which groundwater extraction is less severe, but the number of marginal farmers has increased.

**Yogendra Kanitkar**  
Environmental Engineering  
The Application of Loop Mediated Isothermal Amplification (LAMP) for Rapid Detection of vcrA, bvcA and tceA in Groundwater Samples

Typically, real time PCR (qPCR) based on the TaqMan probe or DNA binding dyes are used to quantify and monitor the in situ activity of Dehalococcoides spp. in groundwater. To date, a wide range of qPCR protocols to quantify 16S rRNA genes as well as the reductive dehalogenase genes such as vcrA, tceA and bvcA are available. Although qPCR methods have been successful for monitoring reductive dechlorination, alternate molecular methods that are faster and cheaper, may make the quantification of these genes easier. In this study, we developed LAMP assays for the rapid and specific quantification of the reductive dehalogenase genes vcrA, tceA, and bvcA in bioaugmented groundwater samples. The quantification of DNA templates with LAMP was compared to qPCR. Additionally, the use of direct amplification was investigated. For this, templates created from extracted biomass were analyzed with the developed LAMP assays. LAMP primers were designed for vcrA, bvcA, and tceA genes in Dehalococcoides spp. using Primer Explorer V4. The method was applied to two commercially available reductive dechlorinating cultures (SDC-9 and KB-1). Twenty one groundwater samples obtained from bioaugmented sites Concord, CA (3), Tulsa, OK (15), and Kelly Air Force Base, TX (7) were used to prepare triplicates of three amplification template types (DNA templates, direct cells, and centrifuged cells) for each sample. To evaluate the effectiveness of direct amplification templates for absolute quantification, quantification of direct cell and centrifuged templates were compared with DNA templates using plasmid standards for each gene. Detection limits were evaluated using plasmid standards for the three genes. All experiments were performed on a real time PCR thermal cycler. Quantification with LAMP using DNA templates was comparable to qPCR in KB-1 and SDC-9 microcosms over one growth cycle as well as in all groundwater samples (R2~0.99). Quantification using direct cells underestimated the target gene copies in groundwater samples compared to DNA templates. However, quantification was effective above >106 gene copies/L which is lower than 107 gene copies/L, the accepted threshold for natural attenuation. Current efforts involve establishing a quantitative relationship between gene numbers obtained with extracted DNA and those obtained with direct cells. If such a relationship can be established, then future monitoring efforts could occur without the use of DNA extraction. Future research will focus on improving the overall performance of LAMP in order to transfer reaction chemistries and template preparation methods to field deployable platforms.

**Caitlyn Kirby**  
Geological Sciences  
The Current State of Ethical Relationships Between Tribes and Climate Scientists: An Analysis of Interviews from Multiple Perspectives
Native American Tribes have a long history of adapting to ecological changes. Despite this history of successful adaptation, Tribes today are particularly vulnerable to the effects of climate change. Climate science organizations (CSOs) often work with Tribes on climate change adaptation and management plans. Climate scientists must consider Tribes’ histories, cultures, and specific vulnerabilities when interacting with Tribes or Tribal lands. The cultural understanding that scientists can develop in order to work effectively with Tribes can be facilitated through ethical STEM training. Our research is seeking to determine both the quantity and range of activities of ethical STEM at CSOs that work with Tribes, including how to create evaluation of this training that reflects Tribal values and perspectives. Through a collaboration between Michigan State University and the College of Menominee Nation, we developed interview protocols to ask individuals from different perspectives who work at the Tribes-CSO nexus about their experiences and the training they are aware of. Sixteen semi-structured interviews were completed (9=CSO and 7=Tribes) and interviews were analyzed via thematic content analysis. The importance of relationship building emerged from all interviews as a preliminary necessity to working with Tribes. Interviewees also identified themes that described the reasons for working at this nexus, the benefits and challenges of participating in such relationships, the ethical STEM training that is occurring, and how such training might be evaluated. This work will contribute to developing an ethical STEM training curriculum for climate scientists.

Eunsang Lee
Civil and environmental engineering
Chloroaluminium phthalocyanine Synthesis for transparent organic photovoltaics: tracking carbon, water and energy footprint

Metal phthalocyanine (M-Pcs) are macrocyclic compounds that are widely used as blue-green dye because of their adjustable absorption property and chemical stability. M-Pcs can also be used as electron donor material in organic photovoltaic (OPV) since they are organic semiconductor. Particularly, chloroaluminium phthalocyanine (ClAlPc) in thin layers absorbs only in the near-infrared region which allows their use in new applications such as windows. Energy solutions developed today should remain desirable in the future, and most importantly, not create new environmental issues. The goal of this work is to assess environmental impact of ClAlPc synthesis for two precursors using Life Cycle Assessment (LCA). Including all stages and multiple metrics, prevent trading one problem for another which is essential for studies at the energy/climate/water nexus. Two precursors have been mainly used to synthesis M-Pcs: phthalonitrile and phthalic anhydride. Although it is known that former precursor produces higher purity M-Pcs, latter precursor is preferred by the dye industry because of its lower cost. However, the phthalic anhydride process increases impurity in M-Pcs that could reduce the efficiency of OPV and produce more byproduct, mostly ammonia gas and carbon dioxide from urea as reactant. So far, ClAlPc synthesis has been performed under microwave at approximately 240 °C for one to two hours with refluxing aromatic hydrocarbon solvent having high boiling point. The reaction condition varies depending on the precursors since phthalic anhydride process requires two-step synthesis. This work presents comparison of two ClAlPc synthesis processes in terms of environmental impact assessed by LCA.
Yuanbo Li  
Plant, Soil, and Microbial Sciences  
Enantioselective separation and transformation of metalaxyl in tomato and cucumber

Metalaxyl is a chiral acylamine fungicide, belonging to the most widely known member of the amide group. Many studies showed the enantioselective transformation of metalaxyl in soil and animal, but little is known the enantioselective biotransformation of metalaxyl in plants. In this study, a sensitive and convenient chiral liquid chromatography coupled with tandem mass spectrometry (LC-MS/MS) method was developed for simultaneous measuring metalaxyl and its major metabolite metalaxyl acid enantiomers in tomato and cucumber. Separation was performed using reversed-phase chromatography on a Chiralcel OD-RH column, under isocratic conditions using a mixture of acetonitrile-water (60/40, v/v) as the mobile phase at flow rate of 0.4 mL/min. Then the proposed method was successfully applied to investigate the possible enantioselective transformation of metalaxyl as well as the formation of the metalaxyl acid in tomato and cucumbers. In two vegetables, the (-)-R-enantiomer was preferentially degraded, resulting in relative enrichment of the (+)-S-enantiomer. Furthermore, formation of the metalaxyl acid’s enantiomers also shown to be enantioselective, with the R-metalaxyl acid was formed at a faster rate. This is the first evidence of enantioselective transformation of metalaxyl in vegetables, and the results should be considered in future environmental risk and food safety evaluation.

Shengpan Lin  
Integrative Biology  
Algal biomass responses to climate change in Missouri reservoirs

Climate change and more intensive precipitation potentially bring more nutrients from lands to lakes, which together with global warming create perfect conditions for algal blooms. This hypothesis was tested in four reservoirs in Missouri, U.S.A. About three decades of algae biomass data were produced from Landsat TM imagery using a machine-learning algorithm. These whole-lake, long-term algal data set our research apart from previous studies. Linking the algal biomass data with climate change, we found that not all reservoirs significantly responded to climate change despite increasing lake surface temperature and more intensive precipitation. When lake surface temperatures were higher than 20-25 °C, which is suitable for Cyanobacteria, algal blooms did not necessarily develop, even after intensive precipitations. Our results imply that in complex aquatic systems, climate change impacts may not be as simple as we thought.

Meghan Marx  
Central Michigan University  
Oil in the Great Lakes: A Crude Analysis

Using Enbridge’s Line 5 pipeline that runs under the Straits of Mackinac as a case study, this report discusses the costs and history of twenty-two risks that result from oil spill
contamination. These risks are analyzed to determine their calculability and importance to the decisions made about the prevention and remediation of an oil spill event. The model, entitled the M-22, takes a look at everything from ecosystem recovery and tourism to commercial fishing and emotional harm. This comprehensive analysis provides a basis that is adaptable to the evaluation of any petrochemical contamination event.

Camille McCall  
Environmental Engineering  
Prevalence of Antibiotic Resistant Genes in a Conventional and Membrane Bioreactor Wastewater Treatment Plant

Wastewater treatment plants (WWTPs) are known environments for the presence and transfer of antibiotic resistant genes (ARGs), an evolving environmental pollutant. This study aimed to explore the prevalence of ARGs and antibiotic resistant bacteria (ARB) in two different (conventional and membrane bioreactor (MBR)) municipal WWTPs in Michigan (USA). A bioinformatics approach was implemented in order to detect ARGs in three metagenomes: activated sludge (AS), before disinfection (BD), and effluent, or after disinfection (AD) in each WWTP. Sequence alignment tools were used to align genetic material to two nucleotide ARG reference databases. Metagenomic alignment detected sulfonamide, tetracycline, macrolides, elfamycin, aminoglycoside, and β-lactamase to be prevalent (≥ 80% nucleotide homology) ARGs in both WWTPs. Effluent samples yielded the highest presence of ARGs in each plant compared to AS and BD samples. Quantitative analysis found that 57.89 and 41.67% of unique prevalent ARGs appeared after disinfection for the conventional and MBR WWTPs, respectively. Chlorine disinfection revealed a greater presence of ARGs in effluent samples relative to UV disinfection. The majority of persistent ARB detected were opportunistic pathogens associated with nosocomial or zoonotic infections. The occurrence of ARGs increased in both WWTPs as treatment progressed further suggesting that increased wastewater treatment selects for antibiotic resistance.

Bonnie McGill  
IBIO  
Carbon dioxide emissions and sequestration from agricultural liming and groundwater irrigation

Mineral carbon can act as a carbon sink or source depending on what it reacts with in soil. Row crop farmers routinely add mineral carbon to soils in the form of crushed lime (e.g., calcite, CaCO₃, or dolomite, CaMg(CO₃)₂) and/or inadvertently as bicarbonate (HCO₃⁻) alkalinity naturally dissolved in groundwater used for irrigation. The fate of these carbonates depends in large part on nitrogen fertilization and nitrification. This potentially variable fate of lime carbon depending on nitrogen fertilization is not accounted for in the IPCC greenhouse gas inventory model for lime emissions and irrigation is not accounted for at all. At the Kellogg Biological Station LTER site, we are collecting soil water from the vadose or unsaturated zone of a corn-soybean-wheat rotation across a nitrogen fertilizer gradient with and without groundwater irrigation. Irrigation is a significant source of both alkalinity and nitrate in drier years, compared to normal rates of liming and fertilization. The upper vadose zone is
dominated by carbonate-leached glacial outwash. We analyze the porewater stoichiometry of calcium, magnesium, and bicarbonate alkalinity in a conceptual model to reveal the source/sink fate of inorganic carbon. High nitrate porewater concentrations are associated with net carbon dioxide production in the carbonate-leached zone, according to our model. This suggests that the acidity associated with nitrification of the nitrogen fertilizer, which is evident from soil pH measurements, is driving the ultimate fate of lime carbon in the vadose zone.

**Tula Ngasala**  
Civil and Environmental Engineering  
Analysis Of Water Quality, Water Scarcity And Leading Factors To Using Contaminated Water Sources In Rural Communities

Water scarcity and poor water quality are major challenges facing many rural areas where agriculture and livestock keeping are their main activities. Surface and groundwater sources are highly polluted due to poor water resource management and lack of modern agricultural practices. Families’ well-being are being affected due to poor access to water sources, seasonal availability and their economic status. The water quality of surface, shallow wells and deep wells in Naitolia Village, Arusha, Tanzania was determined to identify the extent of contamination. Water Quality Index (WQI) for pH, nitrate, nitrite, ammonia and turbidity was used to show the overall water quality for each water source. Households were surveyed to identify factors that contribute to poor access and reliability to water sources. Results showed the maximum contaminant levels from all water sources exceeded W.H.O standards. Surface water, shallow wells and deep wells had the WQI of 1973, 833 and 58 respectively (≤50-excellent, >300-poor). Survey responses showed that more than 80% of this community use water sources that are highly contaminated, less than 19% of the population have access to deep wells. Although deep wells are the least contaminated, after considering other factors such as distance to water sources, economic status, seasonal availability and water quality, it was found that, in terms of access and quantity, boreholes were the least reliable, shallow wells were the most reliable followed by surface water. Improving the existing water resources is one of the sustainable solutions to improve health and well-being of families of Naitolia.

**Stephen Plont**  
Department of Geological Sciences, Michigan State University  
Using mesocosms to assess controls of flocculant organic rich sediments on organic carbon and nitrate chemistry at the stream-groundwater interface

Flocculant, organic-rich sediment (floc) deposits are ubiquitous throughout low land streams. However, the current understanding around the nature of floc deposits as a control on biogeochemical cycles in stream systems is lacking. We hypothesize that floc deposits are a significant control on stream-groundwater interface (i.e., hyporheic zone) chemistry, because they function as a source of organic carbon, nutrients, and trace elements. To test this, a hyporheic floc manipulation experiment was conducted using in situ streambed flow-through mesocosms. Mesocosms were inserted into groundwater upwelling sites along a second-order reach of Augusta Creek (Michigan, USA). There were three floc addition treatments, each using
unique floc sources with the Augusta Creek watershed, and one control. Hyporheic porewater samples, along with surface water and groundwater samples, were collected twelve days after the floc addition at four discrete depths in each mesocosm using MINIPOINT samplers. Samples were analyzed for dissolved organic carbon (DOC), nitrate, and various ion concentrations, as well as DOC optical properties, to infer DOC qualities. Results indicate that the floc treatments had no persistent effects on hyporheic DOC quantity or qualities, likely due to the rapid flushing of hyporheic porewaters from upwelling groundwater or fertilization of stream sediments by highly labile DOC and nutrients. Currently, laboratory analysis and experiments are being performed to assess the bioavailability of floc DOC and the nature of the microbial activity in the floc treatments to test these hypothesis, and to further understand the nature of floc as a nutrient source for biogeochemical cycles in stream systems.

M. Melissa Rojas Downing
Biosystems and Agricultural Eng. / ESPP
Vulnerability of Grazing Dairy Systems to Climate Change in Michigan

Livestock systems are being impacted by climate change, mainly due to the seasonal variability in temperature and precipitation. Among these systems, grazing livestock is likely to be the most impacted due to its dependency on feed quality and availability of pastureland. Therefore, adaptation strategies should be implemented to reduce the negative impacts of climate change. The goal of this study is to identify the best pasture composition for a representative grazing dairy farm in Michigan. The representative farm was established based on the results from several surveys that were performed in the Lower Peninsula regarding typical management strategies. Next the collected information was incorporated into the Integrated Farm System Model (IFSM) to evaluate the effectiveness of the adaptation strategy concerning economic and resource use criteria. Several pasture compositions were evaluated in this study consisting of a mixture of cool-season grass species (Orchardgrass, Perennial ryegrass, Kentucky bluegrass and, Tall Fescue) and legume species (white clover and red clover). Each pasture composition was evaluated under both current (21 climate models) and future (42 climate models) climate scenarios. Considering the economic and resource use criteria, the best pasture composition was identified as a mixture of 50% perennial ryegrass and 50% red clover.

Sophia Tanner
AFRE
How Willing Are Landowners to Supply Land for Bioenergy Crops in the Northern Great Lakes Region?

Land to produce biomass is essential if the United States is to expand bioenergy supply. Use of agriculturally marginal land avoids food vs fuel problems and carbon debt associated with crop and forest land. Recent remote sensing studies have identified large areas of U.S. marginal land deemed suitable for bioenergy crops. Yet the sustainability benefits of growing bioenergy crops on marginal land only pertain if land is economically available. Scant attention has been paid to the willingness of landowners to supply land for bioenergy crops. Focusing on the northern tier of the Great Lakes, this contingent valuation study reports on the willingness
of a representative sample of 1107 private landowners to rent land for three bioenergy crops: corn, switchgrass, and poplar. Of the land that was agriculturally marginal, they were willing to make available no more than 21% for any bioenergy crop (switchgrass preferred on marginal land) at double the prevailing land rental rate in the region. On forest land, which makes up more than half the land area, they would rent up to 15% for bioenergy crops (poplar preferred). Regression results identified deterrents to land rental for bioenergy purposes included appreciation of environmental amenities and concern about rental disamenities. In sum, landowners in the Northern Tier are reluctant to supply marginal land for bioenergy crops. If rental markets existed, they would rent more crop and forest land for bioenergy crops than they would marginal land, which would generate carbon debt and opportunity costs in wood product and food markets.

Jean-Rene Thelusmond
Civil and Environmental Engineering
Carbamazepine Biodegradation, Putative Carbamazepine Biodegrading Phylotypes and Xenobiotic Degrading Genes in Agricultural Soils

The antiepileptic drug carbamazepine (CBZ) has been introduced into agricultural soils via irrigation with treated wastewater and biosolids application. Such contamination is problematic given CBZ recalcitrance and its unknown risks to the ecosystems or human health. This study examined CBZ biodegradation in two agricultural soils (4 and 6) and its effects on the soil microbial communities. The experimental design involved three CBZ concentrations, aerobic and anaerobic conditions and two sampling events. CBZ concentrations were determined using a modified QuECHERS approach, solid phase extraction and LC MS/MS. The effect of CBZ on the soil microbial community was investigated using high throughput sequencing and a computational approach predicting functional composition of the metagenomes (PICRUSt). The most significant CBZ biodegradation occurred in soil 4 under aerobic conditions. Contrastingly, CBZ biodegradation was limited under anaerobic conditions in soil 4 and under both conditions in soil 6. For soil 4, several phylotypes were enriched following CBZ degradation compared to the controls. These phylotypes are considered putative CBZ degraders as they appear to be benefiting from CBZ biodegradation. In contrast, numerous phylotypes decreased in abundance following CBZ exposure. PICRUSt revealed a greater abundance of xenobiotic degrading genes in soil 4 compared to soil 6.

Xiaoyu Wang
Civil and Environmental Engineering
Utilizing fermentation byproducts to enhance hydrogen production using spinel photocatalysts

It is important to find clean, renewable energy sources which are more abundant, have a lower-cost, and produce less pollution than fossil fuels. One route to this goal is to use sunlight and a semiconductor photocatalyst to produce hydrogen. In this process sunlight excites electrons from the valence band of the photocatalyst into its conduction band where the electron may reduce water or H+ to hydrogen. Unfortunately the efficiency of this process is very low due to rapid electron-hole recombination. One way to enhance the efficiency of this
process is to use a hole scavenger to reduce the extent of electron-hole recombination. In this work the effect of various hole scavengers found in wastewaters, such as alcohols and organic acids, on photohydrogen production is being investigated. The ultimate aim of the study is to produce hydrogen while also reducing the amount of these waste products in the water.

Meredith Zettlemoyer
Plant Biology/Michigan State University
The effect of habitat variation and disturbance on local plant extinctions

Anthropogenic disturbance and land alteration driven by urbanization and agriculture produce high local extinction rates and are the primary cause of decreasing biological diversity. Although rare species and habitat specialists may be at a greater risk due to localized disturbances that fragment and alter their niches, we have a limited understanding of how habitat type and functional groups influence local extinctions. Examination of a large sample of species can reveal the traits that influence the distribution of taxa across habitats and inform their vulnerability to local extinction. We use historical data from Kalamazoo County, MI, to investigate habitat-specific patterns of diversity decline, correlate disturbance with species loss, and examine what functional groups may be at risk. A model testing the role of community, rarity, disturbance, genus, and several species-specific factors on the current status of local species was developed to investigate the role of disturbance and habitat in local extinction rates. Certain habitats, namely prairies and wooded wetlands, experience high rates of extinction, and this habitat variation is important for the persistence of regionally rare species. This suggests that management needs to focus on spatially differentiated patterns of diversity loss. Disturbance affects community composition differently depending on habitat characteristics, and is especially harmful to locally rare species. Finally, we find that functional groups, namely natives, forbs, and habitat specialists, are more vulnerable to local extinction. Understanding spatial and taxonomic patterns of local extinctions will aid in identification of the species and habitats that are most in need of conservation attention.