2020 Sustainability Scholars Project List

Project 1: Exploring the Health and Safety Risks Associated with Combined Exposure to Pesticides

Dr. Kan Shao, Assistant Professor, Public Health

Typically, the safety of pesticides is evaluated on an individual basis and safety reference levels are determined in the same manner. Pesticides, however, are often used in combinations in order to create the desired results. Therefore, it is critically important to understand whether exposure to pesticides mixtures can impose higher risk on human health even if each pesticide is below its reference level. This study starts with investigation on commonly detected combinations of pesticides. The toxicological properties of each individual pesticide will be first reviewed and understood based on existing literatures. Then, extended literature search will be conducted to identify studies, experimental data or other useful information, which can help us better understand the toxicity of the mixtures. Based on the collected evidences, we aim to qualitatively or even quantitatively (if available data permit) determine if the commonly detected pesticides mixtures are more toxic. The results can inform regulatory agencies if safety reference levels are adequate and appropriate given the real-world potential for exposure to combinations of pesticides.

Desired skills and interests: interest in health sciences, strong written and verbal communication skills, literature search, analytical skills

Project 2: Climate Adaptation, Agricultural Practices, and Public Health

Dr. Khalid Khan, Assistant Professor, Environmental Health

Want to investigate how climate change affects health of rural people living in an agricultural community in a developing country? There is an opportunity to work with Dr. Khan on an ongoing project in Bangladesh that aims to explore public health challenges and environmental governance systems associated with the new climate change adaptation approaches in the agricultural communities. In collaboration with Dr. Khan, the student will review literature and prepare survey questionnaire to collect preliminary data on the exposure, food security and current health from people living in coastal areas in Bangladesh. Following data collection, the student will prepare a report describing the major health effects associated with climate change events such as increased use of pesticides, increased survival of vectors, salinity and heat waves. The student will be involved in all phases of the research process—from literature review, to survey development, and finally analysis and summary of findings.

Desired skills: familiar with Microsoft Office software, some knowledge/interest in statistics

Project 3: Restoring Native Prairie with Turf as a Pre-Treatment?

Dr. Heather Reynolds, Associate Professor, Biology

Natural landscaping uses native plants to create beautiful, healthy, cost-effective, resource efficient and biodiversity-promoting alternatives to lawns and conventional plantings. However, it can be challenging to establish stable natural plantings on previously disturbed soils. Pilot work suggests that prairie plantings on former lawn establish more sustainable, weed-free plantings compared to areas formerly under mixed herbaceous vegetation (e.g. old field). This project would build on prior experiments to test the effectiveness of turf as a prairie
planning pre-treatment, and explore underlying mechanisms. Key tasks involve design and execution of a greenhouse experiment and testing native plant community establishment and weed bank viability as a function of soil history (e.g. turf, non-turf).

Desired skills and interests: plant ecology interest, experience with or strong interest in vegetative surveys, plant-soil interactions. Prefer basic understanding of Microsoft excel and some basic familiarity with statistics.

**Project 4: Can Weeds Be Effective as Mulch in Organic Agriculture Systems?**

Dr. Heather Reynolds, Associate Professor, Biology

Mulch is organic matter used as a ground cover around crop or other target plants in order to smother weeds, hold in moisture, add organic matter and nutrients to soil, and even reduce pathogens and pests. Mulch is therefore an important technique in organic agriculture, which relies on non-chemical means of crop production. However, mulch can be expensive and, in the case of plastic mulch, fossil fuel intensive and non-recyclable. Weeds have potential as a source of mulch, especially for small organic farmers who struggle to keep costs and external inputs low. Certain weed species produce large quantities of biomass rapidly and reliably. This project would assess and test the most promising species of weeds as a mulch for vegetable crops. Key tasks involve weed surveys of local organic farms and at the Hilltop Garden, and design and execution of a greenhouse experiment testing the effects of different weed species on crop yield.

Desired skills and interests: plant ecology interest, experience with or strong interest in vegetative surveys, plant-soil interactions. Prefer basic understanding of Microsoft excel and some basic familiarity with statistics.

**Project 5: Identifying Optimal Composting Protocols for Hilltop Garden**

Dr. Heather Reynolds, Associate Professor, Biology

Compost is a humus-like product that results from the decomposition of organic material under controlled conditions, and it can be valuable as a source of essential nutrients for plant growth. Hilltop garden has several compost bins, a fan system to provide oxygen to the compost, and control of the mix of organic inputs for composting. This student would review the literature on optimal composting techniques and then apply a variety of treatments (different oxygen, and nutrient inputs) to identify an optimal compost procedure at Hilltop garden. The location in the Hilltop greenhouse allows for year-round data collection and the outcomes will be used to provide high nutrient soil to Hilltop and the Campus Garden.

Desired skills and interests: plant ecology interest, experience with or strong interest in vegetative surveys, plant-soil interactions. Prefer basic understanding of Microsoft excel and some basic familiarity with statistics.

**Project 6: Visualizing the Energy System**

Dr. Shahzeen Attari, Assistant Professor, School of Public and Environmental Affairs

From phones, to computers, to air conditioners, we are completely reliant on electricity but mostly oblivious to where it comes from, how it is created, and how it is distributed. In this project, students at SPEA and other departments will be asked to draw and describe the entire electricity system, from generation to distribution. These diagrams will then be coded and compared to an accurate diagram for analysis. The goal of this project is to understand the prevailing misperceptions of how students at IU conceptualize the entire electricity system and determine which factors predict accurate depictions. The key tasks associated with this project may include: literature review, creating the paper survey, pretesting the survey thoroughly, disseminating the survey across a
wide spectrum of classes, data entry, coding each of the student drawings, cleaning the data, performing preliminary analysis. The selected student would be working alongside a SPEA graduate student and Dr. Attari.

Desired skills and interests: Dedicated, hardworking, and detail-oriented. Strong interest in decision-making, sustainability, energy, and systems thinking. Qualified female and minority students would also be desired.

**Project 7: The Rise of Local Orchards in the U.S.: Trends and Impacts on Local Food Systems**

Dr. James Farmer, Assistant Professor, Recreation, Park, and Tourism Studies

Community gardening projects have long been a part of American culture and tradition, with the number of programs and participants increasing greatly during economic recessions and periods of political and social unrest. Recent interest in local food has led to an increase in such projects, particularly the development of "green infrastructure," which has the dual goal of increasing community resilience and bolstering food security. A more contemporary conception of community food initiatives recently emerged on the urban agriculture scene in the form of community orchards. Community orchards are a growing part of this green infrastructure, blending notions of the commons with traditional narratives of community gardens, however, little is understood about how they are conceived, organized, or their impacts. The selected undergraduate researcher will assist with the creation, distribution, and analysis of a survey to community orchards (and their participants) from across the United States. The survey will explore the driving force(s) behind the growth of community orchards, the diversity of governance systems employed in these orchards, how engagement with orchards may impact human-nature connections, and other key themes. Results will contribute to the effectiveness of existing and future orchards, and bring orchards into the growing body of literature on alternative food projects.

Desired skills and interests: local food and alternative food networks. Interest and/or experience with social science research. Interest in quantitative and qualitative research. Excellent writing skills.

**Project 8: Evaluating Ecological Health of the Jordan River Using Chemical, Physical, and Biological Indicators**

Dr. Thomas Simon, Adjunct Professor, School of Public and Environmental Affairs

The Jordan River is an aesthetic centerpiece of the IU Bloomington campus and was identified in the 2010 Campus Master Plan as a target for future restoration. This research examines the ecological health of the Jordan River watershed, from Hilltop garden and Aquatic Center tributaries to the Indiana Avenue bridge. The study uses a geometric grid design to evaluate chemical, physical, and biological indicators. The student will be involved in the collection of monthly samples of nutrient levels, chemical-physical parameters, qualitative assessment of the watershed habitat, biological indicators, as well as an assessment of land cover using geographic information systems (GIS). The goal is to use existing data and new data collection to produce a "State of the River" report that can inform campus restoration efforts.

Desired skills and interests: interest in environmental issues, especially aquatic resources. Willingness to do fieldwork. Experience or interest in statistics and GIS.

**Project 9: Interdisciplinary Assessment of the Desired Future Condition of the Jordan River**

Dr. Stephanie Kane, Professor, International Studies

Students, faculty and staff walk by the Jordan River daily as they conduct their business on campus. But, what does the Jordan River mean to the campus community, and how does our view of it shape its future? The goal of this project is to understand current campus-wide perceptions of the Jordan River and identify a preferred future
condition for the river. The student will use current information on the biological, chemical, structural condition of the river to engage members of the IU community in discussions about the desired future condition of the Jordan River. The student will work with a broader group of researchers interested in the biophysical status of the river to ensure those characteristics are accurately described, and will work closely with Dr. Kane to learn how to conduct ethnographic fieldwork which may include participant observation, visual image documentation, informal and formal interviews, as well as textual analysis. The chosen student will engage the university community, identify important themes in the data, and report key findings. The findings will be shared with the IU Architect’s Office and will inform their planned Jordan River restoration efforts.

**Desired skills and interests:** passionate about campus aesthetics and ecological health. Interest in qualitative research approaches that bridge the natural and social sciences.

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**Project 10: Exploring the Potential for Geothermal Heat Pump Systems on the IU Campuses**

Kevin Ellett, Research Scientist, Indiana Geological Survey  
Shawn Naylor, Director, Center for Geospatial Data Analysis, Indiana Geological Survey

Broad implementation of geothermal heat pump systems may be a game changer for achieving IU’s sustainability goals because of the potential for significant reductions in energy use for heating and cooling buildings. Recent research on geothermal heat pump systems suggests that enhanced geological characterization during the system design phase may lead to significant cost savings on initial capital expenses associated with the ground heat exchange component. Such CAPEX savings will reduce the payback period which could ultimately push geothermal technology to the standard approach for HVAC at campus buildings. Geothermal technology will also help IU meet its newly implemented requirement for LEED Gold status on all new buildings. This project will involve data collection and analysis to support the broader evaluation of the potential for geothermal heat pump implementation throughout the IU system. The project will leverage the extensive rock core holdings and other instrumentation and data collections of the Indiana Geological Survey to develop a database of critical geothermal parameters associated with specific building locations at IU campuses across Indiana.

**Desired skills and interests:** detail-oriented and fast learner. Familiarity with spreadsheets, databases, GIS software, and/or computer programming is desirable. Interest in geothermal/renewable energy and geology is preferable.

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**Project 11: Sustainability Potential: U.S. Breweries and Renewable Energy**

Dr. Sanya Carley, Associate Professor, School of Public and Environmental Affairs

Breweries use a significant amount of energy, yet also have significant potential to incorporate sustainability practices. For example, breweries could install solar photovoltaic panels and bio-digesters to provide at least a portion of their energy during brewing time, the most energy-intensive time of their operation. Breweries also have a significant amount of organic waste that can be reused in other applications. Several breweries across the country have invested in solar panels and digesters, as well as other sustainability efforts. This research project will explore the greenhouse gas emissions savings possible if all breweries were to adopt similar practices, and the cost-effectiveness of such efforts in a dollars per greenhouse gas emissions savings estimate.

**Desired skills and interests:** strong quantitative, research, and writing skills.
**Project 12: Impact of Annual Variation in Winter Weather on Differential Migration**

Dr. Adam Fudickar, Postdoctoral Research Associate, Department of Biology  
Dr. Ellen Ketterson, Distinguished Professor, Department of Biology

In order to predict the consequences of future climate change, it is necessary to know more about how populations respond to change. Migratory birds are perhaps some of the most vulnerable animals to climate change. Throughout the annual cycle migratory birds traverse 1000’s of kilometers, utilizing resources in diverse habitat in order to survive for another chance to reproduce. However, it is this reliance of migratory birds on sustained suitability of habitat and climate on continental and global scales that requires immediate study of the impact of alterations to the environment in all seasons of their annual cycle. Differential migration, in which the distance migrated by individuals within populations differs by sex or age or some other attribute, is common among migratory bird species. This project will examine how annual variation in winter weather affects differential migration in migratory birds. The undergraduate researcher will be involved in the capture of the dark-eyed junco (a bird species that shows differential migration), taking a variety of morphological measurements, and conducting statistical analysis (with support of faculty mentors) to address key research questions.

Desired skills and interests: comfortable working outside, self-directed, has personal transportation to get to off campus banding station.

**Project 13: Historical Ecology of Campus**

Dr. Jim Capshew, Associate Professor, Department of History and Philosophy of Science

The IU Bloomington campus is where we work, where many of us live, and we are all fortunate to spend time on a campus that is nationally recognized for its natural beauty. But, what do we know about the origins of the campus and how does that inform future decisions about the campus landscape? The chosen student for this project will be involved in an ongoing research project to document the biological, environmental, and human history of the IU Bloomington campus, from 1883 to the present. The goal of the project is to strengthen sense of place in the IU community, a key feature of sustainability. Among the major analytic themes are: biological inventory of land purchases and changing uses; the origins and extensions of the “woodland campus” idea; changing perceptions of the campus design; and the intertwined roles of greenscape and architecture. Among other sources, the student will be using valuable collections in the IU Archives.

Desired skills and interests: A basic understanding or interest in the process of historical research, ability to seek out a variety of materials (textual, visual, observational, etc.), and a curiosity about how the past relates to the present.

**Project 14: Reactivating the Regional Weather Research Forecast Model for IU Bloomington**

Dr. Paul Staten, Assistant Professor, Atmospheric Sciences, Department of Geological Sciences

How well can one trust a rain forecast in Bloomington? Do national weather models provide detailed enough guidance to make water and energy use decisions, or can a regional model do better? In this project, students will reactivate the regional Weather Research Forecast model, and schedule daily forecast simulations on the Big Red II supercomputer at IU. The model has been run recently by a previous undergraduate student, and just needs some attention to get it running regularly once again. Once the model is running, we will evaluate our regional forecast against national forecasts. Finally, the student will consult with campus operations, and create guidance products.
for their use – like evaporation rates, and heating-degree-days and cooling-degree-days – to be hosted online at http://atmos.indiana.edu/weather. Expected outcomes include an appreciation for campus energy and water use management, an understanding of the weather forecast process, and the extraction of useful information from big data. The undergraduate student will work with Dr. Staten and consult with campus operations staff.

Desired skills and interests: A student that is consistent, curious, and computer-literate. Female and minority students are encouraged to apply.

Project 15: Large Scale Solar and Peak Demand: Estimating the Costs and Benefits for IU

Jeff Kaden, P.E., LEED AP, Director of Energy Management and Utilities

Solar (photovoltaic) panels are a promising technology for renewable, sustainable energy. Photovoltaic panels (PV) to produce power are installed to reduce kilowatt hour (KWH) consumption. In addition, they are a possible tool to reduce kilowatt (KW) demand. Since both KWH and peak KW demand are factors in our power bill (each about half the bill), reducing both is beneficial, and estimating these reductions is important to an overall assessment of the costs and benefits associated with large scale solar. This project will focus on understanding how PV often shifts the timing of peak demand and how that shift in timing reduces energy costs. The analysis will include a study of typical IUB load profiles seasonally or even monthly (using existing IU data) compared to a typical PV array output (from web search and research into various PV projects). The student will work with the Director of Energy Management and Utilities and other personnel with IU physical plant to acquire the needed data and complete this analysis.

Desired skills and interests: interest in renewable energy, quantitative skills and interest in quantitative analysis. Persistence.

Project 16: Sea Level Rise and the Patterns and Processes of Land Loss on the Mississippi Deltaic Plain

Doug Edmonds, Assistant Professor of Geological Sciences and Sedimentology

Deltaic coastlines are in danger of drowning under rising relative sea level and sediment retention behind dams. The Mississippi River Deltaic Plain (MRDP) is a particularly poignant example of deltaic land loss: every hour a football field’s worth of coastal wetlands disappears. Understanding the future of the MRDP is critical because it accounts for 15-25% of US hydrocarbon production, and 30% of the coastal fishing revenue. Understanding the processes of coastal land loss associated with drowning is needed to restore the MRDP and develop strategies to mitigate future hazard. This project will focus on documenting processes of land loss in the MRDP from the time period of 1984-2014 using freely available remote sensing data. Specific questions could include, but are not limited to, what are the effects of hurricanes on land loss? Are there hotspots of land loss (or growth) within the MRDP? How does the rate of land loss change as a function of relevant independent variables? Tasks will include learning how to use Google Earth Engine. Google Earth Engine is a powerful remote sensing tool that allows users to access pre-downloaded and compiled remote sensing imagery with unprecedented ease. Key tasks will include building a remote sensing database, distinguishing between land and water from reflectance data, calculating land loss rates, and assessing patterns of land loss relative to independent variables.

Desired skills and interests: Enthusiasm to understand natural and human dynamics of earth’s surface and interest in coastal environments. Preferable skills include familiarity with basic knowledge of computers, principles of remote sensing, and coding languages. Knowledge of JavaScript is not required, but a plus. Other relevant languages that will help in learning JavaScript include Python, C, C++, and Fortran.
Project 17: Evaluating Changes in the IU Woodland Campus from 2007-2008 to Present.

Dr. Kim Novick, Assistant Professor, School of Public and Environmental Affairs

IU Bloomington’s woodland campus is essential to campus sustainability and essential to its reputation as one on the nation’s most beautiful college campuses. The Indiana University Office of Sustainability (IUOS) in collaboration with the IU Campus Division is in the process of developing a geographic information systems (GIS) inventory of all trees on the Bloomington campus. This project involves updating tree inventory data for a subsection of campus and comparing the updated database with data collected in 2007-2008. Between 2007-2008, the woodland campus has experienced a tornado, severe drought, as well as other disturbances and the student will explore how these disturbances have impacted tree health, diversity, and overall canopy cover. The project involves updating the tree inventory using a GPS unit or the Arc Collector app. The student will also become familiar with updating the overall tree inventory using ArcGIS online. Outcomes will be shared with Campus Division as well as the IUOS Environmental Quality and Land Use working group and inform long-term efforts to sustainably manage the woodland campus.

Desired interests and skills: Experience or strong interest in learning ArcGIS software. Some tree identification skills or strong desire to learn those skills. Willingness to work outside.

Project 18: Improving Accessibility to Real Food at IU Bloomington

Dr. Dan Knudsen, Professor, Department of Geography

How much of the food served on campus qualifies as “real food” and what can be done to increase that number? The goal of this research is to analyze existing data on IU food purchases and use the findings to create recommendations for increasing the purchase of “real food” at IU. IUOS currently has a class in the Department of Geography that runs the Real Food Challenge Calculator (hereafter RFCC) on purchases by campus food units (RPS, etc.) each fiscal year. This generates a host of data concerning food purchases, however, output from the RFCC is cumbersome and not condensed in form that can be easily used by food purchasing units. This chosen undergraduate researcher will be involved in data analysis that will eventually lead to the development of a “real food ordering guide” for the campus.

Desired interests and skills: reliable, eager and not easily discouraged, coachable, and an excellent communicator.

Project 19: Comparing U.S. and E.U. Food Labeling Regulations and their Impacts on Consumers

Dr. Dan Knudsen, Professor, Department of Geography

Many in the US argue that the EU is “ahead of the curve” on food labeling. They suggest that consumers want to know more about their food and that they are being frustrated by large food corporations. There are also public health benefits to straightforward food origin trace-ability. Others argue that the EU requires “over-labeling” and that too much information on labels scares and confuses consumers. Further, they argue that consumers don’t really care or want to know about the origin of their food. The main goal of this research is to compare U.S. food labeling regulations with those used by the E.U. and project how altering U.S. food labels regulations would impact business, politics, and consumers. Key tasks associated with this project include: becoming familiar with labeling regulations; critical evaluation of whether or not E.U. labeling systems can be used in the U.S.; estimating increased cost to consumers; and potentially others.

Desired interests and skills: reliable, eager and not easily discouraged, coachable, and an excellent communicator.
Project 20: Transportation Safety in the IU Bloomington Community: As Observational study of behavior, context, and engineering at busy IUB Intersections

Scott Robinson, Planning Services Manager, City of Bloomington Planning and Transportation Department

This research will identify predominant travel behaviors that either distract individuals from making proper decisions, contradict with widely accepted “rules of the road,” or otherwise creates a near miss accident situation. This research may also include a sample survey for students/participants on their views of the “rules of the road” to use in comparison with any of the observed behaviors. Study methods will be devised to observe key hotspots on campus including: north end of Ballantine, corner of 7th and N. Forest, bike lane north of auditorium, intersection of 7th & Jordan, and the passageway between Art Museum and Wildermuth. This observational study will help identify any trends in behavior exhibited at these intersections that may impact the traffic safety or patterns at these intersections. The student will spend some time working outside to collect data and should be comfortable engaging with the general IU campus population. The goal of the study is to produce safety recommendations and/or identify needs for continued research, both of which will be shared with the City of Bloomington and the IUOS Transportation working group.

Desired skills and interests: Interest in travel management (bike, auto, pedestrian), hardworking and is willing to collect data outside is a variety of weather conditions. Must also be willing to approach members of IU community for survey purposes. Prefer strong analytic and writing skills.


Dr. Scott Shackelford, Assistant Professor of Business Law and Ethics, Kelly School of Business

Social entrepreneurship is the practice of applying business techniques to findings solutions to social problems. The increasing interest being paid to social entrepreneurship has brought with it the beginnings of a legal revolution in the way that firms are incorporated and managed; twenty-seven states have now enacted statues permitting the formation of special corporate entities known as benefit corporations (B-Corps). These businesses are permitted under B-Corp laws to pursue a public benefit or community purpose while still earning a profit for their shareholders. Yet, not all B-Corp statutes are created equal. This project analyzes the differences between how the Connecticut and Virginia B-Corp laws evolved in juxtaposition to Delaware, along with investigating their successes and challenges in an effort to identify best practices. Since different top-down and bottom-up approaches were taken to enact these laws leading to vastly different rates of uptake, Professor Elinor Ostrom and her colleagues’ theories of collective action, polycentric governance, and the Institutional Analysis and Design (IAD) Framework are used as a lens through which to view the promise and pitfalls of B-Corp laws as a vehicle to better understand what role they may play to further the cause of socially responsible corporate forms in the twenty-first century. The selected student will focus on Connecticut as a cases student, examining who pushed for the state’s benefit corporation statute, why, describe the campaign used to enact the law, as well as assessing outcomes from the passage of the law.

Desired interests and skills: interest in corporate social responsibility and sustainable development, some coursework or previous experience with journalism or business.

Paul Brunner, Associate Professor, Theatre, Drama and Contemporary Dance

Most audience members overlook the behind-the-scenes creation of live entertainment and performing arts. Theatrical production is assumed to be inherently wasteful. What is the waste stream in a theatre production, and how can it become more environmentally sustainable and/or respond to greener building techniques? Can traditionally low recycling rates be improved? The student will study current efforts in the field of sustainable design and production for live entertainment and become intimately familiar with live stage production. The student will study one or more theatrical productions at IU and identify a method to track the flow of materials and wastes. This may include stage scenery, properties, or other aspects of production. The student will work alongside Professor Brunner and one or more production staff to reveal the inflow and outflow of materials and wastes. They will identify misconceptions about the waste stream of a stage production, determine ways to address wastes in material use, and seek to reduce landfill refuse by exploring alternative opportunities for materials that are traditionally challenging to recycle.

Desired skills and interests: curiosity and passion for live theatre, performing or entertainment arts; a willingness to "get dirty" in gathering research data, ability to develop an approach to basic field data gathering, and an interest in hands-on and detailed oriented work.