2021 Symposium on Resilience Research for Global Development Challenges

September 30 & October 1, 2021

Program for Presentations for Thursday, September 30, 2021

With support from AIR International Programs partners

Morning Session 1-A
ENR2 S107 | 10:15am–12:00pm | Thursday, September 30

Time	Presenter	Title
10:15–10:25	**Karletta Chief** **Dept. of Env. Science**	**Indigenous Food, Energy and Water Security and Sovereignty during COVID-19**
	COVID-19 amplified food, energy and water (FEW) insecurities across the world and disproportionately impacted Indigenous communities. In the United States, COVID-19 is rampant on the Navajo Nation, the largest tribe in the United States where poverty rates (38%) are more than twice the state of Arizona (15%). Navajo tribal officials cite lack of healthy foods and running water as reasons for the prolific transmission resulting in one of the highest COVID-19 infection rates in the United States, third only to New York and New Jersey. The Navajo Nation is a rural food desert with only 13 grocery stores across the 25,000 square miles of remote terrain for a population of nearly 200,000 tribal citizens (8/sq.mi. on average). Comorbidities such as diabetes and cancer are prevalent due to environmental exposure from abandoned mines. In the United States, Native Americans have the highest rate of diabetes and arsenic-contaminated waters on tribal lands, including the Navajo Nation, increases the risk of diabetes, chronic kidney disease and cardiovascular health conditions. Furthermore, nearly 40% of remote Diné (Navajo) homes lack electricity and 30% lack running water. The Diné haul water from potable and non-potable sources 5-50 miles away incurring an enormous expense of $13.30 per 100 gallons. Community resilience is critical for Diné communities to respond to and recover from perturbations such as pandemics and disasters.	
10:25–10:35	**Ann Furbush** **Agricultural & Resource Economics**	**Family ties: Understanding household labor allocation for mitigating impacts of disasters, conflict, and COVID-19**
	The reverberating impacts of the COVID-19 pandemic have brought to the fore the hardships faced by households and individuals as they cope with ongoing shocks, including those from weather, conflict, civil unrest, and macroeconomic instability. Smallholder farmers across Sub-Saharan Africa (SSA) are particularly vulnerable to these various shocks, and thus employ a number of ex-ante and ex-post coping mechanisms. For these farming households across SSA, coping strategies often involve reallocation of resources, monies, and labor, within the family structure and larger household. In this work, we investigate livelihood diversification as one such strategy to manage the multiple stressors and compounding risks of COVID-19, climate, conflict and civil unrest, and other shocks. This research expands our understanding of the existing and emergent ways that households cope with various and compounding disasters. Understanding these household dynamics is vital to generate policies that appropriately mitigate and reduce risk, prepare for recovery, and cultivate household resilience to future shocks.	
10:35–10:45	**Nupur Joshi** **School of Geography, Development & Env.**	**COVID-19 lockdowns: Linkages between lockdown-induced employment disruptions, water access and hygiene practices in informal settlements of Nairobi**
	An estimated one billion people reside in informal settlements around the world. Informal settlements are more vulnerable to COVID-19 lockdown measures as they already lack basic services such as water, toilets and secure housing. In addition, the majority of urban poor work in informal labor markets, which have been significantly affected by government-imposed lockdowns, resulting in reduced income and resources including clean water. This study uses a cross-sectional design (n=533) to examine the intersecting and compounding vulnerabilities of households to employment loss, water access and hygiene practices during the first COVID-19 lockdowns (April to June 2020) in Kenya. Data were collected with households across three informal settlements in Nairobi in July 2020 using questions from the cross-culturally validated Household Water Insecurity Experience Scale (HWISE). Relationships between employment disruptions and water access were examined in addition to four hygiene practices such as hand washing, body washing, clothes washing and being able to use or drink clean water. We find that 96% of households indicated reduction in work during lockdowns, out of which 67% could not afford water more than 20 times a month since April. Households that indicated low water affordability and availability had lower hygiene scores. While the majority of households in the study sample used informal water sources, households that accessed water through tanker-trucks scored 1.32 points less on the hygiene score than households that used tap-points. Our empirical results highlight the double tragedy of informal settlements during the ongoing pandemic: low access to water at a time when water has become extremely important to follow hygiene guidelines and reduce disease burden.	

10:45–10:55	Kate Chambers College of Science	Assessing the barriers to and reasons for intention to vaccinate against COVID-19 among United States adults: A scoping review
	BACKGROUND: Despite effectiveness of COVID-19 vaccines, millions profess resistance. The World Health Organization has categorized this vaccine hesitancy as among the top ten threats to global health. As such, understanding nuanced rationales behind these vaccination barriers is imperative in eliciting worldwide resiliency. METHODOLOGY: In May 2021, the scoping reviewers utilized five databases (PubMed/LitCOVID, PsycInfo, Embase, CINAHL and OVID/MEDline) to procure quantitative articles measuring COVID-19 vaccine intention within U.S. adults. A minimum of two authors then screened and reviewed each article's titles and abstracts in the first screen and full text in the second screen in accordance with specific inclusion criteria (Quantitative, vaccination intention, English publication, adult population, studies conducted in the USA) in Covidence. The senior author reconciled any emerging conflicts. This scoping review follows Cornelia Betsch's empirically validated 5C Scale as a framework for analyzing immunization intentionality. The notions of confidence, complacency, convenience, communication, and context encapsulate these 5 C's and are useful in determining barriers to and facilitators of COVID-19 vaccination. RESULTS: After importing 5,693 studies for screening, 4,655 were excluded due to irrelevancy. The remaining 325 full-text studies were then assessed for eligibility before including 140 studies within the review. One significant trend found in preliminary analyses was that confidence appears to be a significant factor in vaccine decision-making in the USA. Minority populations consistently professed vaccine hesitancy across studies included within this scoping review. Understanding the contextual component of such barriers is needed if the USA wishes to achieve resiliency in the wake of the pandemic.	
10:55–11:05	Apurba Saha Department of Systems & Industrial Engineering	Resilient NdFeB magnet recycling under the impacts of COVID-19 pandemic: Stochastic programming and Benders decomposition
	Neodymium−iron−boron (NdFeB) magnets are the most powerful magnets per unit volume sold in the commercial market. Despite the increasing demand for clean energy applications such as electric vehicles and wind turbines, disruptive events including the COVID-19 pandemic have caused significant uncertainties in the supply and demand for NdFeB magnets. Therefore, this study aims to alleviate the risk of supply shortage for NdFeB magnets and the containing critical materials, rare-earth elements (REEs), through the development of a resilient reverse supply chain and logistics network design. We develop scenarios to model the unique impact of the COVID-19 pandemic on the proposed business, incorporating both disruption intensity and recovery rate. We formulate a chance-constrained two-stage stochastic programming model to maximize the profit while guaranteeing the network resiliency against disruption risks. To solve the problem in large-scale instances, we develop an efficient Benders decomposition algorithm that reduces the computational time by 98.5% on average compared to the default CPLEX algorithm. When applied to the United States, the model suggests the optimal facility locations, processing capacities, inventory levels, and material flows for NdFeB magnet recyclers that could meet 99.7% of the demand. To the best of our knowledge, this study is the first to incorporate the impacts of the COVID-19 pandemic to design a resilient NdFeB magnet recycling supply chain and logistics network, leveraging risk-averse stochastic programming.	
11:05–11:15	Javier Osorio School of Gov. & Public Policy	Political and criminal violence in Latin America
	My research primarily focuses on understanding the micro-dynamics of political and criminal violence in Latin America. To do so, I primarily rely on quantitative methods including computerized text analysis, randomized controlled trials, survey experiments, and geographic information systems. My ongoing projects cover the following topics. 1. Use of computational text analysis to geolocate the violent presence of armed actors (e.g. insurgents, paramilitaries, criminal organizations) in Colombia and Mexico. 2. Use of survey experiments to assess domestic violence and gang recruitment targeting students in El Salvador. 3. Use of RCTs to evaluate a large violence prevention program in El Salvador. 4. Use of survey experiments to assess state repression in Nicaragua. 5. Use of online expert surveys to analyze different types of violent and non-violent governance by armed actors in Colombia and Mexico. 6. Use of computerized text analysis and quasi-experimental statistics to assess the effect of criminal violence, political instability, environmental stressors, and poverty on migration flows from Central America and Mexico into the U.S. My research has been funded by NSF, USAID, U.S. Department of Defense, among other donors.	

11:15–11:25	**Susan Brewer-Osorio** **Center for Latin American Studies**	**The Collective Reincorporation of Ex-Combatants and Post-Conflict Stability**
	This project addresses the implications of collective reincorporation of ex-combatants for post-conflict stabilization. Colombia's 2016 peace agreement with the rebel group Revolutionary Armed Forces of Colombia (FARC) adopted an experimental collective reincorporation policy that supported ex-combatant cooperatives and permanent settlements in different regions. This approach broke with United Nations standards that direct governments to detach ex-combatants from the rebel organization to reduce the threat of recurring violence. This project capitalizes on Colombia's unusual reincorporation program to analyze impacts of ex-combatant unity on post-conflict stability and local peacebuilding in communities where ex-combatants settle together.	
11:25–11:35	**Jeannine Relly** **School of Journalism, School of Gov. & Public Policy**	**Surviving Mexico: Resistance and Resilience among Journalists in the 21st Century**
	Mexico is among the most dangerous countries in the world for journalists to work with assaults, threats and killings often coming from organized crime groups and co-opted government employees working outside of the law. Presently, on average one journalist a month is killed in the country. The nation has a greater than 90 percent impunity rate for government investigation, prosecution, and conviction of the perpetrators. Our overarching research question looked at how, after such extensive heartache and trauma in many cases, journalists were able to persist and continue doing important work. We utilized historical and contemporary documents and public records from governments, government statistics, semi-structured interviews and oral histories in conducting more than 150 interviews examining 20 years of violence and the responses to these conditions. Interviews included journalists, representatives from transnational and domestic NGOs, intergovernmental organization representatives, government officials and academics. Key findings demonstrate journalists have persisted in this environment through resisting the status quo in everyday and extraordinary ways, bolstering emotional intelligence through a host of strategies and coping skills, which strengthened professional identity and we argue, resilience. Moreover, journalists with their advocates built communities of networks, with supranational organizations, transnational and domestic advocacy organizations who lobbied political and governmental leaders and administrators, sought funding from governments of other countries for safety, security and psychosocial programming and solutions-oriented approaches to apathetic civil society, insecurity and risk. We argue that these networks of communities at the individual level, professional level and external level contributed to resilience in the period that we studied.	
11:35–11:45	**Maria Porter** **Dept. of Political Economy & Moral Science**	**Picture-Based Crop Monitoring and Social Comparison Improves Perceptions of Fairness and Raises Demand for Insurance: A Field Experiment in Ethiopia**
	Smallholder farmers in developing countries are exposed to covariate weather-related production risks, and to idiosyncratic natural hazards that are difficult to cover using index insurance. Insured farmers who experience crop losses and do not receive a payout develop mistrust of weather index-based insurance (WBI). At the same time, insurance for idiosyncratic risks would introduce differences in payouts within social networks, which might be considered unfair, introduce jealousy, and further depress demand for insurance. We therefore conduct lab-in-the-field experiments with farmers in Ethiopia to examine the effects of a novel insurance approach that uses smartphone images of insured crops to verify crop losses and ensure insurance payouts for farmers with crop losses. We introduce such picture-based insurance (PBI) to a random subset of our study respondents in the context of games framed in terms of real-world types of situations in which potential crop losses are insured through WBI. We cross-randomize whether farmers are informed of seasonal outcomes only for themselves and then separately for their neighbors; or as a comparison between their own and neighbors' outcomes. In treatments with social comparison, farmers perceive outcomes as more fair than in treatments without social comparison. Moreover, perceived fairness and absolute willingness to pay for insurance are higher for PBI than WBI; with social comparison not reducing perceived fairness under PBI. Thus, providing insurance for idiosyncratic risks increases farmers' perceived fairness of outcomes and willingness to pay, without introducing jealousy over neighbors receiving payouts for idiosyncratic events.	

11:45–11:55	**William Simmons** **Human Rights Practice, Dept. of Gender & Women's Studies**	**Measuring Individual-Level Resilience and Post-Traumatic Growth in International Development: The Case of an Arts-Based Intervention among Rohingya Refugees in Bangladesh**

How do we measure individual-level resilience and its corollary post-traumatic growth in an international development context? Can culturally specific measures be developed that are also translatable across contexts?

Although the development literature does mention "the capacity to transform in the face of shocks and stressors" (Hoddinott et al., 2019), this will be the first study that we know of to systematically consider the exciting new field of post-traumatic growth (PTG) in the resiliency in development context. Resilience often carries the connotation as someone functioning on the same trajectory as before suffering a traumatic event. PTG claims that those who have experienced trauma can find room for growth from the experience, to shape themselves and their larger community anew (see Simmons 2019). Our work will conceptually put the literatures on resilience and PTG from other disciplines in conversation with the exciting new resilience work in development.

We have an excellent opportunity to address such issues in multiple refugee contexts through our partnership with the NGO Artolution (Artolution.org) that works with, the Rohingya in Bangladesh, Venezuelans in Colombia, South Sudanese in Uganda, and Syrians in Jordan. They have an acclaimed participatory arts curriculum—with a well-developed theory of change—that is trauma informed and culturally specific. Artolution has asked UArizona's Human Rights Practice program along with colleagues in Bangladesh to develop a participatory Monitoring & Evaluation protocol to quantitatively measure their programs' impact.

Morning Session 1-B
ENR2 S225 | 10:15am–12:00pm | Thursday, September 30

Time	Presenter	Title
10:15–10:25	**Yevheniia Varyvoda** **The Mel & Enid Zuckerman College of Public Health**	**Considering Ecosystem Services in Food Systems Resilience**
	Food security and sustainability of food systems depends fundamentally on ecosystems and their services in the time of disasters triggered by far-reaching extreme weather events, climate action failure, human environmental damage, and biodiversity loss. In terms of economic losses between 2008-2018, the impacts of disasters cost the agri-food sector of developing country economies over $108 billion in damaged or lost crop and livestock production, particularly susceptible to livelihoods of smallholder and subsistence farmers, pastoralists, and fisheries. Most of the time, ecosystems themselves can offer sustainable strategies for the reduction of disasters damage and the severity of their impacts based on the benefits people get from nature, including cultivated and wild terrestrial and aquatic biomass for nutrition, materials or energy, genetic material, water, pest and disease control, regulation of baseline flows, etc. However, there is a scantiness of literature on the effectiveness of sustainable strategies (e.g. adoption of non-timber forest products, neglected and underutilized plant species, soil conservation practices) and limited research has examined the potential contribution of available ecosystem services to food system resilience and how they can be synchronized into resilience stewardship. To illustrate this relationship, empirical examples of the application of ecosystem services-based resilience strategies across different types of agri-food systems will be described. The findings of this review of the science are intended to provide practical rationale that promoting food system diversification; increasing cohesion between technological innovation and nature solution; and utilizing traditions and local/indigenous knowledge by means of ecosystem services utilization increase the resilience capacity of vulnerable food systems.	
10:25–10:35	**Elisa Marchi** **Human Rights Practice, College of Law**	**Building a New Framework to Address Ecological Crises: The Relationship Between Biocultural Diversity Discourse and Indigenous Collective Rights**
	In addressing the current ecological crisis, conservation scholars have focused on the negative impact of human activities on the earth. This focus has revealed the inconsistency of some of the pillars of Western enlightenment thought and led scholars to challenge the Western Cartesian dogma of the separation between nature and culture. These challenges have resulted in the development of the discourse of biocultural diversity. This new approach promotes intercultural scientific dialogue between Western and non-Western systems of knowledge. In fact, by conceiving ecosystems as the product of an inextricable link between biological and cultural diversities, indigenous epistemologies that envision the relationship with nature holistically become central in defining the object of conservation. Despite the uneven impact of conservation policies on indigenous territories, legal scholars have under-explored the effects of conservation discourses on the enjoyment of indigenous collective rights. My research seeks to bridge this gap by answering this question: Can biocultural diversity discourse in conservation enhance indigenous collective rights, indigenous governance, and participation in climate change solutions? In addressing this question, I borrow methodological tools from constructivist, legal pluralism, decolonial, and Science, Technology and Social Studies. I rely on analyzing court decisions, indigenous customary law, international law, and interviews collected during field works. Geographic area: Mexico, Colombia, Ecuador	

10:35–10:45	**Marie-Blanche Roudaut** **Arid Lands Resource Sciences**	**A biocultural lens to understand how agroforestry can contribute to climate resilience and sustainable rural livelihood**
	This study aims to contribute to the ongoing conceptual development and practical application of resilience, the ability to absorb and respond to shocks. It moves beyond simply identifying the biophysical and financial constraints on agricultural production and rural development to address underlying political and social issues as well as knowledge and beliefs that contribute to and undermine resilience (Shackleton et al., 2015). The 'biocultural' lens examines the interaction between livelihood practices, institutions, local knowledge and beliefs and investigates how investment in agroforestry can increase the resilience of farmers' livelihoods and their ecosystems in the semi-arid region of northern Ghana. The goal is to demonstrate how agroforestry can strengthen and diversify rural livelihoods while maintaining and improving critical natural capital and ecosystem services that are essential for human and economic well-being. The analysis demonstrates the utility of an expanded conception of resilience that links livelihood practices, with the constituent knowledge, institutions and beliefs that shape those practices. It focuses on three factors that are essential to designing resilience initiatives in agrarian environments: a focus on the landscape scale; an analysis of trade-offs that farmers assess in pursuing agricultural intensification; and assessing how gender, social and economic differentiation play out in farmers' decision-making. This biocultural approach provides a clear diagnosis of key challenges to the resilience of agricultural systems and insights into where policy interventions might be most effective.	
10:45–10:55	**Greg Barron-Gafford** **School of Geography, Development & Env., Biosphere 2**	**Harvesting the sun twice: Co-using land for sustainable food and electricity production in East Africa**
	Food and energy security challenges are widespread across East Africa, where crop productivity is predicted to decrease by 8-45% under a 2°C warmer global average temperature, and 73% of the population do not have access to electricity. Policy and planning commitments have begun to expand energy provision across the region, with a focus on decentralized renewables – largely through photovoltaics. This electrification will require significant land use change that will conflict with agricultural land and/or unclaimed land that provides other ecosystem services (e.g. carbon sequestration, flood mitigation, and wildlife habitat provision). To avoid a "food vs. fuel" land use conflict, food and electricity can be produced on the same land using integrated systems termed "agrivoltaics" – combining agriculture with photovoltaic arrays. Agrivoltaics hold particular promise in East Africa, where access to reliable power remains low and food, nutrition, and water security are continual challenges. Nevertheless, meteorological, technical, and socio-political factors are barriers to wider-scale deployment. We have built a multi-national coalition with diverse specialties in physical and social sciences, development, and capacity in international programs in the region. Over the last year, we have constructed an agrivoltaics installation in Kenya at a working farm and training facility, and a similar research and production facility should be completed within Tanzania by Fall 2021. We are already seeing not only excitement from locals, but also policy makers who are now able to see food crops not only surviving, but thriving in the shade of renewable energy production.	
10:55–11:05	**Kevin Fitzsimmons** **Dept. of Env. Science**	**Seven Years of Sustainable Aquaculture Development in Myanmar**
	Myanmar has the eleventh largest national aquaculture industry on a biomass basis. However, the bulk of that is provided by polyculture of carps in extensive aquaculture conducted in large (10ha+) ponds. With the economic and democratic opening up starting in 2013 several development and aid groups began to work with the industry to introduce more sustainable and resilient technology and training. The US Soybean Export Council, Aquaculture Without Frontiers, US-AID, JICA, KOIKA, AUSAID, WorldFish and Chinese and European countries, devoted resources to improve culture techniques and post-harvest handling. The aid groups also introduced new equipment, feed ingredients and processing improvements. Another area of intense interest was introduction of selectively bred shrimp, tilapia, sea bass and other species that would garner higher prices compared to the ubiquitous carps. USAID, EU-GIZ, and FAO supported projects focused on sustainable and resilient aquaculture development. Capacity building to upgrade fish, shrimp, Artemia, Macrobrachium, and Scylla crab hatcheries was also a priority. Several activities were devoted to helping small farmers to better understand the need for more resilient methodology to address climate change and social adjustments and urbanization. Training in more sustainable farming practices and the role of NGO's and how to achieve certifications was another key topic of instruction. Phone apps, training manuals, workshops and online instruction during covid restrictions were all important tools for building the capacity of farmers to produce more seafood products in a more sustainable manner.	

11:05–11:15	Joey Blankinship Dept. of Env. Science	**Mitigating Dust Pollution for Climate-Resilient Development in Arid Regions**
	For Arizona to be resilient amidst continued drought and climate warming, land managers need effective solutions ready to mitigate hazardous sources of dust pollution. Barren lands devoid of vegetation and with damaged soils are responsible for 60-95% of dust emission in arid regions. Besides loss of precious topsoil by erosion, dust pollution harms human health and safety, including deadly automobile accidents on highways. The Arizona State Dust Group is urgently searching for long-term dust solutions that cooperate with natural ecosystem processes. Our work aims to help conserve and restore soil stability in arid ecosystems, thus enhancing human resilience. We used a systems approach integrating soil physical, chemical, and biological properties with native plants to eco-engineer life in arid landscapes for the end goal of dust mitigation. We first used a rhizobox-based laboratory experiment to identify combinations of fast-growing native grass species and commercially available microbial inoculants that best stabilize soil from a known dust source along Interstate-10 between Tucson and Phoenix. We then determined the efficacy of the best microbial and plant treatments at stabilizing soil and reducing dust emission under realistic field conditions. Our interdisciplinary team is assessing a novel suite of soil physical (e.g., aggregation), chemical (e.g., organic glues), and biological properties (e.g., microbial community composition) in concert with above- and below-ground plant production and functional traits. If successful in small-scale plots, "jumpstarting" biology may serve as a long-term solution for dust mitigation in arid regions that purely physical and chemical solutions fail to achieve.	
11:15–11:25	Flurin Babst School of Natural Resources & the Env., Laboratory of Tree-Ring Research	**The role of arid ecosystems in climate change mitigation depends on a carbon-energy trade-off**
	Drylands are not only key drivers of short-term variability in the terrestrial carbon sink, but their capacity for long-term carbon storage in woody biomass appears more substantial than previously assumed. As such, (semi-)arid forests, woodlands, and shrublands could play an important role in emergent negative emissions solutions that seek to strengthen carbon capture in long-lived vegetation. However, the common notion that dense tall vegetation cools the climate is not straightforward in arid systems. Instead, its widely appreciated cooling effects via carbon sequestration and transpiration must be carefully balanced against the higher energy absorption of dark, dense canopies compared to lighter desert soil. Where the optimal balance between these antagonistic effects lies is presently unclear. Within the freshly launched vertically integrated project BEST-CLIM, we postulate that an optimal vegetation structure and density exist to maximize the climate cooling potential of US Southwestern ecosystems. We strive to quantify the carbon, energy, and water balances of various vegetation types using a combination of plot-based ecological field studies and ground, airborne, and spaceborne remote sensing. Our long-term goal is to develop wall-to-wall maps of desired vegetation conditions for the Southwest, as well as forward-looking scenarios of how vegetation transitions and disturbance dynamics will impact climate feedbacks. This knowledge will help improve the scientific basis of adaptive ecosystem management and support climate-conscious decisions during ecosystem restoration.	
11:25–11:35	Yang Song Dept. of Hydrology & Atmospheric Sciences	**The feedback of Arizona Grassland to Longer Seasonal Droughts and its Implication for Dryland Carbon Cycling: Insights from Model-Experiment Integration**
	The US Southwest is experiencing fewer, larger precipitation events and longer dry intervals between rainfalls. These longer droughts have triggered physiological, phenological, morphological, and community-level responses of dryland vegetation and have unknown impacts on the major role played by drylands in the global carbon cycles. It remains unclear how seasonal drought intensity and duration affect the magnitude, duration, and direction of dryland vegetation carbon cycling and atmospheric feedbacks. To address this question, we integrated the measurements of soil hydrology, plant community, and carbon fluxes from a new rainfall manipulation experiment site (RainManSR) in the Santa Rita Experimental Range of Southeast Arizona, US into the Community Land Model (CLM5). This field experiment imposed four precipitation treatments (S1–S4), each with the same summer growing season total rainfall (205 mm) but packaged into a range of many/small to few/large rainfall events. This experiment allowed us to parameterize distinct drought tolerances of semiarid grassland plant functional types and their effects on climate extreme-carbon cycles feedbacks. The ability of the improved CLM model to capture dryland productivity and carbon fluxes was then validated at larger scales with observed carbon fluxes at AmeriFlux sites in the US Southwest (e.g., US-WKG). Applying this model in the Arizona grassland sites indicated that high tolerances of dryland plants to lower soil water potential maintains the growing season length of the dryland ecosystem under drought conditions, whereas the acclimation of carbon assimilation and root dynamics to drought mitigate drought effects on vegetation productivity and interannual variability of carbon exchange.	

11:35–11:45	**Jason Field** **School of Natural Resources & the Env.**	**Resilience in action: Guiding management responses to ecological transitions from disturbance and tree mortality**
	Healthy forests and woodlands in the western United States provide many important benefits, including habitat for wildlife, forage for livestock, and clean water for fish and human use. Extensive death of living trees, from wildfires, insect attacks, and severe droughts, is followed by slow recovery of forests, sometimes leading to forests different from those before the mortality events. The questions of how to manage terrestrial ecosystems into the future under highly uncertain climate and disturbance has emerged as a central challenge regionally, nationally, and globally. This project will examine in detail how different sources of widespread tree mortality might lead to different kinds of forests across the southwestern US. More specifically, we will examine the linkage zone between the science of mortality events and the study of subsequent ecosystem reorganization. We will investigate the dynamics of post-mortality recovery using a dual approach integrating scientific exploration and ecosystem manager engagement. Results from this project will attempt to demonstrate that both creative science and full engagement with the management community is the best pathway to generating management-relevant science, and more importantly, to helping address growing problems of alarming concern in ecosystem management. This scientific information will be useful to forest and wildlife managers in their decisions regarding climate change and variability and efficient uses of available resources in guiding forest recovery.	
11:45–11:55	**Diana Liverman** **School of Geography, Development & Env.**	**Safe and just targets for people and the planet**
	I will discuss my work with the Earth Commission (https://earthcommission.org/) to ensure that the science-based targets for governments, cities and business will stabilize the earth system and reduce the risks of tipping points while also addressing social justice and sustainable development. We focus on how we can mitigate climate change, biodiversity loss, water, and nitrogen pollution while reducing poverty and hunger. We are evaluating the transformations in political economy, values, behavior, technology, and governance that will allow us to survive and hopefully thrive during this time of environmental and social change.	

Afternoon Session 2-A
ENR2 S107 | 2:15pm–4:00pm | Thursday, September 30

Time	Presenter	Title
2:15–2:25	**Kacey Ernst,** **The Mel & Enid Zuckerman College of Public Health**	**Health in the face of global change- building community resilience**
	Faced with new and persistent threats, resilience in the health of global communities is tested every day. Framed within the context of vector borne diseases, this presentation will outline some of the key pathways that climate change may influence their emergence. Multi- level community strategies will be discussed to build capacity to respond to these and other emerging infectious disease threats.	
2:25–2:35	**Charles Gerba** **Dept. of Env. Science**	**Water Quality and Health in a Changing World**
	Our group has been involved in several international research and projects related to assessment of microbial water quality and quantitative microbial risk assessment. These have included training more than 20 workshops on assessment on the latest methods for assessment of microbial water quality and quantitative microbial risk assessment. We are also involved in collaborative projects in several countries on wastewater reuse, detection of pathogens in water, assessment of water treatment household systems in rural areas in developing countries, and impact of climate change on microbial water quality impacts on food safety.	
2:35–2:45	**Hannah Friedrich** **School of Geography, Development & Env.**	**Satellite image analysis for anticipatory research and planning at flood-prone informal settlements**
	Floods are a leading climate hazard at urban informal settlements that have cascading effects on shelter, transportation, energy, and human well-being. Under changing climate extremes, urban flood events are expected to occur more frequently, and urban infrastructure and populations are increasingly at risk of flooding. Much of the recent and expected urban growth is informal, which is characterized by dense agglomerations of small buildings and a lack of access to secure housing, essential amenities, and adequate stormwater infrastructure. Repeat flood events and unaddressed recovery and preparation for future flood events at informal settlements further marginalize populations who remain some of the most vulnerable. Despite the growing fleet of remote sensing satellites to monitor surface water flooding, urban flood mapping remains a challenge, and limited attention has been given to monitoring flood exposure at informal settlements. While my past research utilized satellite imagery to assess land cover change at informal settlements, I'm pivoting to focus on how satellite imagery can be used to track flood impacts on infrastructure and population change in informal settlements as a reaction to flood risks. To extend these insights, my research objectives are to study if and how the limits of adaptation planning result in decisions to resettle in less flood-prone locations or engage in practices of managed retreat. As I develop and conduct my PhD research in Geography, I seek to collaborate with others assessing disaster risk reduction and the evaluation of climate impacts and habitability of the built environment.	
2:45–2:55	**Rohit Mukherjee** **School of Geography, Development, & Env.**	**High-resolution satellite imagery to train and validate deep learning models for mapping urban inundation extent**
	Mapping floods from public and commercial satellite sensors improves response, relief, and mitigation efforts. Urban flooding remains difficult to capture as the narrow channels and features cannot be detected using low-resolution satellite sensors. Higher-resolution commercial satellite imagery, such as 3 m Planetscope imagery, combined with advanced computer vision algorithms, such as deep learning networks, could improve urban flood detection. However, adequate training and validation data are required for effective deep learning model performance. Therefore, to improve flood model accuracy, we are creating a multi-sensor, co-located, labeled, spatial-temporal dataset to test, train, and validate deep learning algorithms for surface water detection. This data set will be used to evaluate the efficacy of deep learning approaches while also contributing a curated and publicly available dataset for coincident imagery for Planetscope, Sentinel-2, and Landsat overpass before, during, and after regional, major flood, and inundation events distributed globally from 2017-2020. We are building on existing inundation datasets, such as Sen1Floods11, (Bonafilia et al. 2020), xBD (Gupta et al. 2019), and NASA's Sentinel-1 labeled surface water detection dataset (NASA IMPACT team) by adding spatially and temporally coincident satellite sensor data from Planetscope and publicly available 30m Harmonized Landsat and Sentinel-2 satellite products. We will also include five additional flood events from 2020. Using high spatial resolution Planetscope imagery, we are labeling image chips using NASA IMPACT Team's ImageLabeler. We will present updates on the labeled dataset we plan to publicly release in 2022.	

2:55–3:05	Christopher Castro **Hydrology & Atmospheric Sciences**	**High-resolution forecasting of extreme events in semi-arid to arid environments out to the sub-seasonal timescale**

One of the consequences of our changing climate is an increase in extreme precipitation events, due to long-term increases in atmospheric instability and water vapor. These impacts of these events are becoming more severe, in terms of loss of life and damage to the natural and human environments, necessitating improved and longer-lead advanced warning capability. Our research focuses on weather forecasts of extreme events out to the sub-seasonal timescale (3-4 weeks) in semi-arid to arid environments with complex terrain, similar to Arizona. Present target locations include Saudi Arabia and the Tarapacá region in northern Chile, with the Chilean effort specifically supported as an International Development Project by the University of Arizona. Heavy precipitation in such places is typically the result of thunderstorms that result in hazards of flash flooding, extreme winds, and dust storms. The approach employs high-resolution convective-permitting modeling at the kilometer scale to explicitly represent storm-scale processes with multiple ensemble realizations, consistent with operational modeling standards of the National Weather Service for short-term operational weather prediction used within the United States. This yields significant improvements in forecast skill of precipitation events, even out to a period of three weeks, such that forecasts may be usable for decision making. There is thus high potential to develop this type of technology throughout the world to improve extreme precipitation forecasting, which we envision through an internationally coordinated research effort that can be under the auspices of the World Meteorological Organization.

3:05–3:15	Jonathan Sullivan **School of Geography, Development & Env.**	**Satellite imaging reveals increased proportion of population exposed to floods**

Flooding affects more people than any other environmental hazard and hinders sustainable development. Investing in flood adaptation strategies may reduce the loss of life and livelihood caused by floods. Where and how floods occur and who is exposed are changing as a result of rapid urbanization, flood mitigation infrastructure and increasing settlements in floodplains. Previous estimates of the global flood-exposed population have been limited by a lack of observational data, relying instead on models, which have high uncertainty. Here we use daily satellite imagery at 250-metre resolution to estimate flood extent and population exposure for 913 large flood events from 2000 to 2018. We determine a total inundation area of 2.23 million square kilometers, with 255–290 million people directly affected by floods. We estimate that the total population in locations with satellite-observed inundation grew by 58–86 million from 2000 to 2015. This represents an increase of 20 to 24 percent in the proportion of the global population exposed to floods, ten times higher than previous estimates. Climate change projections for 2030 indicate that the proportion of the population exposed to foods will increase further. The high spatial and temporal resolution of the satellite observations will improve our understanding of where foods are changing and how best to adapt. The global flood database generated from these observations will help to improve vulnerability assessments, the accuracy of global and local food models, the efficacy of adaptation interventions and our understanding of the interactions between landcover change, climate and floods.

3:15–3:25	Abu Kibria **Arizona Institutes for Resilience, School of Natural Resources & the Env.**	**The influence of development on the adaptation response to climate change in small coastal cities**

Small coastal cities (50,000 to 100,000 population) exhibit comparable knowledge and planning infrastructure. However, at a global scale, there is little data about small cities, and their adaptation response to climate change thus so far unknown. In this paper, five cases of small coastal cities, two of which are located in the USA - Miami Beach and Milford - and three, in Australia (Mandurah), Bangladesh (Sundarbans), and South Africa (Knysna) respectively, are presented and discussed in view of adaptation to climate change. All cases reported vulnerability to sea level rise, with impacts compounded by increasing storminess (and even hurricanes of increasing intensity), tides, inland flooding and loss of natural habitat. Changes in precipitation resulted in both reduced river flow, leading to sediment deficits and coastal erosion (from the sea) or increased river flow with similar damage (from the land). Adaptation response was most clearly delineated along lines of development status with wealthier, more highly developed cities pursuing more technologically advanced solutions, whilst the two cities of the Global South focused more on governance and capacity building solutions. Also, it was clear from the Knysna case that if a city or municipality lacks the capacity to effectively respond with adaptation measures, local private wealth may dominate and result in haphazard adaptation responses to the detriment of regional adaptation planning efforts. While this paper provides a first step for richer understanding, more studies across global regions are required to deepen our understanding of climate change adaptation planning in small cities.

3:25–3:35	**Sabrina Helm** **Norton School of Family & Consumer Sciences**	**Consumer Adaptation and Resilience in the Context of Climate Change**
	The limits of the earth's natural carrying capacity require us to curb overconsumption which is also a main driver of climate change. In order for any meaningful decrease in consumption to occur consumers need to adopt different lifestyles; they need to adapt and develop resilience to survive and thrive in changed environmental conditions characterized by decreased access to products and services that require scarce natural resources. Anticipated consequences of climate change for the individual cause stress as can already be noted in increased negative mental health effects which affect a growing share of the population in the U.S. and beyond. Increased research efforts into the psychological effects of climate change, conditions for augmenting consumer resilience, and pathways toward curbing overconsumption are important a) to increase understanding and widespread discussion of consumers' role in decreasing strain on environmental resources and carbon footprint, b) to prevent negative mental health effects induced by climate change threat (climate anxiety) and the realization that consumer lifestyles will have to change, and c) to develop educational approaches for preparing consumers and those involved in consumer education and research for a future characterized by widespread climate change effects.	
3:35–3:45	**Maria Porter** **Dept. of Political Economy & Moral Science**	**Picture-Based Crop Monitoring and Social Comparison Improves Perceptions of Fairness and Raises Demand for Insurance: A Field Experiment in Ethiopia**
	Smallholder farmers in developing countries are exposed to covariate weather-related production risks, and to idiosyncratic natural hazards that are difficult to cover using index insurance. Insured farmers who experience crop losses and do not receive a payout develop mistrust of weather index-based insurance (WBI). At the same time, insurance for idiosyncratic risks would introduce differences in payouts within social networks, which might be considered unfair, introduce jealousy, and further depress demand for insurance. We therefore conduct lab-in-the-field experiments with farmers in Ethiopia to examine the effects of a novel insurance approach that uses smartphone images of insured crops to verify crop losses and ensure insurance payouts for farmers with crop losses. We introduce such picture-based insurance (PBI) to a random subset of our study respondents in the context of games framed in terms of real-world types of situations in which potential crop losses are insured through WBI. We cross-randomize whether farmers are informed of seasonal outcomes only for themselves and then separately for their neighbors; or as a comparison between their own and neighbors' outcomes. In treatments with social comparison, farmers perceive outcomes as more fair than in treatments without social comparison. Moreover, perceived fairness and absolute willingness to pay for insurance are higher for PBI than WBI; with social comparison not reducing perceived fairness under PBI. Thus, providing insurance for idiosyncratic risks increases farmers' perceived fairness of outcomes and willingness to pay, without introducing jealousy over neighbors receiving payouts for idiosyncratic events.	
3:35–3:45	**Benjamin Lawrence** **History Dept.**	**What About Widows? Violence, Refuge, and Resilience in Sub-Saharan African Widow Asylum Claims**
	For many African women, the sudden arrival of widowhood is not confined to the emotional trauma of losing a companion. African widows are often subjected to a series of socio-cultural practices and customary laws that foreshadow a longer-term struggle for basic needs, human rights, and dignity. Widows may be denied inheritance rights to property, evicted from marital homes, coerced into conjugal unions with brothers-in-law, or subjected to traumatizing rituals. In many cases, widows are permanently stigmatized, shunned and shamed, while their ordeals remain unnoticed by wider society. In scholarly surveys on widows and widowhood in sub-Saharan Africa studies have demonstrated the widespread collapse in communal, family, and social support for bereaved women. A sudden and new autonomy, independence, and self-reliance, however, is often an opportunity, unleashing a complex set of survival strategies, resistance, and resilience. Asylum claims featuring widowhood as an element of the "persecutory nexus" provide a fresh opportunity to scrutinize the widowhood experience. Because there no widespread communal support for widows, self-reliance is typical; widowhood as a lived experience is highly mutable. While widows today form a relatively small sub-set of African asylum claims, the persecution from which they flee ranges from clan and family violence, coerced leviratic and sororatic re-marriage and other patriarchal rituals, misogynistic statutes and policies.	

3:45–3:55	Brian Mayer **School of Sociology**	**Community Resilience: Integrating Culture, Networks, and Governance for Disaster Risk Reduction**
	Interest in community resilience as a metaphor for the capacity of social groups and organizations to adapt to, and recover, from disasters continues to grow. This presentation will focus on findings from my research on the measurement and impacts of community resilience following disasters like the 2010 BP Oil Spill and the 2012's Hurricane Sandy. Specifically, we will explore how communities can access forms of cultural and social capital in the aftermath of disasters to accelerate the recovery process. Questions of culture, networks, and governance remain largely understudies in the existing social-ecological literature. Community's adaptive capacity can be greatly enhanced by better integration of these concepts.	

Afternoon Session 2-B
ENR2 S225 | 2:15pm–4:00pm | Thursday, September 30

Time	Presenter	Title
2:15–2:25	**Adam Henry** **School of Gov. & Public Policy**	**Policy Networks and Learning for Sustainable Development**
	Policy networks are endemic to the policy process; stakeholders to policy issues must often seek out ties with other policy stakeholders in order to gain information about salient problems, coordinate action, or collaborate on joint efforts. And yet the particular configuration of these policy networks has a great influence on policy outcomes and the potential for stakeholders to collectively learn to manage complex, emerging, and uncertain problems. It is widely believed that segregation within policy networks—meaning a separation between actors with divergent belief systems, functional expertise, or resource availability—inhibits the ability of actors to effectively manage complex problems. This is particularly true in the domain of climate change, where policy systems are characterized by large amounts of information asymmetry and fierce conflicts over values and goals. This presentation reviews major research questions about the connection between networks (interconnections among individuals and organizations that are stakeholders to environmental issues) and learning for sustainability. Examples are drawn from a variety of research projects focused on different domains of sustainable development, including environmental risk policy, local water governance, energy policy, and invasive species management.	
2:25–2:35	**Sharon Megdal** **Water Resources Research Center, Dept. of Env. Science**	**Water resilience challenges for groundwater-dependent communities along the United States-Mexico Border**
	For over a decade, University of Arizona researchers have collaborated on binational research of transboundary aquifer systems along the United States-Mexican Border. Research results indicate that border communities are facing challenges due to increasing pumping of groundwater and changing climatic conditions. Published papers document increased groundwater budget deficits and severe risk of water shortages. Despite documented challenges, there is limited discussion of binational management of transboundary aquifer systems. The presentation will describe the binational and cross-disciplinary collaborations that have enabled the scientific investigations. It will also explain how the joint research endeavors examining physical and governance systems may facilitate respectful exploration of binational groundwater resources. Final remarks will address how the Transboundary Aquifer Assessment collaborative experience facilitated by the International Boundary and Water Commission is relevant to other regions where water is shared across borders.	
2:35–2:45	**Aletheia Ida & Susannah Dickinson** **School of Architecture**	**Climate Change and Design for Resiliency and Adaptation in the Built Environment**
	The climate change emergency requires that we drastically re-evaluate the design of the built environment and our pedagogical methods and tools. Our work looks at this issue directly through a methodology that was implemented in an upper-level architecture design studio course as an initial testbed. At its core, the methodological framework insists upon interscalar observation and analysis across natural biomes, the built environment, and sociocultural conditions. The framework is established to address and reconsider our approach to design of the built environment through careful study of regional sociocultural and natural system dynamics. The architectural design process is informed by intense research beginning with contemporary theory readings, digital design methods, and regional field work. Our research questions pertain to how we might advance the design process and outcomes through these specific layers of climate change and dynamic system considerations. The theories, tools, and methods are posed to enable responsive and adaptive design outcomes. In particular, this essay explores the interscalar context for grounded research and climate change impacts within the Sonoran Desert of Arizona, USA and Sonora, Mexico. The transborder region was selected to highlight the challenging political context, migration paths (for humans and others), ecological flows, and various humanitarian crises. Student projects demonstrate the interrelationships between natural and human, biotic and abiotic, boundary and expansion, micro and macro, and past and future that might be realized through this multiscalar design research process. The outcomes convey that multidisciplinary expertise is required to inform a necessary socio-cultural shift towards climate change resiliency.	

2:45–2:55	**Mette Brogden** **Human Rights Practice**	**Orange economy as an approach to resilience and addressing climate change in the South**
	The presentation will conceptualize how engaging rural indigenous and peasant populations in "orange economies" constitutes a resilience strategy for addressing a variety of severe sociopolitical, economic, and environmental stresses and wicked problems. Indigenous and rural communities have cultural traditions that address conflict resolution, economic stability and growth, food security, sustainable sociality, and environmental stewardship/repair in communities of place. Orange economies can help launch a salutogenic trajectory out of longstanding "wicked" problems through bringing new opportunities for livelihood strategies. Done well, the orange economy can connect diverse urban and rural populations in a shared endeavor. As an economy that thrives with more—rather than less— players, it behooves cooperation between urban and rural populations through inclusive participation of individuals and businesses.	
2:55–3:05	**Jennifer Post** **School of Music**	**Sonic Practices and Resilience: Cultural Forms and Ecological Knowledge in Mongolia**
	Sonic practices, including sounds, soundscapes, and music, play critical roles in resilience building. As expressive forms in multi-species realms, actions tied to listening, communicating, and responding are also like narrative structures that hold knowledge, give agency, and encourage action. In this brief talk I discuss how sonic practices as cultural forms, in holistic more-than-human systems, are key knowledge sources for resilience. I draws from my work in pastoralist communities in Mongolia where herders labor to maintain healthy grasslands for their livestock, support their families, and provide food and other resources (such as wool) for urban areas. My recent research addresses ecological knowledge and human and ecological well-being. Herders' mimetic vocalization, narrative songs, and instrumental tunes carry knowledge about resources and sites, and this acoustic information also informs about climate-related issues. Trained in ethnomusicology, during the last few years I have partnered with landscape and soundscape ecologists, and have developed approaches to social-cultural-ecological systems that improves SES by providing a more equal and meaningful role for expressive forms in cultural contexts. As I prepare to engage in teamwork with a group of scientists in 2022, my work will be with communities in different settings (rural, semi-rural, peri-urban, urban) and stages of their pastoral lives (from active to inactive). I will establish an ethnomusicologically-informed knowledge base about sonic practices with links to our scientific data, and encourage community co-production that supports maintaining or restoring practices (or establishing new ones) toward a future that offers grassland stability.	
3:05–3:15	**Amelia Natoli** **The Mel & Enid Zuckerman College of Public Health**	**Using the Tarjimly interpretation app to enhance refugee integration and communication at Iskashitaa Refugee Network and worldwide.**
	Iskashitaa Refugee Network is a Tucson-based organization that has worked in food security and refugee integration for 18 years. Part of its success is the ability to find innovations that enhance the lives of refugees and asylum seekers. Translation is an obstacle in refugee health-care-seeking, work, legal services, and daily life. Most resettled refugees do not speak English, and Iskashitaa serves many clients who are not literate in any written language. The use of the live translation app Tarjimly has been of great assistance in removing communication barriers for health, legal issues, and community integration. Based on live volunteer translators, the app fills a need where machine translation is inadequate, while ensuring privacy and providing 60 languages so far. NGOs are the biggest user of Tarjimly, and many of its successes include disaster situations where nuanced immediate communication is essential, as well as basic translations for school and health care contexts. Emerging from translation needs during the Syrian refugee crisis, the service is accessible worldwide and focuses specifically on refugees, immigrants, and asylum seekers. Recent changes in the demographics of the refugees and asylum-seekers in the borderlands has called for responsive changes in refugee-serving NGOs. This presentation will explore the uses of the Tarjimly translation service as a communication tool by Iskashitaa refugee network as an innovative technology that can be used worldwide to enhance refugee integration.	

3:15–3:25	**Lysette Davi** **Honors College**	**Do students need to be resilient in the classroom? Leveraging Cultural Humility in Online Learning**
	In this presentation we question whether instruction should ask students to be resilient? More specifically, what would a classroom experience be like for global students if cultural humility was practiced? During the session, findings from a 2020 study entitled, "Transnational Education Student Learning and Sense of Belonging Through a Flipped Classroom Model in Southeast Asia" will unveil practical steps to assist instructors in developing curriculum and strategies for their content by considering a global mindset. After contextualizing global learning pre and post pandemic, this talk will consider barriers global students face and resiliency shown when pursuing global online learning. This is an important topic to the resiliency of education as the number of higher education seekers is predicted to accelerate and in-person college models will find difficulty in meeting the future demands of higher education enrollment. The talk will continue by defining cultural humility and redefining international students to establish a clear understanding of the future of global education. The talk will leave participants with recommendations on how to navigate and facilitate cultural humility through online platforms and instruction.	
3:25–3:35	**Adriana Zuniga-Teran** **School of Landscape Architecture & Planning, Udall Center for Studies in Public Policy**	**Developing an outreach model for green infrastructure to address flooding and sewage spills in Ambos Nogales**
	Green infrastructure (GI) is known to decrease flooding and make cities more livable and healthier. In addition, GI can enhance aesthetics and provide multiple ecosystem services to the community. However, one of the main challenges for the broad-scale implementation of GI is ensuring its long-term maintenance, and community engagement shows promise to meet this challenge. In this project, we develop a community engagement model in a secondary school of Nogales, Sonora, along with a GI demonstration project in that school, which could be replicated in other schools and eventually scaled up to Ambos Nogales. We hypothesize that through engagement between university students, teachers, students, and staff at a secondary school in Nogales, Sonora, we can develop an understanding of barriers, opportunities, and strategies to have the local community learn about the benefits of GI and adopt and implement this type of water management approach. This pilot project has the potential to be scaled up to a larger regional project and be part of the long-term solution to localized water problems.	
3:35–3:45	**Winslow Burleson** **School of Information**	**Justice Equity Diversity Inclusion (JEDI) Inventioneering: Socio-Technical Convergence Catalysts Empowering Humanitarian Engineering**
	Designing for societal needs is core to engineering, yet 90% designers focus on the wealthiest customers. The National Academy of Engineering asserts that "to overcome the barriers that block [engineers'] accomplishment…. [we must] promote improved STEM education and [increase the efficiency of acquiring] the knowledge and tools required to meet society's needs…. [We need to foster] the spirit of curiosity in individual minds and in society as a whole." At University of Arizona we envision training Just, Equitable, Diverse, and Inclusive—JEDI Inventioneers as next-generation socio-technical convergence catalysts, equipped with the skills and actualizing resources to advance transformative Humanitarian Engineering—empowering high risk/high reward impact to resolve societal grand challenges. Humanitarian Engineering enables the creation of technologies that can enhance community resilience (i.e., clean water filtration systems, home-building technologies, agricultural innovations, and solar power), but these technological solutions are most sustainable when they are developed in collaboration with that community, i.e., through participatory design. Resilience cannot be imposed from the outside; it must start with the community itself. Through UA's Vertically Integrated Projects (VIP) we are developing integrated research, education, and innovation programs that incorporate transdisciplinary collaboration to generate novel socio-technical solutions to increase community resilience—for example, through tools that improve health care and gender equality—in challenging and resource-deprived settings.	
3:45–3:55	**Joaquin Ruiz** **RII Biosphere 2**	**The University of Arizona-Arava-JNF Institute**
	The Arava region in southern Israel is located between the Dead Sea and the Red Sea. The region has about 5000 habitants in small communities. Average rainfall is 2 inches. Arava is not part of the Israeli water system, so its water comes from deep wells and therefore is somewhat saline. Even though the conditions in the region are extreme, Arava produces about 60% of the peppers consumed in Israel, during daytime it produces 120% of its electrical needs from solar panels. Further Arava educates people from other arid regions, like Kenya to become resilient. Arava is an example of resiliency in action. We will discuss in our talk some of the joint projects of the University of Arizona and Arava.	