



SESSION #5A

CHAIR: Dr. David Quanrud

Sustainable Urban Development

Friday, Oct. 25, 2019

11:00 am – 12:30 pm

Papers:

1.) **Framework of urban sustainability indicators in drylands**

By Parastoo Parivar, Yazd University; David Quanrud, University of Arizona; Hassan Vafai, University of Arizona

2.) **Sustainable Water Resources: Urban scapes and restoring the commons**

By Itzchak Kornfeld, TransboundaryWaters, Ltd., and the Hebrew University of Jerusalem

3.) **Hydro-energy cooperation in the Bangladesh-Bhutan-India-Nepal region:**

Prospects for transboundary energy and water security in South Asia

By Aditi Mukherji, International Water Management Institute; Christopher Scott, University of Arizona; Udisha Saklani, University of Cambridge; Padmendra Shrestha, University of Arizona

4.) **The Central Role of Energy in the Urban Transition: Global Challenges for Sustainability**

By Joseph R. Burger, University of Arizona; James H. Brown, University of New Mexico; John W. Day Jr., Louisiana State University; Tatiana P. Flanagan, Louisiana State University and Sandia National Laboratories; Eric D. Roy, University of Vermont

Framework of urban sustainability indicators in drylands

By **Parastoo Parivar**, PhD, Assistant Professor, School of Natural Resources & Desert Studies, Yazd University, Iran; **David Quanrud**, PhD, Associate Research Scientist, School of Natural Resources and the Environment, University of Arizona; **Hassan Vafai**, PhD, Research Professor, Civil and Architectural Engineering and Mechanics, University of Arizona

Keywords: Sustainability, City, Drylands, Urban landscape

Abstract: The sustainability of cities, especially in arid and desert regions, is threatened by population growth and increased urbanization. Moreover, future impacts of climate change increase the uncertainty of urban water resources. Urban development should be based on ecological capability and basic environmental services within watersheds. Urban expansion beyond ecological capacity that relies on borrowed environmental services cannot ensure sustainability. This paper presents a framework for assessing the sustainability of cities in arid areas. Considering the city as a social ecological system, three main axes are considered as indicators of sustainability. The first axis is pattern of biophysical structure in the urban landscape and focuses on diversification and expansion of a vibrant network throughout the city. It determines whether ecosystem services can be effective in the whole city based on the design of the urban structure. The second axis is urban ecosystem dynamics and function and is related to the base ecosystem services in the city. It assesses whether the city is sustainable in terms of the life support system. The third axis is citizens' security and satisfaction and relates to the reflection of previous axes on the citizens. Based on this axis, a city is sustainable when its citizens feel safe and positive about their present and future. A sustainable city should also inspire citizens to feel a relationship with nature. Utilizing the three axes in the proposed framework, planners in arid areas can assess the sustainability of their cities. If the assessment indicates instability, planners can utilize results to develop a more appropriate approach to urban growth and development.

Sustainable Water Resources: Urban scapes and restoring the commons

By Itzhak Kornfeld, PhD, TransboundaryWaters, Ltd., and the Hebrew University of Jerusalem

Abstract: In his Tragedy of the Commons, Garret Hardin asked the reader to picture a pasture open to all. Each herdsman that kept cattle on the grassy commons, Hardin posited, would try to maintain or maximize the highest number of cattle as possible on the commons. Once social stability became a reality – that is, diseases and tribal wars would subside – the various herdsmen being rational, Hardin theorized, would seek to maximize the number of animals that they brought to the commons. Thus, the commons are destroyed.

However, Hardin’s model has proven to be incorrect. There is no rationality in the way humans use natural resources. That is why, we must employ sustainable methods, specifically with regards to water issues. These applications must be set in motion urgently, in order to change peoples’ ways and mindsets. I present a number of case studies to demonstrate how we can sustainably reuse water. They are as follows: **Case Study I:** one way to end the cycle of destruction and rebuilding is to stop the construction of buildings on barrier islands, coastal areas, low-lying areas and wetlands, among other locations, and returning the land back to nature. These include New York City, Philadelphia and the efforts of the Nature Conservancy across the U.S. **Case Study II:** the use of constructed wetlands in Orlando, Florida, as the “earth’s kidneys”, filtering pollutants and contaminants that flow through them, and providing much needed clean water; **Case Study III:** Retention Ponds/Basins in Virginia; **Case Study IV:** Urban Forests, as filters for water, recharging aquifers and lakes and cooling the environment around them, as well as, Habitat III, the United Nations conference in Quito, Ecuador, in 2016, focusing on sustainable urban development, and the U.N.'s General Assembly's Resolution, number 67/216; and **Case Study V:** central and southern Arizona’s reuse of water and its development of sustainable architecture.

Hydro-energy cooperation in the Bangladesh-Bhutan-India-Nepal region: Prospects for transboundary energy and water security in South Asia

By **Aditi Mukherji**, PhD, Principal Researcher, International Water Management Institute; **Christopher Scott** (*presenter*), Research Professor of Water Resources Policy, Professor and Distinguished Scholar, School of Geography and Development, and Director of the Udall Center for Studies in Public Policy, University of Arizona; **Udisha Saklani**, PhD Candidate, Geography and Public Policy, University of Cambridge; **Padmendra Shrestha**, PhD Candidate, School of Geography and Development, University of Arizona

Abstract: The last decade has seen rapid progress in energy cooperation in the Bangladesh-Bhutan-India-Nepal (BBIN) region. Earlier, such cooperation as existed was bilateral, with each of the countries entering into energy development and trade agreement with India. In recent years, bilateralism is transforming into multilateral energy sharing agreements, Bangladesh signed energy trade agreements with Bhutan and India – where hydro-energy from Bhutan will be transmitted to Bangladesh via India and Nepal plans to do the same with Bangladesh. What does this shift in energy cooperation away from bilateralism to multilateralism mean for the region? More importantly, given how closely energy and water are related, what does this shift imply for transboundary water cooperation?

In this paper, we will review the evolution of water and energy cooperation in the BBIN region – focusing on the Ganges and Brahmaputra river basins. We will identify major shifts in policies and implications of those shifts on both energy and water cooperation. We will track the commonalities and differences in trajectories of water and energy cooperation and discuss the implications of the changing landscape of energy cooperation for transboundary water cooperation, and ultimately, sub-regional energy and water security.

The Central Role of Energy in the Urban Transition: Global Challenges for Sustainability

By **Joseph R. Burger**, *Institute of the Environment, University of Arizona*; **James H. Brown**, *Department of Biology, University of New Mexico*; **John W. Day Jr.**, *Department of Oceanography and Coastal Sciences, College of the Coast and Environment, Louisiana State University*; **Tatiana P. Flanagan**, *Department of Computer Science, University of New Mexico and Sandia National Laboratories*; **Eric D. Roy**, *Rubenstein School of Environment and Natural Resources, University of Vermont*

Keywords: Biophysical Economics; Climate Change; Economic Demography; Energy; Employment; Human Ecology; Sustainability; Urban Footprint; Cities

Abstract: The urban transition, the increased ratio of urban to rural population globally and within countries, is a hallmark of the 21st century. Our analysis of publicly available data from the World Bank spanning several decades for ~195 countries show that across and within nations over time, per capita Gross Domestic Product (GDP), energy use, and CO₂ emissions are lowest in predominantly rural countries (rural > urban pop.), increase rapidly across urbanizing countries (rural ≈ urban pop.) and are highest in the most urban countries (rural < urban pop.). These trends coincide with changes in employment by sector and gender. Rural economies are based largely on employment in the resource-extraction sector, which includes agriculture, fisheries, forestry, and mining. In urbanizing nations, male employment is predominantly in the industrial sector, including public utilities, while female employment is higher in service-based than resource-based economies. In the most urban nations, service economies predominate with some countries employing 90% of women and 65% of men in the service sector. Our analysis shows that per capita GDP, energy use, and CO₂ emissions increase by over two orders of magnitude from low-income, resource-based rural countries to high-income, urbanized countries with predominantly service economies. Data from the U.S. over the past 200 years illuminate a socio-metabolic urban transition similar to that seen globally in recent decades across countries and through time. Our study suggests that increased energy demand and climate consequences of burning fossil fuels will continue to accompany a rapidly urbanizing planet posing major challenges for global sustainability.