ASU SCHOOL of SUSTAINABILITY

ARIZONA STATE UNIVERSITY

In Partial Fulfillment of the Requirements for the Degree of

Doctor of Philosophy

David J. Yu

Will defend his dissertation

Robustness of social-ecological system under global change: Insights from community irrigation and forestry systems

Abstract

Social-ecological systems (SES) are replete with hard and soft human-made components (or infrastructures) that are consciously-designed to perform specific functions valued by humans. How these infrastructures mediate human-environment interactions is thus a key determinant of many sustainability problems in present-day SES. This dissertation examines the question of how some of the designed aspects of physical and social infrastructures subtly influence the robustness of SES under global change. Due to the fragility of rural livelihood systems, locally-managed common-pool resource systems that depend on infrastructure, such as irrigated agriculture and community forestry, are of particular importance to address this sustainability question. Here, I present three studies that explored the robustness of communal irrigation and forestry systems to economic or environmental shocks.

In the first study, I examined how the design of irrigation infrastructure (a physical infrastructure) affects the long-term system dynamics and the robustness of system performance to an economic shock. Using a stylized dynamic model of an irrigation system as a testing ground, I show that changes in infrastructure design can induce fundamental changes in qualitative system behavior (i.e., regime shifts) as well as altered robustness characteristics.

In the second study, I explored how connectedness among social units (a kind of social infrastructure) influenced the post-failure transformations of large-N forest commons in South Korea. Using inferential statistics, I argue that some attributes of the social infrastructure that helped system robustness in the past made the system more vulnerable to undesirable transformations in the current era.

The third study explored the question of how we can guide adaptive management of infrastructure-dependent SES for more robustness under

uncertainty. I used an existing laboratory behavioral experiment in which human-subjects tackle a decision problem on collective management of an irrigation system under environmental uncertainty. I analyzed the contents of group communication and the decisions and outcomes of individuals to understand how different emergent patterns of learning-by-doing processes and supporting conditions may be causally linked to robustness under environmental uncertainty. The results show that robust systems are characterized by active learning-by-doing through outer-loop processes, i.e., frequent updating of shared assumptions or goals that underlie specific group strategies or actions.

Tuesday, April 14th, 2015
12:00pm
Cowden Family Resources Building, Room 124

Faculty, students, and the general public are invited.

Dr. John M. Anderies, Chair
Dr. Marcus A. Janssen, Member
Dr. Rachata Muneepeerakul, Member