School of Sustainability
Arizona State University

In Partial Fulfillment of the Requirements for the Degree of

Doctor of Philosophy

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Will defend his prospectus

Food, a global product: an enhanced FEW Nexus approach

Abstract

Food security is a major concern with the rate at which population has been increasing and the threat of climate change. The Food -Energy-Water (FEW) nexus is one of the frameworks used to assess the issue of food security. Energy and water are essential resources for agriculture – water is used directly and energy is used directly and indirectly. The idea of the nexus is complete when the contribution of the food system to the energy and water systems are assessed. It is common to take one of the system's perspective – food, energy or water. The food system, specifically the agricultural produce sub-system, perspective is taken for the purposes of this dissertation. The agriculture industry in the US contributed $992 billion, 5.5% of the US GDP in the year 2015. With increasing temperatures and changes to the climate, the stress that water bodies and farms experience are predicted to increase drastically. Food security is about restrictions on availability and accessibility of food, making the traditional FEW nexus framework insufficient.

The dissertation intends to examine and quantitatively model the food system interaction with the energy system and the water system. Traditional FEW nexus studies have focused on food production alone. This is itself is insufficient since food is extensively traded. Various food miles studies have highlighted the extensive virtual energy and virtual water footprint of food. Hence transport needs to be a part of the nexus framework, and since food is perishable, storage needs to be considered as well. The Life cycle assessment framework presents the best option to estimate the net energy and water exchange between the food, energy and water systems. As we know climate plays an important role in food production as well as food preservation. Crops are very sensitive to temperature changes and it directly impacts a crops productivity and also our ability to store and transport. Changing temperatures are also accompanied by changes in precipitation. This directly

impacts on crop productivity since water availability is a key factor for agriculture. Conservation technologies can provide some leeway from the energy and water perspective. Even under varying climates it might be possible to meet demand for food through trade. The complex trade network might have the capacity to compensate for the produce lost due to climate change, unlike the local first option. In this case, re-visualizing the FEW nexus as a network of networks, in this case a FEW-e (FEW exchange) nexus would better inform policy and conservation. We hope to achieve this by answering the following questions,

- What are the direct and indirect energy and water requirements for agriculture in Arizona? How does disproportionate consumption of energy and water occur across crops?
- What is the impact of conservation strategies on Arizona's FEW Nexus? How does conservation strategies from another sector impact the agriculture?
- Given spatially-explicit climatologic and hydrologic forecasts, where might agriculture productivity in Arizona be affected and how? If agricultural yield drops with temperature rise, is there sufficient water available to mitigate this effect, and what are the possible impacts of increased water use?
- Is it possible to re-visualize the FEW nexus and quantify it? How does this change the FEW nexus for Arizona?

Monday, September 25, 2017
8:30 am to 10:30 am
College Avenue Commons, Room 401

Faculty, students, and the public are invited.

Supervisory Committee:
Dr Mikhail Chester (Chair)
Dr Benjamin Ruddell (Member)
Dr Andrew Fraser (Member)
Dr Jose Lobo (Member)