Chapter 9
Entangled Systems at the Energy–Water–Food Nexus: Challenges and Opportunities

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ABSTRACT

This chapter assesses energy, water, and food resource systems based on their inter- and intra-sectoral imperatives of large scale development investments at the institutional level (including private and public activities) and how to achieve security of resource supplies. It identifies key interrelated processes, practices, and factors that underpin integrated resource management (IRM) and their attendant benefits. Applying the E4 framework concerned with energy, economy, environment, and equity to identify the main threats to these systems, the chapter evaluates their institutional, political, economic, cultural and behavioral components, and characterizes the forces that drive each of them at different governance scales. The chapter is guided by political economy, economic, and sociological theories that suggest that institutional structures affect economic factors and processes (i.e. production, distribution, and consumption processes). A case study of energy, water, and food (EWF) conflicting sectoral imperatives in Delaware is discussed in detail to better understand how these policy and institutional processes occur, which forms they take, and in which ways they define the quality and quantity of EWF resource systems in the State. In order to verify these parameters, the analysis considered the advantages of a sectorally balanced, E4 framework, in particular to evaluate the valency and magnitude of cross-sectoral connections, balance competing needs, and identify policy options that address various trade-offs.

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INTRODUCTION

The energy-water-food nexus is essential for sustainable development and conceptually relevant to mitigating the risk of unintended consequences of large-scale sector-specific investments and negative trade-offs. Energy is required to produce, transport and distribute food as well as to extract, pump, lift, collect, treat, and transport water (Halstead et al., 2014). Water is required in energy generation and in the cultivation of food crops. Likewise, food is required to support the world's growing population that both generates and relies on water and energy services (Belden et al., 2008). This highlights the interlocking between water, energy and food resource systems (Figures 1 & 2).

Furthermore, policymakers and researchers in the United States, China, Spain, and Australia duly recognize the important role of a nexus approach as opposed to static experiments in deepening our understanding on "how the occurrence, valency and magnitude of sectoral connections emerge and are altered as a consequence of single sector interventions in a water–food–energy nexus" (Smajgl et al., 2016). For instance, in the United States, a proposal to create specific institutions (such as an Energy-Water Architecture Council to foster data collection, reporting, and technology innovation) to administer and research water, food, and energy ''provisioning" regulatory and planning regimes and promote optimal cross-sectoral coordination was included in the Energy and Water Research Integration Act of 2012 (GAO, 2012). However, the bill was never enacted.

REALIZING A NEW PARADIGM

The Nexus Framework

To date, water, energy, and food resource systems are still largely organized, studied, and prescribed independently. However, decisions, actions, choices, and preferences in each of the three domains fun-

Figure 1. An integrated model showing the complexities between energy, water, and food systems (Belden et al., 2008)