Water-energy-food nexus: challenges and opportunities

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Population growth and improved living standards have and continue to increase our basic demands for water, energy, and food. There are serious concerns on the availability of water, energy, and food to meet our current and future demands. For instance, according to some recent estimates, about 768 million people in the world remain without access to an improved source of water (WHO/UNICEF 2013), more than about 1.3 billion people still lack access to electricity (IEA 2012), and about 868 million people are undernourished due to a lack of food or lack of access to food (FAO 2013). Projections for 2050 indicate that global water demand (in terms of water withdrawals) will increase by 55% (OECD 2012), energy demand from hydropower and other renewable resources will rise by 60% (WWAP 2009), and food production will need to increase by as much as 60% to meet the demand (WWAP 2012). Global climate change is anticipated to have serious influences on the water, energy, and food sectors. All these will likely have threatening consequences on our socio-economic development and environmental sustainability.

In view of these, there are urgent and pressing questions about the water, energy, and food sectors, especially in the face of climate change. While these questions have often been independently addressed in the respective fields, such a sectoral approach is clearly inadequate, since there are strong links among the different sectors. For instance: (1) agriculture accounts for about 70% of global water withdrawal; (2) about 75% of all industrial water withdrawals are used for energy production; (3) food production and supply chain accounts for about 30% of global energy consumption; and (4) about 90% of global power generation is water-intensive. What is needed, therefore, is an integrated approach that can incorporate the complex interactions among the different sectors. In light of this,

research on the “Water-Energy-Food nexus” (WEF nexus) (and between any two sectors) has been gaining considerable attention in recent years, and the role of climate (change) is also starting to be incorporated.

Despite the efforts and progress in recent years, our understanding of the WEF nexus remains very limited. Many factors contribute to this situation: (1) the systems and the interconnections (both within and between) are inherently complex, and a strong scientific theory for studying such complex dynamically-evolving systems and the associated interconnections is largely absent; (2) there are natural and anthropogenic influences, which are not adequately known; and (3) there are often only limited data. There are also other important factors that are not given the required attention. For instance, there are even questions on the basic definition of the Water-Energy-Food nexus. Literature on these are often scattered and fragmented, which makes it hard to address the Water-Energy-Food nexus in a coherent manner.

This Special Issue is intended to bring together some of the latest, yet scattered, research activities on the Water-Energy-Food nexus into a single platform, to discuss the major challenges in studying this nexus and the opportunities that exist to address such. The papers together cover a broad range of topics related to research on the WEF nexus, including: (1) concept of the WEF nexus; (2) key natural and anthropogenic factors that influence the WEF nexus; (3) development and application of methods to model the structure, connections, and dynamics of the WEF nexus; (4) role of the WEF nexus in assessing our socio-economic development and environmental sustainability; (5) guidelines for adaptation and mitigation of the negative impacts of the dynamics of the WEF nexus; and (6) formulation of a general and integrated framework to study the WEF nexus in an interdisciplinary and multi-disciplinary setting. The contributions also cover WEF nexus studies conducted for many regions around the world, including regions that are highly vulnerable in terms of population growth and socio-economic development, such as Asia, Africa, and South America.

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