



The water-energy-food nexus: Is the increasing attention warranted, from either a research or policy perspective?



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ABSTRACT

In recent years, the notion of a nexus involving water, energy, and food has been gaining attention in the scholarly literature and popular press, due partly to the impetus provided by an international conference on the nexus in 2011, and partly to the increasing interest among researchers and public officials in determining the investments and policies needed to achieve and sustain water, energy, and food security. While the notion of such a nexus is compelling to some observers, interactions involving water, energy, and food have been known and studied for many years by scientists and policy analysts. The need for greater integration of research and policy discourse across sectors and regions has been expressed in international meetings since the late 1940s. In addition, the conceptual basis for including water, energy, and food in the “nexus,” to the exclusion of other resources and inputs is not evident. In many cases, the information excluded from studies claiming to implement a nexus approach might be of greater importance to science and policy than the information included in the analysis. In this paper, I review some of the experience gained in earlier attempts to enhance integration and policy coherence, and to promote systems analysis. The challenges observed in implementing programs of integrated natural resources management (INRM) and integrated water resources management (IWRM), in particular, suggest that efforts to implement a water-energy-food nexus approach will not enhance the policy process in all settings. In sum, it is not clear that the increasing attention given to studies claiming to implement a nexus approach is warranted.

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1. Introduction

Scholarly and popular interest in the notion of a water-energy-food nexus have increased markedly in recent years, following the release of a World Economic Forum report in January 2011 (Waughray, 2011), and the gathering of scholars and practitioners at an international conference regarding the nexus, later that year. The Bonn Conference highlighted many distinguished speakers who promoted the water-energy-food nexus as a novel and meaningful depiction of interactions involving water, energy, and food security (Hoff, 2011). In the intervening years, many authors have described research and policy outreach activities in which they have taken a nexus perspective or applied nexus tools. Several authors have suggested that a nexus approach should be followed when describing efforts to achieve the sustainable development

goals (Sachs, 2012; Boas et al., 2016; Giupponi and Gain, 2016; Rasul, 2016).

The attention given to the water-energy-food nexus in the scholarly literature is somewhat surprising, particularly as the nexus is not a clearly defined construct or an agreed and tested framework. One can discern several themes that characterize much of the nexus literature, yet there is sufficient variation around those themes to prevent one from stating clearly what constitutes a nexus approach or nexus analysis. The nexus literature that has proliferated since 2011 reflects a call for greater integration of research efforts and policy prescriptions across disciplines (Endo et al., 2015). Many authors suggest that investments and interventions should acknowledge linkages involving the water, energy, and food sectors (Bazilian et al., 2011; Leck et al., 2015). Some call for greater coherence when designing policies involving natural resources, to achieve efficiency and to minimize the likelihood of unintended consequences (Mercer et al., 2014; Rasul and Sharma, 2016). Integrated research, inter-sectoral analysis, and policy coherence are desirable goals in many settings,

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yet the rationale for promoting these within the context of a water-energy-food nexus is not fully evident. One might imagine that other inputs (such as land and labor) and other outcomes (such as health care, housing, and employment) also should be considered, in the interest of achieving integrated research, inter-sectoral analysis, and policy coherence.

The selection of water, energy, and food as the key nodes of a nexus that should guide research and policy analysis, although compelling at first glance, is somewhat arbitrary. Water and energy are two important inputs in many production settings, while food is certainly an important output. Yet, many important variables and interactions are not considered explicitly when examining only issues pertaining to water, energy, and food. Descriptions of the water-energy-food nexus are largely silent on such critical issues as soils, plant nutrients, farm chemicals, and land tenure (with regard to agriculture); population, labor, human capital, health, and welfare (with regard to livelihoods); and finance, risk, and uncertainty (with respect to farm-level and firm-level decisions).

Many of the authors discussing the water-energy-food nexus address issues involving water and energy use in agriculture. Some authors describe efforts to achieve efficient use of water and energy on farms or across a river basin (Doukkali and Lejars, 2015; Smidt et al., 2016), while others address interactions involving hydropower and irrigation (Hurford and Harou, 2014; Rasul, 2014; Jalilov et al., 2016) or the competition for water involving farmers and the operators of thermal power stations (Xiang et al., 2016). Several authors address water quality issues and the use of wastewater for irrigation within the context of the water-energy-food nexus (Bell et al., 2016; Mortensen et al., 2016; Psomas et al., 2016). Others invoke the nexus when assessing the outlook for global food security (Hurni et al., 2015; De Laurentiis et al., 2016) or describing the tradeoffs involved when allocating land and water to produce crops either for food or biofuel (Jarvie et al., 2015; Rulli et al., 2016). Given the frequent discussion of agriculture in much of the nexus literature, it seems reasonable to examine questions regarding the increasing interest in the nexus using technical information and examples pertaining to agriculture.

The current interest in addressing agricultural and environmental issues in the context of a water-energy-food nexus is reminiscent of earlier discussions in the literature regarding integrated natural resources management (INRM) and integrated water resources management (IWRM). Systems analysis also comes to mind when reading papers promoting the water-energy-food nexus. All three approaches have been described in the literature for some time. Several countries have attempted to implement policies and programs based on principles aligned with INRM and IWRM with limited success (Medema et al., 2008; Schreiner, 2013). Systems analysis has enhanced understanding of interactions involving natural resources, economic development, and livelihoods in many settings (Mayya and Prasad, 1989; Peralta et al., 2011; Gheewala et al., 2013; Villarroel Walker et al., 2014), perhaps in ways that resemble the aspirations of those promoting the water-energy-food nexus. Systems analysis research can generate enhanced policy recommendations (Grant, 1998; Ewert et al., 2009), yet policy coherent outcomes that reflect interaction across sectors are not guaranteed.

In sum, much of the discussion of the water-energy-food nexus in the literature seems to be calling for trans-disciplinary integration of research efforts, greater focus on inter-sectoral analysis, and improvements in policy coherence. However, it is not clear that the nexus is a well-defined, fully descriptive analytical framework that enhances understanding of resource interactions. It is also not clear that the discussions of the water-energy-food nexus represent a substantial departure from earlier

descriptions of research integration, inter-sectoral analysis, and policy coherence, which have appeared in the literature for some time.

My goal in this paper is to consider whether or not the increasing attention given to the notion of a water-energy-food nexus is warranted, from either a research or policy perspective. To this end, I address several questions regarding the genesis and pertinence of the water-energy-food nexus.

1. Is the water-energy-food nexus, as described in recent literature, something new and innovative? Does it provide information or insight that is not already well known? Given that similar ideas have appeared previously, and are still discussed in the literature, what has given rise to the current interest in the water-energy-food nexus?
2. Is there a supporting conceptual framework for the water-energy-food nexus? Is the water-energy-food nexus well defined and are the boundaries of what the nexus includes clearly stated and generally accepted?
3. Is the water-energy-food nexus approach either necessary or sufficient in efforts to describe or achieve sustainable resource use?

Throughout the paper, I speak of the water-energy-food nexus and a nexus approach or perspective as if those notions are well-defined constructs. I do this only in the interest of easing the burden on readers. I do not wish to suggest, *a priori*, that there is such a construct as “the nexus,” a “nexus approach,” or “nexus tools.” One motivation for preparing this essay is the wide use of such terminology in the literature, often in capitalized form. It is not clear that the notion of a water-energy-food nexus warrants such status.

2. Is the water-energy-food nexus new or innovative?

The notion of a nexus involving water, energy, and food is not particularly new. Farmers, fishers, and livestock herders have been aware of interactions involving water, energy, and food production for millennia. Researchers, practitioners, and public officials also have been aware, although perhaps over a much shorter time horizon. Resource modelers and civil engineers have known about interactions involving water, energy, and food for many years (Allouche et al., 2015; Benson et al., 2015). Indeed, many studies had been conducted worldwide regarding interactions involving natural resources and the environment, long before the World Economic Forum published its report regarding a water-food-energy-climate nexus (Vaughray, 2011) and the Bonn Conference on the water, energy, and food security nexus was convened in 2011 (Hoff, 2011).

Many researchers and policy makers have been aware of resource interactions and environmental externalities, at least from the 1960s, given the seminal writings of Rachel Carson [Silent Spring (Carson, 1962)], E.P. Odum [Ecology (Odum, 1963); The Strategy of Ecosystem Development (Odum, 1969)], Paul Ehrlich [The Population Bomb (Ehrlich, 1968)], Garrett Hardin [The Tragedy of the Commons (Hardin, 1968, 1998)], Frances Moore Lappé [Diet for a Small Planet (Lappé, 1971)], and Meadows et al. [The Limits to Growth (Meadows et al., 1972, 2004)]. None of those authors spoke specifically about a nexus, yet their writings conveyed the notion that the impacts of human activities on natural resources and the environment are complex and are best assessed in a systems context.

The need for greater integration of research and policy analysis across sectors and regions has been expressed in international meetings since the late 1940s. Several international conferences have addressed the need to examine environmental and natural

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