The Takeaway

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Governing the Water-Energy-Food Nexus

What it Is and Why it Matters

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The science of the "water-energy-food nexus" suggests that these resources need to be managed and governed together. But, few people know much about what nexus governance is or why it matters. This brief addresses the governance of these resources as reflected in research of the Institute for Science, Technology, and Public Policy.

The water-energy-food (WEF) nexus describes the ways in which water is needed to extract and generate energy and to grow food; energy is needed to extract and distribute water and to grow food; and agricultural production, food processing, and transport rely on water and energy resources. In short, it describes the idea that these three resources are heavily dependent on each other. Underlying this dependency is the idea that in order to achieve greater sustainability, more efficient means of using these resources must be found. We

WHAT'S THE TAKEAWAY?

Water-Energy-Food nexus research prescribes coordinated resource management.

Little is known about how these resources are governed.

Analysis of governance in the San Antonio, Texas, region as a nexus hotspot highlights the need for better coordination.

Explicit reforms need to be made to facilitate better conjoint management of resources.

need to learn to use less water for both energy and food production. The science of WEF nexus has come far in helping us understand in some detail how these resources are connected to each other.

WEF NEXUS HOTSPOTS

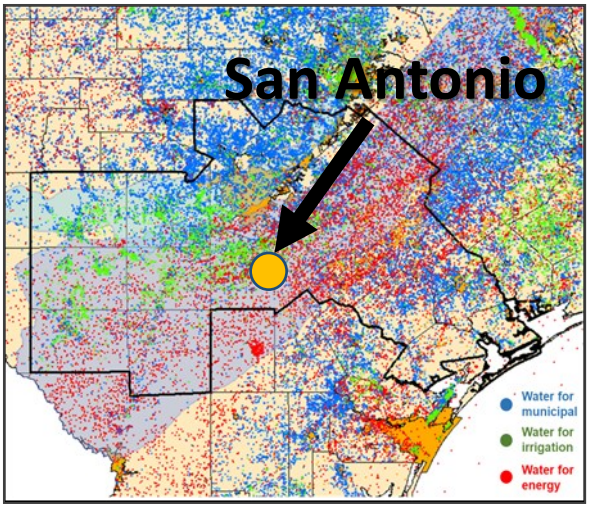
One way of understanding and addressing the nexus of water, energy, and food is to identify "hot spots"—geographic areas where the linkages among these resources are particularly salient. One such hot spot is in the San Antonio, Texas, region. This is an area where rapidly growing demand for water and challenges of drought have led to dwindling groundwater supplies, especially in the Edwards, Trinity, and Corrizo Aquifers. At the same time, growing reliance on hydraulic fracturing (fracking) to extract natural gas and petroleum energy resources in the Eagle Ford shale play (requiring significant quantities of water) and intensive agricultural activities (requiring irrigation water and energy-intensive fertilizers and chemicals) have significant implications for all of the resources. With extensive water, energy, and food activities all occurring in the same geographic space, the conditions are ideal for defining a nexus hotspot.

Figure 1 shows a map of the San Antonio, Texas, region with blue, green, and red colored dots representing the locations of water wells used for municipalities, for agricultural irrigation, and for fracking. The co-location of wells used for these different purposes characterizes the essence of a nexus hotspot.

GOVERNANCE OF THE WEF NEXUS

While the water-energy-food nexus is increasingly well understood, prescribing ways that these resources can be used more efficiently has been more elusive. In the end, finding ways of improving resource use efficiency inevitably raises the issue of how these resources are governed.[1] How does public policy affect the nexus efficiencies, and how do policy makers and other stakeholders make decisions that affect the nexus? When decisions are made about water resources, this indirectly affects decisions about energy and food. We usually think of each of these resources as being managed in isolation, without regard for the others. This "siloing" of decision making is a common description of water policy and management, energy policy, and food policy as they are individually understood. Governing these resources in a coordinated way requires that apparent silos be transcended in ways that might be unfamiliar in the public policy world.[2] The water, energy, and food/agricultural resources depicted in Figure 1 need to be co-managed in order to avoid depleting one or more of them.

Figure 1: Anatomy of the WEF Nexus Hotspot in San Antonio, Texas



Source: Daher et. al, (2019), p. 2916. See note 2.

So, how well is the co-management of these resources going? We set out to answer this question. We first identified all of the governance agencies that have legal authority and responsibility for water decisions in the San Antonio region. We discovered that there are at least 58 such agencies, including state, regional, and local organizations. They include groundwater conservation districts, aquifer authorities, special water districts, river authorities, state water planning, environmental and land agencies, drainage and irrigation districts, and others. Each of these types of organizations has some legal responsibility for managing water resources, and as they engage in water management, they inevitably affect energy and food resources.[3] Do these agencies coordinate their decisions? Do they communicate with each other about how to optimize the uses of the resources?

We surveyed representatives from each of these 58 organizations and asked them how often they contact each other. Over 100 representatives answered our questions, and we used the results to create social network diagrams depicting their interactions. What we found is shown in Figures 2, 3, and 4, where for each square

- blue depicts a water agency,
- red depicts an energy agency, and
- green shows a food/agriculture agency.

The size of the squares reflects the frequencies of regular contacts with other agencies. Despite the many lines, the predominance of small squares indicates little regular contact.

What becomes clear in Figure 2 is that the water agencies communicate with each other very infrequently, with two state agencies,

Figure 2: Frequency of Contact of Water Agencies

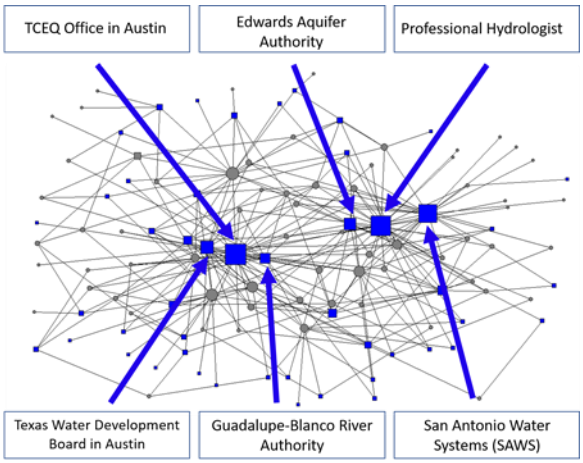


Figure 3: Water and Energy Agency Contacts

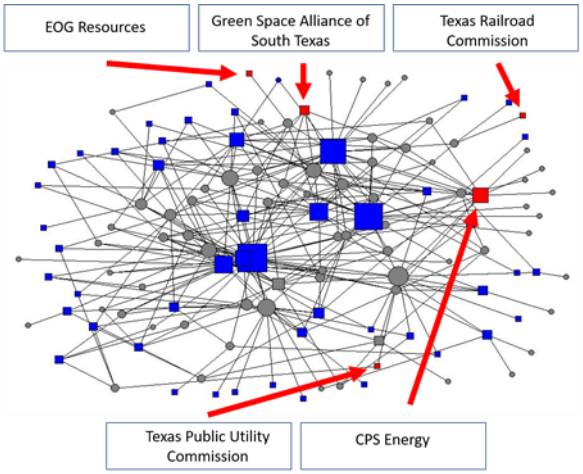
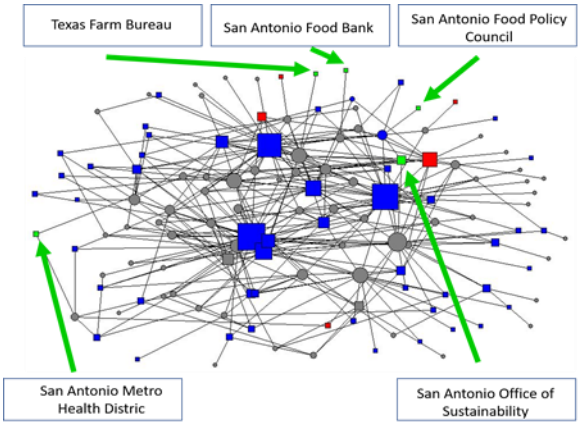


Figure 4: Water, Energy, and Food Agency Contacts



two river authorities, and one local water agency interacting most often.

Figure 3 adds information about energy agencies, and Figure 4 completes the picture with information about all three types of agencies. Taken together these network maps reveal an important fact. There is very little contact interaction among water, energy, and food and agriculture agencies. If "nexus governance" requires interactions, cooperation, and coordination, there is very little evidence here that such requirements are being met.

WATER-ENERGY-FOOD GOVERNANCE IMPLICATIONS

These results suggest that if coordination is an important part of achieving greater resource efficiencies, then explicit steps might need to be made to ensure that great communication takes place. These could include state mandates for regular meetings, stakeholder engagement opportunities, and conjoint planning. They could also include making such coordination an explicit responsibility for existing state agencies, especially the Texas Water Development Board, the Texas Council on Environmental Quality, and the Texas Land Office. It could also be accomplished by creating a new consolidated state agency with dedicated coordinating responsibility.

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Notes:

[1] Portney, K. E., Vedlitz, A., Sansom, G., Berke, P., & Daher, B. (2017). Governance of the water-energy-food nexus: Conceptual and methodological foundations for the San Antonio region case study, *Current Sustainable Renewable Energy Reports*, *3*. DOI:10.1007/s40518-017-0077-1

[2] Daher, B., Hannibal, B., Portney, K.E., & Mohtar, R. (2019). Toward creating an environmental of cooperation between water, energy, and food stakeholders in San Antonio, *Science of the Total Environment*, *651*, 2913-2926. DOI:10.1016/j.scitotenv.2018.09.395

[3] Daher, B., Mohtar, R., Pistikopoulos, E., Portney, K.E., Kaiser, R., & Saad, W. (2018). Developing socio-technical-economic-political (STEP) solutions for addressing resource nexus hotspots, *Sustainability*, *10*(2). DOI:10.3390/su10020512