

**Governance of the Water-Energy-Food Nexus:
The Conceptual and Methodological Foundations for the San Antonio Region Case Study**

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A significant part of the Texas A&M Water-Energy-Food Nexus initiative focuses on issues of governance and public policy. The governance and public policy element of this initiative represents one potentially unique contribution to the applied scholarship on nexus issues *writ large*. Both as a significant research project in its own right, and as a proof-of-concept effort, the initiative has decided to engage in a significant collaborative research project centered on a San Antonio Region Case Study. This white paper is designed to provide an outline of the “governance” group’s approach to conducting research on nexus issues in this case study.

1. Background

Our facet of the Texas A&M Water-Energy-Food Nexus initiative will aid in the understanding of the complex governance systems managing these resources as well provide evidence of the impact these networks have on community perceptions, health behaviors, and social capital. This project will serve to underscore the importance of proper management and allocation of water, energy, and food on the wellbeing of communities within San Antonio, TX.

State of Water, Energy, and Food Governance

Issues of policy and program governance typically focus on who makes significant decisions in a particular policy area despite the complex interdependent nature of governance systems. Studies of

governance usually seek to understand the institutional, legal, administrative, and personal dimensions of the decision-making environment. In this case study of nexus issues, the initial challenge is to properly characterize this environment as applied to multiple policy areas. Common understandings of public policies suggest that water, energy, and food are governed separately and differently from each other. Scientific and technical research on nexus issues argues that these three areas are interconnected, or at least should be understood that way. Despite the broad scientific literature on this topic, no parallel research has examined the possible management or policymaking connections. Indeed, existing research implies that governance in the nexus is not connected; rather the three areas are governed separately, stove-piped, or siloed. This implies that policymakers in one area are different people than those in other areas, not aware of the policymakers in the other areas, and policymaking institutions in one area do not communicate, share information, or otherwise collaborate when making decisions. Yet to date, no research exists to examine the extent to which these three areas are at all connected to each other, or even whether policymaking in one area is connected to policymaking in either of the others. The governance group's research is designed to fill this gap.

Significance on Public Health

Human and economic development are complex qualitative and quantitative processes that lead to potentially rapid social change with far reaching consequences for society. Understanding the potential impacts of these changes on governance within the water, energy, and food nexus is essential to ensuring a sustainable future for individuals, communities, and the environment. Using the San Antonio, TX, region as a case study to better understand the implications of these competing viewpoints as they relate to urban agriculture, water management, energy use, and individual choices on health and the environment. We expect the character of nexus governance (the extent to which water, energy, and food are governed in coordinated or siloed fashion) will affect a variety of community health outcomes. The governance and public health aspects of the case study will be conducted in partnership with community organizations and residents in selected neighborhoods across San Antonio. The goals of the case study are to better understand the role that governance networks play on water usage, energy expenditure, and food development and consumption, as well as individual and community health outcomes and choices. The case study takes advantage of the potential of conducting a natural experiment. Starting January 1st, 2016, the San Antonio Council made all urban agriculture and farming pursuits legal within the city border, thus making it an excellent location to study the impacts of this policy change on the governance of these resources, as well as on specific community health outcomes and individual choices.

2. Characterizing Governance and Governance Systems

Significant research has focused on understanding governance systems in the US with a particular effort to outline how significant public and management decisions are made and why. Governance systems are typically described as "complex," involving many people, organizations and institutions, and geographic areas. The governance, management, and policymaking systems associated with water, energy, and food are individually highly complex. They appear even more complex when the intersection of these systems – the intersection of water governance, energy governance, and food and agricultural governance -- is contemplated. Indeed, there is no existing published research explicitly investigating this nexus governance.

The first order of business is to begin describing these systems as they are practiced in specific places. In this case, the specific place is the San Antonio region. The description of these systems conjures reference to a number of more general conceptions of governance, including those that are “polycentric,” “multi-level,” and “fragmented.” Moreover, many such conceptions rely on some form of “social network analysis,” (described more fully below) where network analysis represents both a framework and a methodology for empirical analysis. This is especially appropriate in the San Antonio region. Below is an outline of some of the water, energy, and food governance organizations in the San Antonio area. Because the case study project has not delimited an exact geographic area to be covered, this may include some specific agencies, organizations or types of organizations that, in the end, would be considered not relevant.

The governance of water, energy, and food in the San Antonio area is partly delimited geographically by the location of resources. San Antonio relies on reasonably well defined areas where water resources are located, especially groundwater resources and surface waters associated with river systems. It also relies on areas where energy resources are located, especially the Eagle Ford Shale, where significant natural gas and oil drilling and extraction activities are concentrated, as well as locations of electric generating facilities. When biofuels are included, it also includes agricultural areas that grow the crops used to produce ethanol. The food and agriculture element of the nexus, as applied to San Antonio, has a geographic area that is much more difficult to identify. Certainly, the region relies on food grown a great distance from the area and while these conditions are outside the scope of this project, local urban farming will be explored. Other areas of food governance relevant to the nexus will be pursued in order to better understand its relationship to, and impact on, individual choices. The institutions and organizations involved in the San Antonio region’s nexus governance deserve elaboration.

It should also be noted that while this white paper focuses on the organizations and institutions of governance, the fact is that these organizations are populated by people. Each organization or institution identified here employs and engages many individuals, and no preliminary effort has been made to identify all of the individuals who are involved in making decisions relevant to the nexus. Suffice it to say that there may well be many hundreds of such people, and this project will eventually turn its attention to eliciting information about nexus governance from these people.

The “Structure” of Water Governance in San Antonio

The first effort here is to begin describing water governance. Governance of water resources in the San Antonio region is probably about as complex as that found anywhere. There are many different water agencies, organizations, and processes involved in making significant decisions about water. The list below includes local water institutions, regional institutions, and state agencies that have a role in water decision-making affecting the San Antonio area.

Each of these organizations has its own mission, legal authorities, and responsibilities. Many operate as independent or quasi-independent organizations. Some are government (public sector) agencies, and others are incorporated as nonprofit organizations with their own internal governance structures. Some of these are purely professional administrative organizations with their own employees. Some are membership or volunteer organizations. Some engage in various methods of engaging stakeholders or

even the general public, while others have no such methods. Some have extensive finance authority, able to engage in capital finance of projects, to impose taxes or user fees, and others have little or no finance authority. What they all have in common is that they are involved in one way or another in

Water Governance Organizations in the San Antonio Area

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<p><u>Groundwater governance</u></p> <p>Groundwater conservations districts (GCDs)</p> <ul style="list-style-type: none"> • Bandera County River Authority and GCD • Barton Springs/Edwards Aquifer and GCD • Blanco-Pedernales GCD • Comal Trinity GCD • Cow Creek GCD • Evergreen GCD • Gonzales County Underground Water • Hays Trinity GCD • Headwaters GCD • Kinney County GCD • McMullen GCD • Medina County GCD • Pecan Valley GCD • Plum Creek GCD • Post Oak Savannah GCD • Trinity-Glen Rose GCD • Uvalde County Underground Water <p>Groundwater Management Areas</p> <ul style="list-style-type: none"> • Texas Groundwater Management Area #9 TWDB • Texas Groundwater Management Area #10 TWDB • Hill Country Priority • Trinity Aquifer Priority <p>Aquifer Authority</p> <ul style="list-style-type: none"> • Edwards Aquifer Authority <p>Texas Irrigation Districts</p> <p>Texas Groundwater Protection Committee</p> <p>Groundwater-related Nonprofit Organizations</p> <ul style="list-style-type: none"> • Edwards Aquifer Association • Texas Association Watershed Sponsors (TAWS) • Texas Alliance of Groundwater Districts 	<p><u>Surface water governance</u></p> <p>River authorities</p> <ul style="list-style-type: none"> • Bandera County • Brazos River Authority • Central Colorado River Authority • Guadalupe-Blanco River Authority • Lavaca-Navidad River Authority • Lower Colorado River Authority • Nueces River Authority • Trinity River Authority • San Antonio River Authority • Upper Colorado River Authority • Upper Guadalupe River Authority <p><u>Ground and surface water governance</u></p> <p>Texas Commission on Environmental Quality</p> <p>Texas Water Development Board Regional Planning Areas</p> <ul style="list-style-type: none"> • Region K (Lower Colorado) • Region L (South Central) <p>Texas State Soil and Water Conservation Board</p> <p>Texas State Public Utility Commission</p> <p>Texas General Land Office</p> <p>County and municipal elected officials</p> <p><u>Water service providers</u></p> <p>San Antonio Water System (SAWS)</p> <p>Live Oak municipal utility</p> <p>Canyon Regional Water Authority</p> <p>Other municipal providers</p> <p><u>Wastewater service providers</u></p> <p>San Antonio Water System (SAWS)</p> <p>Live Oak municipal utility</p> <p>Other municipal providers</p> <p><u>Storm Water Control Districts (TCEQ)</u></p> <p><u>Freshwater Supply District (TCEQ)</u></p> <p><u>Drainage District (TCEQ)</u></p> <p><u>Subsidence Districts</u></p> <p>Fort Bend Subsidence District</p> <p>Harris-Galveston Subsidence District</p>
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making decisions that affect water resources in the San Antonio region. The existence of these organizations, with their specific often overlapping geographic-based responsibilities, raises issues of coordination. Do these organizations utilize mechanisms to cooperate, coordinate, and communicate with other organizations having responsibilities in the same geographic area? More broadly, how do these organizations govern water collectively? This is one research area that this case study seeks to investigate. Which kinds of organizations have larger budgets, revenue streams, and other financial capacities? Perhaps even more important, this project seeks to understand the impact of variations in finance capacity on the decisions made in each nexus area. Particularly with respect to water, are governance institutions and organizations with limited financial capacities likely to make different kinds of decisions than those with greater capacities? Are they less likely to engage in cooperative networks than those with greater resources? Or does limited resource availability incentivize engagement in cooperative water, energy, or food management?

The Structure of Energy Governance in San Antonio

The governance of energy in Texas, in many respects, bears little or no resemblance to water governance. In the context of the water-energy-food nexus, energy governance would typically address issues of who makes decisions about electricity generation, extraction of energy resources (oil and natural gas), the production and use of biofuels, and reliance on renewable resources such as wind and solar. Decisions of this kind are rarely made in small geographic areas, instead made by Texas state agencies or commissions operating under state legislative authority. Decisions about where to site an oil well, whether to permit hydraulic fracturing operations, where electric power plants will be built, and many others are made at the state level. However, the retail delivery of energy resources to end users and consumers is often the responsibility of local, county, or regional officials. In other circumstances, such delivery is performed within the private sector, with designated corporations selling electricity to consumers in designated geographic areas.

Energy Governance Organizations in the San Antonio Area

<p><u>Nonprofit Organizations</u></p> <ul style="list-style-type: none"> CPS Energy (City Public Service -- city owned public utility) Blue Wing Solar (collaboration with Duke Energy and CPS Energy) <p><u>Private Sector Organizations</u></p> <ul style="list-style-type: none"> Duke Energy Marathon Oil Pioneer Natural Resources/Reliance Joint Venture EOG Resources <p><u>Government Organizations</u></p> <ul style="list-style-type: none"> San Antonio Office of Sustainability Texas Railroad Commission Texas Comptroller, Office of Energy Conservation Texas Public Utility Commission Texas General Land Office

The Structure of Food Governance in San Antonio

Governance of food is the least well understood aspect of the nexus governance. Primarily because of the connection between food and water through issues of agricultural production and food processing, and between food and energy through issues of harvesting of agricultural products and transportation, it is important to describe how food is governed. Food and agriculture are typically thought of as private sector issues, with only limited public sector involvement. From a private sector perspective, food governance is largely about the character and management of supply chains. Water and energy enter into supply chain considerations at various stages, and nexus analysis seeks to understand these stages. Moreover, there is probably an expectation or assumption that linkages among the nexus areas – connections between food and water or between food and energy -- would be captured through market processes. With this said, there are many aspects of food governance that need to be addressed. For example, urban areas often lack access to food options for residents, in the worst case characterized as

Food Governance Organizations in the San Antonio Area

Municipal and County Government Organizations

San Antonio city
Bexar County
San Antonio Metropolitan Health District
San Antonio Parks and Recreation Department

State and Federal Government Organizations

U.S. Department of Agriculture
Texas Department of Agriculture

Nonprofit Organizations

San Antonio Food Policy Council
San Antonio Food Bank
Green Spaces Alliance of South Texas
San Antonio community gardening
Community centers
Social service providers
FitCitySA
Community health centers/clinics
Southwest Workers Union

Private Sector Organizations

Food retailers, grocery stores and chains

- HEB
- Kroger

Food wholesalers and distributors

- NatureSweet
- Sysco Central Texas Inc.
- Labatt Food Service
- Del Norte Goods
- Cargill Food Distribution

Farms and Farmers

Farm Organizations

“food deserts.” The existence of such areas in cities carries numerous implications, including deprivation of adequate nutrition and associated public health risks, higher costs, and the need to expend more energy to travel greater distances to shop. When local governments engage in efforts to mitigate food deserts, they are engaging in food governance. Additionally, numerous cities have developed formal food governance systems in the form of food policy councils. These councils are explicitly designed to coordinate access to food, especially through promoting farmers’ markets, community gardens, and sustainable agriculture. San Antonio has a particular mix of institutions and organizations active in various aspects of food governance. Perhaps more relevant to the geographic area of food governance is the concept of a “foodshed,” designed to be analogous to a watershed. A foodshed is a geographic area in which food is produced for a designated population of people. Another conception of foodshed is that it is the geographic area between where food is produced and where it is consumed. There is, to date, no generally agreed upon geographic area considered to be the foodshed for San Antonio, but this project will seek to take advantage of existing research to help delineate the area of relevance for food governance. Because agriculture, in general, is a significant user of water resources, food governance would include issues directly related to agriculture, including the role (if any) of agricultural producers (farms), and farm related organizations (include agricultural extension services).

3. Analysis of Nexus Governance in San Antonio

Given the character of governance in each of the nexus areas, the challenge for nexus governance analysis is to articulate the central research questions, and to define an initial methodology for addressing these questions. Many of these questions are implied in the discussion above.

To begin a meaningful cross analysis of nexus governance research is to adequately and accurately characterize the governance systems. This means that an effort needs to be made to understand what each institution has authority and responsibility for accomplishing, and what they actual do. What processes do they use, and who are the people, parties, and stakeholders who are involved in making decisions? Which organizations engage in monitoring and data collection? Which are engaged in formal planning efforts? Which deliver services or make explicit decisions impacting water, energy, and food? Which rely on stakeholder engagement processes? Which have developed public participation initiatives?

Characterizing the governance systems requires identifying specific organizational features, each of which represents an important independent variable (potentially explaining organizational networks and performance). And each of these features taps into its own body of organizational or management theory. An example of this is found in the nature of financial authorities of each organization.

As noted above, there are many different kinds of organizations involved in water governance. Many of these organizations would be considered examples of “special districts” – organizations created by law with designated responsibility for making decisions about some specific aspect of water. Groundwater conservation districts (GCDs) in Texas represent one such type of special district. However, unlike traditional special districts, GCDs almost all have their respective origins in the nonprofit sector, becoming legally recognized entities with specific governmental authorities after being incorporated and

ratified by the Texas state legislature. Other special districts include river authorities, the Edwards Aquifer authority, and the San Antonio Water System (SAWS).

The existing literature on special districts suggests that efficacy is at least partly a function of capacities and resources. This requires that this project should do a comprehensive job of understanding variations in capacities and resources. Specifically, we will determine for each special district organization what kinds of capacities and resources are available to it. What is the source of the revenues each has available? Does it have authority to raise its own revenues? Does it have the authority to engage in debt financing for capital projects? The efficacy of these special district organizations may well be linked to these characteristics. Moreover, this literature also suggests that decisions to create and rely on special districts may be motivated by the argument that they provide mechanisms to consolidate expertise, but there are other motives as well. Some suggest that special districts are designed to shield decisions and decision makers from political accountability based on the argument that political accountability produces decisions that are not “good” from the long-term interest of water resources. Others suggest that when special district organizations engage in extensive public outreach and engagement of stakeholders and residents, this ensures some level of accountability. In any case, this project will include a comprehensive effort to understand the full range of characteristics of all of the governance organizations across all three nexus areas.

Many of the central research questions embedded in nexus governance relate to the nature of connections between the institutions within each nexus area, and the connections between institutions across the three areas. Presumably if the purpose of framing issues in nexus terms is to promote greater resource efficiency, then a mechanism through which this efficiency is to be achieved is through some form of coordination within and between nexus areas. If water efficiency is a worthwhile goal, then those who make decisions about energy and food must become aware of the connections. If energy efficiency is a goal, then those who make decisions about water and food must understand the implications of their decisions.

A well accepted approach to understanding organizational and process connections is rooted in “social network analysis.” Network analysis allows researchers to document and map the nature of various kinds of interactions or interconnections between organizations. We propose engaging in an extensive effort to study the governance networks involving water, energy, and food in the San Antonio region. Network analysis will provide metrics and visual representations of the extent to which organizations interact with each other. This proposed project will focus on numerous dimension of these interactions, including interpersonal interactions (talking, emailing, attending meetings); sharing of resources (finances, personnel and human resources, facilities); sharing technical knowledge (water, energy, food, agriculture information); sharing responsibilities (data collection and monitoring, planning, collaborative decision making); overlapping memberships and participation in forums; and others.

Conducting network analysis requires collection of original data from each participant in each relevant organization. This will be done by formulating a core questionnaire for each area of the nexus asking people involved in each organization questions about their interactions with people in other organizations. Each core questionnaire will be modified and tailored to accommodate the nature of each type of organization. Efforts are made to administer the exact same question to each respondent

whenever possible, and questions would only be modified when required by the particular type of organization or respondent. After initial questionnaire formulations, the instruments will be pre-tested and validity before being administered to all respondents. The questionnaires will also be used to acquire information about the organizations, and the full range of the organizations' authorities, responsibilities, and activities. It will also be used to capture information about other people who should be included in the survey through a "snowball" method.

Potential respondents will be identified for each prospective organization. A comprehensive list of people in each organization will be compiled and invited to answer the questionnaire. Given the number of groups and organizations involved in water, energy, and food governance in the San Antonio region, we expect to solicit information from well over 1,000 respondents. Respondents will include agency heads and administrators, organizational leaders, CEOs, board members, officers, and staff members, volunteers, and forum participants and stakeholders. Questionnaire administration will rely on multimodal techniques, including mail and internet based formats. Respondents will be provided a choice of which mode they wish to use. Every effort will be made to maximize response rates by using techniques found to be effective according to the best available research. All respondents will be guaranteed anonymity and confidentiality as required by the Texas A&M IRB approval process.

Data resulting from the completed surveys will be analyzed with UCINET and NetDraw software. These analyzes will provide metrics of the strength of ties among network nodes, and visual representations of these ties. We also expect to subject the data to analysis that will allow inferences about what factors or characteristics of network nodes and their participants might be said to influence the strength of network ties. To accomplish this, exponential random graph models, using either STATNET or PNet software, will be estimated.

4. Connecting Governance Networks to Water, Energy, and Food Decisions

The larger endeavor in this project is to tie the character of governance networks to the efficacy of decisions about water, energy, and food. We expect that when governance is characterized by linked networks, "better" decisions, or at least different decisions, will result. Within water governance, we expect that the stronger the connections between and among organizations will yield decisions that are coordinated and less likely to work at cross purposes. Similar expectations apply to energy and food governance. Perhaps more important, we expect that the strength of the connections among the water, energy, and food governance networks will influence how effectively water decisions will take into consideration energy issues, and so on. When conducted in a single geographically defined area at a single point in time, San Antonio in the current time period in this case, the explicit connection to policy decisions will inevitably be somewhat speculative. This case study is expected to serve as a proof-of-concept prototype for analyzing nexus governance issues in many locations, and variations in patterns across locations will eventually provide the foundation for understanding the connection between governance networks and outcomes more broadly.

Within the San Antonio region, there are a number of specific hypotheses that are derived from existing governance network analyses. These include an expectation that each of the nexus elements will be characterized as having a governance network, that each network will be fairly complex involving

numerous institutions, organizations, and individuals; that there will be very little connection between the governance networks, e.g. the water governance network will have very few connections with energy governance, and these networks will have very few connections with food governance; and that the more complex the governance network in any one of these areas (e.g. the more participants or nodes) the more likely the network will be siloed and have few connections with the other networks.

An actionable result of these network analyses is the promise of being able to identify points of access into the governance network. Presumably, to the extent that working toward a more integrated form of policy decision making represents a goal of this research, network analysis has the capability of delineating core or central decision nodes. These core decision nodes provide windows into the respective networks, windows that promise to outline avenues for affecting changes in decision making.

5. Governance Networks and Game-Theoretic Modeling

One way of making the results of this research “actionable” is to conduct analysis with the benefit of an underlying theoretical model. This will be accomplished by relying on the development of a game-theoretic formulation that prescribes particular relationships between and among the various policy makers and stakeholders. Because of the complexity implicit in the governance networks, this game-theoretic model is very likely to be rooted in an “ecology of games” in which numerous agencies and organizations apply their own respective internal logics, and the resulting policy and management decisions represent an aggregation of all of these logics. The exact nature of the ecology of games that might be inferred from the social network analyses promises to provide additional information about effective avenues for changes in decision making.

6. Linking Governance Networks and Public Health

Completion of nexus governance network analysis will provide a geographic representation of neighborhoods with relatively high levels of interconnectedness and neighborhoods with lower instances of interconnectedness. To better understand the impact that nexus governance has on communities across the San Antonio region a cross sectional study will be performed comparing difference in perceptions on governance issues, food choices, and adoption of healthy behavior. The adoption of urban agriculture and farming pursuits across the entire city provides an opportunity for a case study to assess the impact of changes in governance. Two methods will be employed to assess the impact on human wellbeing and the overall environmental changes on water, energy, and food usage.

A comparison between geographic areas of relatively higher interconnected governance to areas with relatively lower levels of interconnectivity will allow for spatial land use analysis to assess the rate of adoption of urban farming. A Community Assessment for Public Health Emergency Response (CASPER) household survey will be used to collect information on health outcomes, health behaviors, perceptions of communal functioning, and knowledge of local policy. A total of 210 (n=210) individuals per neighborhood will be collected to ensure adequate statistical power. We hypothesize that areas of higher interconnected governance will adopt more local farming techniques, score higher on health behavior choices, and have more knowledge on communal and governing policy and norms compared to regions with more exclusive functioning.

The data on food choices obtained in the CASPER household survey will inform water and energy use modeling techniques to predict savings on these resources, such as a reduction on distances from farm to table and comparing large agricultural water usage and small urban agriculture.

7. Closing

This project will produce cutting-edge research results. To date, there have been no analyses anywhere in the academic world of nexus governance. Numerous reports and papers have pointed to the need to develop information about governance, but no such research currently exists. We expect the results of this project will provide extensive, actionable, research that will inform decisions in the San Antonio area and Texas generally. These results will, for example, provide clear “maps” of effective access points to governance in each area. They will also provide clear evidence of where inter-connections need to be created, cultivated, or strengthened in order to improve levels of understandings of nexus issues. For example, when new “tools” area designed to highlight the energy impacts of water, or the energy impacts of food and agricultural practices, who would be the most effective people and what would be the most appropriate organizations to receive these tools? Equally important is that it seeks to create a model for how to conduct nexus governance research in other geographic areas. We expect research in other geographic areas to provide the basis for making inferences about what kinds of governance systems and networks seem most and least capable of accommodating and acting on nexus information.

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