

Water governance: the complexity of interactive dynamics among stakeholder groups

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Abstract: The management of water involves complex issues related to just allocation and sustainability. While integrated approaches incorporating diverse stakeholders have emerged as the dominant global framework for 21st-century challenges, policymakers face difficulties in assessing stakeholder participation and integration. This study generated primary data from a survey and interviews and used social network analysis to reveal and map the dynamics of interaction among ten groups holding stakes in the water resources of the Açú Lake State Park, a Brazilian coastal estuary. The results indicate that stakeholder group interaction was concentrated within two distinct clusters, such that high interaction correlated positively with political power, while those most dependent on the resources were characterized by limited decision-making influence and low interaction with other groups. These results offer insight for the equitable and sustainable governance of water resources and the assessment of participation and interaction among stakeholder groups.

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Introduction

Water has a direct connection to the climate, food and energy production, human and ecosystem health, and economic prosperity. World population growth and increasing levels of consumption among humans are increasing stress on water resources. As a result, researchers have worked to develop tools aimed at increasing water security, described as “the capacity of a population to safeguard sustainable access to adequate quantities of acceptable quality water” (UNITED NATIONS UNIVERSITY, 2013, p. 1). However, given the complex coupling that exists between social groups and natural water systems, the study of water resources in a given water basin is inherently a multiscale, multimedia, and multidimensional one, depending on endogenous and exogenous attributes over different time scales (VOGEL et al., 2015).

In the face of the challenges posed by the management of such a multifaceted substance, a strong international consensus has emerged in favor of the Integrated Water Resource Management (IWRM) framework. IWRM is a “process which promotes the coordinated development and management of water, land, and related resources in order to maximize economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems and the environment” (UNITED NATIONS WORLD WATER ASSESSMENT PROGRAM, 2009). IWRM is based largely on the four “Dublin Principles,” the second of which states that “Water development and management should be based on a participatory approach, involving users, planners and policy-makers at all levels” and the third of which recognizes the central role of women “in the provision, management and safeguarding of water” (TAC GLOBAL WATER PARTNERSHIP, 2000, p. 14). Therefore, a key aspect of IWRM involves decentralized and integrated planning and implementation of water management policies through the active involvement of all watershed stakeholders.

However, certain inherent aspects of natural resource and water governance pose challenging problems for the design of IWRM configurations and activities. For one thing, they tend to involve “wicked” or ill-defined problems for which consensus is very difficult to achieve (RITTEL; WEBBER, 1973). Likewise, Collins and Ison (2006) maintain that water catchment management involves interdependency, complexity, uncertainty, and controversy, a situation that can make it difficult to define and manage diverse stakeholder groups with varying motivations and levels of participation.

Even when the stakeholders that may be affected by water governance decisions are identified, assessing the nature and dynamics of their participation is not easy. In one of the most influential paradigms published, Arnstein (1969) devised a simple empowerment-based ladder scheme ranging from low positions, characterized by the manipulation of citizens, to higher ones, involving decision-making and citizen control of the process. Arnstein’s framework has become an enduring part of participatory inquiry that surfaces in topics ranging from public administration, law enforcement, business ethics, development studies, urban planning, health planning, and child studies (COLLINS; ISON, 2006).

The Global Water Partnership defines ‘water governance’ as the “range of political, social, economic and administrative systems that are in place to develop and manage

water resources, and the delivery of water services, at different levels of society” (Rogers; Hall, 2003, p. 16). Yet if integration is one of the most central aspects of IWRM and water governance, how should integration be assessed? As Carlsson and Sandstrom (2008) point out, the concepts of governance and co-management assume the existence of social networks, comprising social structures made up of nodes (actors, organizations) connected through a multitude of links. Thus, the identification and characterization of network properties (i.e., stakeholders and connections) can help shed light on how individual actors and stakeholder groups behave and make resource management decisions (BODIN, ÖRJAN; CRONA, 2009). Water governance institutions and actors can operate formally (through legal codes) and informally (through local unwritten agreements) (DE MESQUITA; STEPHENSON, 2006), and social network analysis (SNA) has been used to analyze the structural properties related to water governance in Tanzania (STEIN; ERNSTSON; BARRON, 2011), the Sahel (MAZZUCATO et al., 2001), Spain (HERNÁNDEZ-MORA; BALLESTER, 2011), and Canada (RATHWELL; PETERSON, 2012). According to OECD (2015), SNA is useful for gaining insights into which stakeholder groups are “leading,” “connecting,” or “isolated” in water governance (p. 95).

Stakeholder analysis theory has explored criteria for the identification of and categorization of stakeholder groups. Stakeholders are those that can “affect or be affected by” the relevant organization or policy (FREEMAN, 1984). Townsley (1998) asserts that the identification of “key stakeholders” is vital in the complex and far-reaching context of natural resource management. Mitchell et al. (1997) have said that important or “salient” stakeholders are those who are relatively powerful, are seen as possessing legitimacy, and/or have urgent claims, discerning “latent,” “expectant,” and “definitive” stakeholder status based on different combinations of those variables. Other authors have divided stakeholders into primary and secondary stakeholders, i.e., those who are dependent on local resources and those who make decisions influencing those resources, respectively (AFRICAN DEVELOPMENT BANK, 2001; GRIMBLE; WELLARD, 1997). In a similar manner, the geographic proximity of stakeholders to the natural resources being managed has been cited as a measure of stakeholder importance (DRISCOLL; STARIK, 2004).

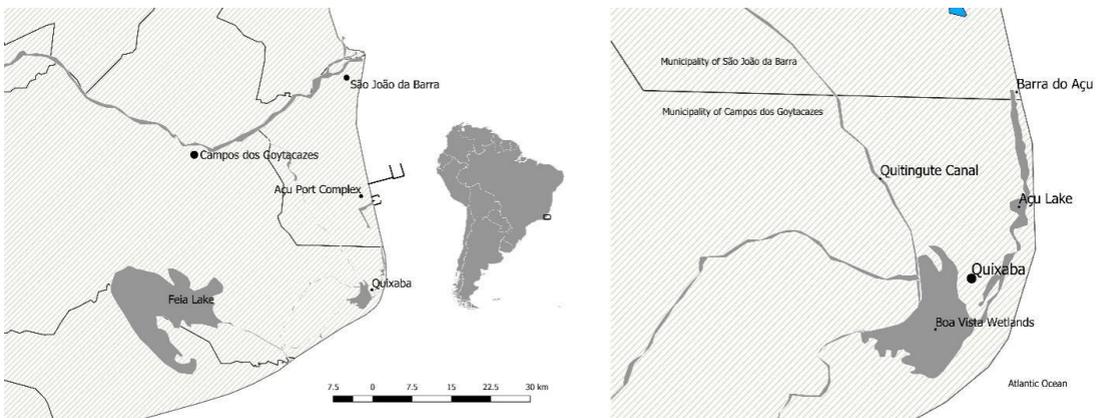
This study sought to investigate the interactive dynamics of ten stakeholder groups concerned with the management of a freshwater coastal lagoon system in Brazil. Using primary data from interviews, an online survey, and in-person and online participant observation, it analyzed patterns and characteristics of interaction among the groups considering the variables of decision-making power, water resource dependency and proximity to those resources, and numbers of connections with other groups. This article is the result of research financed by the Pescarte Environmental Education Project (PEA), which is a mitigation measure required by Federal Environmental Licensing, conducted by IBAMA.

Materials and methods

This study made use of primary data to analyze the connectivity dynamics between the ten principal stakeholder groups involved with the governance of the Açú Lake State

Park (Parque Estadual de Lagoa do Açú) (ALSP). The ALSP is located in the northern region of Rio de Janeiro State, Brazil, within the municipalities of Campos dos Goytacazes and São João da Barra, and possesses 8,251 ha of coastal lakes and estuaries, mangroves, and restinga. The ALSP's principal bodies of water include the Açú Lake, the Boa Vista Wetlands, and the Quitungute Canal. This protected area was established in 2012 as a form of environmental compensation during the licensing process of the Açú Industrial Port Complex (APIC), a very large port industrial complex located approximately 8 kilometers to the northeast. The ALSP was formally designated for conservation, research, and education and is managed by the Environmental Institute of the state of Rio de Janeiro State (INEA). Figure 1 shows the location and principal features of the study area.

Figure 1 – Maps showing the location of the study area in Brazil (left) and principal bodies of water comprising the Açú Lake State Park (ALSP) (right)



Source: maps created by the authors using ArcGIS.

The stakeholder groups with interests in ALSP water resources were classified as: (1) Governing Body, (2) Fishermen, (3) Mat Weavers, (4) Small-scale farmers, (5) Local Residents, (6) Large Landowners, (7) Private Sector Actors, (8) Public officials, (9) Watershed Committee, and (10) Academics. The Governing Body is composed of the employees of the Environment Institute of the state of Rio de Janeiro (INEA), especially those tasked with managing the ALSP. Fishermen refers to a group of over a hundred males living near and extracting fish resources from the ALSP wetlands. Mat Weavers is a group made up almost exclusively of women who produce mats entirely from the southern cattail plants growing in the wetlands. Small-scale Farmers is composed of individuals working in small family and community-based teams who cultivate crops of mostly okra, maroon cucumber, pineapple, and taro root near the ALSP, while Local Residents are several thousand people living near the ALSP in and around the towns of Açú, Folha Larga, Quixaba, Marrecas, and Xexé. Large Landowners is a group composed of wealthy plantation owners and cattle ranchers living on the edges of the ALSP and its inflow canals. The Private Sector Actors group refers to the people and corporations involved

in the various types of industrial activities carried out at the APIC. Public Officials is a group composed primarily of Environment Agency and Emergency Management personnel of the municipalities of Campos dos Goytacazes and São João da Barra. Watershed Committee are diverse members of an advisory body, and Academics refers to a group performing mostly post-secondary education, research, monitoring, and outreach activities related to the ALSP and its natural resources.

While there is often a certain degree of overlap among these groups, especially among the local residents and resource users, the group categories above reflect community-based distinctions observed by the first author during direct participant observation fieldwork in the study area. The sources of data include previously published ethnographic data related to fishermen, mat weavers, and small-scale farmers (DITTY; TOTTI, 2019) as well as unpublished primary data collected between November 2019 and June 2020. This unpublished data is derived from interviews, the participant observation of two private WhatsApp Messenger groups, and an online survey composed of 14 open and closed questions answered by 69 local residents, fishermen, mat weavers, and small-scale farmers.

Once the primary data was collected, social network analysis was used to quantify the number of connections each stakeholder group had with other stakeholders and analyze the connectivity dynamics of stakeholder interaction to identify important structural properties.

Results and discussion

Connections Between the Stakeholders

The Governing Body is composed of six park rangers and a director. These workers interacted with Large Landowners interested in prohibited land use changes such as wetland conversion into pasture or plantations or, alternatively, water diversion for irrigation and/or cattle sustenance. Conflict also occurred between the Governing Body and Fishermen and Local Residents involved in illegal resource extraction or use practices.

Public Governing Body meetings took place every two months until the Covid-19 pandemic of 2020 and covered a range of topics and planned park activities. The meetings were attended by Fishermen, Local Residents, Watershed Committee representatives, Public Authorities, and Academics. Special tree planting events in the ALSP during Environment Week in June 2020 stimulated direct interaction between the governing body and members of the local residents' association. In addition, the Governing Body maintained regular contact with key stakeholders through a private WhatsApp Messenger group called Lagoas Costeiras. The active participants in this group were the Environment Secretary of the Municipality of São João da Barra, the Environment Director of the APIC, members of the Watershed Committee, and two university professors. The interviews, participant observation of WhatsApp groups, and online survey did not reveal interaction between the Governing Body and the Mat Weavers or the Governing Body and the Small-scale Farmers.

Fishermen had representation in the regional fishermen's colony and a local fish-

ermen's association. Many lived in proximity and had close family or marital ties with Mat Weavers, most notably in the village of Quixaba. Fishermen often engaged directly in the mat production process by collecting southern cattail, the primary raw material in mat production, from the ALSP wetlands. Likewise, many fishermen had family and community ties with small-scale farmers and with other local residents. On certain occasions, Fishermen interacted with Public Officials, who may have viewed the fishermen as important regional economic agents comprising a significant voting bloc and provided them with canal dredging equipment and services. In addition, public officials considered the decisions of certain fishers illegal and moved to apply legal sanctions, most notably in the illegal opening of a beach barrier in May 2020 (discussed below). The findings show that neither the fishermen's colony nor the fishermen's association was represented at the ALSP – INEA public meetings, and that only one or two individual fishermen were in attendance. This fact indicates very limited interaction between the Fishermen and the Governing Body, Private Sector Actors, Watershed Committee members, and Academics. The study results did not reveal any kind of interaction between Fishermen and Large Landowners.

As mentioned, the Mat Weavers were often the neighbors and family members of Fishermen; they also had close community ties with Small-scale Farmers and Local Residents. However, there was no evidence during the study period of interaction between Mat Weavers and the Governing Body, Large Landowners, Private Sector Actors, Public Authorities, Watershed Committee, or Academic representatives.

The Small-scale Farmers, like the Mat Weavers, did not benefit from any type of association or vocational social organization. Probably for this reason, the only interaction of the Small-scale Farmers was with neighboring Fishermen, Mat Weavers, and Local Residents and the findings revealed no interaction between the Small-scale Farmers and the Governing Body, Private Sector Actors, Public Authorities, Large Landowners, Watershed Committee, or Academic representatives.

In contrast, the Local Residents living near the ALSP had a relatively high degree of social organization and cohesion made possible through an active local residents' association called Associação dos Moradores e Amigos do Açú (AMA) communicating through a private WhatsApp Messenger group. AMA's formal goals are the "promotion of communication among community members and income generation through sustainable, socially responsible education and tourism" (AMA AÇU, 2017, our translation). The AMA WhatsApp group averaged between 80-120 messages per day on a wide range of topics including public transportation, goods and services, local and national news, current events, charity work, and religious messages.

The AMA's governing board actively attended and promoted ALSP – INEA meetings and events, informing WhatsApp group members of activities through text and voice messages, photos, and videos. In addition, the ranks of this residents' association included local Fishermen, Mat Weavers, and Small-scale Farmers, all of whom posted messages, often related to their economic activities. The AMA's WhatsApp group posted information regarding the Private Sector Actors, most notably job opportunities and

news of expanded development of the APIC, as well as information concerning Public Authorities. The findings did not reveal interaction between Local Residents and Large Landowners, Watershed Committee, or Academic actors.

According to an ALSP park ranger interviewed for this study, the Large Landowner stakeholder group interacted frequently with the Governing Body. This group was engaged in sugar cane cultivation and cattle raising on the edges of the park and the watercourses linked to its wetlands. Rangers reported that individual members of this group dug canals to access water or constructed barriers to increase pasture area, often in conjunction with public officials who supplied heavy equipment, generating conflict with the Governing Body. In addition, an INEA consultant in the Lagoas Costeiras private Whatsapp group and a member of the watershed institution separately reported that the Large Landowner farmer/rancher stakeholders were well represented and politically active in the Watershed Committee working group known as the GTMC, a commission responsible for the management of seventeen locks regulating water flow in the ALSP and its associated watercourses. Large Landowner interests were represented in the GTMC by the North Fluminense Sugar Cane Planters Association (ASFLUCAN) and by the Association of Rural Producers of the Left Bank of the Paraíba do Sul River (APROMEPS). As the GTMC is also composed of Academic, Private Sector Actors, and Public Authorities, the Large Landowner group interacted with the Governing Body, the Watershed Committee, Academics, Private Sector Actors, and Public Authorities. There was no evidence of Large Landowner interaction with Small-scale Farmers, Fishermen, Mat Weavers, or Local Residents.

With respect to Private Sector Actors, the environmental affairs director of the APIC was an active participant in the Lagoas Costeiras private WhatsApp group, interacting with Governing Body, Public Authorities, Watershed Committee, and Academic actors. On the morning of 13 April 2020, during official public health measures restricting interpersonal interaction due the coronavirus pandemic, the APIC environmental affairs director informed the members of these five groups of the illegal excavation of canals in three separate barrier beaches, including the one at Barra do Açu in the ALSP. This excavation had been carried out by Fishermen the previous night in order to connect the three lagoon systems with the Atlantic Ocean and increase fishery stocks. During the following four days the members of this WhatsApp group exchanged over 150 text and voice messages, videos, and photos as these actors worked to mobilize personnel, equipment, and public security agents to assess the situation, fill in the canals, and fine or arrest violators. After restoring the barrier beaches, these actors worked to monitor and manage the system of locks in order to re-establish previous water levels. In addition, a representative of the Federation of Industries of the State of Rio de Janeiro State (North Fluminense) (FIRJAN) is on the board of directors of the Watershed Committee. The present study's findings did not indicate interaction between APIC Private Sector Actors and Fishermen, Mat Weavers, or Small-scale Farmers.

Thus, Public Authorities were also interacting with the four other groups in the Lagoas Costeiras WhatsApp group (Governing Body, Private Sector, Watershed Commit-

tee, and Academic groups). They included the municipal Secretaries of the Environment for Campos dos Goytacazes and São João da Barra, and provided the back-end loader that restored the integrity of the beach barriers on 29 April. Afterwards, the municipal Secretary of the Environment for São João da Barra provided material resources for the repair of damaged locks and the municipal Emergency Management Department of Campos dos Goytacazes provided support in that effort. As Public Authorities also participated in the GTMC meetings of the Watershed Committee, including the municipal Emergency Management Department of São João da Barra, they interacted to a significant degree with Large Landowner actors. The municipal Secretary of the Environment of São João da Barra also hosted reforestation events with Local Residents in the ALSP during the first week of June 2020, in celebration of the Environment Week. The results did not reveal interaction between Public Authorities and Fishermen, Mat Weavers, or Small-scale Farmers.

As mentioned, members of the Lower Paraíba do Sul Watershed Committee interacted frequently in the Lagoas Costeiras WhatsApp group with Governing Body, Private Sector, Public Authority, and Academic actors. Watershed Committee members also interacted with those same groups and with Large Landowners stakeholders in the GTMC commission regulating water levels in the region through the management of locks. The findings of this study, however, did not indicate interaction between Watershed Committee actors and Fishermen, Mat Weavers, Small-scale Farmers, or Local Residents.

With respect to Academics, an environmental science professor of a local university actively communicated with Governing Body, Private Sector, Public Authority, and Watershed Committee actors in the Lagoas Costeiras Whatsapp group. These same groups and Large Landowners also interacted in the GTMC meetings of the Watershed Committee, whose president is a local university professor. In addition, Academics from a different local university interacted with many of these groups and with Local Residents in meetings held by the Governing Body of the ALSP. However, the analysis of stakeholder interaction in this study failed to reveal connections between Academics and Fishermen, Academics and Mat Weavers, or Academics and Small-scale Farmers.

Table 1 contains the interactions that existed among the respective stakeholder groups. In addition, Figure 2 shows the connectivity between the various stakeholder groups interested in the ALSP water resources

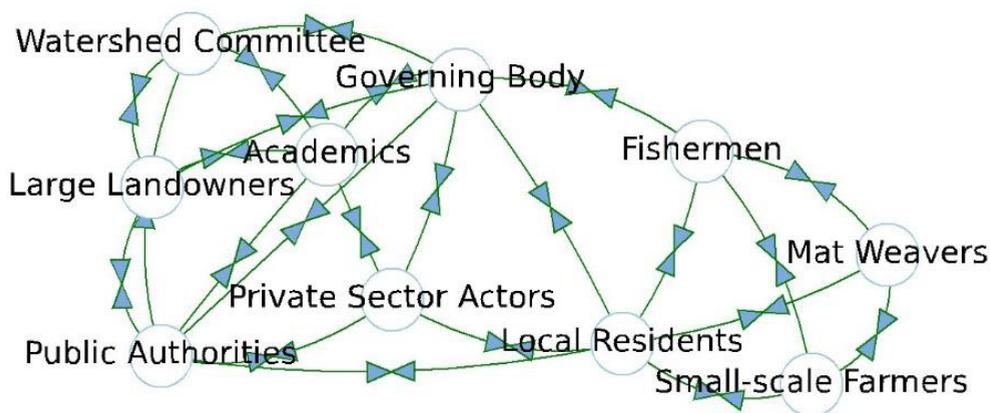
Table 1 – Interactions registered among the stakeholder groups.

	Govern- ing Body	Fisher- men	Mat Weav- ers	Small- scale Farm- ers	Local Resi- dents	Large Land- own- ers	Private Sector Actors	Pub- lic Auth- orities	Water- shed Com- -mittee	Aca- dem- ics
Govern-ing Body	N/A	X			X	X	X	X	X	X
Fisher- men	X	N/A	X	X	X					

Mat Weavers		X	N/A	X	X					
Small-scale Farmers		X	X	N/A	X					
Local Residents	X	X	X	X	N/A		X	X		
Large Landowners	X					N/A		X	X	
Private Sector Actors	X				X		N/A	X	X	X
Public Authorities	X				X		X	N/A	X	X
Watershed Com-mitee	X					X	X	X	N/A	X
Aca-demics	X					X	X	X	X	N/A

Source: elaborated by the authors.

Figure 2 – Social network graph of the patterns of connections between the ALSP water resource stakeholder groups



Source: elaborated by the authors.

It is possible to observe two separate clusters in the social networks. On the left is a larger cluster composed of the Governing Body, Private Sector Actors, Public Authorities, Watershed Committee, Academics, and Large Landowners mainly interacting among themselves, each of which possessed between four and six links to other stakeholders. On the right, Mat Weavers, Small-scale Farmers, Fishermen, and Local Residents comprise a separate smaller cluster with between three and five links. While Local Residents and Fishermen functioned as bridging links between the two clusters, the Mat Weavers and Small-scale Farmers groups have only three contacts with other groups, the lowest number for any stakeholder group. This configuration is consistent with what Bodin et al. (2019) call “conflicting coalitions,” whereby subgroups of actors are “socially tied to each other but not to other subgroups” (p. 555).

Differences in Decision-making Power among the Stakeholders

In addition to relative degrees of interactive social distance, it is possible to analyze the dynamics of the stakeholder group relations through the application of an eight-rung ladder scheme based on the distribution of power throughout the participatory decision-making process (ARNSTEIN, 1969). Those hierarchy categories, from bottom to top, are Manipulation (1), Therapy (2), Informing (3), Consultation (4), Placation (5), Partnership (6), Delegated power (7), and Control (8). Manipulation and Therapy designate different degrees of non-participation, with Therapy involving attempts by powerholders to “educate” or “cure” participants. Informing and Consultation are characterized by one and two-way flows of information, respectively, but with no follow-through. Placation involves the possibility of citizen influence, but within a structural configuration marked by tokenism designed to marginalize that influence. At the Partnership level, power is negotiated between citizens and traditional powerholders, usually by way of citizen representatives held accountable to their constituencies in well-organized social entities. Delegated Power is characterized by the dominant decision-making of certain groups with a majority of seats and specified powers; Control denotes full managerial power.

Arnstein’s typologies offer an analytical lens through which it is possible to discern and quantify the relative degrees of decision-making power held by each of the ALSP stakeholders. The Mat Weavers and Small-scale Farmers had no organized society or dedicated social organization and did not interact with the powerholding groups or processes making decisions affecting water governance in their region. This complete degree of non-participation corresponds to Arnstein’s first rung (“Manipulation”) and a value of “1”.

While the ALSP Fishermen had a regional fishing association with a formal membership and governance structure that had participated in past political decisions affecting its interests (DITTY; REZENDE, 2014), this organization’s focus was marine fishery and did not participate in ALSP – INEA or the Watershed Committee’s GTMC meetings. Although individual ALSP fishermen did participate in the Governing Body meetings and may have had the ability to voice opinions, they possessed no voting rights. Furthermore, there was no interaction between them and any of the more powerful stakeholder groups.

The Fishermen were thus assigned a value of “3”, corresponding to an “Informing” rung on the participation ladder.

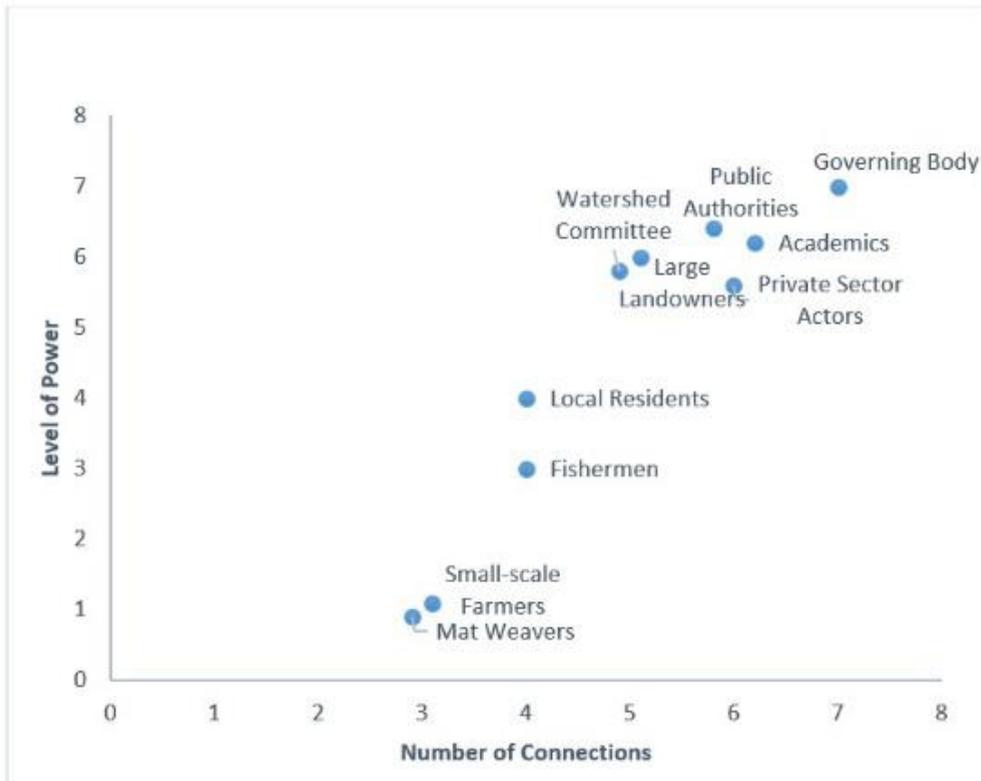
Local Residents, however, were well organized within the AMA residents’ association and in active daily high-volume communication via the WhatsApp group. The AMA had a formal organizational structure and mission statement and residents and their AMA representatives actively participated in ALSP meetings and events related to the ALSP and private sector initiatives and diligently informed their fellow residents of news. However, the Local Resident group did not interact with Watershed Committee, Large Landowner, or Academic stakeholders and had no vote the GTMC decision-making process directly affecting water resources in their region. Therefore, Local Residents received a “Consultation” classification with a value of “4.”

With the exception of the Governing Body, the other stakeholder groups all fell within the “Partnership” level (“6”) with respect to the governance of ALSP water resources in terms of Arnstein’s ladder of participatory decision-making. In the case of Academics, although this group possessed no formal organizational entity with specified powers and accountability of its representatives participating in water management decisions, academic individuals held chief executive power in the Watershed Committee and its GTMC working group, participated in the key decisions involving ALSP water resources, and interacted with the powerholding stakeholder groups. Watershed Committee actors dominated the management of ALSP water levels even though no high-level watershed committee actors interacted with the Governing Body regarding other factors related to the waterscape. Likewise, though Large Landowners had considerable authority and voting rights in the GTMC, these stakeholders did not interact with other powerholders such as the Governing Body through the established channels analyzed. Public Authorities participated in Watershed and GTMC meetings, the Lagoas Costeiras private WhatsApp group, and a tree-planting event with Local Residents and the Governing Body. Private Sector Actors, then, actively coordinated and exchanged information and resources with the most powerful stakeholder groups via the Lagoas Costeiras private WhatsApp group, yet were not represented in Watershed Committee, GTMC, or ALSP - INEA meetings.

The Governing Body retained “Delegated Power” (“7”) on Arnstein’s ladder. It had voting rights in the GTMC group, participated in the Watershed Committee, and presided over ALSP – INEA meetings. However, due to a lack of financial and human resources, this group was forced to appeal to the other members of the Lagoas Costeiras group when local actors excavated the barrier beach disrupting the ecological integrity of the ALSP.

Figure 3 shows the correlations between the number of interactive connections between the various stakeholder groups and their respective levels of power in the participative decision-making process vis-à-vis the Arnstein framework.

Figure 3 – Correlations between stakeholder group levels of power (Arnstein ladder) and numbers of connections with other groups



Source: elaborated by the authors.

Figure 3 displays strong positive correlation between the number of connections a stakeholder group had with other stakeholders and the level of power that group possessed in participatory decisions stemming from the Arnstein ladder. Mat Weavers and Small-scale Farmers both had a low numbers of connections respective to the other groups and a low level of participatory power. In contrast, the Governing Body, Watershed Committee, Academics, Public Authorities, Private Sector Actors, and Large Landowners all possessed high relative numbers of interactive connections and levels of decision-making power. Fishermen and Local Residents occupied intermediate positions between the other group clusters that are consistent with the overall correlation pattern.

Similar to studies finding a positive correlation between socioeconomic status and political participation (BRADY; VERBA; SCHLOZMAN, 1995; COHEN; VIGODA; SAMORLY, 2001; SCOTT; ACOCK, 1979), the link between participation and power in natural resource governance has been reported in other works, such as Grimble and Wellard (1997). Powerful stakeholders, for example, participated more in water planning

and management than small users in Zimbabwe (NARE; LOVE; HOKO, 2006).

Relative Levels of Economic Dependency of Stakeholders on the ALSP Water Resources

It is important to recognize the manner in which policy decisions may disproportionately distribute environmental outcomes among different classes of stakeholder groups. The results of this study indicate that network interaction and decision-making power is concentrated among the stakeholder groups that are not economically dependent on the ALSP water resources, do not live or work near them, and are not directly affected by those decisions. Such secondary stakeholders include the Governing Body, Private Sector Actors, Public Authorities, Academics, and Watershed Committee actors. In contrast, the primary stakeholders are economically dependent and/or live in proximity to the ALSP resources; they include Fishermen, Mat Weavers, Small-scale Farmers, and Local Residents. In the case of the Large Landowners, the results indicate a high degree of stakeholder interaction and influence over the ALSP water resources while this group maintained primary stakeholder status due to its local dependence on watershed resources for farming and cattle raising.

However, the question of the resource dependency of the Large Landowners is one that requires further analysis. Although Fishermen, Mat Weavers, Small-scale Farmers, Local Residents, and Large Landowners all depended on the ALSP water resources, there were significant differences between the relative degrees of dependence. Because a significant portion of the region surrounding the ALSP has no public water infrastructure, members of these stakeholder groups rely on water pumped from the water table, a resource that directly interacts with the region's bodies of water and other water cycle processes, for all their household water needs. In addition, the Fishermen, Mat Weavers, and Small-scale Farmers had high levels of economic dependence on the region's fish, southern cattail, and groundwater for irrigation, respectively. The very low levels of education and income of these groups, reflected in the local population surrounding the ALSP (SANTOS; JUNIOR; OLIVEIRA, 2016), constrained their ability to seek other forms of economic income and exacerbated resource dependency, especially in the case of Mat Weavers, who as women faced an additional layer of social oppression. In contrast, the significant factor of production held by the Large Landowners in the region represented a historical legacy of political and economic privilege that is largely inconsistent with economic dependence on any one resource or location.

Likewise, while the Private Sector Actors of the APIC were dependent on the water resources interacting with the ALSP for the industrial operations carried out at the complex, this was not the arrangement stipulated in the Environmental Impact Assessment (EIA) upon which APIC's various environmental permits were contingent. According to the EIA, the APIC would make use of 10m³ per second of water transferred by pipeline from the Paraíba do Sul River for all of its industrial and human necessities (ECOLOGUS, 2011), a quantity equivalent to that of a Brazilian city with a population of 2.8 million.

However, the pipeline was not built and the APIC has relied on six on-site deep wells (Licenses IN001541, IN022389, IN028801, and IN038837) and fifteen shallow wells of less than ten meters (License IN039654) for its water needs. The APIC's dependence on the ALSP waterscape thus reflects a voluntary decision related to capital accumulation made by LLX, the port developer in 2013, a decision that could be reversed at any time. The APIC is currently controlled by EIG Global Energy Partners, an investment company headquartered in the US with investments in 36 countries. Because corporations routinely relocate production sites based on factors including the cost and availability of raw materials and resources (BJELKEMYR et al., 2013; KINKEL; LAY; MALOCA, 2007), the APIC's water resource dependence is of a much lower order than that of the local primary stakeholders.

Finally, the relationship between the Governing Body, Public Authorities, and Private Sector Actors with respect to the APIC has been characterized by deep conflict of interest and contradiction. At the time of its inception, APIC developer Eike Batista claimed the project would create up to 40,000 jobs, securing the public endorsements of Brazil's President Dilma Rousseff, Rio de Janeiro's Governor Sergio Cabral, and Campos dos Goytacazes and São João da Barra's municipal executives and council members. The São João da Barra municipal council authorized the creation of an Industrial District leading to the forced evacuation of thousands of small-scale farm families in 2008 (ASSOCIAÇÃO DOS GEÓGRAFOS BRASILEIROS, 2011). Batista and Cabral were later convicted of corruption charges stemming from the payment of a USD 16 million bribe in exchange for a Gubernatorial Decree expropriating the farmers (ZUAZO, 2017) and served time in federal prison.

In addition, the APIC's Private Sector Actors were required to fund the creation and maintenance of the ALSP as a compensatory measure stipulated in the concession of the APIC's environmental license. This created a conflict of interest because while the Governing Body (INEA) was tasked with protecting the region's natural resources from externalities caused by the APIC, it was receiving significant and ongoing financial support from the APIC's Private Sector Actors. This contradictory relationship may have been on display when the Governing Body agency fined APIC developers approximately USD 350,000 in 2013 for an accident causing the saline contamination of local water resources even as it authorized APIC deep well water extraction putting the coastal region at risk of aquifer depletion and saltwater intrusion.

Conclusions

The results of this study show that the ten stakeholder groups interested in the governance of the ALSP's water resources did not have the same degrees of participation in management decisions or interaction with other stakeholder groups. In addition, the differing levels of stakeholder engagement were stratified according to each group's relative levels of economic dependence on the water resources being managed. Thus, those groups with high levels of dependence on the water resources – Fishermen, Mat Weav-

ers, Small-scale Farmers, and Local Residents – had the lowest levels of empowerment, engagement, and organizational representation. In contrast, the stakeholder groups with the lowest levels of true economic dependence on the water resources being managed – the Governing Body, Public Authorities, Academics, Private Sector Actors, and Large Landowners – had high degrees of involvement in collaborative decisions, significant numbers of connections with other groups, and acted through formal organizations.

This configuration of stakeholder group interaction poses significant challenges for the sustainable management of the ALSP water resources. Because the primary stakeholders – those in most frequent contact with the biotic and non-biotic components of the ecosystem and whose social vulnerability coincides with stark economic dependence on them – were largely excluded from the formal water governance process, the governance process benefited neither from the local ecological knowledge of actors who sustainably managed the resources in question for many generations nor the unique ability these actors have to monitor the resources for changes.

Past failures to coordinate with primary stakeholders in the water governance process have generated grievances among this group based on the belief that others wish to expropriate ALSP resources (Ditty and Totti, 2019). Such resentment, especially within the larger context of non-integration with water governance actors, may have produced negative outcomes for the local ecosystem and waterscape carried out by members of Fishermen, Small-scale Farmers, and Local Residents. Examples of such outcomes include the deliberate breaching of the beach barrier protecting the Açú Lake from the ocean, unsustainable irrigation and fertilizer practices, and cases involving purposeful fire-setting in large cattail stands for game hunting. At the same time, the lack of effective and formal social organization among these groups, likely both a cause and result of non-participation in the formal water governance process, reduced the ability to share critical information, debate and coordinate strategies, and sanction deviant behavior. As Cunningham et al. (2019) point out, strong community-based organizations are able to improve water supply outcomes.

Other than the primary ALSP stakeholders, this investigation revealed two other stakeholder groups wielding significant power in the water governance process while causing extreme impact to the waterscape. Although the interests of both Large Landowners and Private Sector Actors appear dependent on ALSP water, they should not be considered primary stakeholders due to their political and economic power. Furthermore, the dependence these group do have on the ALSP waterscape is largely a result of strategic, financial choices carried out by the actors themselves. Many farmers and ranchers expanded their productive areas in contravention of the ALSP's legal framework, while the investments required to construct the water infrastructure stipulated in the APIC's EIA were not made. As a result, the APIC's deep-well extraction of water greatly in excess of the Emborê Aquifer's recharge capacity is likely to increase social conflict in the region, cause ground subsidence, and exacerbate saltwater intrusion in the ALSP waterscape (WERNER et al., 2013). The collaborative involvement of local, primary stakeholder groups, especially if organized in formal community based organizations, could ensure that

harmful water practices do not go unchecked and increase the likelihood that ecologically sustainable solutions and strategies result.

These results underscore the challenges associated with involving socially vulnerable, primary stakeholders in water governance deliberations and illustrate how unsustainable configurations can result. Water planners should perform stakeholder analysis to identify all interested groups, considering power disparities and differing levels of dependence on the water managed, and assess the dynamics of stakeholder interaction. They should employ mechanisms and practices that encourage both the participation of vulnerable stakeholder groups as well as their self-organization in dedicated community-based social organizations.

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Governança das águas: a complexidade das dinâmicas interativas entre os grupos de interessados

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Resumo: A gestão da água envolve questões complexas relacionadas à justa alocação e sustentabilidade. Embora abordagens integradas incorporando diversos interessados tenham surgido como a abordagem global dominante para os desafios do século 21, ainda se enfrenta dificuldades para avaliar a participação e integração de stakeholders. Este estudo gerou dados primários com questionário e entrevistas e usou a análise de redes sociais para revelar e mapear as dinâmicas de interação entre dez grupos interessados nos recursos hídricos de um parque estadual no Brasil. Os resultados indicam que a interação entre os grupos foi concentrada em dois aglomerados distintos, de modo que alta interação se correlacionou com poder político, enquanto aqueles mais dependentes dos recursos foram caracterizados por influência decisória limitada e baixa interação com outros grupos. Esses resultados oferecem insights para a governança equitativa e sustentável de recursos hídricos e a avaliação da participação e interação entre grupos de interessados.

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Artigo Original

Palavras-chave: Governança da água; gestão de recursos naturais; participação das partes interessadas; GIRH; análise de rede social.

La gobernanza del agua: la complejidad de la dinámica interactiva entre grupos de de interesados

John Marr Ditty
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Resumen: La gestión del agua implica cuestiones complejas relacionadas a la asignación justa y sostenibilidad. Aunque han surgido enfoques integrados incorporando diversos interesados, como el enfoque global dominante para el siglo XXI, es difícil evaluar la participación e interacción de los mismos. Este estudio generó datos primarios, a partir de cuestionarios y entrevistas, y realizó análisis de redes sociales para revelar y mapear la dinámica de interacción entre diez grupos interesados en los recursos hídricos en un parque estatal en Brasil. Los resultados indican que la interacción entre los grupos se concentró en dos conglomerados distintos, siendo que la alta interacción se correlacionó con el poder político, mientras que los más dependientes de los recursos se caracterizaron por una influencia limitada en decisiones y una baja interacción con otros grupos. Estos resultados proporcionan información sobre la gobernanza equitativa y sostenible de recursos hídricos y la evaluación de la participación e interacción entre grupos de interesados.

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Palabras-clave: Gobernanza del agua; manejo de recursos naturales; participación de los interesados; GIRH; análisis de redes sociales