

The Cantareira Water Supply System and Local Efforts for Sustainable Agriculture in Nazaré Paulista

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1 Static Analysis - Collective action

Nazaré Paulista is a mostly rural municipality in the state of São Paulo, Brazil, and is one of the 12 municipalities that lie within the Sistema Cantareira, an engineered water system that distributes water from the countryside to nearly 10 million people in urban areas, including the cities of São Paulo and Campinas. The region is also part of the Atlantic Forest ecoregion, an important biome in terms of biodiversity and global recognition of endangered species. After severe impacts from an extended drought between 2014-2016, local efforts increased focus on the importance of sustainable agriculture and water conservation practices in the form of participatory engagement and capacitation of smallholder rural producers. Agricultural production in the region includes cattle ranching, dairy farms, small-scale crops for sugar cane, fruit, fungi, and eucalyptus.

This case is based on actor-focused field work that aimed to elucidate the narratives for sustainable water futures in a system of collaborations between local stakeholders (specifically small to medium scale agricultural producers), an environmental NGO, and governmental agencies that integrate into agrobusiness-related activities (Carvalhoes, 2018; Staats, 2019). The resource system is the “Represa Atibainha” (Atibainha Reservoir) and connected micro-watersheds located within the Sistema Cantareira in the Atlantic Forest biome in Southeast Brazil. This analysis focuses on water for irrigation as the key resource, and on the social infrastructure that supports agricultural productivity and forest restoration efforts. The scope of the system is bounded mostly to actors in Nazaré Paulista but extends to actors and action situations in the municipalities of Bragança Paulista and Atibaia by way of the actor networks and observed events of collective action.

1.1 The Commons Dilemma

The commons dilemma is due to conflicting uses for water and related land-uses that affect the water system. A collaborative rural outreach program attempts to mitigate the conflicts between restoration and mandated conservation coded against sustaining the production of small-scale agricultural producers.

Potential over-appropriation / poor coordination of appropriation: Drought conditions and systematic impacts from land-use practices have impacted the productivity of small-scale agricultural producers, who are also being incentivized to adopt novel practices that provide ecosystem services to the watershed. If all or part of their land is within a Legal Reserve (LR) or Areas of Permanent Preservation (APP), these producers are legally mandated to refrain from clearing land for production and restore native vegetation. Some small-scale producers in need of higher productivity are strained in resources to sustain livelihoods and traditional farming. There is also a potential for mis-appropriation as urban areas continue to develop downstream in the watershed, and subsequently increase the demand for water and further stress the need for intervention upstream that affects producers.

Potential under-provisioning of public infrastructure: The region has a historical background of family farming, familial ties between farmers, and close-knit neighboring landowners that self-organize into informal cooperatives that provide financial and technical support, as well as a vehicle for collective CPR management by resource users. However, the informal social infrastructure that supports traditional collective action is threatened by the increasing heterogeneity of landowners and geographical fragmentation of the system due to development and urban migration to rural areas (e.g., lots are split into multiple properties for touristic getaways and second homes). Additionally, current participatory engagement efforts may be insufficiently effective as participation by rural producers is drastically waning. Challenges also exist to monitor compliance and sanction violations for Legal Reserves and Areas of Permanent Preservation due to insufficient enforcement capacity and legal instruments (Hirakuri, 2003).

1.2 Biophysical Context (IAD)

Natural infrastructure: The Atlantic Forest is characterized by two sub-classes of vegetation cover: Atlantic coastal rain forests and Atlantic semi-deciduous forests. This biome has a very high potential for biodiversity that rivals parts of the Amazon, and is home to several endemic and endangered species, including the Mico-leão, a flagship species to local environmental efforts. Since colonization and ongoing anthropogenic transformation, less than 8% of the forest's original distribution remains (Morellato & Haddad, 2000). The region is known to experience cycles of drought conditions, but the 2014-2016 drought event was the worst in 50 years due to higher temperatures from a changing climate during rapid urban growth (Nobre et al., 2016)

Hard human-made infrastructure: The Cantareira water distribution system collects water from the hinterlands and redistributes it to nearly 10 million people in the urban areas in the nearby metropolitan area. The system is composed of five interconnected open-air reservoirs: the Paiva Castro, Atibainha, Cachoeira, Jacaré and Jaguari reservoirs. All five are connected by ducts in a successive gravitational system that leads to the final stages that pump water uphill to a treatment facility prior distribution to the São Paulo metropolitan area. Construction began in 1966, with the first reservoirs being flooded in by January 1973. During this process, many agricultural families were displaced to less productive lands in the hills around the reservoir, particularly in Nazaré Paulista, which created a legacy of distrust in government (Ditt et al., 2008). During the drought of 2014-2016, the system readily hit critically low levels of reserved water reaching a mere 5% of its 1.3 billion m^3 capacity by

January of 2015 (Porto et al., 2014).

1.3 Attributes of the Community (IAD)

Social Infrastructure: The municipality of Nazaré Paulista is a mostly rural community with a history of informal collectives based on familial ties between landowners (Carvalhaes, 2018; Hostiou et al., 2015; Staats, 2019). However, this potential for collective action is fragmented by changing demographics in the area as many traditional farmers have had difficulty sustaining their livelihoods due to low productivity as related to heavy environmental and agricultural regulation, and development in the region toward local tourism and leisure-based landownership.

A mix of agrobusiness-related governmental agencies and NGO programs provide participatory engagement-based frameworks and spaces for rural capacitation and sustainable agriculture efforts. Instituto de Pesquisas Ecológicas, or IPÊ (Institute for Ecological Research), is a local NGO that focuses on community outreach, biodiversity and water conservation, and capacitation of local small to medium scale agriculture. While this collaborative system of efforts has seen some successful cases, participation of the small-scale producers is waning due to apparent loss of interest, trust or faith, or insufficient incentives. There is a governmental program for payments for watershed services that may be insufficient in producing the intended incentives for producers to maintain ecosystem services in their land (Richards et al., 2017), and difficulties in the monitoring compliance for Legal Reserves and Areas of Permanent Protection has also been observed (Ditt et al., 2008).

Human Infrastructure: There are roughly 140, 000 residents between the twelve municipalities associated with this portion of the system, with the population of Nazaré Paulista estimated to be roughly 18,000 (IBGE, 2018). The region has a history of family farms, and the area remains mostly rural as of the writing of this paper. A subset of the population are business owners in the relatively small center of town, and owners of second homes in the rural areas that are used largely for leisure and often rented to tourists. Researchers and organizers in the Nazaré Paulista headquarters of IPÊ also spend significant time in the area, and some are landowners within this municipality.

There are four types of key actors that interact and have the potential for conflicting values for the CPR in this system: (1) Rural agricultural producers that have traditional and historical knowledge of land-use practices and agriculture in the area, (2) IPÊ researchers, organizers, and collaborators that provide community outreach and research-based knowledge transfer, (3) agrobusiness governmental agents – Namely, those from CATI (Coordinator for Integrated Technical Assistance) and The Bureau of Agrobusiness of Bragança, which also provide community outreach and technical assistance to capacitate rural producers, and lastly, (4) leisure and absentee landowners along with local tourists from nearby urban areas.

1.4 Rules in Use (IAD)

Position Rules:

- Leaders in governmental agencies, such as environmental secretaries that lead and coordinate capacitation programs, are elected officials.
- Leaders in the NGO programs are normally senior scientists that are hired by the organization and sometimes external collaborators.
- Landowners can participate as members in workshops based on owning agriculturally productive land within the micro-watersheds related to the Cantareira system (i.e., one of the rural municipalities). By nature of IPÊ being headquartered in Nazaré Paulista, many producers are from this municipality and Bragança Paulista, which is nearby and well-connected as part of the social infrastructure.

Boundary Rules: Geographically, the Sistema Cantareira’s boundaries are based on the watersheds that directly feed the reservoirs. In addition to IPÊ and the local agrobusiness agency, actors in this system are bound to rural landowners with agriculturally productive land within the municipalities within watersheds that feed the Atibainha reservoir. At times, other external actors who collaborate with IPÊ participate in this system.

Choice Rules: Depending on the location and specific properties of the land, a landowner may have to comply with land-use regulations established by the Native Vegetation Protection Law and National Water Acts. If all or part of the land lies within an ecologically sensitive or important zone, they may have to dedicate a percentage of their land to native vegetation (LR) or dedicate areas to ongoing restorative efforts in the case of APPs.

Aggregation Rules: Actors from the various positions collaborate in workshops to devise strategies and plans for sustainable practices. Collective decisions related to these plans are normally done on a basis of verbal consensus where actors speak up to consent, disagree, or provide constructive feedback. However, they are not required to speak or formally provide consent or disapproval. Some actors, namely small-scale producers, have been observed to remain quiet during workshops but had poignant (or even somewhat fervent) opinions regarding the commons dilemma and current strategies during individual ethnographic interviews (Carvalhoes, 2018). At the end of some of the more eventful workshops, actors from all positions sometimes sign a statement of intent in the form of a large poster card or booklet as a sign of collective commitment.

Scope rules: The Atibainha reservoir has been visibly low even during times outside of drought conditions, as mentioned by several actors of various backgrounds. During the last drought, the reservoir was so low many producers and even leisure landowners expressed worry. It is not clear that all actors, mainly those outside of governmental and research spaces (i.e., some producers and leisure landowners) know much about the technical and ecological function of the Cantareira system, or the drivers that lead to the reservoir’s extraordinarily low levels. Additionally, some new landowners such as second home owners from urban areas are detached from the agricultural history of the area, and thus unaware of legacy norms and values of other actors. Alternatively, it is not clear that cattle ranchers are aware of the effects their land-use practices have on urban drinking water supplies.

Information Rules: Collaborative plans and practices developed in participatory engagement events are shared with workshop members (i.e. producers, NGO and governmental actors) in the form of reports. Producers can share concerns during these workshops and

provide feedback on devised strategies. Generational and established landowners have a tradition of informally sharing information regarding their water and land-use decisions and practices. However, this is threatened by demographic transition in the area as increasingly more land is transformed for local tourism and increasingly fragmenting communities that have a history of successful collective action. One producer mentioned new landowners that built a fence around what was previously a small family farm he would share information, strategies, and negotiate land uses, but he now feels his new neighbors are closed-off and unapproachable so that he cannot know how that land is being managed.

Payoff Rules: Due to a lack of financial and legal resources and devolution of responsibilities among federal, state, and municipal government levels, monitoring exploitation and enforcement capacity to sanction violations is insufficient (Hirakuri, 2003). Thus, compliance with legal mandates to conserve land or manage native species are weakly implemented. Additionally, several actors of different positions mentioned the “real problem” is due to informal payoffs by developers to clear land.

1.5 Summary

The Cantareira system induced a dramatic transformation to the Atlantic Forest and the communities of traditional agriculturalists in the region. While this change was dramatic during and right after the system’s construction, systematic effects are still cascading as many small-scale farmers and ranchers struggle to produce enough to sustain livelihoods amid challenges for restoration efforts. Drought conditions present mounting challenges for producers and urban water users that experience rationing during extreme conditions. To mitigate the commons dilemma for water use, a system of rural producers, governmental agencies, and an NGO have built a collaborative framework to capacitate rural productivity and adopt more sustainable agriculture practices. However, participation by rural producers is waning and compliance to federal mandates for land-use practices that restore native vegetation remains a challenge. Therefore, the current system is insufficient in providing sustainable infrastructure to manage the local Atlantic Forest watersheds and the Cantareira System of water distribution.

2 Part II. Dynamic Analysis – Robustness

2.1 Update on the Commons Dilemma

As land tenure transitions away from small-scale agriculture dominated landscape toward increasingly touristic uses, the robustness of the system becomes increasingly fragile as a tradition of self-organized collective action is fragmented. Newer landowners tend to fence off properties and some are largely absent since they rent the property for tourists for either part or all of the time. This change may be part of the systematic breakdown of the social infrastructure that supports participatory engagement efforts amongst rural producers, IPÊ, and the Bureau of Agribusiness. Furthermore, the threat of increasingly intense impacts from droughts and warming climates place an even greater strain on the commons dilemma.

2.2 Shocks, Capacities, Vulnerabilities

The system is increasingly becoming vulnerable to water scarcity. There are three main drivers that systematically compound: (1) Longer, more intense drought conditions, (2) increasing water demand due to urban expansion and densification downstream in the major Metropolitan area, and (3) further fragmentation of the social infrastructure along with the ecosystem itself due to demographic change, development, and land-uses that impact the watershed. While it is difficult to say if the 2014-2016 drought's heavier impact is due to specifically to global climate change, observations have been consistent with climate projections for the region in terms of higher temperatures and precipitation variability (Nobre et al., 2016).

2.3 Robustness Summary

While the state of São Paulo has engaged with climate change related mitigation efforts via its State Climate Change Policy of 2009, systematic vulnerabilities remain in form of demographic changes, unsustainable land uses, and increasing demand for potable water due to both increasing populations in urban areas and a changing (warming) environment. As tourism becomes more prominent in the hinterlands, it is unclear whether this can be harnessed for a sustainable transition or expose fragilities in the system. However, beginnings of discussions regarding the adoption of ecotourism as a means for conserving the natural infrastructure among members of IPÊ and certain rural producers have been observed (e.g., organic permaculture farms that host site visits for tourists).

3 Case Contributors

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4 Sources

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