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*Advocacy Coalition Framework: Advancing Theory and Evidence
about Phenomena of Policy Processes*

**Climate and Water Policy Integration in Brazil's Semi-arid Rural
Region: Insights from an Advocacy Coalition Framework and
Policy Network Perspective**

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Climate and Water Policy Integration in Brazil's Semi-arid Rural Region: Insights from an ACF and Policy Network Perspective¹

Abstract: Climate change introduces an additional concern to the semi-arid Northeast Brazil region, which already faces water scarcity challenges. This study analyzes water use and climate adaptation strategies and policy integration in the Petrolina and Juazeiro region. Drawing on the Advocacy Coalition Framework (ACF) and using policy network analysis, the paper explores the interactions across and within coalitions at multiple levels, the decision-making spaces, and the distribution of political resources. Finally, it discusses the changes in Brazil after the 2016 presidential shift and the uncertainty of the subsystem consolidated over the past decade.

Keywords: climate adaptation; water policy; Brazil; semi-arid region; ACF; policy network

1. Introduction

Water supply and quality challenges are expected to worsen from global climate change (Henry, 2011; Weibust, 2014). Climate change governance relies on global, national, and subnational arrangements involving both formal and informal policy networks. Moreover, the causes and vectors of climate change and adaptation are embedded across several policy sectors, each sector having different priorities and distinct sets of actors, and varying interests, ideas, and values (Adelle, Jordan, & Benson, 2015; Bulkeley, 2000). These challenges indicate the complex cross-sectoral and cross-level nature of climate policy design and implementation.

Climate change introduces an additional concern to the semi-arid Northeast Brazil region, which already faces water scarcity challenges. As the home of 22 million people, this region is one of the most populated semi-arid areas globally; almost 40% of the population in this region live in rural areas and depend mainly on rain-fed agriculture (Martins, Hochrainer-Stigler, & Pflug, 2017). The region is vulnerable to food, water, and energy insecurity from the increase in rainfall variability (Marengo et al., 2019), which, combined with vegetation

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degradation, has been accelerating the process of desertification and soil salinization (Lacerda et al., 2015). In addition to reducing agricultural and livestock production and lowering the reservoir levels of drinking water, lower precipitation has decreased hydropower generation, especially after the recent drought (2012–2016) (Milhorange, Mendes, et al., 2019). Since most of the region's rivers are intermittent or temporary, rivers such as the São Francisco River, whose source lies elsewhere, are vital to the region.

Meanwhile, the National Adaptation Plan to Climate Change was launched in 2016 to address – among other objectives – Northeast Brazil's vulnerability to increasing droughts (MMA, MI, & WWF, 2017). The plan was a combination of existing policies, but its final result was a stacking strategy juxtaposing the sectoral and thematic agendas within a single framework predominantly centralized at the federal level (Milhorange, Sabourin, Mendes, & Le-Coq, 2019). The gap between the official climate agenda and role of a specific coalition contributing to the gradual diffusion of a territorially embedded approach to cope with drought and promote climate adaptation will be discussed in this paper.

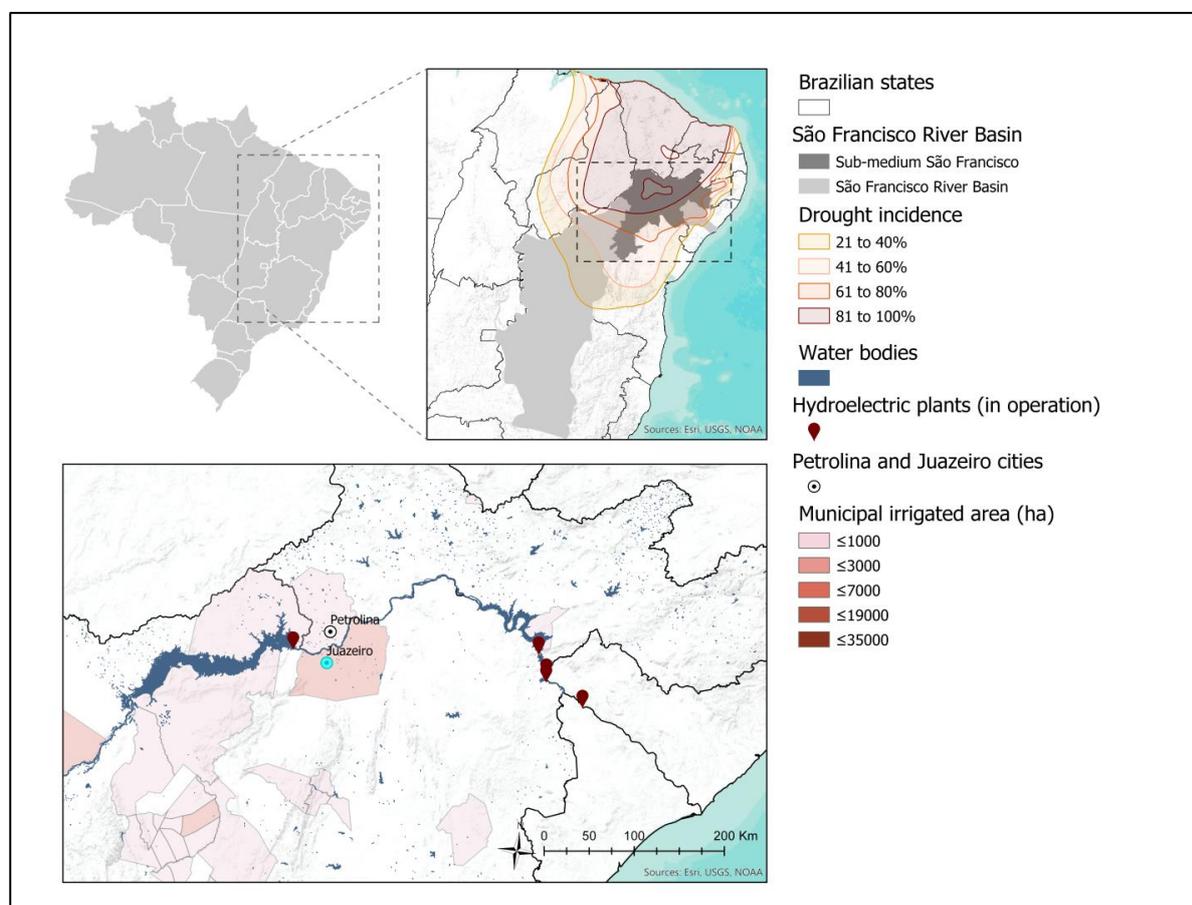
This study considered documental data, interviews, and online questionnaires to analyze water use and climate adaptation strategies and policy integration in the Petrolina and Juazeiro region. It focuses on the rural populations' vulnerability factors and increasing climate variability and droughts. Thus, the main aspects addressed relate to the use of water for energy and farming. Drawing on the Advocacy Coalition Framework (ACF) and using policy network analysis, the paper explores the interactions across and within coalitions at multiple levels, the decision-making spaces, and the distribution of political resources. Finally, it discusses the changes in Brazil after the 2016 presidential shift and the uncertainty of the subsystem consolidated over the past decade.

2. Research design

a. Study area and policy subsystem

The ACF policy subsystems normally involve actors at various levels (Jenkins-Smith, Nohrstedt, Weible, & Sabatier, 2014). The policy subsystem analyzed in this paper is geographically bound by the Petrolina and Juazeiro region (*Citizenship Territory Sertão of São Francisco*), located in the sub-medium São Francisco River (Figure 1), and involving public, private, and civil society actors from local to federal levels.

Figure 1: Location of the study area in the sub-medium São Francisco River, including drought incidence, hydroelectric plants and irrigated areas



Source: Authors (based on ANA 2017, ANEEL 2018)



In addition to the impacts of climate change, this region has been historically affected by land regularization-related challenges, flooding from hydroelectric dams, public and private irrigation programs, and water use competition for different purposes (energy, agriculture, urban supply, etc.). The region currently includes expanses of irrigated and mechanized agriculture, rain-fed agriculture, and goat farming (MMA, 2006).

A drought in Brazil semi-arid from 2012 to 2016 led to a series of socio-environmental and economic impacts, including decrease in agricultural production, significant loss in livestock, and lowering of levels in reservoirs of water used for human needs, animal feed, and power generation (De Nys & Engle, 2014). Family farmers in semi-arid regions are most vulnerable to climate change because of their reliance on scarce and seasonally variable water resources for rain-fed production systems as well as limited material capacity to cope with and adapt to these impacts (Burney et al., 2014). Therefore, drought management and water use competition are key issues for energy, irrigation, and traditional farming, especially in the context of increasing climate variability. This paper discusses these challenges as well as the dynamics of actor and policy instrument interactions from a policy network perspective.

b. Policy networks and theory

The growing pressure of global climate change on freshwater management requires improved governance responses combining multiple sectors and action levels (Weibust, 2014). This scenario covers distinct policy interventions that interact positively or negatively depending on the territory. In this regard, this paper conceives policy integration as a political process over time, rather than a static and desirable technical outcome (Candel & Biesbroek, 2016; Milhorange, Sabourin, Mendes, et al., 2019). This process relies on policy and institutional change, with the actors' interactions constituting the mechanisms for shifts of policy integration (Candel & Biesbroek, 2016). The actors' interactions are analyzed through policy network studies. The analysis focuses on the relational features of policy processes and the interactions across levels of governance (Di Gregorio et al., 2019). Policy



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networks bring together interdependent actors who share an interest in public policy and are institutionally linked formally or informally through a flow of resources (Henry, 2011).

The policy network approach is more of an analytical toolbox than a body of theory (Adam & Kiesi, 2014). The key is to integrate sound theory into explanations for why these networks form, grow, and evolve (Henry, 2011). Weible and Sabatier (2005) applied the ACF to policy network analysis and compared the different types of networks in the same policy subsystem. They confirmed the central premise of ACF on the importance of a belief system to bind coalitions together. Henry (2011) combined the ACF with the “resource dependence theory” to explain the cohesion of policy networks, arguing that policy actors tend to form networks with those in their ideological groups in a way that increases their access to political resources.

Both shared beliefs and political resources have been featured in coalition descriptions since the inception of ACF, with the former receiving more analytical attention (Jenkins-Smith et al., 2014). Political exchange and resources help explain the actors’ strategies and interdependencies as well as role in structuring networks (Hassenteufel, 1995). For instance, an organizational actor considered strongly legitimate may dispose of resources and facilitate implementation of a public decision (Hassenteufel, 2011). Likewise, Adam and Kriesi (2014) highlight the differences between formal institutional structures and informal practices and procedures. Drawing on this and other approaches, a typology of formal and informal ties relating to different political resource was created, aligning with political sociology studies (see Table 1).

Table 1: Typology of inter-organizational ties and main resources related to policy implementation

Dimension	Type	Description	Main resources
Formal	Funding and technical advice	Official technical and financial support.	Material (funds and technical means)
	Monitoring/joint implementation of programs	Joint participation in monitoring or implementation of the programs.	Institutional (practical decision-making)
Informal	Reputation/influence	Organizations considered particularly influential (from a technical, normative, mediation, and representational point of view) in the policy field.	Political (legitimacy)
	Informal collaboration/alliance	Political collaboration and/or collective participation in coordination spaces (municipal council, basin committee, etc.).	Mobilization capacity (alliance)
	Regular exchange of information	Communication and dissemination of institutional, practical, and other information.	Information

Source: Adapted from (Adam & Kiesi, 2014; Di Gregorio et al., 2019; Hassenteufel, 2011; Milhorance, 2018; Milhorance, Sabourin, & Bursztyn, 2019)

c. Data collection and analysis

This study followed a two-step strategy to identify the actors in the subsystem analyzed. First, documentary evidence led to a broad list of relevant programs and organizational actors. Then, a set of 61 semi-structured interviews were conducted with public, private, and civil society actors at all levels (September–December 2018). These interviews related to personal information, core and secondary beliefs, and the opportunities and challenges in implementing several key policies. The interviewees were also asked about the organizations considered relevant in the policy domain and the main inter-organizational interactions and conflicts.

Second, from the list of organizations obtained, an electronic survey was built and sent to the same group of interviewees as well as additional ones, asking about the types of inter-organizational ties. A total of 104 respondents completed the questionnaire (March–April 2019) covering all the relevant organizations. The respondents were asked to indicate, from a full roster list and referring to the typology in Table 1, the ties as follows: (i) three organizations considered especially influential in the policy domain (political resources), (ii)



the organizations that supported (technically or financially) the actions under their supervision (material resources), (iii) the organizations that co-implemented or monitored the actions under their supervision (institutional resources), (iv) the organizations with which the respondent's organization regularly exchanged information (information resources), (v) and the organizations with which the respondent's organization maintained alliances or partnerships in common agendas, forums, and committees (mobilization capacity).

A total of five networks stemmed from this survey: technical/financial support, joint implementation/monitoring, reputation/influence, informal collaboration/alliance, and exchange of information. Referring to formal authority resources, the institutional regulation ties were analyzed using bibliography and institutional data for a more nuanced view; this went beyond the interactions within the policy subsystem. According to Nohrstedt (2011), formal legal authority has a unique status as political resource compared to others.

These were compared with a "beliefs network," designed from the similarity of interviewed organizations by a set of 40 criteria. The criteria related to broad and practical aspects from (i) climate change and sustainability, (ii) strategies for promotion of family farming, (iii) strategies for fostering agricultural production and marketing, (iv) views and positioning on land use and natural resources management (including land titles, water allocation, environmental conservation, and energy production), and (v) political positioning of state and federal governments. Not all the criteria applied to all interviewees, but those whose activity and position were more interrelated (positively or negatively) commonly responded to the same points.

The association of the above-mentioned networks was tested through a Quadratic Assignment Procedure (QAP) correlation test² using Ucinet. Furthermore, the extent to which interactions occur within as opposed to across governance and coalition levels was

² The QAP follows two steps. In the first step, it computes Pearson's correlation coefficient (plus simple matching) between corresponding cells of data matrices. In the second step, it randomly permutes rows and columns (synchronously) of one matrix and recomputes the correlation and other measures. This step is carried out hundreds of times in order to compute the proportion of times that a random measure is larger than or equal to the observed measure calculated in step 1. A low proportion (< 0.05) suggests strong relationship between the matrices, which is unlikely to have occurred by chance (AnalyticTech, 2018).



assessed with the homophily index and density measure by group. Homophily refers to the tendency of actors to share a specific feature and interact more closely with one another, as opposed to those who do not (Di Gregorio et al., 2019). The E-I index (Krackhardt & Stern, 1988) is an overall measure of homophily comparing the internal and external group ties³.

3. Identifying coalitions in the water-climate semi-arid subsystem

a. Beliefs and resources

One basic premise of ACF is that coalitions are formed by actors sharing belief systems corresponding to a set of interdependently bound ideas and practices (Weible, Sabatier, & Lubell, 2004). As explained by Elliot and Schlaepfer (2001), coalitions seek to “out-learn” each other and implement strategies by translating their belief systems into public policies. A second assumption regarding belief systems is that they are hierarchical, meaning that broad (core) beliefs are more resistant to change than specific (secondary) ones.

“Deep core beliefs” include aspects such as the conventional left versus right political ideology, and usually constrain the “core belief” policies that are normative and causal perceptions pertaining to an entire policy subsystem (Weible et al., 2004). The core beliefs in the current case are built on controversies such as (i) conservation vs use of water and other natural resources, (ii) distinct standpoints on sustainability and public policy objectives, and (iii) agricultural development approach to support family farmers. These are detailed in Table 2. “Secondary beliefs” are narrower in scope than the core beliefs. They are more malleable, and deal with aspects such as urgency and causes of problems in specific locales, perceived policy impacts, and preferences of action on specific policy subsystems (Weible et al., 2004).

The members of a coalition do not share all beliefs at the same degree. This paper conceives the different belief categories more as a continuum. Thus, the beliefs in Figure 2 are

³ The value ranges from -1 (high homophily) to +1 (high heterophily), and a permutation test is performed to assess whether the network E-I index is significantly higher or lower than expected.



represented as a similarity matrix corresponding to the members' relative position on the 40 criteria. Often, more than one representative from each organization is interviewed to address the risk of mistaking an individual belief system for an organizational one. The belief system considered here refers to specific climate adaptation issues and water use strategies, even though several organizations may be active in other policy domains.

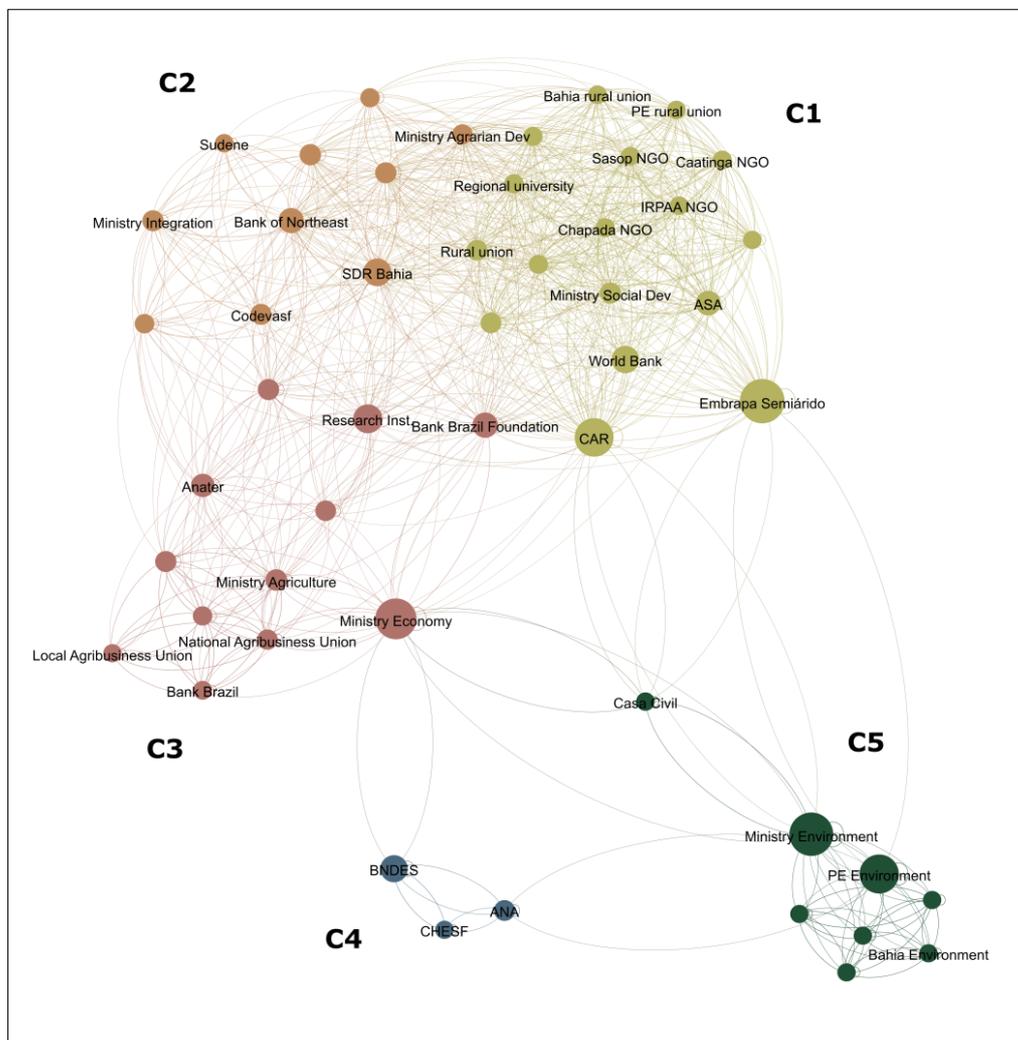
The resulting matrix is illustrated as a network, with the subgroups colored using a modularity optimization index (Blondel, Guillaume, Lambiotte, & Lefebvre, 2008). Colors represent coalitions, whose main beliefs are described in Table 2 and section 4. The node size indicates betweenness centrality, meaning that the bigger the node, the greater is the capacity of that organization to act as intermediary between coalitions when it comes to broadness of members' beliefs. The following five coalitions were identified by their strategies and ideas on water use, climate adaptation, and development in the Petrolina and Juazeiro region: (i) living with semi-arid landscape (C1), (ii) regional development and water infrastructures (C2), (iii) irrigation and agribusiness (C3), (iv) energy production and water regulation (C4), and environmental protection (C5).

A key point in this subsystem revolves around a historical debate on drought management and water use approaches. During most of the 20th century, Brazil attempted to tackle the drought situation by investing in large water infrastructures for agricultural development based on irrigation and the green revolution technological package (Lindoso, Eiró, Bursztyn, Rodrigues-Filho, & Nasuti, 2018). The energy sector followed the same intervention logic of establishing large dams for hydroelectric production. The impacts of these interventions have been questioned. Despite their positive results in terms of job creation, these interventions were not effective to improve social equity and sustainability (Bursztyn, 2008; Lindoso et al., 2018).

As a reaction to these approaches, a new paradigm emerged in civil society, with the local actors trying to ensure human "coexistence with semi-aridity" instead of "fighting drought." This paradigm was built on the need to stock in abundance and cope with resource scarcity

and environmental variability, and has gradually mainstreamed into regional governance (Lindoso et al., 2018). Moreover, it has progressively become associated with agroecology practices (Petersen & Silveira, 2017). This paradigm largely represents the beliefs of C1 illustrated in Figure 2. This belief system has progressively influenced the region and national debates, diffusing some aspects toward other coalitions and influencing policy design and integration. This will be discussed in this paper.

Figure 2: Network of similarity of beliefs colored by modularity measure



*The designations of organizations refer to the period the interviews were conducted (2018), and does not include the ministerial change undertaken in 2019. Only the labels of nodes mentioned in the text and considered more relevant are shown to help visualization.

Source: Authors, based on interviews



Table 2: Definition of coalitions and summary of beliefs, resources, and privileged arenas

<i>Living with semi-arid landscape (C1)</i>	<i>Regional development & water infrastructure (C2)</i>	<i>Irrigation & agribusiness (C3)</i>	<i>Energy production & water regulation (C4)</i>	<i>Environmental protection (C5)</i>
Leading members:				
<p>Public: Embrapa Semiárido, state rural development bodies (<i>CAR/Bahia, SARA/Pernambuco</i>), Social Development Ministry (<i>MDS</i>)</p> <p>Private: Rural workers' unions (<i>Fetape, Fetag</i>)</p> <p>Civil society: Local NGOs (<i>IRPAA, Chapada, Sasop</i>) around the Semi-arid Articulation (<i>ASA</i>)</p> <p>International: World Bank, IFAD</p>	<p>Public: Ministry of National Integration (<i>MI</i>), Regional organizations and funding mechanisms (<i>Codevasf, Sudene, Bank of Northeast – BNB</i>), land bodies (<i>Iterpe, Incra</i>)</p>	<p>Public: Ministry of Agriculture (<i>MAPA</i>), National Agency for Technical Assistance (<i>Anater</i>), Bank of Brazil (<i>BB</i>), Small Companies' Support Service (<i>SEBRAE</i>)</p> <p>Private: Agribusiness unions and technical bodies (<i>CNA, Senar, SPR, Diamantina</i>)</p>	<p>Public: National Water Agency (<i>ANA</i>); National Development Bank (<i>BNDES</i>)</p> <p>Private: Energy Production Company (<i>CHESF</i>)</p>	<p>Public: Ministry of Environment (<i>MMA</i>); State environmental bodies (<i>Inema, Sema, Semas, CPRH</i>), climate research institutions (<i>Cemaden</i>)</p> <p>Civil society: Environmental NGOs (<i>WWF</i>)</p> <p>International: GIZ</p>
Deep and core beliefs:				
<i>Orientation of substantive policy conflicts</i>				
Socioenvironmental promotion	Socioeconomic development	Economic development	Economic development	Environmental protection
<i>Basic choices concerning policy instruments</i>				
Social/production grants, technical assistance, and technological development	Social/production grants and infrastructure development	Economic incentives and technological development	Economic incentives and crisis management tools	Regulatory tools (command and control)
<i>Regional development priority</i>				
Local territorial development and family farming	Regional planning for water infrastructures and family farming development	Agribusiness and integrated value chains with smallholders	Priority for energy production	Priority for environmental conservation
Secondary beliefs:				
<i>Preferences concerning technical advice</i>				
Holistic technical assistance oriented towards agroecology	Traditional (outsourced) technical assistance to family farmers	Private-led technical advice and assistance, entrepreneurship	Sparse initiatives of corporate social responsibility	Sparse initiatives, no structured strategy
<i>Preferences concerning new technologies for water use</i>				
Decentralized social technologies produced locally (plate rainwater cisterns)	Scaling-up foreign made technologies (plastic rainwater cisterns)	Large infrastructure systems to fight drought (irrigation dissemination and efficiency)	Large and concentrated infrastructures to produce hydroelectricity	Control of well water, irrigation and energy licenses

Key resources:				
Social mobilization capacity, information	Practical decision-making, technical	Financial, technical, representation of interest	Financial, formal authority (water regulation)	Technical, formal authority (environmental regulation)
Main arenas:				
Rural and territorial local development councils	Rural and territorial development local councils	Patronal producers' unions (CNA) and fruit exportation boards	São Francisco River Basin Committee, São Francisco crisis room	Environmental local councils, national level climate group

Source: Authors, adapted from (Elliott & Schlaepfer, 2001; Milhorange, 2018)

b. Gap between coalition beliefs and national climate policies

Brazil's Adaptation Plan targeted some challenges such as the relation between climate change and drought in the Northeast region. This has led to a vulnerability to drought index in the context of climate change (MMA et al., 2017). Both the plan and its resulting products have been formulated by representatives at the national level. The process resulted in a cross-sectoral working group created in 2013 consisting mainly of technicians and members of the ministries. The group consisted of a specific arena under the framework of the executive body of the National Climate Policy (*Gex-PNMC*). The plan envisaged local consulting meetings during the elaboration process, but such meetings could not take place owing to budget constraints (GT Adaptação/MMA, 2015, p. 4).

This process contrasts the "living with semi-arid" paradigm, built as a participatory and territorially contextualized strategy and intended to replace the conventional governance model of drought management through large infrastructure and irrigation projects. Recently, the paradigm was associated with the objectives of promoting the adaptive capacity of rural populations to extreme climate scenarios, although it emerged before the adaptation agenda was consolidated in Brazil (Lindoso et al., 2018).

Nevertheless, the climate agenda has not reached the lower policy levels, with a perception differential existing between the coalitions in terms of climate challenges. The survey showed that the concern about climate change and association between global warming and increase in droughts was higher among international organizations based in Brazil and



federal institutions, rather than at the local level (degree of concern: international organizations = 3.25; federal level = 2.24; state and regional level = 2.04; local level = 1.95)⁴. Despite the strong substance connection, the official climate narrative does not really structure the subsystem network, but the environmental coalition (C5) shows a higher degree of climate concern than the others (mean of score: C1 = 2.1; C2 = 1.9; C3 = 1.8; C4 = 1.4; C5 = 2.7). As regards C1, the high concern about climate challenges in the semi-arid region is due to the presence of international and federal organizations rather than local actors.

The next section discusses this gap and the interaction dynamics in C1 and across coalitions. It also discusses how a higher degree of coordination between C1 and C5 may contribute to the “living with semi-arid” paradigm in the federal adverse context and improve the integration between climate and water policies.

4. Coalition formation and interaction: policy learning for drought management and climate adaptation

a. Consolidation of the “living with semi-arid” paradigm

Regional development strategies for Northeast Brazil historically relied on large infrastructures for energy production to feed irrigation projects initially promoted through public–private partnerships. The project was essentially rooted in the objective of transforming semi-arid regions into green agro-export landscapes and large water-storage reservoirs. It was led by institutions such as the São Francisco Valley (Development Company of São Francisco and Parnaíba Valleys—Codevasf). However, the project was criticized for not considering the real causes of local vulnerability, such as unsustainable production systems and limited access to land. Several authors describe the concentration of water reservoirs in private estates, associating water distribution with political clientelism, which

⁴ The degree refers to the mean of the combined score of two opposite statements (-2 to 2, “strongly disagree” to “strongly agree”): (i) the increase in climate variability is a current phenomenon in the Brazilian semi-arid region, and must be addressed by public policies; (ii) droughts in the semi-arid region are a recurrent phenomenon, and there has been no change in their intensity/frequency.



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thrived by blaming rainfall irregularity for social inequalities (Bursztyn, 2008; Lindoso et al., 2018).

In this context, local, public, and civil society actors have progressively turned to government water allocation strategies with new policy ideas strongly based on experimentation. An important milestone in this direction was the Third Session of the United Nations Convention to Combat Desertification held in Recife in 1999. The document released after the conference proposed to change the drought regulation policies and promote new water use technologies, with the plate cistern as flagship; this is currently the most widespread rainwater harvesting technology. The installation of plate cisterns has commonly been followed by participatory approaches, soil conservation strategies, and species and production systems more adapted to semi-arid climates (such as pear cactus, goat farming, and domestic orchards and gardens).

Rainfall cisterns have been used following government policy under the Lula da Silva administration since 2003. The One Million Cisterns Program (*Programa Um Milhão de Cisternas - P1MC*) provided political support and public funds for implementing initiatives identified with the “living with semi-arid” paradigm. A key management approach channeled federal public funds from the ministries of social (MDS) and agrarian (MDA) development to civil society organizations formed around the Articulation in Brazil’s Semiarid (ASA) network. The program became a major institutional experience based on cooperation between civil society and government with political decentralization (Lindoso et al., 2018). Furthermore, local program managers promoted initiative integration at the field level for productive inclusion, social protection, desertification control, and decentralized water use and governance (Milhorange, Sabourin, Mendes, et al., 2019).

The outcome of this integrated approach was to reduce the rural populations’ vulnerability to drought (Lindoso et al., 2018; Peterson, Goodell, Hegde, & Stage, 2017). As affirmed by a local representative of rural workers, “*thanks to the ASA, it was possible to endure the worst*

drought in the region with no deaths, no migration, and no need to occupy [public buildings].”

Several aspects of this paradigm contribute to a diffused belief system. For instance, the World Bank played a key role in promoting the “fighting drought” paradigm and establishing irrigation projects since the 1970s, and is currently engaged in funding initiatives promoted by C1. The bank is now bringing together the technologies and participatory approaches of the “living with semi-arid” paradigm and the narrative of climate adaptation, as evidenced in their involvement in projects like the *ProRural* and *Bahia Produtiva* implemented in collaboration with the Pernambuco and Bahia state governments.

The C1 acquired relational resources to become one of the most important coalitions in the subsystem. Network analysis shows that the C1’s average centrality (*in-degree* and *betweenness*) is higher than that of other coalitions (Table 3). The in-degree centrality of the “energy-water regulation” coalition (C4) was close to that of C1 (higher in the technical/financial network: C1 = 1.8, C4 = 2.0). Nevertheless, C4 presents lower betweenness centrality. Both measures combined provide key information in terms of political resources. The in-degree measure indicates the prominence of coalition members in the whole network, while the betweenness measure indicates the brokerage of control over network connections across other actors (Di Gregorio et al., 2019).

Table 3: Mean of centrality measures (in-degree and betweenness) for each coalition

	C1	C2	C3	C4	C5
In-degree centrality	2.1	1.5	1.3	2.0	1.5
Betweenness centrality	35.0	14.1	34.3	23.9	15.7

Source: Authors, based on survey results.

The “living with semi-arid” coalition (C1) expanded in power over the 2000s, but not without controversies. ASA lost the monopoly in managing the P1MC in 2014. The decision was taken by the Dilma Rousseff administration to mandate scaling up the cisterns distribution to the Ministry of National Integration (MI). This decision was followed by a change in the



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philosophy of the program, as it relied on plastic cisterns made by foreign companies, and excluding the obligatory training for self-construction and maintenance. ASA organizations considered this change constrained the promotion of agroecological practices and participatory governance.

This second perspective was identified with the “regional development” coalition (C2). Most of its members have historically been involved in the promotion of irrigation systems and large water infrastructures based on the “fighting drought” paradigm. This coalition was traditionally led by institutions such as the Northeast Development Superintendence (Sudene), which was created for regional planning, but was bound by authoritarian and technocratic order installed by military governments (1964–1985) (Andrade & Cordeiro, 2016).

While C2 currently shares much of its beliefs with C1 by becoming more open to the “living with semi-arid” technologies (De Nys & Engle, 2014), several differences still exist. The main difference relates to the approach to disseminating rainwater cisterns, which did not include a participatory and collective training process or agroecological practices. In this context, Codevasf competed with ASA over public funds for disseminating cisterns (Andrade & Cordeiro, 2016). Further aspects pertain to production practices such as supplementary brackish water irrigation through well drilling; these practices have been criticized by several C1 members. Note that most of the rural development instruments promoted by C2 can be associated with the instrument mix recognized as the “first generation” of policies favoring peasant and family farming (Sabourin, Samper, & Sotomayor, 2015). These included land access and regularization (agrarian reform), as well as infrastructure development, credit, and technical assistance for traditional agricultural production. The beliefs of C1 and C2 gradually converge, just as most of their policies.

C1 also shares some beliefs with the “agribusiness and irrigation” coalition (C3), as its members became increasingly interested in rain-fed agriculture. Nevertheless, the final objective of public policies for C3 is distinct, with focus on economic feasibility of agricultural



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producers and irrigation agriculture based on private investments and public credit. Technological development is a key factor for most of these organizations, but it does not comprise locally contextualized social technologies as in C1. The agricultural credit system, centralized around the Ministry of Agriculture (MAPA) and the Bank of Brazil (BB), is another essential instrument for C3, whose financial resources conflict with other agricultural coalitions (C1 and C2). Initiatives for promoting greener lines of credit were launched in the early 2010s (e.g., the Low Carbon Agriculture credit line), but they are mainly oriented toward medium- and large-scale producers, to the detriment of family farmers.

Results have unexpectedly shown that the representatives of the newly created National Agency for Rural Technical Assistance (Anater) are ideologically closer to C3 than to the coalitions promoting family farming policies (C1, C2). A main source of conflict with C1 is that Anater extended public calls for funding rural technical assistance to the entire country. Consequently, organizations that are not necessarily familiar with the semi-arid reality may be chosen to advise farmers. According to C1 members, this could hinder continuity of the “living with semi-arid” initiatives and their ability to promote policy integration as this is commonly achieved at the local level through the proactive role of the organizations involved in implementation of the initiatives (Milhorance, Sabourin, Mendes, et al., 2019).

Furthermore, a source of conflict between C3 and the “energy-water regulation” coalition (C4) is the variation in flow of the São Francisco River. The river’s flow is regulated by hydroelectric plants of the CHESF company and endorsed by the National Water Agency (ANA). Given the recent water deficit and climate variability scenario, hydroelectric power production in the region has been compromised. The Sobradinho reservoir received less than 20% of its capacity in 2015 and 2016 (Milhorance, Mendes, et al., 2019). The decreasing flow was commonly perceived to affect the water allocation for irrigation (CBHSF, 2015). For instance, agribusiness representatives in Petrolina and Juazeiro advocated for federal-level changes in water regulation policy. These operations have also been criticized by the C1 and C2 coalition members, and have recently led to an unprecedented change in the company’s perspective on energy production.



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Although hydroelectricity is promoted as a source of low carbon energy production and climate mitigation globally, its socio-environmental impacts have been increasingly criticized. According to company representatives discussing climate issues, *“We realized that, because of social conflicts and the issue of river water flows, it was not feasible to invest in hydro energy anymore. We believe that wind and solar energy power produce lower social and environmental impacts.”*

Finally, the “environmental protection” coalition (C5) shares with C1 the interest for preserving natural vegetation (of the *caatinga* biome) as a means to counter desertification processes. However, C5 is a very isolated coalition in several aspects. Strikingly sectoral and formed by state and federal public bodies, its relationship with production is predominantly controlled by regulations on the use of environmental resources (particularly water) and its presence at the local level is institutionally weak. Now, note that the state environmental bodies are responsible for elaborating and implementing regional climate strategies, including the climate adaptation plan. The climate narrative naturally faces challenges in reaching the lower levels of governance and incorporating the “living with semi-arid” beliefs, which are perceived to promote adaptation to climate change at the national and international levels.

Thus, C1 became a major political force in Brazil’s semi-arid landscape. The political support it gained and public funding it received from federal administration over the 2000s and early 2010s added to its relational resources, thus promoting an innovative paradigm and stimulating development from a more sustainable and contextualized perspective. It became influential in the policy subsystem, as proven by quantitative data, with aspects of its beliefs diffused through a long and gradual learning process. While it has not become an incontestable coalition, with members still struggling to implement some of its more radical ideas, the result of this process was an incremental paradigm shift for water use and rural development in the semi-arid region. As stated by Piraux and Bonnal (2011), the notion of “fighting drought” as a developmental strategy is in crisis. The authors consider it currently



difficult to find any governmental action directed toward development in the semi-arid region that does not point, at least discursively, to the notion of “living with semi-arid”.

How much of this learning process will not be reversed after the presidential change in Brazil in 2016 is still an open question, but some features of the network structure and its interaction patterns may shed light on the issue. Aspects such as coordination among or within action levels and the potential to improve the sectoral integration of water and climate strategies will be discussed.

b. Government shift and prospects for change

Brazil has recently experienced a deterioration in economic situation and a profound political crisis. The roots of these are beyond the scope of this paper, but the crises led to the impeachment of Dilma Rousseff (Workers’ Party) in 2016. Rousseff was removed from office by a right-wing politically conservative group with ultraliberal economic ideas. This represented a major change in the country’s policy scenario. The former vice-president of Brazil Michel Temer took office in 2016, and initiated a process contrary to the main development strategies of the Northeast region. The administration relied on the active weakening of several policies established during the previous decade. They reduced investment in policies of particular interest for progressive groups, such as social and rural development policies (Nierdele, Grisa, Piccolotto, & Soldera, 2017).

The Temer administration also blocked the social participation agenda. Several participatory bodies lost their funding, but officially continued to remain active. In exchange for political support, Temer also signed acts and decrees lowering environmental licensing requirements, suspending ratification of indigenous lands, reducing the size of protected areas, and facilitating land grabbers to obtain deeds for illegally deforested areas. This led to the abandonment of deforestation control policies and indirect support for predatory agricultural practices (Rochedo et al., 2018). Temer’s mandate concluded in 2018, and the far-right populist Jair Bolsonaro was elected president of Brazil. The agenda of the new



president was complete and decisive dismantling of most of the policies analyzed in this paper.

Bolsonaro's administration is still in its early stages, but the trend suggests that the current president intends to go beyond Temer by draining the financial and political resources of the existing policies and demolishing the institutional framework built since the country's redemocratization in the 1980s. For instance, on the first day of his governance, the National Council for Food and Nutritional Security (Consea) was abolished from ministerial structure. A decree was passed in April 2019 to extinguish all the federal public collegiate bodies (Presidential Decree 9.759). Besides inspiring participatory public governance worldwide (Milhorange, 2018), these councils were central to improvement of public policies and coordination of public and civil society actors, as those that led to reinforcement of the C1.

Bolsonaro initiated an actual crusade against most of the policies and ideas favoring the "living with semi-arid" paradigm, including social participation and mobilization, environmentally friendly agricultural practices, and family farming development. His team also concluded that climate change policies are part of an "international Marxist complot" (Watts, 2018). Furthermore, the Northeast was recognized as the region that predominantly voted against Bolsonaro and thus the target of political retaliation.

In this extremely disadvantageous scenario, the future of C1 and its continuation as an influential coalition in the region is unknown. This context aligns with the ACF's assumption that events outside the control of the subsystem participants may pave the way for policy change. This section sheds light on the intra- and cross-coalition interaction dynamics and distribution of resources.

First, data show that the policy subsystem has been largely structured by regular exchange of information and the formation of political alliances more robust at the local and regional levels. A QAP correlation analysis shows the "information network" highly overlapping with the other networks in the subsystem.

Table 4: QAP correlation between networks of the subsystem

	All networks combined	Technical/financial	Joint implementation	Influence	Alliance	Information
Technical/financial	0.568*	1.000				
Joint implementation	0.586*	0.398*	1.000			
Influence	0.632*	0.353*	0.366*	1.000		
Alliance	0.628*	0.324*	0.389*	0.387*	1.000	
Information	0.655*	0.355*	0.412*	0.403*	0.563*	1.000

*QAP *p-value* < 0.001, 5000 permutations.

Source: Authors, based on survey results.

Note that the emergence of ASA related directly to the strengthening of civil society as part of a broader consolidation of the Brazilian democratic regime since the 1980s. The organizations launched the “Declaration of the Brazilian Semi-arid” in 1999 and institutionalized their coordination. Currently, ASA brings together more than 1,000 organizations operating throughout the Brazilian semi-arid region.

This learning and coordination process has been operational at several levels since the 1970s. At the local level, it was based on partnership between municipal trade unions and local NGOs. The process was harmonized at the territorial level with the support of rural NGOs and the academic community (Bonnal & Piraux, 2010). A broader network emerged in the 1980s through regular dialogue between territorial organizations. This acquired a sociotechnical nature in the 1990s, with the involvement of greater number of civil society organizations and increase in density of inter-organizational ties. This long process created a structure for the development of social technologies to cope with droughts (Andrade & Cordeiro, 2016).

This process reinforced the governance by public–civil society partnerships, whose plasticity based on legal measures enacted by each relevant ministry underpinned a dynamic process with intense information exchange and driven by social demand. Despite this progress, the experimentation did not reach the stability of norms and rules (Bonnal & Piraux, 2010; Piraux & Bonnal, 2011). As previously mentioned, the paradigmatic and institutional change analyzed in this paper was reinforced by the Lula da Silva administration. Nevertheless, this



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agenda has been characterized by the fragility of its institutional positioning (Piroux & Bonnal, 2011), whose influence and learning process are currently threatened by governmental shift.

Indeed, studies have criticized the insufficient institutionalization of social policies in Brazil (Eiro, 2017). The ACF showed that formal legal authority has a unique status as political resource relative to others. As claimed by Nohrstedt (2011), legislators have the power to veto any policy change. Therefore, although the “living with semi-arid” paradigm emerged from intense information exchange over several decades, its consolidation benefited from resources provided by the federal government in the 2000s. Weak institutionalization of policy instruments promoted by C1 members is a source of fragility in a context of government shift and redistribution of authority resources.

The next point relates to the alternative political arenas for information exchange and policy decision. These are the venues for coalitions to interact, debate, learn, and possibly negotiate (Jenkins-Smith et al., 2014). The federal government created the São Francisco River Basin Committee (CBHSF) in 2002 as a deliberative institution responsible for allocating water resources, preparing and approving basin plans, defining water use priorities, and arbitrating conflicts between decision makers. The members of the committee belong to federal, state, and municipal bodies, water users (irrigation/agriculture, fishing, electricity...), and civil society organizations, distributed in accordance with bylaws prepared by representatives of all segments of the basin.

ASA recognized the committee at its early stages as the arena for relevant decisions regarding water use and regulation. Nonetheless, ASA decided to leave the committee in 2005 arguing that decisions were highly centralized. Also, government approval of the São Francisco River transposition project, to the detriment of the CBHSF, showed the lack of political legitimacy of the committee in national water policies. In this context, the government moved forward in partnership with ASA, in response to the needs of family farmers, while implementing the infrastructure projects that were condemned by these



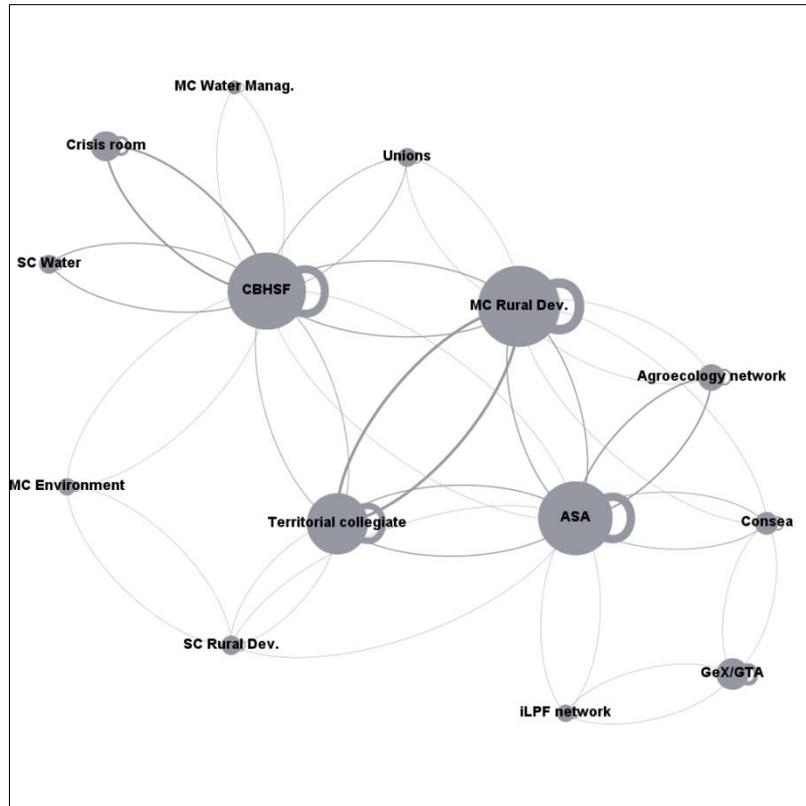
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same actors (Empinotti, 2011). Climate change is not a central subject in the committee as yet, but has started to be discussed in technical meetings and funded projects (CBHSF Website, 2019).

Concrete decisions have been taken on water allocation and flows from energy plant reservoirs in a closed arena set up after the 2012–2013 droughts. The “São Francisco River Crisis Room” was created in 2013 to deal with water deficit in the basin. Coordinated by ANA, the venue is expected to articulate the urgency of the river situation to various institutions and facilitate decision-making through periodic meetings. In addition to ANA, a limited number of representatives participate in the meetings, such as CHESF, the CBHSF, and the National Centre for Monitoring and Early Warnings of Natural Disasters (Cemaden). The latter is also a member of the climate policy executive group.

Meanwhile, municipal and territorial councils for rural development have proven to be key mechanisms for coordinating strategies and actors at the local level. They are part of the territorial development policies implemented with the “living with semi-arid” paradigm during the 2000s (Delgado & Leite, 2011). These groups are required to coordinate with other institutional actors implementing initiatives in the territory and determine which communities will benefit. Despite the recent budget reduction in the 2016 governmental shift, the councils remain active spaces for informal institutional and political coordination at the local level (Milhorange, Sabourin, Mendes, et al., 2019).

Figure 3: Joint participation of respondents on policy arenas



*Acronyms: Municipal Councils (MC), State Councils (SC), Rural Development (Rural Dev.), Water Management (Water Manag.)

Source: Authors, based on survey results.

Thus, despite the differences in membership and decision-making procedures, ASA, the CBHSF, the crisis room, and the local councils have become important spaces for coordination and information exchange beyond federal government. Figure 3 illustrates the joint participation of survey respondents in common policy arenas. Note that the CBHSF remains a central arena for interaction in the subsystem, although its relevance in terms of decision-making has been questioned. However, both the crisis room and climate coordination spaces (adaptation working group and climate executive group – GTA/GeX) are weakly linked to other arenas. Finally, the local and territorial collegiate bodies for rural development are central spaces for connecting policy arenas in the landscape. While federal councils such as the Consea and GTA/GeX may find it difficult to meet during the Bolsonaro administration, improving local and territorial coordination through the operating groups



and the CBHSF may help maintain information exchanges, including on climate challenges and adaptation.

The final point discussed in this section is the interaction across levels of action and coalitions. The literature suggest that cross-level interactions occur when network communities include actors operating at different governance levels (Di Gregorio et al., 2019). Another common assumption is that most limiting and favoring elements to coordination stem from higher governance levels (Heinmiller, 2014).

Data show that regional and federal organizations tend to interact more closely with organizations at their respective action levels, as opposed to local- and international-level organizations (**E-I regional = -0.104**; federal = 0.029; local = 0.406; international = 0.652). Although federal organizations have been central in financing the initiatives of C1 over the 2000s, a large number of intra-level interactions take place, particularly regional level. Recently, international organizations have emerged as additional funding sources for the “living with semi-arid” paradigm. Amplifying these local connections to international ones may ensure material resources to C1. This would require NGOs and local actors to more effectively incorporate the climate change narrative, which barely reaches the local level.

Moreover, results show that organizations in the Bahia state tend to interact more often within its community than with those organizations from the Pernambuco state (E-I Bahia = 0.032; Pernambuco = 0.275). This is consistent with the fact that technical assistance in Bahia has been almost entirely outsourced to NGOs that commonly interact around ASA. The state public body for technical assistance was dissolved in September 2016 and replaced by the Bahia Superintendence for Technical Assistance and Rural Extension (Bahiaater). The Pernambuco state combines both public and NGOs services, although the former has lost some of its political and financial resources. Reinforcing vertical (local–international) as well as horizontal (Bahia and Pernambuco) ties may help maintain the exchange of information and influence of C1 members, despite the unfavorable external context.



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As previously mentioned, the origins of these networks lie in a historical military dictatorial environment, contrary to any kind of political mobilization. Furthermore, the C1 members continue to coordinate actions and discuss projects in local and territorial councils, despite budget cuts. Thus, regional and international coordination are potential means for sustaining the “living with semi-arid” policy instruments.

Finally, data indicate that C1 tends to focus more on intra-coalition interactions than other subsystem coalitions (**E-I C1 = -0.054**; while C2 = 0.354, C3 = 0.385, C4 = 0.313, C5 = 0.132). Despite the inclination of C1 for intra-group interactions, the density of these ties is not very high compared to most of the intra-coalition densities (density C1 = 0.08; while C2 = 0.07, C3 = 0.15, C4 = 0.09, C5 = 0.12). Additionally, even though the mandate to formulate and implement state-level climate change plans is a prerogative of the state environmental bodies, the density of interactions between C1 and the environmental coalition (C5) is the lowest in the network (**density C1-C5 = 0.005**). This indicates the potential for increasing the coordination between the two coalitions to promote higher integration of water and climate initiatives.

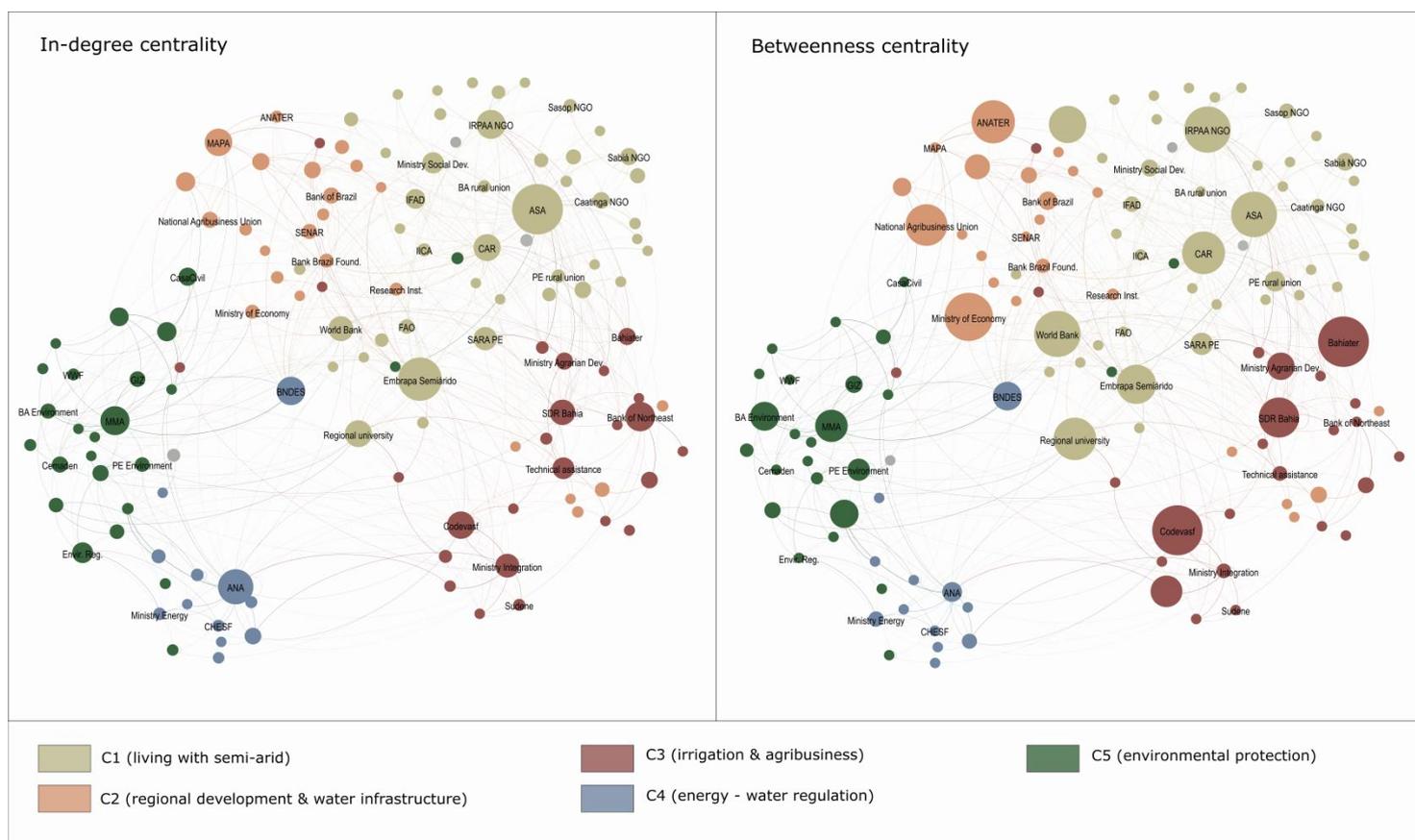
Moreover, several C1 members such as ASA, Embrapa Semiarido⁵, the World Bank, and the state bodies for rural development present high betweenness centrality (Figure 4), confirming that they are relevant brokers who can contribute to improving cross-coalition and cross-level interactions. They also present high in-degree centrality in the “influence network”, thus confirming their reputation in the policy domain. As regards the state bodies, several C1 members revealed that they are becoming privileged partners compared to federal bodies. For instance, see what an NGO representative in Bahia has stated:

“Since Temer took office, all the initiatives thought to benefit family farming have been held back. The government does not disburse the funds. (...) At the state level, it has worked better. Since 2015 we have had additional agreements with the state government. We have been able to maintain the initiatives.”

⁵ Public agricultural research institution for the semi-arid region.

In Pernambuco, the state governor endorsed a subnational coordination strategy to fulfill the country’s Paris Agreement commitments. The decision was taken along with other governors, the Brazil Forum for Climate Change, and several international subnational actors, despite Bolsonaro’s hostility to the global climate pact (Reuters, 2019). Therefore, improving political coordination and information exchange with environmental state bodies, and thus highlighting more explicitly the interactions between rural, water, and climate agenda may be an additional means to sustaining the relevance of the “living with semi-arid” paradigm and promoting policy integration.

Figure 4: Combined networks and centrality measures, colored by coalition



*The designations of organizations refer to the period the interviews were conducted (2018) and does not include ministerial change undertaken in 2019. Only the labels of the nodes mentioned in the text, and those that were considered more relevant were displayed in order to help visualization.

Source: Authors, based on survey results



Conclusion

This paper described the consolidation of a coalition promoting a paradigmatic change in water use and drought management in Brazil’s semi-arid region—the “living with semi-arid” coalition. The member organizations have been for decades attempting to develop a process that would allow for intense information exchange and political collaboration, thus leading to a learning process based on the territorialized experiences of coping with droughts that contradicted the interventions historically promoted in the region. This included techniques such as stocking water in abundance to cope with scarcity of resources and environmental variability, moving toward decentralized and contextualized social technologies, encouraging participative governance and learning, and focusing on family farming and environmentally friendly agricultural practices. More than a policy strategy, this became a political project for the sustainable development of the semi-arid region.

This belief system benefited in the 2000s from the support of the Lula da Silva administration, and led to gradual reinforcement of the coalition and diffusion of several of its beliefs to other competing coalitions of the semi-arid landscape. Nevertheless, the coalition currently faces several challenges in maintaining its role and influence. These were examined from the ACF premises and policy network analysis perspectives, and some points of debate are summarized below.

First, the insufficient institutionalization of instruments promoted by this leading coalition is a main source of fragility, especially when a newly elected federal government does not agree with its beliefs. The relevance of formal legal authority, particularly at the federal level, was presented in the literature as a central source of power and policy change. A governmental shift can hinder the development of the “living with semi-arid” political project, but the extent to which this will lead to overall change is still unknown. The evolution of this case will be interesting when analyzing the relative importance of different kinds of political resources (formal/informal, internal/external to the subsystem) and the potential of cross-coalitions and cross-level ties to maintaining status quo. The case also adds



some analytical difficulties from the recent rise in far-right populism globally and its ability (or not) to persist in power and influence subnational change.

Second, although the “living with semi-arid” paradigm has been recognized as a strategy for adapting to climate change by several international, ministerial, and academic representatives, a gap exists between the paradigm and the climate agenda. Most of the regional and local institutions involved in the process do not indicate climate concern in their beliefs. The growing interactions of C1 with international actors may open up new channels of political and financial support. This would require mobilization of the climate adaptation narrative in political debates and reinforcing of the ties with the state environmental bodies responsible for formulating climate policy at the lower levels. Identifying the coalitions’ brokers and key policy arenas would provide additional elements for the continued information exchange and collaboration.

Methodologically, the paper showed that highlighting both beliefs and resources using the combination of ACF and policy network tools provided a deeper understanding of the dynamics of the coalitions’ interactions, power, and associated policy change and integration. The paper showed that divergences in beliefs and a low degree of coalition interactions are complementary to explaining weak policy integration, especially when it pertains to a multi-sectoral subsystem. Furthermore, shedding more light on the role of international actors and the processes of internationalization of policy processes (including through subnational coordination) might make the analysis more complex, but could provide some insights on the national and local policy processes that contribute to climate adaptation.

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