RESEARCH ARTICLE

Dealing with cross-sectoral policy problems: An advocacy coalition approach to climate and water policy integration in Northeast Brazil

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Abstract

The governance of several cross-cutting challenges, such as food security, climate change, and sustainable development, calls for integrative policy approaches. However, efforts to better theorize the drivers of integration beyond listing explanatory factors remain weak. Viewing integration as a process of policy change for dealing with complex problems, this study argues that policy integration analysis can benefit from an advocacy coalition approach (ACF) to address this theoretical gap. It illustrates the analytical framework by empirically investigating the drivers of policy (dis)integration in Brazil's subnational water policy introduced in the 2010s. The level of conflict between coalitions, adjustment of policy beliefs, coordination within and across coalitions, and existence of venues for interaction and policy-oriented learning were presented as factors that can foster or hinder the integration of public policies. Moreover, the study discusses the potential to acknowledge in ACF the mechanisms for coordinating policy actors and instruments, which would facilitate the analysis of the policy processes of cooperation. It also demonstrates that recent droughts in Northeast Brazil have been increasingly related to the local impacts of climate change, contributing to reframing water management as a cross-sectoral climate and water governance issue. The analysis was based on a literature review, semi-structured interviews, and social network analysis.

Introduction

The governance of several complex challenges, such as food security, climate change, and sustainable development, calls for integrative policy approaches as progress toward one goal may result in either synergies or trade-offs in others. Policy integration, policy mix, integrated


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natural resource management, and policy nexus are concepts developed to address challenges involving a growing number of stakeholders, governance levels, and policy goals (Candel & Biesbroek, 2016; Howlett, 2019; Milhorance & Bursztyn, 2019; Nilsson and Eckerberg 2007; Weitz et al. 2017). A common criticism of these approaches is that most are disconnected from the decision and policy-making processes that they ultimately seek to influence. Policy fragmentation is often addressed as a technical or administrative problem, where better coordination or information can improve or optimize system performance (Weitz et al., 2017). Nevertheless, a large body of research has shown that effectively implementing cross-sectoral and multi-level strategies can lead to heightened conflict and cost owing to the involvement of multiple actors with diverse interests, beliefs, and values that come with the redistribution of power and decision-making authority (Baulenas & Sotirov, 2020).

Recent studies have highlighted the governing and learning processes underlying policy integration (Nilsson and Eckerberg 2007). However, these studies presented typologies to evaluate progress *toward* integration—a desired outcome—rather than approaching it as an inherently dynamic concept (Adelle & Russel, 2013). Candel and Biesbroek (2016) have made progress in aligning these studies by identifying policy dynamics typologies and extending them beyond the dominant domains of environment and climate change. By adopting such a processual perspective, scholars have recently provided a framework to comparatively assess policy integration with specific measurements that link strategic (political), substantive (content), and procedural (organizational) aspects (Candel & Biesbroek, 2016; Cejudo & Michel, 2017). However, efforts to better theorize the drivers of integration beyond simply listing explanatory factors remain weak, and governments are still unclear about dealing with cross-sectoral and complex problems (Cejudo & Michel, 2017; Trein et al., 2020).

Therefore, this study explores *how to theorize the conditions that foster or hinder governments from integrating policies formally and in practice?* It argues that, although the advocacy coalition framework (ACF) has long been used to analyze the governance of cross-sectoral conflicts, it could be combined more explicitly with policy integration analysis to address the theoretical gap in this literature. Assuming that integration is a process of policy change when dealing with complex policy problems (Baulenas & Sotirov, 2020; Candel & Biesbroek, 2016; Cejudo & Michel, 2017; Nilsson and Eckerberg 2007), this article *clarifies the utility of the ACF in identifying the factors of (dis)integration in Brazil's subnational water policy*. By doing so, points needing further development in the ACF, particularly in its learning model, are highlighted. Furthermore, the study discusses the emerging challenges posed by climate change to historically established water policies and to their integration dynamics. Note that the need for integration in the Mid-São Francisco River Basin (Fig. 1) has been discussed extensively. Water supply and competition for its use are key issues in energy, irrigation, and traditional farming, especially in the context of increasing droughts (Marengo et al., 2019; Milhorance et al., 2019). The main ideas concerning the historical shaping of water use and supply strategies in the region were reviewed. Then, the mechanisms of cross-coalition negotiation and learning that were undertaken to change policy paradigms, implementation approaches, and integration patterns in the 2010s were examined.
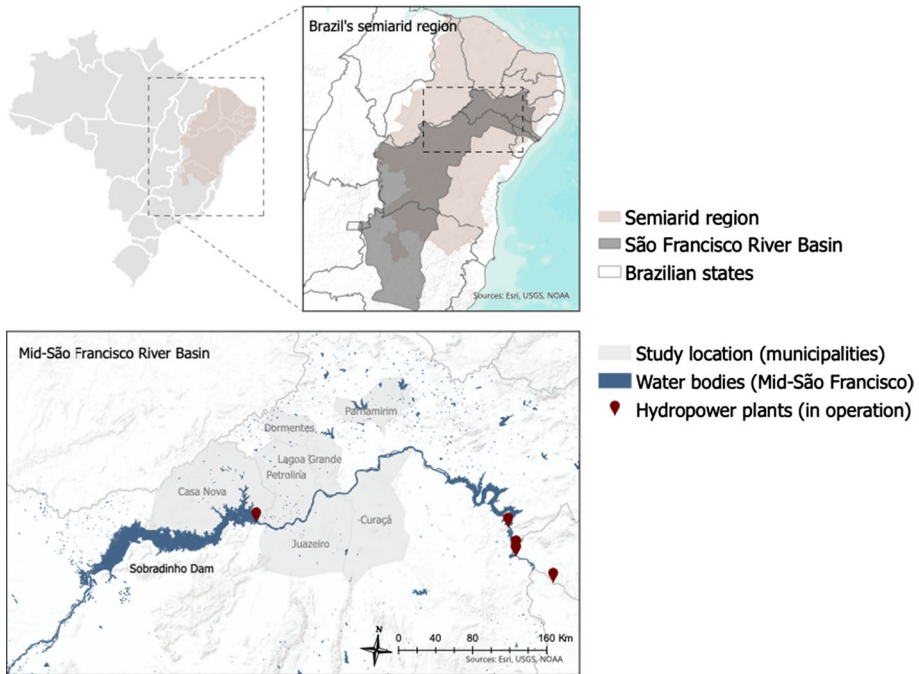
Fig. 1 Location of the study in Brazil's Mid-São Francisco River Basin. Source: Authors, based on ANEEL (2018) and ANA (2017)

Research design

Positioning in the policy integration research agenda

Early studies on policy integration highlighted the objective of making policy design more rational by eliminating contradictions between policy goals. Underdal (1980) defined policy integration as the result of a strategy in which a policy's constitutive elements are grouped and exposed according to a unitary conception. While the idea of trade-offs in policy design is key, studies have highlighted the economic concept of Pareto optimality as the criterion for solving dilemmas (Collier, 1996). Since then, this notion has been used in the context of sustainable development and natural resource management with reference to environmental policy integration (Jordan & Lenschow, 2010), climate policy integration (Adelle & Russel, 2013), and the water–energy–food nexus (Milhorance & Bursztyn, 2019).

Despite earlier studies' emphasis on normative and rationalistic factors in policy fragmentation, recent research has increasingly acknowledged the conflicts between divergent actors, interests, and ideas, and the power asymmetry in decision-making processes. Rather than simply viewing policy integration as a result of fragility in the administration process, it was framed as a governance issue. Later, it was understood as a process of policy learning in which perspectives evolve and reframe sectoral objectives, strategies, and decision-making processes (Adelle & Russel, 2013; Candel & Biesbroek, 2016; Nilsson & Eckerberg 2007). This approach derives from the premise

in the policy-network theory that policy is shaped in networking processes with multiple actors that possess different ideas and interests (Swartling et al. 2007). Thus, policy integration is conceived as a process of day-to-day policymaking, negotiation, and policy-oriented learning (Adelle & Russel, 2013). These studies have been criticized for their normative perspective as the learning process is meant to change the current hierarchy of policy goals and worldviews to achieve sustainable development—a desired state (outcome) (Candel & Biesbroek, 2016; Nilsson & Nilsson, 2005).

Alternatively, current studies consider integration as a process of policy change and design in which actors play a pivotal role. While some theorization gaps have been addressed (Biesbroek & Candel, 2019), studies are yet to explain why (dis)integration occurs (Trein et al., 2020). Accordingly, the present study attempts to contribute to this research agenda by utilizing a processual perspective in examining policy integration. It differs from earlier studies and assumes an innovative approach related to certain points. First, it argues that, although policy integration deals particularly with complex problems that encompass—but exceed—the programs' and agencies' individual goals (Cejudo & Michel, 2017), it can be analyzed using existing policy process theories like the ACF. This approach may not be adequate to address all the concerns of the research agenda, particularly when several policy subsystems are involved, but it provides useful typologies to address the abovementioned questions. Second, the study argues that policy integration can be observed within a policy subsystem—and not necessarily between subsystems. Intra-sectoral conflicts are also key in preventing integration, and they are well captured by coalition conflicts. Third, it provides empirical insights from a case study outside the traditional purview of research conducted in Europe and North America, leading to theoretical contributions to the ACF's learning model in cooperative systems.

Understanding policy integration through the ACF lens

One basic premise of the ACF is that coalitions are formed by actors who share a set of interdependently bound ideas and practices (belief systems). These coalitions, which tend to persist over time, are groups of actors that coordinate their activities to influence policy options. They implement strategies by translating their belief systems into public policies (Jenkins-Smith et al., 2014), and these beliefs drive actual political coordination among coalition members (Henry, 2011; Weible, 2005). In the ACF, policy change is assumed to result from shocks (e.g., socioeconomic conditions, government shifts), coalition dynamics (e.g., change in composition or resources, and negotiation), or learning within or across coalitions. The dispute over the translation of new ideas into policies can result in their rejection or partial adoption, or in a paradigm shift. While shocks that lead to the contestation of powerful groups and established ideas may lead to major policy change, slower learning processes and accumulation of knowledge may bring about minor changes as actors gradually adjust their secondary beliefs, which are more prone to change (Sabatier & Jenkins-Smith, 1993).
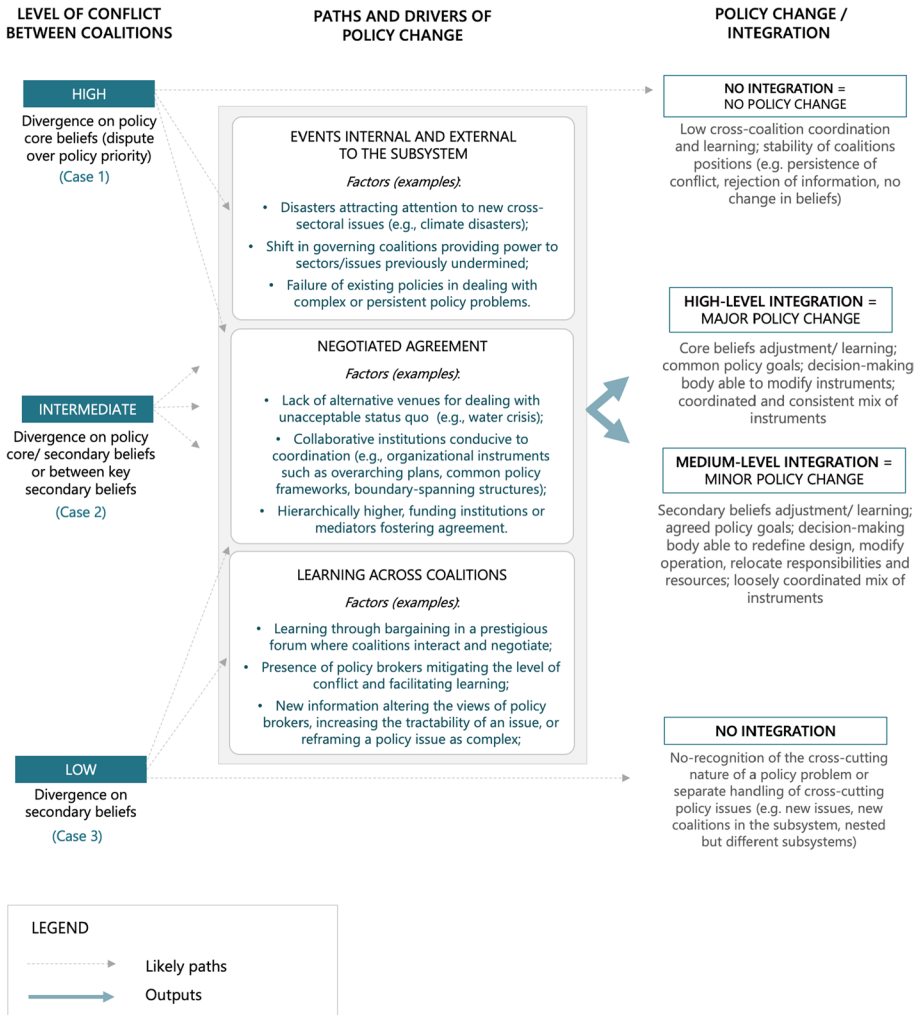
Some studies have identified ACF mechanisms within boundary-spanning issues, including policy learning, coalition building, and policy entrepreneurship. However, these studies only account for the challenges posed by cross-subsystem policy dynamics (Candel & Biesbroek, 2016; Jochim & May, 2010; Jones & Jenkins-Smith, 2009). A policy subsystem is a subset of a larger political and governing system anchored by an

issue, a geographic scope, and policy actors. Policy subsystems can be nested, overlapping, and semi-autonomous (Jenkins-Smith et al., 2018). Therefore, we simultaneously examine a mature policy subsystem that absorbs new issues emerging on the political agenda, as well as the external shocks caused by extreme climate events, new information connecting these events with climate change, and the involvement of new coalitions. Indeed, the limitations of this approach are acknowledged, because the more complex an issue, the more likely it is to transcend the subsystem boundary. However, the focus on one subsystem provides adequate tools for addressing the connection between a number of key issues within a certain jurisdiction or policy field, while deepening the analysis. Although most previous studies have captured two or three coalitions, the literature reviews show that the ACF allows us to consider more coalitions, taking into account the complexity of policymaking in particular regions (Ma et al., 2020). Here, the subsystem evolved from two coalitions in the 1990s to five coalitions in the 2010s.

Figure 2 outlines the analytical framework adopting the ACF drivers of policy change to explain policy (dis)integration. As understood here, policy integration requires some degree of belief adjustments, agreement on policy goals and instruments, a decision-making body capable of bringing about change, and consistency among the selected mix of policy instruments (Candel & Biesbroek, 2016; Cejudo & Michel, 2017; Howlett, 2019; Milhorance et al., 2020).

The theory underlying policy-oriented learning in the ACF emphasizes the following four categories of factors: i) analytical tractability of the problem; ii) level of conflict, which can be assessed considering the types of beliefs that are in dispute (e.g., deep core, policy core, or secondary beliefs); iii) attributes of actors and coalitions (e.g., availability of resources, brokerage strategies, density of network contacts); and iv) institutional arrangements of the forums where coalitions interact (e.g., openness, routines, operational rules). This study utilized these factors to address policy integration of a highly uncertain issue, such as the local-level impacts of climate change. The intensity of conflict was assessed by identifying the types of beliefs that diverge and by measuring the density of similarity in beliefs among coalitions. Moreover, power relations were analyzed using statements from interviews and by conducting a social network analysis of the distribution of resources (e.g., political/legitimacy, technical and financial resources, institutional authority, information, and mobilization capacity). Finally, the potential for establishing professional venues for coordination and integration was addressed.

- At *high levels of conflict*, when coalitions' core beliefs are in dispute, there is little cross-coalition learning because actors defend their positions and reject information that confronts their belief systems (Jenkins-Smith et al., 2018). Hence, policy integration is also unlikely, as political conflicts normally lead to fragmentation in policymaking and implementation (Milhorance & Bursztyn, 2019). In this context, policy change is more often related to shocks that are internal and external to the subsystem. External perturbations, followed by a change in decision-making bodies or crises/disasters that attract public opinion regarding the need for integration, are possible factors of integration. Negotiated agreement is an additional path to change; however, this is expected in the presence of a "hurting stalemate" —when opponents do not have other venues to influence decision-making and they perceive that the status quo is unacceptable.
- Policy-oriented learning is more likely to occur at *intermediate levels of conflict*, in which opposing coalitions are threatened enough to attend to the given issue but they remain receptive to new information (Jenkins-Smith et al. 2018). The factors of learning include the presence of an adequately prestigious forum to ensure participation, the analytical trac-

LEVEL OF CONFLICT
BETWEEN COALITIONS

PATHS AND DRIVERS OF
POLICY CHANGE

POLICY CHANGE /
INTEGRATION

HIGH

Divergence on policy
core beliefs (dispute
over policy priority)
(Case 1)

NO INTEGRATION =
NO POLICY CHANGE

Low cross-coalition coordination
and learning; stability of coalitions
positions (e.g. persistence of
conflict, rejection of information, no
change in beliefs)

**EVENTS INTERNAL AND EXTERNAL
TO THE SUBSYSTEM**

Factors (examples):

- Disasters attracting attention to new cross-
  sectoral issues (e.g., climate disasters);
- Shift in governing coalitions providing power to
  sectors/issues previously undermined;
- Failure of existing policies in dealing with
  complex or persistent policy problems.

HIGH-LEVEL INTEGRATION =
MAJOR POLICY CHANGE

Core beliefs adjustment/ learning;
common policy goals; decision-making
body able to modify instruments;
coordinated and consistent mix of
instruments

INTERMEDIATE

Divergence on policy
core/ secondary beliefs
or between key
secondary beliefs
(Case 2)

NEGOTIATED AGREEMENT

Factors (examples):

- Lack of alternative venues for dealing with
  unacceptable status quo (e.g., water crisis);
- Collaborative institutions conducive to
  coordination (e.g., organizational instruments
  such as overarching plans, common policy
  frameworks, boundary-spanning structures);
- Hierarchically higher, funding institutions or
  mediators fostering agreement.

MEDIUM-LEVEL INTEGRATION =
MINOR POLICY CHANGE

Secondary beliefs adjustment/ learning;
agreed policy goals; decision-making
body able to redefine design, modify
operation, relocate responsibilities and
resources; loosely coordinated mix of
instruments

LEARNING ACROSS COALITIONS

Factors (examples):

- Learning through bargaining in a prestigious
  forum where coalitions interact and negotiate;
- Presence of policy brokers mitigating the level of
  conflict and facilitating learning;
- New information altering the views of policy
  brokers, increasing the tractability of an issue, or
  reframing a policy issue as complex;

LOW

Divergence on
secondary beliefs
(Case 3)

NO INTEGRATION

No-recognition of the cross-cutting
nature of a policy problem or
separate handling of cross-cutting
policy issues (e.g. new issues, new
coalitions in the subsystem, nested
but different subsystems)

LEGEND

- - - - → Likely paths

──→ Outputs

Fig. 2 Analytical framework using the advocacy coalition framework to explain policy integration. Source: Authors, based on Candel and Biesbroek (2016), Howlett (2019), Henry (2011), Jenkins-Smith et al. (2014)

tability of a policy issue, and the role of brokers. These factors help the opponents reach agreement and facilitate learning, and may also work as factors of policy integration.

- Finally, at *low levels of conflict,* there is little cross-coalition learning because coalition actors attend to other subsystem affairs (Jenkins-Smith et al. 2018). Drawing on the policy integration literature (Candel & Biesbroek, 2016), we argue that policy (dis) integration, in this case, is more a factor of low coordination and separate handling of cross-cutting policy problems than of dispute over coalitions' beliefs. Furthermore, in contrast with most ACF studies, we shed light on two additional elements of learning and change, namely, the *organizational instruments* and process of *reframing* a policy issue as complex. These elements can foster coordination between coalitions and cross-sectoral governance.

The policy frame is about whether a complex problem is recognized as such and, if so, to what extent it is thought to require a cross-sectoral governance approach. For instance, Brazil's Northeast region's vulnerability to drought has been reframed with new scientific knowledge as a climate change issue involving water, rural, and environmental policy (Lindoso et al., 2018; Marengo et al., 2019). By analyzing the reframing process, this study recognizes the limitations of the ACF learning model and distinguishes between the types of learning. The instrumental use of knowledge created around an issue with high uncertainty and low analytical tractability fosters *epistemic learning*, which is key to reinterpreting and reframing a policy issue. This can be observed at low levels of conflict, and contrasts with *learning through bargaining*, which is more commonly observed in the cross-coalition learning that occurs at intermediate levels of conflict (Dunlop & Radaelli, 2013, 2018).

Therefore, knowledge can be used to reframe policy problems—originally handled as separate—into one cross-cutting issue. However, knowledge generation in itself is not sufficient to build capacity to meet increasingly complex challenges; policy and institutional change are needed to achieve this (Huntjens et al., 2011). Similarly, policy learning also takes place through the coordination of the policy implementation process, as information on policy outcomes is produced and exchanged to improve implementation performance (Bouleau, 2017). In this context, coordination in professional venues can lead to policy integration by combining the factors of learning and negotiation to adjust not only goals but also techniques of policy. These include organizational instruments such as overarching plans, common policy frameworks, boundary-spanning structures, collaborative institutions, cross-sectoral information, and conducive funding (Baulenas & Sotirov, 2020; Biesbroek & Candel, 2019).

Case study and data collection

The subsystem analyzed here is geographically bound by the Mid-São Francisco River Basin, located in Brazil's Northeast region (Fig. 1). It is shaped by conflicts over water use and supply in the context of social vulnerability and increasing droughts.

Drawing on our literature review, the historical background of the coalitions' emergence and dynamics between the 1950s and 2000s is presented in the next section. Then, to identify the coalitions currently interacting in the subsystem, the study followed a two-step strategy. First, a broad list of potential coalition members was pre-identified using documentary evidence of a combination of their positional, decisional, and reputational roles (Ingold & Varone, 2012). Subsequently, semi-structured interviews were conducted with public, private, and civil society actors at all levels ($N = 88$, November 2018–March 2019). These interviews consulted all relevant institutions involved in the subsystem, using snowball sampling. These interviewees provided information on their professional background, policy core and secondary beliefs, instrument preferences, and opinions regarding the opportunities and challenges in implementing several key policies. They were also asked about the organizations considered relevant in the policy domain and the main inter-organizational interactions and conflicts perceived. Second, based on the list of organizations obtained, an online survey was developed and sent to the same group of interviewees as well as additional participants, to collect additional data on the types of inter-organizational ties ($N = 106$, March–April 2019).[1]

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[1] From a full roster list, the respondents were asked to indicate the ties as follows: (i) three organizations considered especially influential in the policy domain, (ii) organizations that supported (technically or financially) the actions under their supervision, (iii) organizations that co-implemented or monitored

Policy networks have become commonplace in political science literature, underlying the ideas of iron triangles, policy communities, epistemic communities, transnational networks, advocacy coalitions, and so on. In the ACF, network analysis has been consistently used to analyze the network structures of coalitions, their contacts, belief homophily, and brokerage roles (Henry, 2011; Henry et al. 2011; Ingold, 2011; Weible, 2005). Most of these studies adopt a "power dependence" approach, explaining the interplay among actors and policy outcomes as structured based on the deployment of resources, whether constitutional-legal, organizational, financial, political, reputational, or informational. Drawing on these studies, we use network analysis to assess (i) similarity in beliefs that shape coalitions, (ii) patterns of intra- and cross-coalitions coordination, and (iii) position of certain actors as policy brokers.

Based on the results of the survey and interviews, the collective actors were positioned according to eight major issues regarding development priorities and water use and supply in the region, which corresponds to their policy core and secondary beliefs.[2] This provided a belief similarity matrix in which clustering tests (*modularity optimization index*) were applied (Blondel et al., 2008). The test identified five subgroups representing coalitions, which were then analyzed to identify the internal and cross-group density of interactions. A positive density represents the dominance of cooperative interactions, which is useful for defining coalitions as well as similarities in beliefs (Ingold & Varone, 2012).

Additional analyses were conducted to identify policy brokers and coalition resources. Centrality informs the structural importance of a node, or a group of nodes, in a network. Several measures are used to assess different aspects of centrality, such as the connectedness of independent groups or the accumulation of ties in the network (Borgatti et al., 2013). Drawing on policy-network studies, *in-degree centrality* was used to indicate the prominence of a coalition member in the whole network, while *betweenness centrality* was used to indicate the brokerage of control over network connections across other actors (Di Gregorio et al., 2019). Policy brokers are located between conflicting coalitions; this requirement is similar to the concept of betweenness centrality (Ingold, 2011). Finally, group centrality measures were used to assess coalition power, particularly *in-degree group centrality* and *average brokerage* (Everett & Borgatti, 1999; Gould & Fernandez, 1989).

Historical paradigms of water use and supply

With a population of 22 million people, Brazil's semiarid region is one of the most populated dryland areas globally. Almost 40% live in rural areas and depend mainly on rainfed agriculture (Martins et al., 2017). Since most of the region's rivers are intermittent or

temporary, the São Francisco River is vital. Two key controversies have historically shaped water regulation strategies in the region since the 1950s, i) the approach to water supply (e.g., centralized vs. decentralized), and ii) water use priority (e.g., conservation, hydropower, and agriculture). These priorities, along with the understanding of drought—either as an exclusively natural phenomenon or a social, political, and natural issue—have historically framed coalition belief systems.

The "fighting drought" development strategy

Between the 1950s and 1970s, Brazil's central government promoted integrated macroregional development plans that endorsed investments in water supply infrastructures. This strategy reinforced a historical paradigm known as *fighting drought,* which relied on the assumption that drought was a climatic problem that could be overcome by establishing large-scale water reservoirs and agribusiness-oriented irrigation projects fed by hydroelectric plants (Bursztyn, 2008). The irrigation projects were initially promoted through public–private partnerships, combined tax-exempt agribusiness companies, medium farmers organized in public irrigated plots, and private plots that encouraged agribusiness development among these farmers. Institutions such as the Development Company of São Francisco and Parnaíba Valleys (Codevasf) and Northeast Development Superintendence (Sudene) spearheaded these strategies. This integrated planning process primarily aimed to achieve job creation, reduction of regional inequalities, and structural economic growth. Note that this paradigm is not exclusive to Brazil, as practices in water governance worldwide have traditionally been characterized by a technocratic logic and they have been supportive of large-scale technology, infrastructure, and engineering practices of optimal design (Pahl-Wostl, 2009).

These strategies have been criticized for not considering the real causes of vulnerability to drought, such as unsustainable production systems and limited access to land. They produced major environmental impacts and contributed to the maintenance of social inequalities. The tendency to concentrate water resources in large-scale reservoirs, often built on private land, and reliance on clientelist local politics (benefiting local elites through federal transfers, tax exemptions, and debt negotiations) reinforced the power asymmetries and water use conflicts reproduced to date (Bursztyn, 2008; Lindoso et al., 2018; Milhorance et al., 2019). Moreover, this paradigm was consolidated during the military dictatorship characterizing Brazil's political system from the 1960s to 1980s. Policy design and implementation have been marked by the logic of resources and political centralization, hindering rural access to water (Nogueira, 2017).

Elements for change

In the late 1980s, along with the democratization period in Brazil, a network of territorially based civil society organizations began questioning the conventional governance of droughts. Moreover, an extreme drought event during 1992–1993 caused high rates of death and population migration because of crop rupture, food insecurity, and water-related diseases (Diniz & Piraux, 2011). Since this shock, public opinion has progressively recognized the limited results of drought management policies in improving the living conditions of rural populations. This episode spurred previously unrecognized actors to build development alternatives for the semiarid region and pressure public authorities (Cardoso,
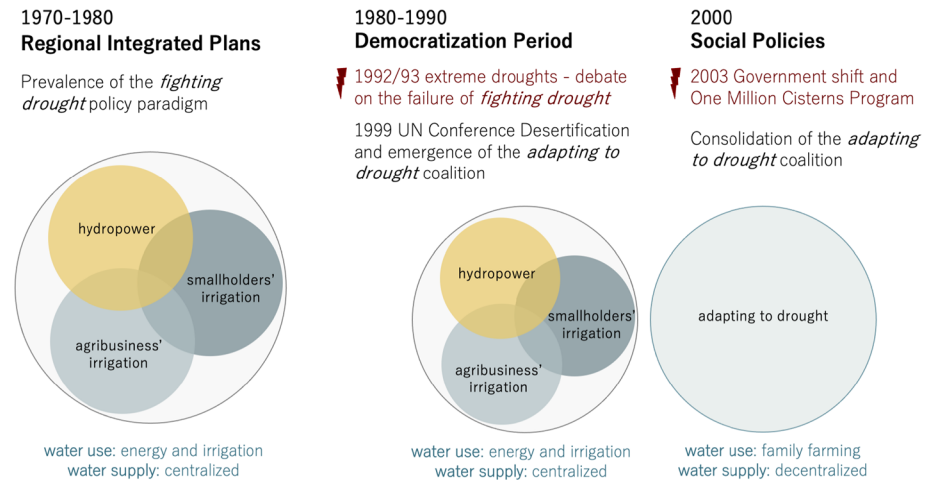
2007). A set of permanent actions became the object of dialog between the democratically elected government and an emergent coalition comprising civil society organizations. However, these were emergency rather than structural measures, and funding for water infrastructure favored large and medium landowners (Bursztyn, 2008). Parallelly, the 1992 United Nations Conference on Environment and Development in Brazil set guidelines for the sustainable use of natural resources and provided legitimacy resources to the emergent coalition and other groups concerned with the environmental impacts of large-scale infrastructures.

In 1999, the Third United Nations Conference of Parties to Combat Desertification and Mitigation of the Effects of Drought (COP 3) was held in Brazil's Northeast region, welcoming numerous representatives of rural workers' unions, social movements, religious entities, and NGOs. It was organized around the Articulation in the Semiarid (*Articulação do Semiárido*–ASA). Owing to the increasing empowerment of civil society actors and the sustainable development agenda, alongside a growing opposition to past drought management policies, these actors formulated the *Declaration for the Semiarid Region*. The text was based on the idea that it was possible to live and produce in the drylands by maintaining environmental resilience and stocking resources to use during scarcity periods. These ideas shaped what became known as the "coexistence with the semiarid landscape" paradigm (*Convivência com o Semiárido*), the main premise of which was to increase water access based on an autonomous and decentralized approach. It questioned the narrative of drought as a climatic problem against which policy should fight, and offered solutions to cope with scarcity and adapt to climate variability (Lindoso et al., 2018; Pérez-Marin et al., 2017). Hereafter, this is referred to as the *adapting to drought* paradigm.

Consolidation of the "adapting to drought" coalition

While the democratization process and recognition of the failure of drought management policies in the 1990s led to the emergence of a coalition advocating for the *adapting to drought* paradigm, it was consolidated in the 2000s, underpinned by another major political event. In 2003, the presidential shift toward a left-wing government set the basis for the establishment of a mix of social and productive policy instruments prioritizing water access in rural areas. The solutions proposed under the *adapting to drought* paradigm, especially the rainwater catchment and storage cisterns, were institutionalized as a national policy, namely the "One Million Cisterns Program." Political and financial resources were distributed to this coalition, as their members became official partners of the federal government in the implementation of the policy at the field level. The paradigm became the main development agenda for the region (Piraux & Bonnal, 2011).

Alongside the decline of the authority of the traditional *fighting drought* paradigm, the accumulated failures in dealing with vulnerability to drought contributed to the appearance and consolidation of new actors who were engaged in the dispute over the institutionalization of new ideas. This paradigm was seldom challenged because of the authoritarian regime. It attracted strong political contestation in the 1990s, but the level of conflict decreased in the 2000s, when the federal government institutionalized several elements of the *adapting to drought* paradigm. The "One Million Cisterns Program" allocated considerable public funds from the Ministry of Social Development to ASA members who were responsible for its local-level implementation. This decision reinforced the government–civil society and cross-sectoral partnerships (Lindoso et al., 2018).

1970-1980
Regional Integrated Plans

Prevalence of the *fighting drought* policy paradigm

1980-1990
Democratization Period

1992/93 extreme droughts - debate on the failure of *fighting drought*

1999 UN Conference Desertification and emergence of the *adapting to drought* coalition

2000
Social Policies

2003 Government shift and One Million Cisterns Program

Consolidation of the *adapting to drought* coalition

hydropower
smallholders' irrigation
agribusiness' irrigation

water use: energy and irrigation
water supply: centralized

hydropower
smallholders' irrigation
agribusiness' irrigation

water use: energy and irrigation
water supply: centralized

adapting to drought

water use: family farming
water supply: decentralized

Fig. 3 Evolution of paradigms and coalitions for water use and supply (1970s–2000s). Source: Authors

The budget allocated in the 2000s scaled up the implementation of the policy instruments promoted by this coalition. The literature confirms that *fighting drought,* as a developmental strategy, has been in crisis, and it is currently difficult to find policies aimed at the semiarid region development that does not point, at least discursively, to the notion of *adapting to drought* (Diniz & Piraux, 2011). Figure 3 illustrates this history, including the emergence of the *adapting to drought* coalition and its position regarding the two policy controversies mentioned earlier.

Emergence of climate change concerns and ingredients of policy (dis)integration

By recognizing policy integration as a process of policy change, driven predominantly by learning and negotiation, the presence of policy brokers and venues for negotiation, besides the establishment of coordination instruments such as boundary-spanning policy frameworks and decision-making structures, emerge as potential factors to increase integration. Policy integration studies highlight the relevance of the density of interactions across sector-based policy actors. Policy-oriented learning is not only a matter of framing policy goals and relative priorities but also a matter of *learning to work togethe*r in policy design and implementation (Candel & Biesbroek, 2016; Swartling et al. 2007). Conversely, high levels of intra- and cross-sectoral conflicts are key in preventing changes, learning, and integration. Finally, a change pathway that is less developed in the ACF is the reframing of a policy problem into a cross-sectoral and complex issue on the basis of the instrumental use of new knowledge.

In the late 2000s, several events led to a change in the subsystem as a whole, which rendered it more complex by reflecting on the rearrangement of coalitions and their interactions. These included a shift in the institutional framework of the water policy for the Northeast region with the creation of the "Water for All Program" in 2011. Following this, a crisis triggered by an extreme drought event was observed from 2012 to 2017. Consequently, several shifts could be observed in the late 2010s. Drawing on the literature, field observations, and analyses described in the methods section, the following five coalitions were identified and named according to their main policy preference for water use and

|	Leading members	Policy orientation	Water use priority	Water supply approach	Policy instruments preferences
Adapting to drought (C1)	**Public:** Embrapa Semiarido, Ministry of Social Development, Federal and state rural development agencies; **Private:** Rural workers' unions; **Civil society:** ASA NGOs (IRPAA, Chapada, Sasop); **International:** IFAD	Socio-environmental promotion	Development of rainfed family farming	Decentralized plate rainwater cisterns	Social protection + production support (credit, land tenure, local public markets) + social mobilization + agroecology + decentralized water access (plate rainwater cisterns)
Smallholders' irrigation (C2)	**Public:** Ministry of Integration, Regional development agencies (Codevasf, Sudene, Bank of Northeast), Land tenure agencies.	Socio-economic development	Development of rainfed and irrigated family farming	Mix centralized and decentralized plastic rainwater cisterns	Social protection + production support (credit, land tenure, local and international markets) + productivst agriculture + both irrigation and decentralized water access (plastic rainwater cisterns)
Agribusiness-oriented irrigation (C3)	**Public:** Ministry of Agriculture, Bank of Brazil; **Private:** Small Companies Support Service, Agribusiness unions and technical bodies (CNA, Senar)	Economic development	Development of agribusiness-oriented irrigation	Centralized public-private irrigation plots	Agricultural credit and technology development to foster irrigation + productivist agriculture + international markets + no consideration of water crisis and climate change
Hydropower production (C4)	**Public:** National Development Bank; **Private:** Energy production companies (CHESF)	Economic development	Hydropower production - flow regulation by hydropower dams	Centralized infrastructures	Public incentives for energy production + water crisis management tools + increasing consideration of climate change
Water conservation (C5)	**Public:** Ministry of Environment, National Water Agency, subnational environmental agencies, Climate research institutes; **Civil society:** environmental NGOs; **International:** GIZ	Environmental protection	Water conservation and use regulation	Decentralized infrastructures	Regulatory instruments for water conservation + priority for climate change mitigation and adaptation strategies

Fig. 4 Summary of members, policy core and secondary beliefs, and instrument preferences of each coalition. Source: Authors, based on survey and interviews' results

supply: i) *adapting to drought* (C1), ii) *smallholder irrigation* (C2), iii) *agribusiness-oriented irrigation* (C3), iv) *hydropower production* (C4), and v) *water conservation* (C5).

Figure 4 illustrates their key members, the main points of their beliefs, and the topology of instrument preferences. Note that formal organizations, rather than individuals, were defined as members of these coalitions. From a structural point of view, the *adapting to drought* coalition (C1) lost some of its operational role in the 2010s (but it remained central to the subsystem), the *fighting drought* coalition split into three smaller coalitions (C2, C3, and C4), and a new environmental coalition took part in the subsystem (C5).

The results discussed here draw not only on the factors of the change mentioned above (e.g., external events, presence of brokers, and venues for coordination and negotiation) but also on *densities by groups* of beliefs' and coalitions' interactions (Fig. 5). It is worth mentioning that the density of core and secondary beliefs of each coalition accounted for a minimum of 0.5 and 0.25 of the density of interactions, respectively.[3] To explain these

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[3] A density higher than 0.5 is considered strong convergence and higher than 0.25 medium convergence. The maximal density, where every actor is tied to every other actor, is 1. A valued network is the total of all values divided by the number of possible ties (Borgatti et al., 2002). Although these two networks (beliefs' and coalitions' ties) display the same number of nodes, their densities are comparable not in absolute terms but in proportionately. The networks analyzed here were valued and actors were asked to indicate up to three other actors in each type of relationship, accounting for a maximum of 15 ties for an actor. This considerably reduces the total number of possible ties, reducing maximum network density in comparison with that of the belief matrix.
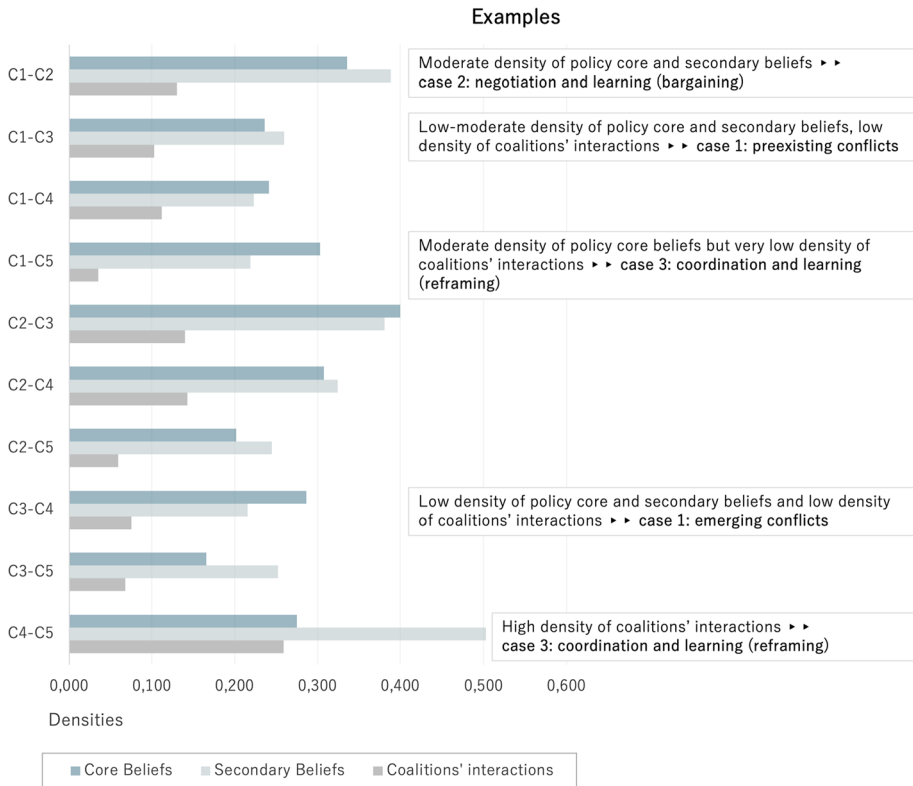
Fig. 5 Cross-coalition density of core and secondary beliefs and coalition interactions (density by group). Source: Authors, based on survey results obtained from analyses conducted using Ucinet

factors and their outputs in terms of change and the degree of policy integration, this section analyzes some of the coalitions' dynamics illustrated through three patterns, i) obstacles to policy change and integration at divergence between policy core beliefs (Case 1), ii) opportunity for policy integration and learning on secondary beliefs and implementation options (Case 2), and iii) the prospects for reframing single policies into cross-sectoral policy issues (Case 3).

Case 1: Divergence of core beliefs and policy fragmentation

Coalition disputes can be translated into conflicting policy approaches and inconsistent goals that prevent integration. This is the basis of well-known cross-sectoral conflicts over the use of natural resources, but they can also be found in a particular policy sector (Milhorance & Bursztyn, 2019). For instance, the provision of financial support to both agroecological practices and agrochemical inputs, as well as to environmentally harmful agricultural practices for the same target group in the same region characterizes the layering of opposing measures. Drawing on the ACF, strong historical cleavages are harder to change as the level of conflict prevents learning and negotiation and often requires major external events or a "hurting stalemate." Consequently, fragmentation in policymaking and implementation resulting from this conflict pattern is often enduring.

Old conflicts in the rural sector Significant politico-economic divergences exist between C1 and C3, as the former promotes rainfed family farming development based on the *adapting to drought* paradigm, while the latter promotes agribusiness-oriented large-scale irrigation based on the *fighting drought* paradigm. This reflects historical cleavages in Brazil's rural sector, which have been institutionalized inside the state with the consolidation of two agricultural ministries with distinct development approaches and with the implementation of opposing policy instruments (Sabourin, 2007).

Note that C3 has become increasingly involved in the support of rainfed family farming, distancing itself from its entrenched position. However, the final goals of C3 relate to the economic feasibility of agricultural projects and are inattentive to the environmental impacts of irrigation projects. Moreover, technology development, as advocated by this coalition, does not refer to locally contextualized or horizontal knowledge dissemination, as in C1 (Fig. 4). Finally, the agricultural credit system sustained by the Ministry of Agriculture and Bank of Brazil is a central policy instrument for C3, which competes for public funds with other rural-sector coalitions. Here, the density of beliefs and cross-coalition interactions between C1 and C3 are low as compared to that of C1 and other rural sector-related coalitions (C2; Fig. 5). This led to the design of distinct policy instruments for water supply and water use in the agricultural sector, although these three coalitions are involved in fostering water access and rural development in the region.

Water dispute in a changing climate While drought events are recurrent in the Northeast region, a major drought occurred between 2012 and 2017. The scientific community linked this event with the impacts of climate change. Future climate projections for the area show large temperature increases and rainfall reductions, which, along with a tendency for longer periods of consecutive dry days, suggest the occurrence of droughts of greater intensity (Marengo et al., 2017, 2019). Besides the possibility of reframing the historical vulnerability to drought as a climate change issue, this event created new conflicts over water use at the territorial level. Hydropower production has been compromised during drought years, as the main regional reservoir reached less than 20% of the total volume capacity (Milhorance et al., 2019).

Therefore, C3 and C4 began disputing the instruments for water regulation, as both compete to use the water resources of the São Francisco River. The decreasing flow and regulation to prioritize energy production impacted the water allocation for irrigation (CBHSF, 2015). The interviewed irrigation-sector representatives emphasized their advocacy efforts to incite federal-level changes in the water regulation policy: "*we promote a debate with the National Water and Environmental Agencies regarding the river's regulation flow which impacts not only irrigation, but also most of the cities down the river*." Reports of the São Francisco River Basin Committee and interviews with its members clearly showed this increasing conflict between energy production and irrigation actors (CBHSF, 2015). Given that the dispute reflects core policy issues and the priority for water use and supply in the basin, the conflict evidenced by an event external to the subsystem resulted in the fragmentation of the coalition to combat drought.

Case 2: Divergence of secondary beliefs and policy integration through cross-coalition learning

Conflict over the options to foster water access As stated earlier, the establishment of the "Water for All Program" in 2011 produced a significant change in the design and imple-

mentation of the strategies of the "One Million Cisterns Program" (Nogueira et al., 2020). Aimed at promoting the universalization of access to water, this new policy framework changed the type of infrastructure for water supply privileged by the government, along with political actors involved in the program's implementation, creating new conflicts between C1 and C2. Specifically, the divergences highlight the disagreement over policy design and the mandate for the implementation of water supply strategies. Both promote decentralized water infrastructure combined with social protection and farming support. Nevertheless, a key point relates to the C2's preference for disseminating plastic-made rainwater cisterns—rather than the plate-made ones advocated by C1. The distinction seems unimportant; however, it underpins the divergences in conception and politics that emerged with the launch of the "Water for All".

Regarding philosophy, the installation of plate cisterns required training rural families in self-construction and maintenance, soil conservation, and community organization. The ASA and other C1 members believed that this instrument reinforced agroecological practices and participatory governance. In contrast, foreign companies manufactured plastic cisterns, and their installation excluded the training component and the potential to develop the local economy (Nogueira et al., 2020). The importance of the training process for promoting agroecological practices was highlighted by C1 members:

> *In order to promote agroecology in the heart of the irrigation polygon, marked by high pesticide use, we combined agroecology technical support with the productive training provided by the cistern's program. The program was a gateway"* (Petrolina, September 2018).

Politically, after the government's decision to privilege plastic cisterns in 2011, the ASA lost its monopoly in implementing water policy in the region. In contrast, the federal government mandated scaling-up water infrastructure dissemination to the Ministry of National Integration, Codevasf, and municipalities. Consequently, C1 and C2 became competitors for public funds and for the leading role in implementation (Andrade & Cordeiro, 2016). As summarized by a C1 civil society representative,

> *The replacement of the plate cisterns by plastic ones, supported by the Ministry of Integration, left the program to private companies and politicians. The plate cisterns were combined with community engagement. Plastic cisterns cost five to six thousand reais and the companies get one thousand reais. In the first case, more than 10,000 bricklayers were trained, and cement was bought in the municipalities. In the second case, they were installed by municipal administration and used for election purposes by mayors* (Petrolina, September 2018).

Venues for negotiation, policy brokers, and learning Strong pressure emerged instantly from civil society groups supporting C1, and the federal government's alliance with C1 led to the establishment of a new policy framework in 2013 by the Ministry of Social Development—the Cistern Program—by combining the preferences of each coalition. Although initially, it reflected an institutional bricolage and layering of several strategies rather than a policy change, it then created a new space for cooperation and learning through bargaining between these coalitions (Nogueira et al., 2020). It is worth mentioning that, historically, C2 members, such as Codevasf, were involved in promoting irrigation and in establishing large-scale water infrastructures in line with the *fighting drought* paradigm, whose implementation approach was characterized by a low level of social participation and technocratic logic, in contrast with C1's advocated approach. This difference indicates that, despite the

relatively moderate density of beliefs of C1–C2 today (Fig. 5), they continue to configure two separate coalitions with intermediate levels of conflict.

Nevertheless, besides the establishment of a common venue for negotiation and coordination in the "Cisterns Program," the members of both C1 and C2 have acted as policy brokers who helped mitigate the conflict at the territorial level. Brokers often advocate moderate policy preferences and connect opposing coalitions in the network (Ingold, 2011; Jenkins-Smith et al. 2018). They foster cross-coalitions and cross-subsystem linkages, which are key to policy integration (Faling & Biesbroek, 2019). The higher the *between-ness centrality* of an actor, the greater is the capacity of that organization to act as a policy broker (Ingold & Varone, 2012). Drawing on this assumption and on interviews, the Brazilian Agricultural Research Corporation (Embrapa Semiarido) was identified as a key policy broker. The organization showed the highest values for several centrality measures (e.g., beta-centrality in the whole network, beta-centrality in the influence network, betweenness centrality, and brokerage score).

Embrapa Semiarido is a central actor in terms of knowledge production and diffusion, and the beliefs its members share are diverse, ranging from productivist views of agriculture and irrigation to supporting decentralized water access and agroecological practices. At the regional level, its relevance was first recognized in irrigation development, but during the 2000s, it collected funds and technical recognition to intensify its support for the *adapting to drought* paradigm. Thus, the actor is capable of circulating across coalitions and interacting with distinct and sometimes divergent actors. This organization also hosts key events and spaces for information exchange and dialog between coalitions at the territorial level (e.g., Semiarido Show).

Case 3: Coordination gap and potential to reframe cross-sectoral policy issues

The ACF argues that cross-coalition learning is unlikely at low levels of conflict. For policy integration, this can imply the separate handling of cross-cutting policy problems since the respective coalitions do not engage in negotiation and coordination. This result can also translate into emerging conflicts that have historically been handled separately. However, we argue that the processes of *reframing* a policy issue as complex and establishing *organizational instruments* are possible elements of policy-oriented learning and of inauguration of cross-sectoral governance. The use of knowledge on an issue with low analytical tractability, such as the impact of climate change at the local level, is key to *epistemic learning* and to the process of reframing. Followed by instruments conducive to the design and implementation of cross-sectoral issues, this can foster policy integration.

Improving water regulation under increasing climate variability The water flow of the Mid-São Francisco River is regulated by the São Francisco Hydroelectric Company (CHESF) (C4 member) and it is endorsed by the National Water Agency. The latter is a C5 member that was not involved in the subsystem until the 2010s. However, the water crisis created by the 2012–2017 drought encouraged the coordination between C4 and C5 in a *crisis room*, mediated by the National Water Agency, to improve and integrate water regulation instruments. Although the beliefs of these coalitions currently differ, the establishment of this coordination space has increasingly stimulated negotiations and learning. As described by CHESF representatives,

> *At the beginning of the crisis, [the organizations in the basin committee] thought CHESF was regulating water for their own benefit and that we were responsible for the problems of water supply, salinization, and so on. Then, the crisis worsened and the perception [of the intensity of the drought] began to be understood thanks to the crisis room … Previously, the CHESF had to request authorization for the flow regulation, and today the decision comes directly from the Water Agency. (Recife, May 2019).*

Moreover, according to interviews, the water crisis and protest against water regulation has led to an unprecedented change in the company's propensity to further invest in wind and solar power production to the detriment of hydropower. Future developments could lead to higher integration with climate policies. For instance, although hydropower has been promoted as a source of low-carbon energy production and climate mitigation globally, it has hindered climate adaptation in the Mid-São Francisco region owing to the socio-ecological impacts of water flow regulation and flooding of farmlands by dams (Milhorance et al., 2019). Aligning these strategies to disseminate decentralized wind and solar energy infrastructures—independent of water use—would potentially foster climate adaptation consistently with water policies (Bursztyn, 2020).

Combining strategies for "climate adaptation" and "adapting to drought" Although the policy instruments promoted by C1 reduced the vulnerability of rural populations to droughts by fostering stocks and conservation of natural resources, decentralized governance, and food security (Lindoso et al., 2018; Mattos, 2017; Nogueira, 2017; Pérez-Marin et al., 2017), the scientific community has recently linked the increasing climate variability and droughts with the impacts of global climate change (Marengo et al., 2017, 2019). Consequently, strategies that consider not only the regional history of droughts but also the climate projections and prospective impacts of global warming on the region are increasingly recommended (Lindoso et al., 2018; Marengo et al., 2017; Milhorance et al., 2020).

This would imply the alignment of water and climate policies that are designed and implemented by C1 and C5, respectively. However, at present, these issues are handled separately. First, although climate adaptation is expected to be undertaken at the local level (Rauken et al., 2015), the present survey showed a very low level of climate concern by subnational actors. Importantly, C1 beliefs are commonly compared to the objectives of climate adaptation (Lindoso et al., 2018), despite the fact that its members, especially at the local level, rarely referred to climate change or adaptation strategies in their narratives in this study. Second, coordination between C1 and C5 was quite low—the lowest in the network—even below the C1–C5 density of beliefs (Fig. 5). Note, however, that C5 members, such as the Ministry of Environment and the state-level environmental bodies, are responsible for designing national and subnational climate plans. Unlike the abovementioned case, in which policy fragmentation patterns reflect historical cleavages and political conflicts, here it can be associated with a coordination deficit and the framing of water and climate policies as separate challenges.

Indeed, C5 comprises environmental agencies that mostly exhibit a weak local-level presence. The interviews conducted in this study showed that, although some of the municipalities in the Mid-São Francisco region were much more populated and richer than other municipalities of the semiarid region, the municipal environmental agency was weak in relation to human resources and budgetary aspects. Their main activities concern sparse initiatives of environmental education in schools and monitoring of environmental impacts. They are not involved in climate adaptation or in initiatives related to agricultural

production. Thus, the interaction between local and national-level actors remains low. The reasons for this weak policy and discursive cross-level alignment, and its effects on political outcomes and policy integration, need further clarification. Hence, the relevance and attributes of the venues for collaboration in agenda-setting and in policy design and implementation could be the basis of a promising research agenda.

Conclusion

This study addressed the theoretical gap in policy integration literature. Despite substantial knowledge on the conceptualization of policy integration and its drivers, efforts to establish causality have traditionally been weak and studies have been limited to listing explanatory factors. We demonstrated that the dynamics of competition in the political process must be incorporated into the analysis on the factors that foster or hinder integration in public policies, and that this could be achieved by using the ACF. Likewise, by combining belief density, coordination patterns, and political factors of change, we presented an approach that could be useful in comparing the substance and politics of the integration process.

Empirically, this study described the consolidation of a coalition promoting a paradigmatic change in water use and supply in Brazil's semiarid region in the 2000s. More than a policy strategy, this has become a political project for the sustainable development of the region. In the early 2010s, external events such as government shift and intensification of the water crisis resulted in the reorganization of coalitions in the subsystem. Drought intensification has been increasingly seen through the lens of the local-level impacts of climate change, despite the uncertainty surrounding this subject. In this context, a deeper conceptualization of ACF's policy-oriented learning has been considered to shed light on the process of reframing traditionally sectoral issues into cross-cutting policy problems. This approach differs from the process of learning through bargaining that has been commonly examined by previous ACF studies. Therefore, the case analyzed here provided insights leading to theoretical contributions to the ACF's learning model in cooperative systems.

In this vein, this study examined the ACF's potential to acknowledge the mechanisms for coordinating policy actors and instruments, which would provide the framework and typologies that facilitate the analysis of policy processes of cooperation and integration. This is a promising research agenda. While the early applications of the ACF focused on interactions among policy actors in high conflict situations, recent applications have recognized cooperative subsystems and levels of conflict fluctuating over time. This study painted a picture of different types and degrees of conflict, which can also be assessed through nested subsystems. Further defining the subsystem boundaries for these complex systems could provide a better understanding of the differential cross-coalition interactions (both conflictive and cooperative) around emerging issues like climate adaptation.

This study also discussed coalition boundaries, employing network analysis to provide a matrix of similarities in policy core and secondary beliefs and to analyze the degree of coordination within and across coalitions. It confirmed that network analysis could be a powerful approach for capturing the discrepancy and convergence between the belief systems of various existing coalitions. This effort can be further developed in a new analysis. Further research is needed to capture the relative weight of policy learning (i.e., evolution of belief systems) and changes in the coalition resource balance as critical factors of policy change. Also important is the in-depth analysis of cross-level ties and their consequences

in terms of political outcomes and policy integration. This would include an analysis of power asymmetries between different administration levels.

Finally, further analysis is needed to understand and address cross-sectoral integration and governance. Future research should focus on the questions raised by Trein et al. (2020), for instance, how to assess the degree of policy integration, how to examine whether expressed intentions to integrate policies result in effective policy outputs, and under which conditions integrated strategies contribute to resolving important policy problems.

Declaration

Conflict of interest The authors declare that they have no conflict of interest.

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