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Policy instruments for governing water in cross-border metropolitan areas, the case of Greater Geneva

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ABSTRACT

Governing transboundary waters is inherently a complex policy issue. However, when waters flow through multiple urban spaces (multiple cities in different countries), it presents a unique challenge to access and control. Policy actors employ a variety of policy instruments to govern such spaces and users' water demands. Drawing from the case of Geneva Metropolis (shared between Switzerland and France), we explain how policy instruments are formulated to manage a combination of water sources. We answer two questions: (1) *what type of policy instruments contribute to reaching transboundary water governance in Greater Geneva? and* (2) *What are the underlying drivers that led to the success or failures of implementing policy instruments at the transboundary level?* Based on policy documents and closed-door interviews, we present various policy instruments that have been developed and implemented in the Geneva metropolis. We further argue that the underlying drivers, such as the existence of communities of practice, political willingness, the influence of civil society actors and the evolution of an anticipatory water governance system, have influenced the policy instruments' success and failure. To conclude, this article calls for further research on comparing different cross-border metropolitan areas, focusing on processual aspects (development and implementation) of policy instruments.

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Transboundary water governance; policy instruments; drivers of implementation; Geneva metropole

1. Introduction

'Cross-border metropolis' (Sohn, 2014) experiences a continuous flow of goods and services beyond political borders and metropolitan areas only. Numerous sectors intertwine with transboundary dynamics; for instance, one can think of mobility, housing, labor, culture, and the environment (Herzog & Sohn, 2019). Coordinated transboundary water management is no exception, requiring special attention and presenting various challenges related to the different political and legal frameworks. As demonstrated by literature focusing on urban water governance (Romano & Akhmouch, 2019; Van de Meene et al., 2011; van den Brandeler, 2022; Vlachos & Braga, 2001), effective management is a pre-condition for the functioning and development of urban areas, and it implies simultaneously considering diverse water types (surface water, groundwater, rainwater, etc.), access, and uses.

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Water allocation within different territories is challenging and comprises exceptionally high and growing transaction costs due to the impacts of climate change. From the operational viewpoint, water and related infrastructure management in the cross-border metropolis is particularly complex. It greatly relies on the capacities of public administrations to define common governance frameworks transcending the particularities of existing territories. These polycentric frameworks (sometimes numerous and overlapping) intervene at different institutional levels, compete, and operate following different jurisdictional processes – not necessarily benefitting in the short-term (Tosun & Leopold, 2019).

Therefore, if metropolitan water governance already demonstrates high intricacy (van den Brandeler, 2022), the transboundary nature of a cross-border metropolis requires designing state-of-the-art and innovative policy goals and instruments that can cope with the specificities of such territories, linking different policy approaches. Simply put, for effective management, policy instruments should operate across borders and across different water management systems in a coordinated fashion. From the institutional viewpoint, such processes imply tailor-made policy instruments and specific arrangements (Hassenforder & Barone, 2018) to be able to cope with the requirements of transboundary settings in an iterative mode (Ostrom, 1992).

Policy instruments are the techniques used by governments to implement their policies and solutions for collective problems (Capano & Howlett, 2022). Such instruments have been the subject of research in policy sciences; however, examining them for cross-border metropolis and water governance has yet been less addressed. Apart from authors such as Chiang et al. (2021), Bennett et al. (2021) and Currie et al. (2017), transboundary metropolis literature has remained limited.

In this contribution, we explore the influence of determining variables such as the operation of diverse legal and political frameworks, the multiplicity of actors, the numerous scales of intervention and the influence of different political cultures on water governance. By analysing the water governance configuration through the diversity of policy instruments involved, we aim to showcase current and future challenges for policymakers and practitioners.

Against this background, we aim to answer two questions: (1) *How do policy instruments contribute to reaching the transboundary water agreement in Greater Geneva? and (2) What drivers led to the success or failures of implementing policy instruments at the transboundary level?* To answer these questions, we take inspiration from the transboundary water governance literature and policy instruments literature from the public policy scholarship, contextualizing the framework in metropolitan areas. Specifically, the study takes inspiration from Capano and Howlett's (2022) understanding of policy instruments, as techniques used by governments to implement their policies and solutions for collective problems. This study focuses on Greater Geneva, a metropolitan area of over 1 million inhabitants shared between Switzerland and France. This case is of particular interest because of the density of transboundary instruments that intervene in water management. It illustrates how regional actors can define tailor-made governance systems that fit the specificities of a transboundary context.

The following section presents the conceptual arguments developed in this article. Section 3 presents the methods used for collecting and analyzing policy instruments for the Geneva metropole area. Section 4 presents the key findings, elaborating on policy instruments and the underlying drivers of policy instruments' successful and failed implementation. Lastly, the discussion reflects on the processes of crafting institutions for transboundary urban water governance, followed by concluding remarks.

2. Complex cross-border metropolis water governance and policy instruments

Cross-border water governance has been extensively studied by scholars since the late 1980s and is characterized as a 'wicked problem' (Mirumachi, 2015). Conflict and cooperation outcomes arise during the cross-border decision-making process, as riparian countries (or cities) interact to meet their water-related social, economic, and environmental demands (Alam et al., 2009; Vij et al., 2020). Any unilateral decision by an upstream riparian will affect downstream riparian(s), creating apprehension with varying degrees of tensions and possible conflicts (Zeitoun & Warner, 2006). However, the scholarship is heavily inspired from hydrological sciences, political science, international relations, and upstream-downstream relations, including specific

focuses on conflict-cooperation nuances, political processes, and power relations (Dore et al., 2012; Mirumachi, 2015; Wolf, 1999; Yoffe et al., 2003; Zeitoun & Warner, 2006).

Moreover, fewer contributions focus on specific challenges related to the management of water in 'cross-border metropolis' (Herzog, 1990; Herzog & Sohn, 2019), a concept that focuses on the dynamics of cross-border integration and on how borders are constantly shaped and reshaped by actors' practices and discourses (Anderson, 1977). The necessity to accommodate a shared metropolis is particularly complex. It is considered a (super) wicked problem as it touches upon multiple institutional territories and various policy subsystems (sectors) with multi-governance regimes (Levin et al., 2012; Rittel & Webber, 1973). Further, such transboundary metropolises must accommodate different regulatory frameworks and institutional set-ups for their day-to-day functioning. As a functional space, such transboundary territory can also provide opportunities (Wiering & Verwijmeren, 2012). Therefore, it is imperative to reflect on accommodating distinct governance practices across the policy cycle, from problem definition to designing, implementing, and evaluating implemented policy instruments (Weible et al., 2012). Policy actors design and implement instruments to tackle such wicked problems; however, several connotations and typologies of policy instruments exist.

Between 1950 and 1980, Lowi (1966) and other policy scholars developed several typologies and conceptual arguments on policy instruments, followed by contemporary scholars such as Henstra (2016), Hood (2007), and Lascoumes and Le Galès (2007). Unique in their cases and approaches, the above public policy scholars agreed that policy instruments are essential for designing policies, implementation and improving policy outcomes (Capano & Howlett, 2022). In other words, given the complexity of reality (in this case, transboundary water governance), policy instruments are perceived to be effective tools to achieve policy goals negotiated and set by state and/or non-state actors collectively.

Several authors have attempted to explain and assess policy instruments – in terms of type and category, strengths and weaknesses, success and failures, and how to have these instruments evolve over time. Hood (2007) suggests that policy instruments can be instrumental, political, and institutional. Although policy instruments are perceived as neutral and objective, instruments provide a cost or benefit to certain policy actors. They are constantly shaped by strategic choices made by policymakers (Peters, 2000) and result from arbitration and complex power games between target audiences and final beneficiaries of the public policy.

Contemporary policy instruments work from Henstra (2016) discusses policy instruments for climate change adaptation. The study is inspired by Hood's (1983) framework of policy instruments, classifying instruments into four categories – Nodality, Authority, Treasure and Organization. The classification does not suggest that these categories must be used exclusively; instead, policy actors must consider policy goals and government agencies' capabilities to effectively deploy a set of instruments that contextually fit to achieve a policy goal.

Vedung (1998) characterized policy instruments via maximalist versus minimalist and choice versus resource approaches. The choice approach is inspired by Howlett's (1991) and Anderson's (1977) work on statecraft, explaining broad government choices to resolve policy issues – market mechanisms, structured options, biased and limited options, and regulations. On the contrary, the maximalist approach has a long list of policy instruments used by the government, including grants, taxes, loans, expenditures etc. The minimalist approach follows the combination of sticks (negative sanctions, costs etc.) and carrots (rewards, benefits and tax exemptions). Taking it forward, Vedung (1998), drewing inspiration from Etzioni (1975), created a threefold typology – regulations, economic means, and information. Howlett (1991) also discussed the American, British and Canadian models of policy instruments.

Policy instruments and water policy literature primarily suggest the usage of economic instruments (taxes, tariffs, water quotas), regulatory, institutional, and functional instruments (Campbell et al., 2004; Shortle & Horan, 2013). For the purpose of this study, inspired by the above literature, by water governance and public policy literature and by empirical data, we come up with four categories of policy instruments, namely – operational, investment, planning and observation (see Figure 1). Considering that this study was conducted in close collaboration with the water bureaucrats of the canton of Geneva (Office for Water, Canton of

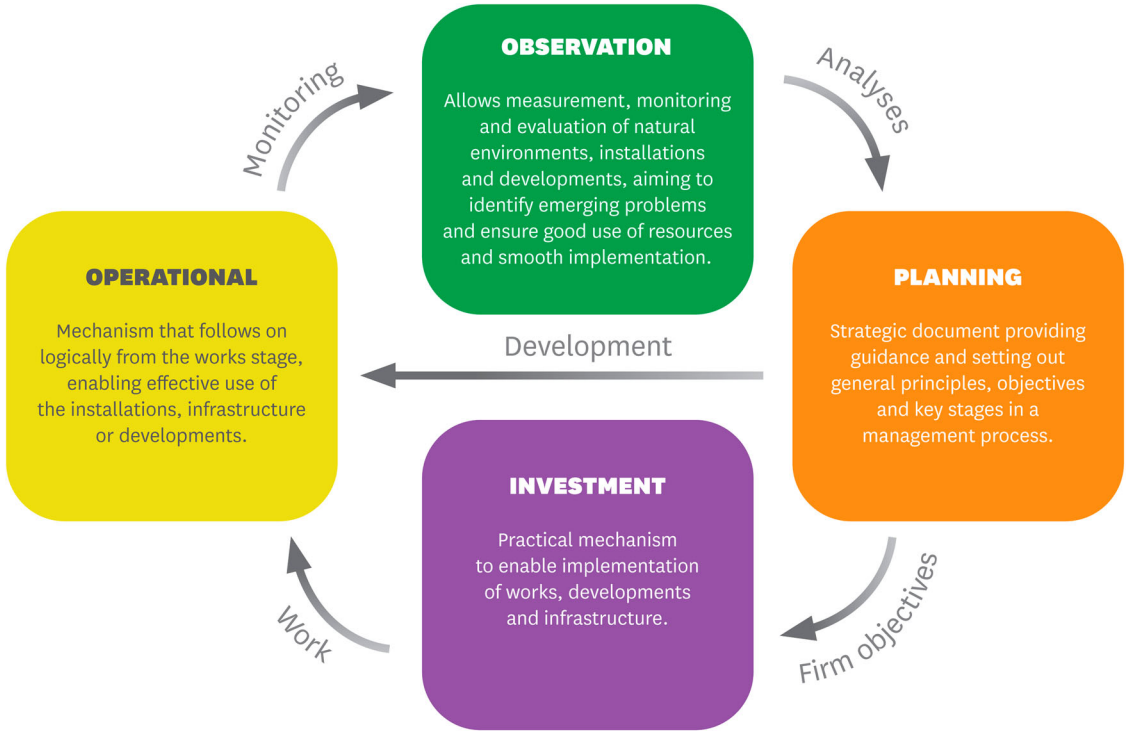

Figure 1. Four categories of policy instruments.

Geneva), each of the terms was aligned and framed to their everyday practice and understanding of policy instruments. For instance, operational instruments aid in implementing large infrastructure projects, relating to the functionalist approach (Lascoumes & Le Galès, 2007). Similarly, observation refers to monitoring and evaluation and closely recounts regulatory policy instruments to maintain water equity and justice (Campbell et al., 2004).

Each policy instrument has a specific task, simultaneously complementing the other policy instruments in its development and implementation. The planning policy instruments are necessary to develop and implement operational policy instruments. For instance, a strategic document that provides guidance, policy goals and critical stages in a management process is a planning policy instrument and is necessary for operational and investment policy instruments. Similarly, investment policy instruments are referred to as the practical mechanisms that enable the implementation processes of an agreed policy. Regulatory instruments influence observation-based policy instruments. This category is derived explicitly from water science and governance literature (Brack et al., 2019; Vergara & Rivera, 2018), essential for monitoring the natural environment (in this case, surface and groundwater) and predicting future concerns and protection measures.

In this contribution, we focus on policy instruments through the lenses of a transboundary context. Therefore, we analyze the different categories of instruments (operational, investment, planning and observation) that contribute to the structure of cross-border dynamics for managing water resources at the Greater Geneva level. Metropolises represent a peculiar case for transboundary water governance, as most transboundary waters scholarship focuses on riparian countries, their inter-relationships and political nuances. Greater Geneva makes an inroad to understand how transboundary cities govern water. Secondly, transboundary scholarship has insufficient emphasis on policy instruments and their role in transboundary water governance. This manuscript makes an attempt to develop research on policy instruments and its role in shaping past and future water governance.

3. Context and methodology

3.1. Policy and political context: greater Geneva

The Greater Geneva (see Figure 2) is a metropolitan area shared by two Swiss cantons (Geneva and Vaud), two French Departments (Ain and Haute-Savoie) and one region (Auvergne Rhône-Alpes), inhabited by a population of about 1 million. This transboundary region is distinguished by its great diversity of water resources and the fact that it contains a lake, a major international river (the Rhône river), a dense web of small rivers and several strategic aquifers (see Figures 2 and 3).

Surface waters occupy 13% of the Greater Geneva region (about 26,100 ha). Its rivers stretch for a total length of 2,400 km throughout the whole area: 350 km in the Canton of Geneva, 250 km in Vaud and 1,800 km in France. The Rhône, the largest river upstream of Lake Geneva, descends from glaciers in the Alps, flows into the Lake in the Canton of Valais and Vaud and leaves it in the City of Geneva, where the

Figure 2. Greater Geneva Metropolis and watercourses.

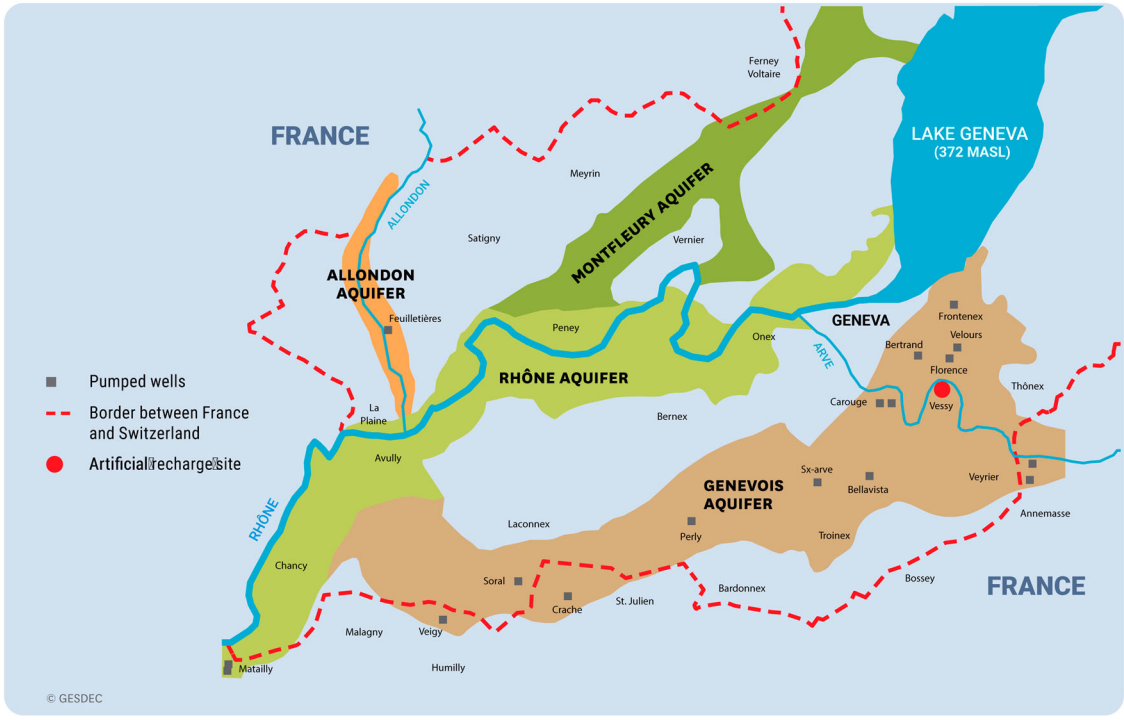

Figure 3. Aquifers in the Greater Geneva Metropolis.

Arve joins it. It then crosses the Swiss border, leaves Greater Geneva and runs through France, finally discharging into the Mediterranean.

As illustrated by Figure 3, groundwater is also an essential part of the water available in the region. There are three types of aquifers within Greater Geneva, distinguished according to their water flows and how far they extend and lie: principal, deep aquifers; secondary, superficial aquifers (often referred to as 'associated groundwater'); and temporary aquifers. Among them are several strategic, transboundary principal aquifers, notably the Geneva, the Allondon, the Montfleury and the Rhône. These are large-capacity aquifers, publicly protected as groundwater sources because they are or may be used to provide drinking water. The Geneva Aquifer is the largest groundwater reserve within Greater Geneva. It is also regulated by a transboundary agreement (signed in 1978) which is one of the oldest (and more substantial) transboundary aquifers globally (de los Cobos, 2018). Recharged by the Arve river, it is 19 km long, varies in width from 1.5–5 km and has a usable capacity of approximately 70–80 million m^3. It is managed on a transboundary basis and used by ten wells on the Swiss side and three wells in France.

The governance of such a transboundary area implies a complex institutional spaghetti with a wide diversity of actors involved and multiple pressures such as growing individual transportation, unbalanced sharing between jobs and housing, raising of land prices, lack of available housing stocks and impacts on the environment. To cope with such challenges and further develop the territory coherently, under the auspices of the Swiss Confederation, actors from the both countries came up with a plan: the agglomeration project of Greater Geneva. Such a project aims to obtain and coordinate Swiss federal funding to support the definition of a cross-border living area and related policy measures. Since early 2000, four projects have been submitted (2007, 2012, 2016, 2021). So far, the project has allowed to obtain a total amount of 550 million CHF, mainly focusing on mobility at the metropolitan and cross-border scale. The project itself reflects the transboundary nature of Greater Geneva. It gave shape to joint territorial planning rationale going beyond political and administrative boundaries and aiming for the definition of synergies with common functional space.

Despite the willingness to harmonize practices and define a common framework for understanding action, challenges related to any transboundary settings remain valid. One can notably note the multiplicity of legal systems or the different structures and paces of decision-making processes.

In Switzerland, the political system is based on the continuous interaction of three levels of government: the Swiss Confederation, cantons and municipalities. It is structured around the principle of subsidiarity and grants a considerable degree of autonomy to regional and local authorities. Consequently, the nation's 26 cantons (of which 2 have territory in Greater Geneva) and over 2,000 municipalities (of which 92 are in Greater Geneva) have substantial responsibilities related to drawing up and implementing public policies. Coherence between the various institutional levels is achieved through 'executive federalism' – the principle that federal laws must be observed. However, it is the lower levels of government (i.e. cantons and municipalities) that are responsible for applying them.

Regarding water management, regulatory powers lie with the Confederation, which is responsible for legislating water conservation and water use. The cantons and municipalities are responsible for implementing directives and adapting them to specific local conditions, in our case, the transboundary nature of the perimeter. It is fair to say that the Swiss legislative framework for water management is substantial, with many coherently implemented rules (Varone et al., 2002). However, various new sets of issues have emerged, such as the effects of climate change, the ageing of infrastructures or managing the problem of micropollutants, putting these legislative frameworks under pressure. What is more, the highly decentralized political system implies a large number of stakeholders and, potentially, difficulties not only in achieving coherence between different policies but also in coordinating and aligning actions and practices at multiple scales, within and across borders. The Canton of Geneva has the distinction of being a 'city-canton', with a significant concentration of water management powers compared to other cantons, and this has made its transboundary relationships easier from the start.

On the contrary, in France, water policy is based on four significant laws (1964, 1992, 2004 and 2006 Water Acts), which now operate in the context of the European Union's water protection legislation, the Water Framework Directive (WFD). From 1964 onwards, France moved towards managing water based on the main river basins, creating six large water agencies responsible for raising taxes and ensuring balanced area-based water management through Water Development and Management Master Plans (SDAGEs).

Even though the French political system is more centralized than the Swiss, French legislation uses public policy instruments designed for decentralized implementation. For example, the SDAGE plans ensure that the relevant laws are implemented contextually, focusing on each river basin.

Implementation of French water law takes place at various levels. Legal provisions supplement national legislative codes at the scale of departments (notably regulatory resolutions enacted by *préfets*) and of municipalities (municipal by-laws). However, it remains the case that water management in France is shaped by a supranational law (the WFD) and national codes. Historically, water management powers have lain with municipalities and have been transferred – at first voluntarily and later imposed by central government – to cooperative inter-municipal public bodies. These consortia are administrative structures that bring together several municipalities to share the exercise of certain powers, including that of raising some local taxes.

3.2. Data collection and analysis

Data on policy instruments and related drivers of change in the Greater Geneva Metropolis was collected using two strategies. First, the research focused on building an exhaustive catalogue of 39 existing transboundary water management policy instruments active at the level of the Greater Geneva Metropolis. Policy documents (treaties, conventions, and agreements) encompassing wastewater treatment, drinking water, fishing, commercial and recreation, hydropower and geothermal energy, biodiversity, floods, and sediment management were included. Second, semi-directive interviews and discussions with present and past key officials of the Office for Water, Canton of Geneva, were conducted to understand the underlying drivers of change, capturing the institutional memory of the interviewees.

To understand the evolution of the transboundary dynamics, we clustered the policy documents in three different periods between 1880 and 2020. The time periods are based on an essential legal advancement in the form of a treaty, convention, or agreement or on a shift (sudden increase or decrease) in policy instruments development. The policy documents were coded for each period based on the category of policy instruments – planning, investment, operational and observation. Each policy document was also analysed regarding its purpose and policy goals. Further, policy goals were noted and connecting policy instruments were marked and extracted. The interviews were also used to identify critical moments, define periods and/or understand significant policy changes illustrating a shift in the way cross-border water management is conceived.

4. Findings

Among the policy instruments used in Greater Geneva, some have been designed and created specifically for transboundary application (e.g. the Franco-Swiss Convention on the protection of Lake Geneva against pollution, the Convention on the protection, use, recharge and monitoring of the Franco-Swiss Geneva Aquifer). It is worth noting that some of the primary structuring area's water management policy instruments (e.g. river contracts) originated on the French side and then integrated into the cantonal legal framework to help local stakeholders respond to specific transboundary needs for cooperation (e.g. cross-funding of infrastructures or projects between Switzerland and France). It is also interesting to note that if numerous policy instruments have been defined for surface water, the Rhône remains to date without any international agreement for its transboundary management (Bréthaut & Pflieger, 2019).

Based on our screening of policy instruments and on our semi-directive interviews, we identify three main historical phases that have shaped the development of transboundary water management policy instruments (see Figure 4). In the last 120 years, this metropolitan area saw the development of about 40 policy

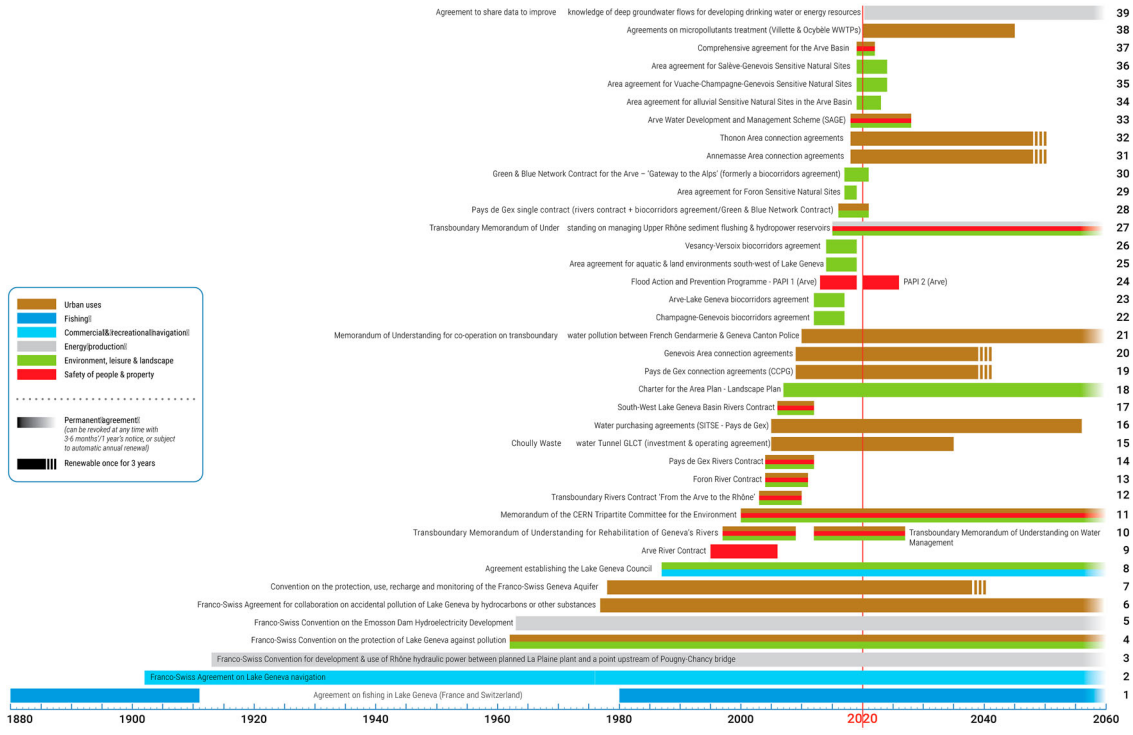

Figure 4. Historical screening of policy instruments operating for transboundary water governance in the Greater Geneva metropolitan area.

instruments, facilitating transboundary water governance by ensuring water availability, increasing water quality and cross-financing equitable water infrastructures.

4.1. Policy instruments for water governance (1880-1982)

The first phase began in the late nineteenth century, with the introduction and formal signature of the first transboundary agreements. During this phase, the policy instruments developed were essentially applied to fishing, navigation and hydropower production. These first policy instruments were primarily oriented towards industrial production and other human activities, aiming to regulate how water resources were used and exploited. There were limited changes in this period, marred by the occurrence of two World Wars.

Later, in the early 1960s, Lake Geneva's visible signs of pollution and eutrophication alerted the authorities and raised concerns in civil society. The pollution led to the first transboundary monitoring and environmental conservation tool in 1963, in the form of the Franco-Swiss Convention on the protection of Lake Geneva against pollution (which led to the creation of the International Commission for the Protection of Lake Geneva – CIPEL). Legislators were equally concerned about water quality beyond the Lake itself, and therefore legal frameworks to increase the protection of water resources were already tending to become more substantial and more complex on both sides of the border. In Switzerland, the second Federal Waters Protection Act (1972) required all sewerage systems and other sources of infiltration leading to pollution to have treatment measures in place by 1987. Also of note is the introduction of the Federal Ordinance on Wastewater Discharge in July 1976 – a primary policy instrument in combating water pollution and enabling new infrastructure financing. In France, the 1964 Water Act created Water Agencies to take charge of managing water in 6 major river basins. We should also note France's 'Clean Rivers Deals' of the 1970s – contracts for the restoration of watercourses made between the central government and local authorities voluntarily: this led, in turn to the first river contracts of the early 1980s.

Despite these different measures, the state of watercourses in the Lake Geneva Basin remained unsatisfactory. In the 1980s, many rivers failed to meet 'good ecological status' objectives, suffered from drought during periods of low flow or led to flooding at times of high water. The situation continued to cause problems for Lake Geneva, and numerous stakeholders stepped up to try and improve the situation. Among them were CIPEL and its partners, including those from civil society – for example, the Lake Geneva Safeguarding Association, which organized a scientific conference in 1983 to examine the problems of eutrophication and water pollution. Among the sources of these were inadequate sewerage systems and the growing pressures of urbanization and human activity, including soil sealing and artificial alteration of watercourses, as well as a lack of coordination between stakeholders.

4.2. Proactive river protection and restoration measures (1986-2007)

It was noted that during the second phase, regional stakeholders were more aware of the management of the catchment area and realized that water resources should be managed across borders. The early 1990s saw greater commitment on the part of visionary politicians, where changes in the legal bases for action and the introduction of new financial mechanisms strengthened the management of the region's water resources. In 1990, the Canton of Geneva launched the 'Ten years to save our rivers' program, a plan of action to raise the visibility of the area's river pollution problems. On the French side, the Water Act of 3 January 1992 gave the water a new status, recognizing it from then on as part of the nation's shared heritage. Funding generated by this innovative law would help the country's territorial authorities to manage their water resources responsibly.

In 1993, the subject of the environment at the transboundary scale was brought into the spotlight by the France-Geneva Regional Committee (CRFG), which held the first transboundary environmental forum, placing particular emphasis on the health of the region's watercourses.

Driven by the same concerns, in 1997, Geneva amended its Cantonal Water Law to create a Rivers Renaturation Service, with special funding and a program that is updated every four years according to the rivers'

ecological needs. In this context, the political will emerged for a transboundary partnership to fund shared thinking, practical actions and management policy instruments. This was formalized within the framework of the CRFG on 4 December, 1997, when the Transboundary Memorandum of Understanding for Rehabilitation of Geneva's Rivers was signed.

This Memorandum concerns the catchment areas of all the transboundary watercourses between France and the Canton of Geneva and creates a financial and legal framework for a river rehabilitation program under several headings: wastewater treatment, protection of people and property against floods, restoration of riverbanks and riverbeds, regenerating aquatic environments and landscapes, raising public awareness. This transboundary Memorandum of Understanding would help to create a new generation of policy instruments, notably transboundary river contracts. The river contract is an instrument that intervenes at the river basin level. It allows investing in different actions (studies, site work, awareness raising) related to river restoration and aquatic ecosystem enhancement. Focused on operational dimensions, the instrument intervenes in a holistic manner allowing it to tackle a great range of water-related problems. This instrument is an emblematic example of successful transboundary cooperation in the Greater Geneva area. Already existing in France, such contracts have been revisited to fit with regional specificities and with Swiss regulatory frameworks. Between 2003 and 2006, the number of river contracts in place increased significantly. This period also saw a proliferation of policy instruments that could respond to the involvement of more – and more specialized – financial policy instruments and the institutionalization of dialogue platforms allowing to connect water practitioners in the region and to increase coordination between projects.

4.3. Greater Geneva emerges as a transboundary space for water management (2007-2020)

The late 2000s saw the Greater Geneva Area Plan become a practical reality (2007). The formalization of this new territoriality implied additional funding provided by the Swiss Confederation and, consequently, the development of transboundary projects across multiple sectors. The Greater Geneva Area Plan has been primarily focused on the development of transportation and housing infrastructures. Between 2007 and 2020, 22 additional policy instruments related to transboundary water management have been developed. However, most of these instruments relate to the development of urban projects. As such, water management has moved from solely sector-based towards greater integration, particularly with spatial planning and development policies. Such a process has led to a reshuffling of political priorities. In this phase, water tends to be mainly considered as a necessary resource linked to urban development.

The transboundary aspects of water management become increasingly embedded in spatial (and urban) planning and development, and Greater Geneva is taking its place as the functional reference space for this to happen. In the situation where water resources remain (for the moment) quite abundant, water (and transboundary water) seems to move out of the political priorities leading to a decreased attention on the necessity to further develop transboundary water cooperation. Transboundary water management currently suffers from a lack of political commitment. Existing dialogue platforms (very active in phase 2) tend to get less dynamic at the regional level. In addition, the discussions around transboundary water cooperation remains influenced by ongoing negotiations around an agreement for the transboundary management of the Rhône River, a major European river that does not entail any agreement or institutional framework at the transboundary level.

5. Discussion

In this section, we will reflect on the key findings of this study, highlighting the value of policy instruments in cross-border metropole water governance. Four critical reflections are provided to understand the changes realized in the policy instruments in the Greater Geneva metropole water governance.

First, cross-border metropole water governance has evolved incrementally as a function of the region's changing concerns and socio-economic development. During this process, the water management structure has pivoted around a practice community comprised of the same stakeholders, each often occupying several vital positions and coming together in different decision-making arenas. This community and these platforms

have enabled them not only to exchange ideas and shape a shared vision of what is at stake across borders but also to set up numerous informal interactions that facilitate negotiation and implementation. Such a community of practices also influenced the development of policy instruments, catering to specific needs in different periods. From this base has emerged a capacity for operational flexibility: the stakeholders can think innovatively about transboundary projects, implement them within a reasonable timeframe and respond rapidly to shared needs. Yet flexibility is combined with legal robustness: these practices have been formalized into a wide diversity of public policy instruments, some of which – river contracts, for example – are unprecedented at the transboundary scale and illustrate the necessity to find tailor-made solutions to deal with regional specificities.

Second, this community of practice could never have become a reality without a certain amount of visionary political thinking and willingness. Determining the kind of instruments required and tailoring mechanisms to suit local circumstances has involved a significant degree of pragmatism. This has meant taking a step back from sovereignty issues, emphasizing getting things done at the ecological (or watershed) scale and identifying appropriate mechanisms to overcome the fragmentation intrinsic to operating within different legislative and political frameworks. In the case of transboundary water issues, we can reasonably assume that bodies operating at the national level have consciously allowed some room for maneuver in drawing up responsive, custom-made agreements. In addition, existing political structures (for instance, the subsidiarity principle in Switzerland) or specific changes in the political and administrative fabric (for example, the introduction of co-operative inter-municipal public bodies in France) has helped to reduce the number of stakeholders and to simplify interactions within a multilevel institutional apparatus. However, the shared political willingness of the regional Franco-Swiss group of policymakers with a shared understanding of the challenges of transboundary water governance and competent public administration have been key drivers in establishing and implementing policy instruments that have been able to cope with regional specificities and tailor-made a functioning governance system. Current challenges at the transboundary level illustrate how such a community of practice becomes critical to maintain the cooperation dynamic and to further position water as a political priority.

Third, historically, the region's transboundary water governance system has never experienced a significant crisis demanding a root-and-branch approach to existing practices. On the contrary, the system has adapted and changed gradually in light of emerging problems that require policy and practical responses. In this sense, the quality issue has been a decisive driver in the dynamics of transboundary water management, whether relating to surface waters or groundwater, whether for the Lake or rivers. For a long time, changes to the design of the system were essentially reactive: now, however, it has moved towards more preventative policy instruments. This evolution can be explained, in particular, by a more vital link between water management and urban planning and development, requiring infrastructure forecasting and provision for the long term. This transition, although welcome from the view of sustainability, also brings difficulties since integrating water management into other sectors leads to difficulty coordinating and some dilution of its own sectoral priorities. It makes a case for sector-based specific policy instruments that can integrate water.

Lastly, while the governance system has enjoyed consistent commitment by key decision-makers, we should not forget (notably considering current challenges) the role civil society played in keeping questions of transboundary water governance on the political agenda. For example, through its publications, campaigns, and events, the Lake Geneva Safeguarding Association has actively involved local people in issues relating not only to the Lake itself but also to the rivers of the Lake Geneva Basin. Civil society stakeholders went beyond straightforward environmental activism, supporting a greater understanding of the water system through the production of scientific studies. From this angle, the scope allowed to civil society and the input of academics have certainly helped to position water as a key issue at the transboundary scale and to influence the policy programs implemented to tackle the sector's problems.

6. Concluding remarks

Drawing from the case of the Geneva cross-border Metropolis, this research explains how policy instruments are formulated to manage a combination of cross-border urban water sources (lakes, rivers, aquifers). We

answered two questions – (1) *what type of policy instruments contribute to reaching transboundary water governance in Greater Geneva? and (2) What are the underlying drivers that led to the success or failures of implementing policy instruments at the transboundary level?*

Our findings illustrate how different policy instruments have been successfully and iteratively developed and implemented (along three main phases between 1880-2020) in the Geneva metropole to adapt to existing water management constraints in a transboundary setting. By doing so, our contribution highlights dynamics at play, combining top-down perspectives (for instance, the definition of a development plan funded by the Swiss Confederation that considers the Geneva metropole as the functional space of reference) and bottom-up dynamics pushing for certain policy changes to happen (see concerns related to water quality that led to the reinforcement of critical arenas such as the CIPEL). Our analysis of instruments illustrates a dense catalogue of policy instruments used to manage the different water bodies of the region (lakes, rivers, groundwater) and a typology informed by regional needs and perspectives. The analysis also presents the gradual shift from sectoral to more integrated perspectives and related challenges, with water being gradually included in land-use and urban policies at the Greater Geneva level.

Although the analysis presented comes from a water-rich region, the last few dry seasons have raised concerns regarding water management. The worries about water sharing and prioritizing and rationing of water use in specific sectors have been recently reinforced by extreme events (notably the drought of 2022) that climate change modeling tends to consider as the baseline context for upcoming years (Ruiz-Villanueva et al., 2015). In this regard, dealing with the transboundary dimension of the Greater Geneva metropole as a shared living area, the role of policy instruments is even more critical to shaping preventive measures, creating efficient interlinkages between sectors and, by doing so, reinforcing adaptation. Our historical analysis, as much as current changes, tends to call for further policy innovation in the mechanisms of policy instruments, allowing us to deal with the complex transboundary nature of the Greater Geneva metropole. It also calls for the continuous influence and participation of civil society in agenda setting and reinforcement of commitments from policymakers, variables that proved to be crucial in today's but also future success. It finally opens up interesting research avenues regarding the diversity of policy instruments contributing to regulate transboundary water management. As such, we hope that our contribution can trigger a dialogue with other cases and the building of a wide catalogue of possible ways forward to deal with institutional complexity observed for managing water in the context of cross-border metropolis.

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