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Governance, sustainability and decision making in water and sanitation systems.

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Abstract: The relationship between governance, sustainability and decision making is receiving increasing attention in academic and policy circles. Governance and sustainability are, however, contested and somewhat imprecise concepts. Both concepts are inextricably linked to local circumstances and therefore need to be defined in terms of the characteristics of the people living in a given place at a given moment. In this paper we present an alternative idea of governance in which its relationship with sustainability is highlighted. We base our understanding of governance on a previously defined conceptual framework for sustainability build on the three pillars of "place" (the spatial dimension), "permanence" (the temporal dimension) and "persons" (the human dimension), instead of the classic triple bottom line of economy, environment and society. This conceptual framework is arguably more sensitive than the triple-bottom-line approach to understand complex, long-term issues such as environmental governance and inter-generational justice. It also makes the idea of sustainability more adaptable to specific settings and more appropriate to understand local, regional, and global processes. Interactions between persons in a given place are usually triggered by specific problems. These interactions directly affect the overall situation in the future, constantly reshaping the temporal dimension in a continuous process of change. To

test the conceptual framework presented we analyze the governance of the WSMS of the city of Salta, Argentina. We briefly describe the system, examine institutional changes in recent years, and discuss the relevance of different stakeholders acting therein in order to identify key features that might be useful to detect governance failures and successes. We organized our finding in a semi-quantitative index that allows a more in-depth analysis of the complex links of governance and sustainability. The index is calculated by aggregating descriptors, indicators and variables in a weighted matrix. Data used to build the index come from literature reviews, information provided by the water company, field visits, and interviews with key actors. We compare our approach with other governance analytical frameworks, highlighting similarities and differences. Some specific recommendations are made to promote a better governance of the system studied.

Keywords: decision making; governance; sustainability; water and sanitation.

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1. Introduction

In many places, the so-called "water crisis" seems to be more related to a governance failure than to physical resource scarcity [1,2]. Especially in those places, the complexities of the governance of water and sanitation management systems (WSMS) cannot be fully understood without paying close attention to the social and political context. The relationship between governance, sustainability and decision making is receiving increasing attention in academic and policy circles [3,4,5,6,7]. It is also clear that governance and sustainability cannot be detached from cultural aspects [8]. Yet the concepts of governance and sustainability remain elusive, contested, and somewhat imprecise. Both are inextricably linked to local circumstances and probably need to be redefined for each given place, system, and moment.

In this paper we present an alternative idea of governance in which its relationship with sustainability is highlighted. We applied this new approach to assess the WSMS of the city of Salta, Argentina. In order to put concrete numbers to the concept of governance, we developed a Water Governance Index (GWI) which will be arguably helpful for decision making.

1.1. Governance

The term "governance" gained prominence in the 90s when the World Bank defined it as "*the set of traditions and institutions by which authority in a country is exercised"* [9, p.2]. Governance has also been understood as the "*mechanisms, processes and institutions through which citizens and groups articulate their interests, exercise their legal rights, meet their obligations and mediate their differences*." [10, p.13]. Evans and co-workers [7] indicate that governance is basically the relationship between society and the government. Similar definitions have been adopted by Kooiman [11] and MacGregor [12]. Hufty [13] puts more emphasis on decision making processes, both formal and informal, which are at the base of the generation of social norms. He is critical of the conventional definitions of governance in which power relationships and historical contexts are usually underestimated. It is generally assumed that public participation legitimizes decisions and facilitates its

implementation [14]. However, human relationships are inherently conflictive and good governance must also take into account the existence of conflicting visions. In that sense, good governance might not necessarily lead to management efficiency, understood in merely economic terms. Kooiman [11] differentiates between hierarchical governance, where decisions are made by the government and the public is only informed about them, and co-governance, in which society plays a more active role in the process of decision making.

There have been many attempts to measure governance. The World Bank periodically monitors the performance of different countries by means of six governance indicators, namely Voice and Accountability, Political Stability and Absence of Violence, Government Effectiveness, Regulatory Quality, Rule of Law and Control of Corruption [9,15,16]. Other way of assessing governance is the Urban Governance Index, which includes four main dimensions: Effectiveness, Equity, Participation, and Accountability [10]. This index includes 21 indicators and was already tested in several countries. Hufty [13] proposed a Governance Analytical Framework to study governance issues. This framework contains five analytical categories: (1) problems; (2) actors; (3) nodal points; (4) norms; and (5) processes.

Institutional and personal participation in decision making processes related to the solution of specific problems seems to be essential in all definitions of governance. Although approaches might vary, the central role of well-organized institutions and public participation in the promotion of sustainable development has been widely recognized [17,18,19,20]. Institutions are basically social problem-solving entities formed and directed by individuals. Therefore, problems, in a generic sense, can be seen both as the ultimate justification and the engine of institutions. Ample participation, on the other side, does not always occur naturally, especially in market-oriented institutions [21]. It has to be actively promoted by governments and specifically designed by the institutions themselves [22,23], bearing in mind that participation is both a right and a responsibility that has to be shared by all relevant actors [14].

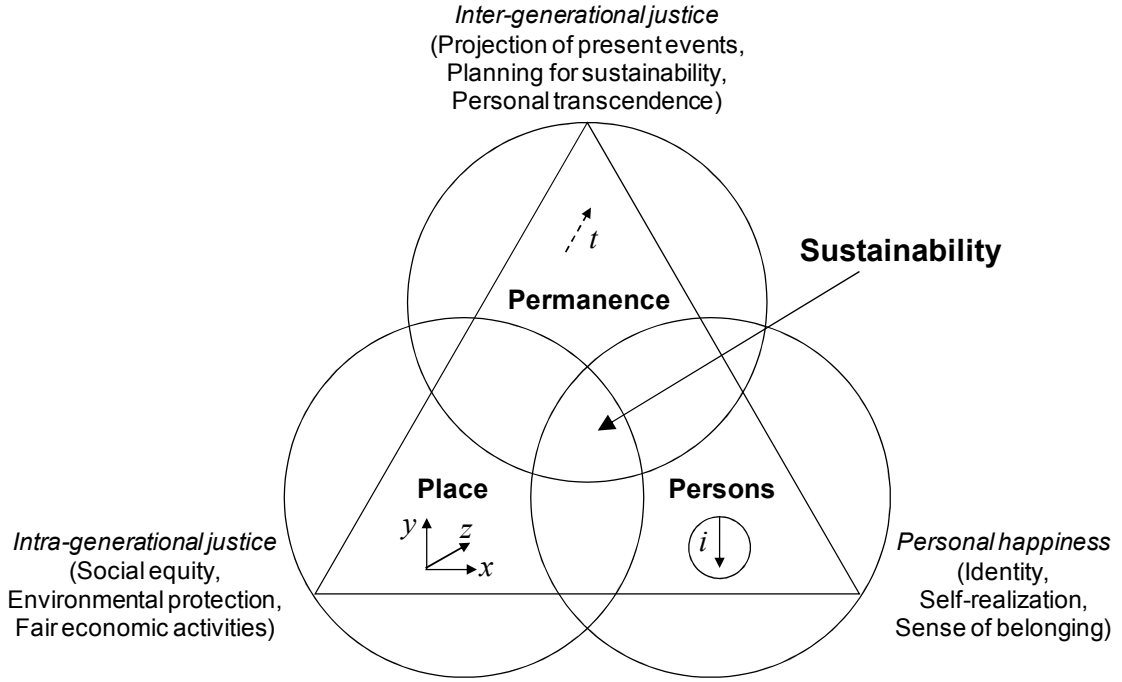
1.2. Governance and sustainability

The notion of sustainability applied to this case study was the "five-dimensional" scheme proposed and discussed by Seghezzo [24]. This conceptual framework considers sustainability as a platform within which "the territorial, temporal, and personal aspects of development can be openly discussed". This idea was represented with a new sustainability triangle formed by "Place", "Permanence", and "Persons" (the 3P's) (Figure 1). Place contains the three dimensions of space (x, y, and z), Permanence is the fourth dimension of time (t), and the Persons corner is the fifth, human dimension (i). The latter dimension was included to explicitly deal with issues of identity, human rights, sense of belonging, and personal happiness. This framework does not see sustainability only in economic, environmental, and social terms. The corners of the new triangle are closely inter-related and is difficult to deal with them in a fragmented way as is generally the case for economic, environmental, and social issues.

Governance and sustainability are inextricably related. It is our contention that the governance of any system is mainly related to the temporal dimension of sustainability. We believe that good governance is paramount to project the current status of any system, including the personal expectations of the people participating in it, into a more desirable situation in the future. Under this assumption, governance becomes the ideal management tool for change towards more sustainable

systems and is an invaluable tool in the quest for inter-generational equity. We believe that the concept of governance can also be explained in spatial, temporal and personal terms. As indicated in Figure 2, the three sustainability "pillars" (Place, Permanence, and Persons) are at the basis of the new concept of governance, which can be defined as the process by which individuals, through their personal values, attitudes, and visions (the Persons triangle), influence and determine the medium or long term evolution of society by affecting societal knowledge, politics, and ultimately the policies of any planning process (the Permanence triangle). Personal and collective action is exerted primarily through participation inside or outside existing institutions, in specific interaction spaces or "nodal points" [13]. Institutions are the reflection and result of the interplay of local culture and norms, while the individuals who run institutions also determine their degree of transparency (or lack thereof) (the Place triangle).

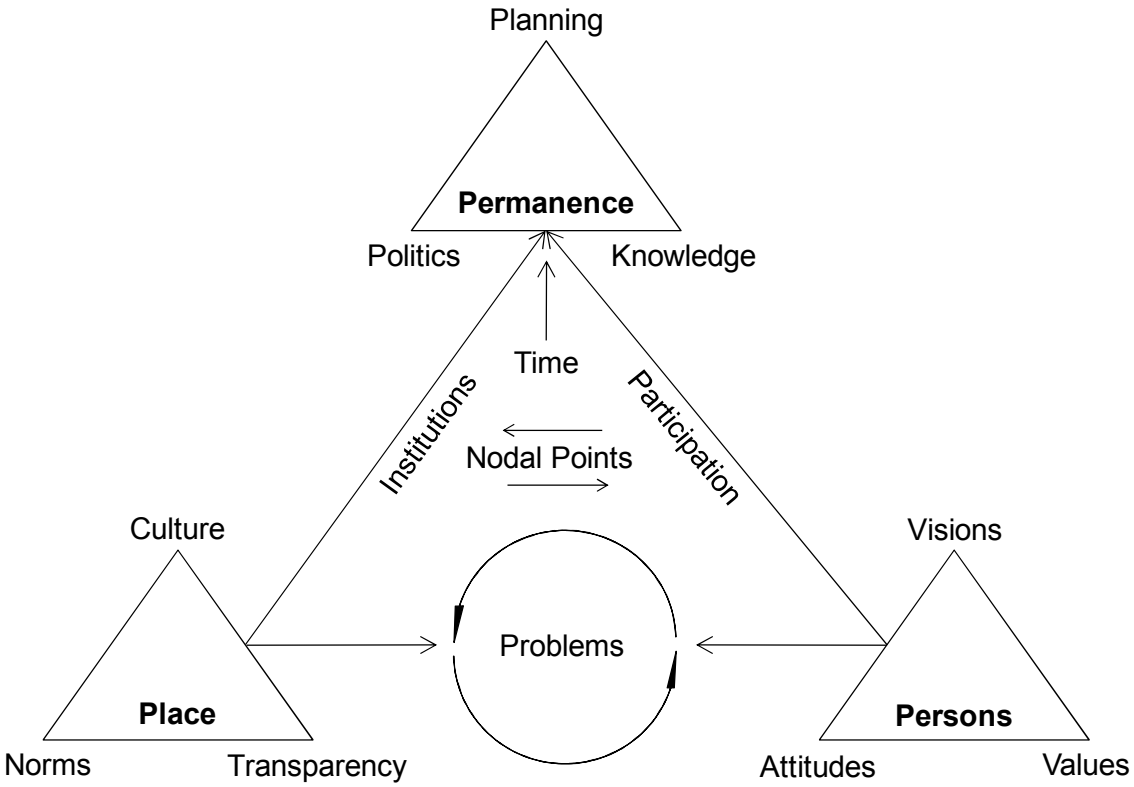
Figure 1. The new sustainability triangle. Adapted from Seghezzo (2009).



Our conception of governance builds on the conceptual framework presented by Hufty [13]. In fact, his categories (problems, actors, nodal points, norms, and processes) are included in a way or another in Figure 2. It is worth noticing that the names of the vertices of the outer triangles in Figure 2 represent the inherently spatial, temporal, or personal aspects of the respective triangle. In the Persons triangle, for example, Values are typically personal features; Attitudes are the observable expression of these values, usually deriving in specific behaviors that affect the surrounding spatial environment; and Visions are the temporal projections emanating from the other two vertices. A similar analysis could be done with the other two triangles, where the lower right vertex represents always personal aspects, the lower left vertex is the spatial aspects, and the apex indicates the temporal facets. This way of analyzing the concepts of sustainability and governance produces multi-level sustainability triangles, each one of them reproducing the conceptual framework at a deeper level. We are convinced that this approach ensures that the sustainability assessment is conceptually coherent no matter the scale or the level at which we work. No aspect is left outside of this assessment. Economic, social, and

environmental issues can all be included in some of the corners, especially in the spatial corner of any level. These aspects, traditionally understood as the only pillars of sustainability since the release of the Brundtland report [25] arguably fail to acknowledge for temporal and personal aspects, in spite of all the rhetoric about inter-generational justice in the debates about sustainable development.

Figure 2. Schematic diagram of the notion of governance used in this work. See a detailed explanation in the text.



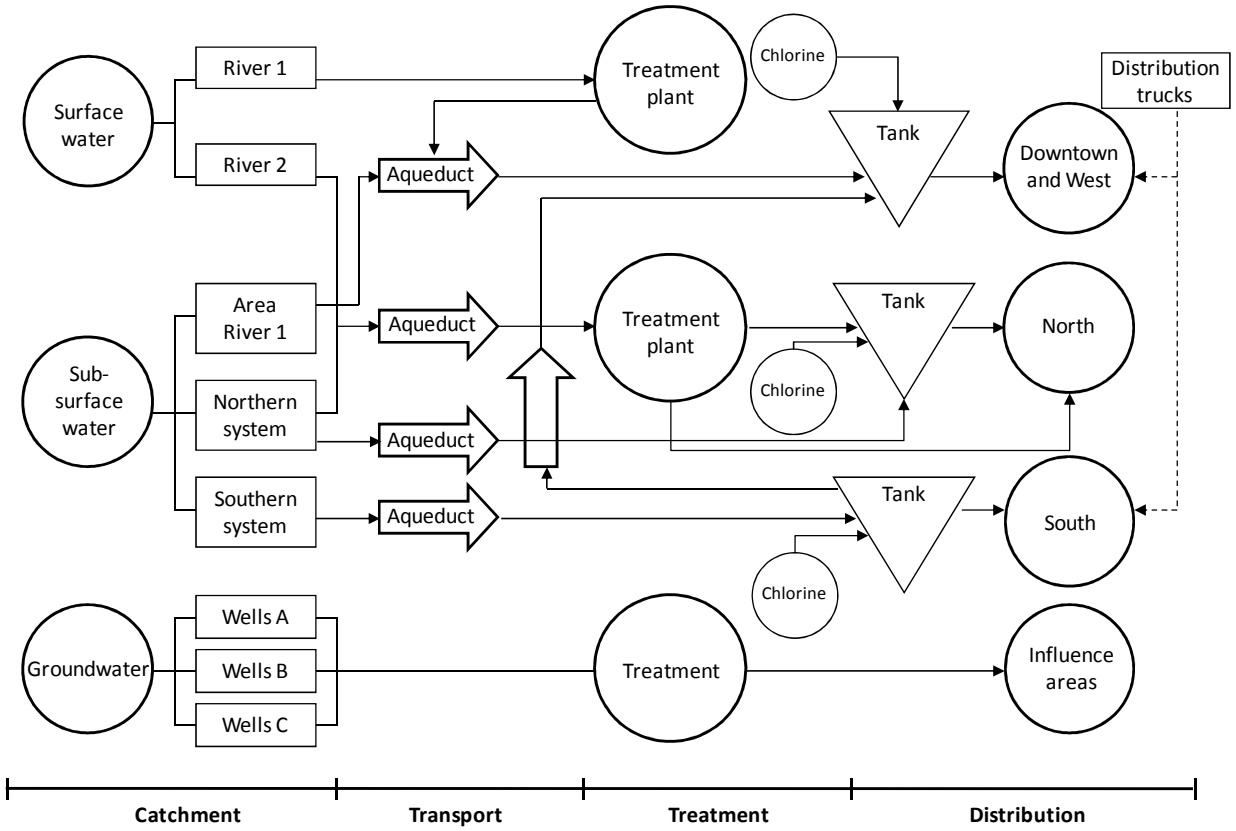
Governance is an essentially political process of interaction in space and time. Local context and history are therefore paramount to understand it. This is also why governance is difficult to understand in generic terms, without rooting it in particular themes or "problems", seen as the engine or "objects" of governance, as proposed by Hufty [26, p.10] (see Figure 2). As it can be deduced from Figure 2, individuals, and the spatial and temporal influence that personal actions exert on the solution of societal problems are central in this new definition of governance [27,28]. The relevance of personal attitudes towards environmental and social problems has received increasing attention in debates on environmental and ecological citizenship [19,29,30,31,32]. It can be argued that conscious citizens follow their values and feelings, not only socially constructed incentives such as the market [29]. Overall, problems will be solved as a direct consequence of the attitudes and interests shown by individuals who are partially, but not totally, determined by their history and culture [31,33]. In governance processes, therefore, the person is the protagonist [8]. This means that the aggregation of individual actions and social interactions (between individuals or between individuals and institutions) will determine to a great extent the good governance and, ultimately, the sustainability or un-sustainability of a given place or system [34,35,36].

2. Materials and methods

2.1. Case study: Governance of water and sanitation in Salta, Argentina

The conceptual framework described was used to analyze the governance of the WSMS of the city of Salta, in northern Argentina. Population in the city is more than 500,000 [37]. The provision of drinking water and sanitation was in charge of state agencies until 1998 but the service was handed over to the private sector in the 90s [38]. The entire provincial territory, which spans an area of more than 150,000 km^2, was given in concession to one single company. The experience was not as expected and the governance and equity of the water management system under private hands came under scrutiny, as in other parts of the country [39,40]. In May 2009, the service reverted back to a (partly) state-owned company (Compañía Salteña de Agua y Saneamiento – CoSAySa). About 65% of the drinking water is extracted from more than 150 wells distributed around the city. The remaining comes from surface water captured either directly from rivers or indirectly through shallow drains located close to water courses. This water is later conveyed to the city by way of closed aqueducts. According to our estimates, per capita water availability is more than 600 L/p.d. A scheme of the water provision system in Salta is depicted in Figure 3 (sanitations aspects not included).

Figure 3. Main stages of the water provision system in Salta, Argentina.



Sewage is collected through a sewerage network designed to be separated from urban runoff although illegal connections between these two systems are common. Collected sewage is conveyed and treated in two main treatment plants and treated effluents are discharged into rivers.

Other key institutions linked to the WSMS of the city are the governmental control agency (ENRESP – Ente Regulador de los Servicios Públicos), the provincial Secretary of Water Resources (SRH – Secretaría de Recursos Hídricos), and the city's Municipality.

2.2. The Water Governance Index (WGI)

Policy makers only pay attention to things that are measured. Failure to identify and quantify fundamental aspects of the sustainability or governance of a management system will render these aspects essentially invisible. A Water Governance Index (WGI) was defined and estimated for Salta (Table 1) in an attempt to put quantitative figures to the idea of governance outlined in this paper. This index is part of a broader sustainability index under development called the WASSI (Water and Sanitation Sustainability Index) [41]. In fact, the WGI described here represents the temporal aspects of the WASSI, as discussed above.

Table 1. The Water Governance Index (GWI).

Descriptor	Definition	Indicator	Definition
Access (spatial aspects)	Compliance of the right to water including physical, economic and social availability	Costs	Economic accessibility to water and sanitation services measured as a percentage of the minimum wage necessary to pay these services
		Information	Quantity and quality of free access information concerning the water and sanitation system assessed through the information contained in institutional websites
		Rights	Indicates whether everybody has access to the amount of water to cover basic water needs. This indicator is measured through the amount of water supplied for free by the water company
Planning (temporal aspects)	Management capacity and institutional framework at the local level	Institutions	Comprehensive assessment of the institutional capacity in the water sector in terms of funds, planning, and personnel
Participation (personal aspects)	Opportunities and instances of public engagement with the water management authorities	Interactions	Number of functioning interaction points and participation instances, measured as the number of significant participation events per year (such as public audiences)

The WGI was built with three "descriptors" [42] or "orientors" [43] and one or more indicators per descriptor (ideally three when strict adherence to the conceptual framework is sought after). Indicators were defined and estimated using a combination of adapted methods [43,44,45,46,47,48,49]. Indicators were quantified through the measurement of one or more variables. Indicators and variables were selected in terms of their relevance to assess the satisfaction of the descriptors. The final decision which indicators or variables to use was based on three basic criteria: (a) maximum possible coherence with the conceptual framework, this is the spatial, temporal, or personal aspects of the governance of

the WSMS under study; (b) minimum potential correlation between parameters at the same level (overlapping is minimized if the conceptual framework is correctly applied); and (c) availability and reliability of local information. When more than one parameter qualified to those ends at a certain level, we either aggregated parameters in a single value or selected one of the parameters.

Indicators selected for descriptor Access intend to describe the most important components of the human right to water, namely economic accessibility [50], free access to enough information on the system [51], and a basic water allowance sufficient to cover basic needs [52,53]. These aspects are essential to describe the current water situation in the city and were considered as proxies for the territorial aspects of the system governance, namely those linked to the compliance of the principle of intra-generational justice.

Descriptor Planning contains an indicator that assesses local institutional capacity. The existence of well-organized, efficient institutions can be considered as a pre-requisite for medium and long term planning processes. Therefore, institutional capacity is a good indication of planning ability and points to the temporal components of the system that can help ensure the effective compliance of the right to water in a framework of inter-generational justice.

Descriptor Participation was assessed through the number of public participation instances. This aspect of the system can help evaluate the degree of personal involvement in water and sanitation issues and therefore points to the personal aspects of the management system.

Quantitative and qualitative values assigned to the different categories were converted into the following sustainability scale: Value<25 = Unacceptable (red), 25≤Value<50 = Danger (yellow), 50≤Value<75 = Good (green), Value≥75 = Excellent (blue). The extremes of the scale (0 and 100) were linked to particular values of the categories under assessment. Linear relationships were assumed whenever possible to calculate the sustainability of actual field data. The threshold was set at 50. Measures and actions must be recommended according to the value obtained, i.e. relief and restorative measures in the lowest quarter, corrective action in the second quarter, optimization in the quarter above the threshold, and monitoring and maintenance of the system in the top quarter. Information was collected by several means including literature and press reviews, semi-structured interviews, field visits, and risk assessments.

3. Results and discussion

Table 2 shows the results obtained for the GWI of the city of Salta, Argentina. The governance of the entire system obtained 49.9 points in the 0-100 scale (see Table 2, bottom of column 10). This value falls in the Danger category. As shown in Table 2, all values estimated for the different variables were converted into a unified scale by means of linear transform functions (columns 6 and 7). A detailed description of the rationale behind the construction of transform functions is beyond the scope of this paper. However, it is worth mentioning that these limits can vary depending on the variables selected and the experience of the members of the assessment team. This is not an inconvenience as long as the criteria are explicit and respected over time, especially when comparative assessments need to be made.

Table 2 . The GWI for the city of Salta, Argentina.

1	2	3	4	5	6	7	8	9	10	11
Descriptor	Indicator	Variable	Units	Value	Transform function		Governance			
					0	100	Variable	Indicator	Descriptor	Category
Access	Costs	Relative water cost	%	1.90	5	0.2	64.5	64.5	67.1	Good
	Information	Web sites	-	36.7	0	100	36.7	36.7		
	Rights	Basic water allowance	L_{dw}/p.d	87.7	5	50	100.0	100.0		
Planning	Institutions	Institutional assessment	-	2.51	0	4	62.7	62.7	62.7	Good
Participation	Interaction	Participation events	N°/year	0.20	0	1	20.0	20.0	20.0	Unacceptable
								GWI =	**49.9**	**Danger**

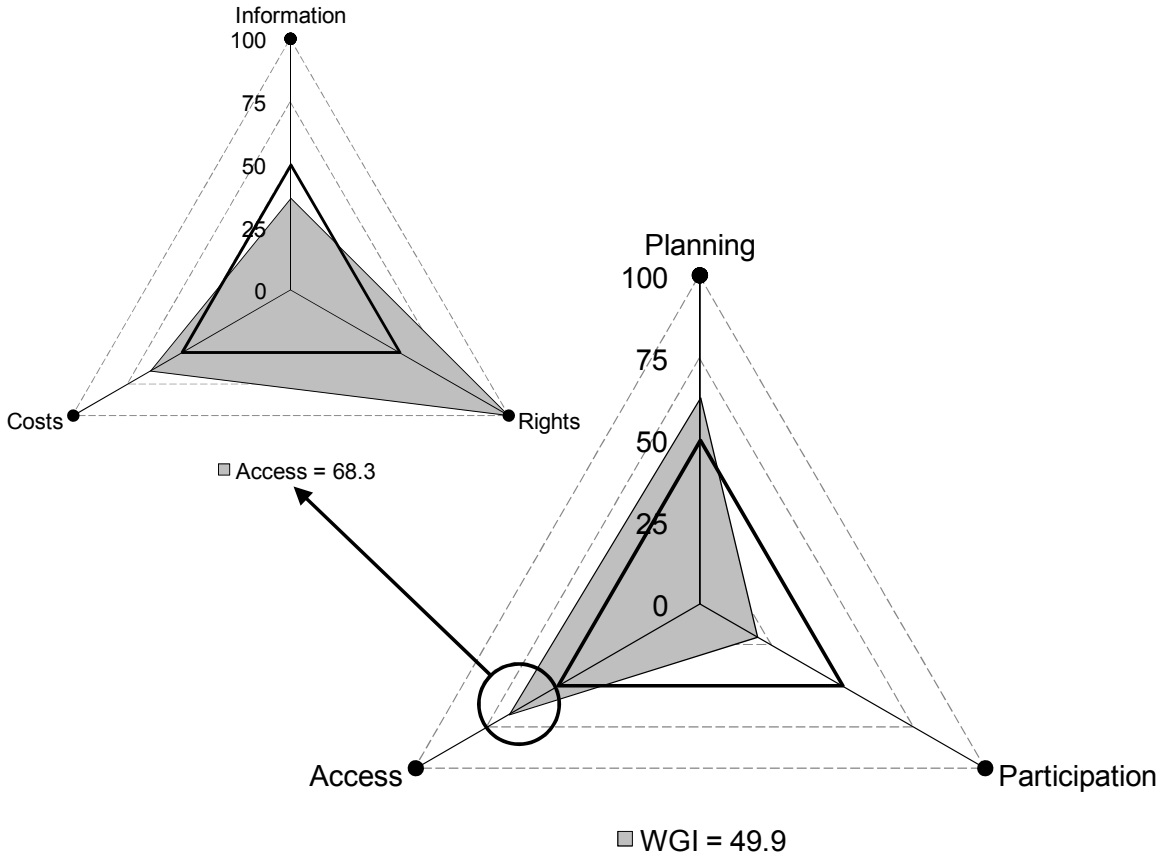
Descriptors Access and Planning obtained scores within the Good category, while Participation was considered in the Unacceptable range. The worst-performing indicator was Interaction, which obtained a low score because of the small number of public audiences called by the water company, during both the private and public periods (only 2 significant public audiences in the last ten years to discuss investments and projects). The best indicator was Rights, with the maximum score. In fact, the company has a system by which a minimum water allowance of 10 m^3 is given for free to all households, in exchange of an affordable fee to cover fixed costs. This allowance is equivalent to 87.7 L/p.d considering that the average number of persons per household is 3.8.

Indicator Costs was considered in the Good range because the cost to afford sufficient water consumption per household represents only 1.9% of the minimum official wage. Indicator Information received a relatively low value, in the Danger category, based on an assessment of the existence and quality of the websites of the three most important institutions of the WSMS of the city (namely CoSAySa, ENRESP, and SRH). It was observed that these institutions have no user-friendly ways of providing quality information on the water and sanitation system. The institutional assessment performed for the city to assign a value to indicator Institutions obtained a score of 62.7, in the Good range. This assessment involved an expert assessment of different aspects of the institutions acting on the WSMS of Salta (mainly availability of enough funds to perform their tasks, planning capacity in terms of projects in progress, and presence of trained personnel at different institutional levels).

The results in Table 2 have been arranged in Figure 2 as modified radar diagrams. These "sustainability triangles" can be a visual aid to understanding the complex issues of sustainability [49]. Inner shaded triangles can be interpreted as "sustainability areas" (or, in our case, governance areas). The inclusion of the threshold value (as a thick line) helps detect areas below the threshold, where improvements are needed.

These triangles are straightforward and give a rapid indication of the degree to which the governance or sustainability of a process or system complies with a given standard. We can see that, at the level of descriptors, immediate action is needed to improve the level of public participation in the decision making processes governing the WSMS in Salta. However, when descriptor Access is analyzed in detail, we see that indicator Information is also deficient. That means that corrective actions are also needed for this descriptor. Once measures are taken, their effectiveness must be assessed and monitored in a process of continuous improvement.

Figure 2. The WGI for Salta as a governance triangle (bottom right). Descriptor Access is shown as a smaller triangle on the top left. The threshold value of 50 is indicated by full, thick lines.



Decision making can be facilitated when quantitative measurements such as indices or indicators are available. However, indicators must not replace reality. Responsible decision making should take all aspects of the problem into account. Index and indicators are simplifications and the information they provide has to be used with caution. The importance of historical and political contexts should not be underestimated. Indicators will never reflect the subtleties that only a comprehensive political ecology analysis can unveil. As it name suggests, the field of political ecology focuses its attention on "politicized environments" [54] and the power struggles generated at the interface between environmental and social issues [55]. Central to political ecology is the analysis of the ideas and discourses supported by different actors when confronted with a given policy decision [56]. This complexity will never be entirely captured in numeric terms.

4. Conclusions

In this paper we presented a new approach to studying the complex issues related to the governance of water and sanitation management systems (WSMS). We highlighted the relationships between the concepts of governance and sustainability and discussed their relevance for decision making. It is our contention that governance is a direct expression of the temporal aspects of sustainability and represents an invaluable tool in the quest for inter-generational equity. Basically, we understand governance as "the process by which individuals determine the evolution of society". We applied this

conceptual framework to analyze the governance of the WSMS of the city of Salta, in northern Argentina. We developed a Water Governance Index (WGI) that arguably helps understand the links between governance and sustainability and will be useful for decision making.

The WGI for the city of Salta obtained an overall value of 49.9 in a scale from 0 to 100. This value is considered in the Danger range and indicates that corrective measures are needed, especially with respect to the level of participation in public audiences and other interaction points. We compared our approach with other governance analytical frameworks, highlighting similarities and differences. We concluded that a semi-quantitative index such as the WGI, complemented with a careful analysis of the political and historical context of local WSMS, can be very helpful to assist policy makers to establish the WSMS of the future.

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Conflict of Interest

The authors declare no conflict of interest.

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