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Article

Upscaling Urban Recycled Water Schemes: an Analysis of the Presence of Required Governance Conditions in the City of Sabadell (Spain)

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Abstract: Cleaning wastewater and using it again for secondary purposes is a measure to address water scarcity in urban areas. However, upscaling of recycled water schemes is challenging due to the possible emergence of various barriers. Based on a review of the governance literature we suggest that a set of five governance conditions is necessary for a successful upscaling of recycled water schemes; (1) policy leadership, (2) policy coordination, (3) availability of financial resources, (4) awareness of a problem, and (5) the presence of a public forum. In order to elaborate on the practical relevance of these conditions we studied a recycled water scheme currently being upscaled in Sabadell, Spain. We reviewed policy documents, conducted a set of 21 semi-structured interviews, and attended two policy meetings about the subject. Our results suggest that Sabadell meets the required conditions for upscaling reused water to a certain extent. However, the presence of a public forum is lacking. We discuss the implications of the absence of the venue and procedures for public participation in Sabadell and how it could be strengthened. Following this discussion, we conclude with some lessons for other cities that plan to upscale their recycled water schemes.

Keywords: Water recycle; upscaling; water governance; water availability; climate change adaptation

1. Introduction

Water scarcity is a crucial challenge that affects nearly 40% of the world population and its effects are projected to increase in the future due to climate change [1,2]. The growing importance of water scarcity motivated the United Nations to recognize freshwater availability and a sustainable management of water and sanitation for all as one of the 17 sustainable development goals established in 2015 for the sustainable development horizon of 2030 [1,2]. One of the available strategies to mitigate water scarcity and to ensure water availability, especially in urban areas, is wastewater recycling [3]. Traditionally, water scarcity was addressed

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by conventional methods such as transferring water from other river basins, therefore importing water from other sources [4]. Recycling wastewater consists of cleaning wastewater to the standards appropriate for irrigation, industrial and residential uses and even direct consumption [5,6,7,8]. Recycling water has many potential benefits in urban areas with respect to conventional sources, as recycling water is a strategy that, embedded in a demand management strategy oriented to substitute natural with recycled sources, can contribute to climate change adaptation [4,9]. Environmentally speaking, recycling water has the potential to reduce freshwater demand, helping to increase downstream river flows and eventually to improve their quality [10]. Under certain conditions, recycling water has the potential to be an economic efficient strategy to obtain water when wastewater is located near the source of use, reducing transport costs [11], and because it is generally regarded as a cheaper strategy than desalination [12, 13].

However, there are several barriers that challenge the application of recycled water schemes, and need to be considered [7, 14, 15, 16, 17]. The barriers that can jeopardize the upscaling of recycled water schemes in urban areas can be related to environmental factors, such as the presence of viruses, bacteria, trace organics or heavy metals in the water [18], or shaped by complex interrelations between socio-institutional, technological and economic factors [14]. This paper focuses on the socio-institutional challenges that may block the implementation of non-potable recycled water (NPRW) schemes rather than the technical ones. Barriers that are mostly mentioned in this respect are the lack of institutional coordination, poor leadership, and an inadequate public participation, among others [14, 20]. In particular, societal opposition is a major barrier hampering the upscaling of recycled water schemes in water scarce urban areas [14, 21, 22]. In the city of Toowoomba (Australia) for instance, the upscaling of a water recycling scheme had to be aborted due to negative reactions from the public, who didn't trust the water quality. [15, 16]. In Los Angeles (USA) a project to produce drinking water from recycled water was rejected [23]. In Utrecht (The Netherlands), an already built non-potable water scheme had to be stopped when an incidental cross-connection was made that contaminated the potable water network system [24].

The existing governance literature on upscaling water recycling schemes has been mostly focused on public acceptance, such as in the case of Lejano and Leong (2012), Smith et al., (2018), Dolnicar, Hurlimann and Grün (2010), Russell and Gampton (2005), or the role of emotions in upscaling recycled water schemes as in the studies of Leong (2010) and Leong (2016) [15, 17, 22, 23, 25]. Few papers address the overall socio-institutional barriers that prevent the upscaling of recycled water measures, such as Alcalde-Sanz and Gawlik (2014) or Frijns et al., (2016). Therefore, this paper seeks to complement the existing literature by proposing a framework to ex-ante analyze the governance conditions that are required to upscale a recycled water scheme.

Subsequently, this paper analyzes the case study of the city of Sabadell (Spain) and its process of upscaling a Non-Potable Recycled Water scheme (NPRW). To conduct an ex-ante analysis on the capacity of the municipality of Sabadell to upscale

a NPRW scheme, we assume that a NPRW scheme can be upscaled given the presence of a set of conditions This does not mean that the upscaling of a NPRW scheme is always guaranteed but that the absence of the conditions included in our framework can jeopardize the upscaling of such scheme.

The paper will proceed with a description of the conceptual framework to ex-ante evaluate the capacity to upscale a NPRW scheme (section 2). Section 3 will elaborate on the research methods and the case study of this research. Subsequently, section 4 will present the results of our research, followed by a discussion and reflection on our findings (section 5) and the conclusions (section 6).

2. Governance conditions for upscaling recycled water schemes, An analytical framework

2.1. The concept of upscaling

Upscaling refers to an expansion or replication of a certain measure or policy [26, 27]. For instance, Uvin (1995) defines upscaling as an expansion, and distinguishes between four typologies of scaling up; quantitative scaling up, functional scaling up, political scaling up and organizational scaling up [28]. Smith et al. (2016) define upscaling as the spread-up of projects and distinguishes upscaling from outscaling, that is related to replication instead of expansion [29]. In turn, Gibson et al., (2000) define upscaling as an increase in the spatial, temporal, quantitative, or analytical dimensions of a specific phenomenon, measure or initiative [30]. In this paper, we use the definition from Van Doren (2018) which refers to upscaling as the increase or expansion of either the means or the ends of initiatives or programs [26].

Scaling up can be distinguished between horizontal scaling up and vertical scaling up [26]. Vertical scaling up refers to structural learning and changing the institutional roots of a pre-existing regime by expanding sets of ideas, values, knowledge or other lessons from individuals or local institutions to other institutions or organizations at a higher administrative level, to achieve a wider impact [26]. This concept is also described as political scaling [28], mainstreaming [33, 34] or translation [35, 36, 37]. Horizontal scaling up refers to the spatial growth of an initiative [26] and is also called quantitative upscaling [28, 31] or spatial scaling [32].

2.2. Governance conditions to upscale a NPRW scheme

There is a debate on the possible existence of universal and standardized guidelines or conditions to explain cross-scale dynamics [30,38]. However, we follow the approach of Van Doren (2018) that suggests using observations of individual case-studies to understand the dynamics of cross-scale processes for specific measures and policies [26]. Consequently, we map out the internal dynamics and conditions that explain the upscaling of NPRW schemes in urban areas based on a literature review of previous case studies that upscaled recycled water schemes.

From this literature review, an analytical framework has been built to form a methodology for evaluating the upscaling of a NPRW scheme in Sabadell.

The following set of conditions has been mapped out from a review, exclusively from the literature on upscaling recycled water schemes. This review aims to firstly build understanding on the dynamics and factors that explain the success of upscaling a NPRW scheme, and secondly, to provide a framework to evaluate these dynamics. The following conditions are derived from diverse literature sources, such as Frijns et al., (2016), Lejano and Leong., (2012), Smith et al., 2018 and Khan & Gerrard, (2006) among others.

The literature review conducted to map these conditions has been limited to empirical peer-reviewed papers and scientific dissertations reporting on factors that influence the upscaling of recycled water schemes, thereby appearing as enabling conditions to allow the upscale of NPRW schemes. The analyzed literature was collected through a structured keyword search by using major scientific citation databases such as Scopus or Google Scholar, using relevant keywords such as 'upscaling', 'implementing', 'non-potable water', 'recycled water' or 'regenerated water'. The secondary source of the literature review was the use of cited references from the first source of references. Considering these limitations, a total of 41 references was identified, including papers and PhD dissertations, to build the following framework. Five main conditions that need to be present to allow the upscale of NPRW schemes are; policy leadership, availability of financial resources, coordination, awareness of a problem and the presence of a public forum (Table 1).

2.2.1. Policy leadership

Policy leadership is the presence of a leading institution or a policy entrepreneur that promotes a policy change. Frijns et al., (2016) suggests that a poor policy leadership can undermine the upscaling of a water recycling scheme due to a lack of policy promotion [14].

This condition is also acknowledged by Leong (2016) and Van Doren (2018). Leong (2016) hypothesizes that policy leadership can not only promote a policy upscaling but can also influence public opinions to encourage acceptance [17], making this condition also relevant to build public acceptance of a water recycling policy. In addition, Van Doren identifies the role of leaders as preeminent stakeholders who can put the initiative on the political agenda, motivate and coordinate other stakeholders, promote commitment and mobilize resources [26].

2.2.2. Coordination

Coordination is the capacity of different institutions to cooperate, to share goals, and to craft consistent policies [14, 26, 39]. Frijns et al., (2016) hypothesize that factors like institutional fragmentation or bureaucratization can hamper the decision-making capacity of an institution or a policy entrepreneur. Institutional fragmentation is recognized as a barrier to upscaling policy measures by several scholars such as Biesbroek (2014),) or Van Doren (2018). Fijns et al. (2016) observed

how the political fragmentation, bureaucratization, and a lack of decision-making capacity acted as a barrier in the case of the *Urban Water Reuse* project at the Olympic Park in London (United Kingdom) and in the municipality of Capitanata (Italy). Whereas, in the case of Torreele, in Belgium, a significant amount of time and effort was invested in setting common goals between water regulators and other authorities, contributing positively to the upscaling of a recycled water project in that city [14].

2.2.3. Availability of financial resources

The availability of financial resources refers to the capacity of project developers to make financial resources available for upscaling a specific policy or measure [26]. This condition determines the economic feasibility of the policy itself and its presence can be a crucial enabling element to upscale a policy [14]. The existence of public and private financing mechanisms is also identified by van Doren (2018) as an enabling element that allows policy developers to upscale the recycled water initiative [26].

2.2.4. Awareness of a problem

The awareness of a problem is the general perception among all stakeholders that there is a relevant problem that needs to be addressed through a policy measure, such as a problem of water scarcity. The presence of awareness, caused by an effective communication or through a direct experience with real water scarcity issues, is expected to increase the public understanding of the water-related challenge [22], while an insufficient awareness is likely to prevent stakeholders from understanding the crisis and the necessity for a policy or measure [39]. This awareness can be caused by a catalyzing event that, through effective communication between policymakers, experts, and non-governmental stakeholders, generates public understanding of a crisis [40]. Van Doren (2018) identifies environmental awareness as a condition that can strengthen public acceptance and demand for solutions [26] and Leong (2010) also hypothesizes that a sense of crisis can stimulate a change in water institutions, enabling policy changes such as the application of a recycled water scheme [15].

2.2.5. Presence of a public forum

We define the presence of an open forum as the existence of a means for policymakers and non-governmental stakeholders to dialogue and to collaborate with the aim to co-design publicly agreed strategies to solve the water-scarcity challenge [3, 6, 15, 20].

We identify in the literature two different approaches to understand public participation. Firstly, Leong and Yu (2010) argue that public acceptance can be fostered when policy entrepreneurs and institutions adopt an active role of communicating and persuading the public at the early stage of a policy process [16]. However, other scholars such as Smith (2018) or Ansell and Gash (2008) suggest that

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public participation should go beyond the simple provision of information and persuasion to actively engage citizens in consensus-based decision-making processes [22,41].

Several scholars suggest that making policies involving all stakeholders through public participation is a means to ensure that the policy outcome will not generate public opposition, based on the existing experiences in London, Florida or Australia [42, 43, 44]. Public engagement is expected to integrate legitimate public concerns about certain measures, to strengthen trust between stakeholders, and to build acceptance on the policy outcomes [41, 45, 46]. The final output of enabling a public participation process on policymaking is to foster social acceptance of policies, to expand the democratic participation in public decisions and to avoid the costs of adversarial policymaking [41, 47]. Conversely, a lack of involvement, information and lack of consideration for legitimate public concerns can trigger negative public reactions [21]. Therefore, we assume that engaging all the relevant stakeholders in a public participation mechanism is necessary to create public deliberation and to generate a policy output acceptable by all stakeholders [45, 48, 49].

Table 1. Enabling governance conditions to ex-ante analyze the upscaling of NPRW schemes.

Condition	Definition	Indicator	References
Policy leadership	Presence of a leading institution or a political entrepreneur that promotes policy change.	Presence of a leading stakeholder that promotes the upscale of the NPRW scheme.	Frijns et al., (2016) Leong (2016) Lejano and Leong., (2012)
Coordination	Capacity of different institutions to share goals, cooperate and to craft consistent policies.	Other relevant stakeholders do not block the NPRW scheme or they participate in its upscaling process.	Biesbroek, (2014); Frijns et al., (2016);
Availability of financial resources	Capacity of project developers to have financial resources available to ensure the economic feasibility of the policy.	Presence of a financial scheme to ensure the financial resources to upscale the NPRW scheme.	Frijns et al., (2016); Van Doren, (2018)
Problem awareness	General perception of a relevant problem that needs to be addressed.	Stakeholders acknowledge the existence of a water scarcity challenge	Smith et al., (2018) Johnson, Tunstall, & Penning-

		that needs to be addressed.	Rowsell, (2005) Biesbroek, (2014)
Presence of a public forum	Existence of a process of public participation that enables a dialogue between governmental and non-governmental stakeholders about public policy.	Existence of a public forum where governmental and non-governmental stakeholders have the possibility to dialogue on water-related policies and co-design policies to address possible challenges.	Frijns et al., (2016) Khan & Gerrard, (2006); Marks, (2006); Russell & Hampton, (2006); UNESCO, (2017)

3. Materials and Methods

Sabadell is a city located in the Besòs river basin, in the Province of Barcelona (Spain), and it had 209.931 inhabitants in 2017, being the fifth most populated city in Catalonia [50]. The water supply of Sabadell is challenged by two factors. Firstly, the growing population and increasing water demand in Sabadell and in the other municipalities of the 'Àmbit metropolità de Barcelona', and secondly, a reduced freshwater availability caused by climate change and changing rain patterns [51, 52, 53]. This situation has compelled the water authorities of Sabadell to create strategies to guarantee its water supply by means of innovation or by means of managing its demand [51, 54]. According to the definition given in section 2.1, we understand the upscaling of a NPRW scheme in Sabadell as an example of a horizontal scaling up process where an existing measure that has been applied in a section of Sabadell is being upscaled throughout the rest of the city.

We performed a desk research to analyze the existing literature on water governance in Sabadell, the different reports on water governance, and all the published policy documents, presentations and summaries available that analyze how the NPRW scheme is being upscaled by the water authorities in Sabadell. The analysis of the existing reports and policy documents has been complemented by conducting a set of 21 semi-structured interviews with policymakers, water users, relevant employees from different institutions and relevant stakeholders involved in the application of the NPRW scheme in Sabadell and we attended two workshops on water governance with relevant stakeholders (Appendix 1, Table 2). The interviewees were selected from the institutions, companies and organizations relevant to the water governance in Sabadell such as the municipality of Sabadell, the water supply company, members of non-governmental organizations, and

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relevant staff from the Government of Catalonia, and agencies such as the Catalan Water Agency. The interviews were conducted to reach a saturation point where further data collection was not bringing new information to the research.

The resulting information was recorded, transcribed and systematically catalogued by identifying the references to the presence of the five conditions explained in table 1. This systematic cataloguing and comparison aims to enable a systematic analysis of the extracted information to reconstruct the policy process that leads to the NPRW scheme design and upscaling through means of qualitative data analysis. In addition, the content of the interviews has been verified by comparing it to other interviews and with complementary information in the available policy documents. Finally, the report was sent to the interviewees to verify that the information in the report correctly reflected the information that they provided.

4. Results

4.1. Upscaling in Sabadell

The municipality of Sabadell has been crafting policies since 2002 to prepare the city for situations of water scarcity, as Sabadell has experienced severe cases of water scarcity due to droughts and a growing water demand [53, 56]. At the first stage (2002), these policies included projects of groundwater reclamation to use water from local wells for cleaning streets or campaigns to encourage the reduction of water consumption [54, 55, 56, 57, 60, 61].

The municipality of Sabadell approved a Non-potable Water Masterplan in 2004 where it detailed the ambition of the local government to create a non-potable recycled water (NPR) scheme throughout Sabadell to reduce the consumption of freshwater from other sources [51, 54, 55]. The NPRW scheme of Sabadell was firstly upscaled in the industrial park of Sant Pau de Riu Sec, where all companies were supplied with two types of water, potable freshwater and non-potable recycled water [56, 57, 58]. The municipality of Sabadell aims to expand this scheme to the rest of the city to extend the recycled water supply and to further reduce the consumption of freshwater throughout the city [51]. In the case of Sabadell, non-potable recycled water is meant to be used for non-drinking purposes such as cleaning streets, watering urban parks and gardens, industrial purposes and flushing toilets [51]. The city of Sabadell meets almost all the conditions considered in this study to allow for a successful upscaling.

4.2 Policy leadership

With regards to the policy leadership, the municipality of Sabadell is assuming the role of leading the upscale of the NPRW scheme. This role is recognized and legally reinforced in the Masterplan for the use of non-potable water, also known as "Pla Director d'Utilitzacions Externes a la Xarxa de Distribució d'Aigua Potable (2004)" [54, 56, 59]. This leadership has been crucial to approve a city regulation to require real estate developers who build new households to meet certain conditions

to include a greywater system, to create a financing system to invest in a double pipeline network for non-potable water, and to convince other institutions such as the Catalan Water Agency (ACA) to invest in a water recycling facility in the wastewater treatment facility of Riu Sec.

4.3. Coordination

The institutions involved in the water governance of Sabadell are positively coordinated to allow the upscale of a NPRW scheme. At a local level, the good coordination between the water supply company (CASSA) and the municipality of Sabadell allows the upscale of the NPRW scheme at all the levels, from the upscaling, the establishment of communication between the two organizations, the mutual evaluation of the upscaling process, and the expansion of the infrastructure needed to upscale the NPRW scheme. For example, these two stakeholders share the objective of implementing the NPRW scheme and are actively involved in its upscale and the installation of the necessary infrastructure to implement the scheme. The coordination between the municipality of Sabadell and river-basin institutions such as the Catalan Water Agency (ACA), the department of Public Health of the Government of Catalonia and the Ministry of Sustainability and Environment of the Government of Catalonia is also positive. This coordination has been realized by the municipality of Sabadell, which brought about the involvement of these institutions in the creation and upscale of the NPRW scheme, for instance by investing in an updated water treatment facility by ACA to enable the recycling of wastewater. This coordination helps to avoid the existence of contradicting legislation and policies or excessive bureaucratization of the water service by centralizing all the procedures to request recycled water in the municipality.

4.4. Availability of financial resources

The financial resources needed to make viable the NPRW scheme in Sabadell are made available through a financial scheme that combines private and public funding in a scheme divided into three parts; (1) the financing of the water recycling facility, (2) the financing of the expansion of the double pipeline network and (3) the financing of the network within urban dwellings. The presence of a financial scheme that relies on real estate developers and water taxes is expected to ensure the financial resources needed to expand the NPRW scheme throughout Sabadell. The absence of a specific measure that targets existing buildings is the only limitation found that can possibly delay the upscaling of the NPRW scheme because it limits the upscale of the NPRW scheme to only newly constructed dwellings.

4.5. Problem awareness

With regard to the public awareness of the water scarcity challenge of Sabadell, all the interviewed stakeholders acknowledged the existence of a lack of freshwater to satisfy the demand from the urban areas of Sabadell and the rest of the conurbation of Barcelona. All the stakeholders pointed at the 2007-09 drought [53]

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as the latest experience in water-scarcity that created a societal awareness among the public in Sabadell. The drought of 2007-09 was the worst drought that has affected Catalonia for the last 70 years and provoked a severe institutional, political, and environmental crisis, and it led to the most intense awareness campaign ever performed in Catalonia to involve citizens in reducing water consumption [53].

4.6. Presence of a public forum

There are three different projects to create a public forum in Sabadell, but despite their presence, these public forums do not effectively enable a dialogue between governmental and non-governmental stakeholders. Firstly, the water supply company (CASSA) is performing its own outreach campaigns to collect societal feedback on the performance of the company and how the application of water-related initiatives is perceived by the public. Secondly, a European-funded project with the only local collaboration of the same water supply company is implementing a Social Digital Platform (DSP) to enable public participation through digital means and reducing the transaction costs of public participation to generate a trustworthy method of informing all citizens on water-related measures or policies [58, 59]. Thirdly, the municipality of Sabadell has started a public participation initiative called 'Taula de l'Aigua de Sabadell'.

Despite their existence and the willingness of their promoters to create a public dialogue on water governance, a lack of legitimacy among the different water-related stakeholders and their lack of coordination to create an integrated public debate has resulted in a fragmentation of the public debate. Additionally, none of the initiatives to create a public forum involve stakeholders relevant to water governance at a river-basin level such as ACA or the different Ministries of the Government of Catalonia as Public Health, Environment and Sustainability or Agriculture [62]. This fragmentation of the public debate jeopardizes the capacity of the public forum initiatives to enable an effective dialogue between stakeholders on water policy.

To summarize, we propose a framework of five different conditions to ex-ante analyze the capacity to upscale NPRW schemes in urban areas. These conditions are: (1) policy leadership, (2) coordination, (3) availability of financial resources, (4) awareness of a problem and (5) presence of a public forum (table 1). The policy leadership is a very relevant enabling condition since the NPRW scheme needs a leading actor that promotes the upscaling of the scheme and enables other necessary conditions to implement a NPRW scheme. Coordination is also a relevant condition to avoid political fragmentation and inconsistent legal frameworks that can act as barriers, hampering the upscaling of the NPRW scheme. Financial resources are a key element to ensure the viability and the necessary means to upscale the NPRW scheme, as the necessary infrastructure. The general awareness of a problem, in this case water scarcity, is also a relevant element, since public understanding of the challenge that the NPRW scheme aims to address is key to justify its upscaling. Finally, the presence of a public forum is also a necessary condition to enable a public

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dialogue between governmental stakeholders and non-governmental stakeholders to ensure that the NPRW scheme is the outcome of a wide public agreement.

Sabadell meets almost all the enabling conditions considered in this study to upscale a NPRW scheme throughout the city; only the lack of a public participation mechanism jeopardizes the upscaling of the scheme. The municipality has adopted a leading role to promote this policy and all the institutions involved in the water governance in the city are aligned to its upscaling. Also, there is a general sense of awareness of the water-scarcity situation in Sabadell that justifies the goal of this policy. However, the existing initiatives to create a public participation process are hampered by a lack of coordination in promoting a common public participation in Sabadell. This lack of coordination is also reflected in the institutional arrangement of the existing public participation mechanisms, that do not include all the stakeholders involved in the water governance of Sabadell.

5. Discussion

The lack of public involvement in the creation of climate change adaptation strategies and public participation makes the upscale of the NPRW scheme vulnerable to a potential negative public reaction. Despite the presence of several projects to create public participation mechanisms in the city of Sabadell with regard to water governance, the lack of collaboration between the relevant stakeholders has led to the fragmentation of the public debate in three different public participation projects that do not integrate all the stakeholders related to local water governance in Sabadell (section 4.1.5.). In contrast to the coordination to upscale the NPRW scheme (section 4.1.2.), the institutions and stakeholders related to water governance in Sabadell are not coordinated to create a consistent public participation mechanism or to integrate all the stakeholders. According to Ansell and Gash (2008) such a lack of inclusivity may hamper fruitful debates [38].

The presence of a public forum *per se* does not guarantee either the establishment of an effective public debate on water policy or stakeholder involvement. Therefore, to encourage stakeholder involvement and to encourage an effective public forum, we suggest the inclusion of two elements in the proposed framework. These are: firstly, a facilitative leadership, a leadership differing from the policy leadership characterized in section 2.2.1 because it does not want to promote a specific policy, but instead assumes the tasks of bringing all the parties at the table, acts as a mediator and sets and maintains clear rules for interaction, deliberation and negotiation; and secondly, an institutional design that brings procedural legitimacy to the collaborative process and ensures that the process is open and inclusive [41]. The inclusion of these two elements should help to analyze whether a public forum can effectively engage stakeholders to create an effective public debate.

Both the '*Taula de l'Aigua*' in Terrassa and the the '*Taula del Delta i de la baixa Tordera* could be considered as good practices of public participation mechanisms in water governance. The '*Taula de l'Aigua*' in Terrassa, is a public participation mechanism composed of political organizations, non-governmental organizations, members of the local government, technical staff and experts from academia [64].

This mechanism has the capacity to generate advice, to monitor water management in Terrassa and it involves governmental and non-governmental stakeholders in the decision-making process of water governance [64, 65, 66]. This public participation initiative succeeds in integrating all the relevant stakeholders related to water governance within the municipality of Terrassa, thanks to the facilitative leadership role adopted by an enthusiastic group of citizens, the willingness of all stakeholders to collaborate in this common space and the agreement of the local government to democratize and to integrate public deliberation at the core of its water governance. To take up the example of the '*Taula de l'Aigua*' in Terrassa, we suggest the creation of a public participation mechanism in Sabadell that involves all the relevant stakeholders involved in local water governance, such as political organizations, non-governmental organizations, members of local government, relevant staff from the local water supply company and experts from academia.

The '*Taula del Delta i de la baixa Tordera*' is a deliberative multi-stakeholder platform that aims to increase institutional coordination and foster public dialogue on the issue of water management and adaptation to climate change [67]. The '*Taula del Delta i de la baixa Tordera*' includes a variety of stakeholders such as municipalities, supra-municipal entities, regional and national administrations, economic sectors, citizens, NGOs and researchers, therefore ensuring the representation of as many parts of society as possible and avoiding the fragmentation of the water-governance deliberation. This public participation was fostered by local administrations and researchers, that have adopted the role of a facilitative leadership to ensure that the public participation mechanism involves a relevant number of stakeholders, and to ensure knowledge sharing, to integrate social perceptions, scientific data and causal relations between crucial factors to diagnose and co-design solutions in the frame of an integrated planning exercise. To take up the examples of the '*Taula del Delta i de la baixa Tordera*', we suggest "opening up" the recycling master plan of Sabadell in a public participation mechanism and integrating this with other policies affecting water use and climate change adaptation, such as, for example, urban expansion policies [67].

Public debate in Sabadell could also benefit from the presence of a digital social platform (DSP). Such a DSP has the potential to make information more available, creating more transparency, facilitating public monitoring, and eventually even lowering transaction barriers for public participation in water governance [68, ,69, 70, 71]. However, DSPs are no panacea. For instance, Mukhtarov et al., (2018) argue that democratization and public deliberation are political issues at their core, so the presence of a DSP alone is not enough to provoke a policy change towards collaborative governance [72]. Fung et al., (2013) also argue that democratization and public participation are political processes that cannot be promoted only by means of implementing ICT tools [73]. Therefore, a DSP can open up new opportunities for stakeholders to participate in water-governance and can foster public participation, but these contributions are limited, and the democratization process needs to be supported by a facilitative leadership that encourages a policy change and that

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promotes stakeholder involvement in a face-to-face public participation process to ensure representativity and inclusivity.

This research built an analytical framework based on the existing literature on upscale recycled water schemes, and this framework has been applied to the case-study of Sabadell. In this sense, this report aimed to reconstruct an analytical framework by using the available literature that specifically analysed cases of upscaling recycled water schemes, but it did not intend to expand this list of conditions by identifying new elements. Due to the limited literature available on conditions to upscale recycled water schemes, we acknowledge that this framework can be still further developed by including other relevant conditions. Since this research is an ex-ante analysis of the situation of Sabadell made before the actual upscaling of the NPRW scheme, we suggest a further study of the role and relevance of the conditions in the analytical framework and whether new conditions enabled actual upscaling efforts.

6. Conclusions

In conclusion, to upscale a NPRW scheme is a measure with the potential to bring many opportunities for urban areas suffering from water scarcity to adapt to climate change. In this paper we studied the governance conditions to upscale a NPRW scheme based on a literature review and an ex-ante evaluation of Sabadell's urban water management.

To enable upscaling of a NPRW scheme, it is important to meet five governance conditions; (1) the presence of a policy leadership that promotes the upscaling process of a NPRW scheme and creates the necessary conditions to upscale the policy, (2) coordination among the relevant stakeholders to avoid potential blocks to upscale the NPRW scheme, (3) availability of financial resources to ensure the viability and the financial capacity to upscale the NPRW scheme, (4) problem awareness or the awareness among the general public that there is a problem of water scarcity that justifies the upscale of a NPRW scheme, and (5) the presence of a public forum that creates an open debate among all stakeholders to generate public acceptance on the NPRW scheme. This last condition is especially relevant, because as said in the introduction, the lack of a sound public debate was behind the failure of the upscaling of the NPRW schemes in the cases of Utrecht, Toowoomba and Los Angeles.

Therefore, other municipalities or governments who may consider upscaling a NPRW scheme should consider analyzing the proposed five conditions above, and pay special attention to the condition of the creation of a public forum to integrate public participation in a common evaluation and co-design of any potential climate change adaptation policy. This public forum should engage all the relevant stakeholders that are involved in water governance and create tools to make this participation more accessible, for example by means of considering the inclusion of a DSP within the public participation mechanism.

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Appendix A

Table 2. List of interviewees.

Number interview	Role	Organization	Kind of organization	Municipality
1	Expert	GIACSA	Water management company	Manresa
2	Expert	AGBAR	Water management company	Barcelona
3	Expert	UAB	Water consumer	Bellaterra
4	Expert	ACA	Water authority	Barcelona
5	Expert	CREAF	Research institution	Bellaterra
6	Activist	Observatori de l'aigua	NGO	Terrassa
7	Expert	Generalitat Catalunya	Water authority	Barcelona
8	Journalist	iSabadell	Local media	Sabadell
9	Activist	Aula de l'Aigua	NGO	Barcelona
10	Manager and businessman	Industrial park of Sant Pau de Riu Sec	Water consumer	Sabadell
11	Director new uses	CASSA	Water management company	Sabadell
12	User	None	Water consumer	Sabadell
13	Expert	Ajuntament Sabadell	Water authority	Sabadell
14	Expert	Ajuntament Sabadell	Water authority	Sabadell

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15	Communication expert	CASSA	Water management company	Sabadell
16	Activist	Enginyers sense fronteres	NGO	Barcelona
17	Expert	CTM	Research institution	Manresa
18	Expert	Diputació de Barcelona	Water authority	Barcelona
19	Expert	ACA	Water authority	Barcelona
20	Activist	PDE	NGO	Tortosa
21	Team of seven people with diverse backgrounds.	CASSA	Water management company	Sabadell
22	Three experts in water governance involved in the creation of Taula de l'aigua.	Observatori de l'aigua	NGO	Terrassa
23	Politician from Crida per Sabadell.	Crida per Sabadell	Local political party	Sabadell

Appendix B

Questions for the semi-structured interviews:

- What do you know about the situation of water scarcity in Sabadell? Did you have direct experiences with water scarcity situations?
- Is water scarcity an important problem in Sabadell? Why?
- What is your vision on the NPRW scheme in Sabadell? Do you know this policy?
- What has been your role in the implementation of the NPRW scheme in Sabadell?
- What other policies do you know of to prepare Sabadell for future droughts? And to adapt to climate change?
- Who is leading the implementation of the NPRW scheme? How is it leading it?
- How does this actor involve you in the NPRW scheme?
- How is the NPRW scheme being financed? Do you participate in this financing?

- Are there public participation mechanisms in which you can feedback the water-related policies in Sabadell? How is the general public involved in public participation?
- Do you know about the existence of the POWER DSP? What is your opinion on this initiative?
- Do you have any other thoughts about the issues of public participation or the NPRW policy?

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