
Governing the reuse of treated wastewater in irrigation: the case study of Jericho, Palestine

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Abstract: Wastewater reuse in irrigation provides additional water supply for agriculture and saves freshwater resources for human consumption. Through these benefits, wastewater reuse can significantly alleviate the water scarcity in Palestine and fit to the complexity of the geopolitical context. However, the governance of reusing treated wastewater in Palestine is understudied. The paper bridges this knowledge gap by outlining the governance factors that influence the reuse of treated wastewater for irrigation in Palestine. Jericho was selected as the case study site, given its significant role for agricultural production in Palestine. Based on interviews and document reviews that were carried out using a governance assessment tool, three governance-related factors are identified: 1) weak coherence among the actors, reflected in overlapping and unclear responsibilities; 2) low extent and coherence of legal instruments, indicated by the absence of laws and by overlapping and conflicting provisions; 3) low extent of resources, such as appropriate infrastructure.

Keywords: wastewater treatment and reuse; water governance; governance assessment; water law; Jericho, Palestine.

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1 Introduction

Water scarcity is becoming an alarming issue, specifically in (semi)arid areas and many developing countries, as the water demand for agricultural, domestic and industrial purposes is on a rapid rise (WWAP, 2015). However, as the available supply is often not able to meet these rising demands of various sectors, the governance of water resources becomes a pivotal issue in order to achieve water security. Nonetheless, in most developing countries, water governance suffers from poor resource management, lack of appropriate institutions, corruption, bureaucratic impediments, insufficient capacity, and shortage of new investments in the water sector. These obstacles call for the need of effective water governance globally (Rogers and Hall, 2003).

Recently, finding innovative approaches to counter the effects of water scarcity in water-scarce settings has become a crucial issue. The need for well-coordinated and improved water governance also increases in such settings (Özerol and Günther, 2005). Water governance is a complex system that involves a wide range of elements that work together for the delivery and management of water resources. Mainly, water governance aims at guiding decision making with regards to water resource development and management (Moench et al., 2003). In particular, water governance comprises organisational, legal, financial, social, economic, environmental and political dimensions that guide and facilitate actions and interactions among relevant stakeholders and actors involved in the management of water resources. To understand water governance functions, assessments of these elements are conducted (UNDP, 2013; Bressers et al., 2013).

Treated wastewater is considered an invaluable additional source of water for agricultural and landscape irrigation. The reuse of treated wastewater reduces the amount of freshwater used for irrigation and the amount of wastewater discharged in the environment, creating a significant potential for health, environment and economic benefits, especially in the Middle-East and North Africa (MENA) region (Nassar et al., 2015; Shomar and Dare, 2015). The treated wastewater represents a potential for reuse by farmers (Qadir et al., 2010). However, integrated, cross-sectoral efforts are required in water, agriculture and environment sectors to govern the reuse of treated wastewater in irrigation. This also requires overcoming the governance challenge of implementing improved policies, institutional dialogues, financial mechanisms and interdisciplinary research (Qadir et al., 2010; Shomar and Dare, 2015). Furthermore, water and wastewater governance systems can be both costly and complicated in middle and low income countries (Tchobanoglous, 1995).

Like most countries in the MENA region, Palestine is considered to be a semi-arid area with significantly low availability of freshwater resources. Not only is Palestine a water scarce country, but also most of its natural water resources are controlled by Israel (Mizyed, 2013). Palestine comprises of the West Bank and the Gaza Strip, both of which face several challenges in the water sector. Although wastewater reuse – in some parts of Gaza-represents a significant potential source for additional water, in this paper we focus only on the West Bank, due to limitations of access to conduct field work in the Gaza Strip.

With a population of 2.6 million (PCBS, 2011) and a gross domestic product (GDP) of 4,979 USD/capita/year (World Bank, 2012), agriculture has always been a main source of income and employment in the West Bank. However, due to the conflict and the increasing scarcity of water, the contribution of agriculture to the GDP has dropped to

about 5.3% in 2010 and to only 13% of contribution to labour over the past ten years (PCBS, 2011). Irrigated agricultural production, in Palestine, accounts for 38% of all agricultural production; however, the most limiting factor to irrigation is water availability (Mizyed, 2013). Increasing water supplies for irrigation could significantly improve food production and thus food security and living conditions especially in vulnerable Palestinian communities (Mizyed, 2013).

Moreover, due to population growth and socioeconomic development, the water demand for domestic use is on the rise in Palestine, which results in increasing pressure for diverting water from agricultural use. Hence, it is necessary to find alternative and additional water resources for agricultural use. The use of unconventional water resources, such as treated wastewater represents a major opportunity for increasing the water available for agriculture in Palestine (Abu Madi, 2006; Mizyed, 2013; Özerol, 2013). Due to the scarcity of water resources and the dependence of many Palestinians on agriculture as their primary source of income, as well as the fresh/drinking water being the main source of water for irrigation, there is a significant need to utilise non-conventional water resources in irrigation. The reuse of treated wastewater is one of the few feasible measures to increase the availability of irrigation water for agricultural production in Palestine.

This paper focuses on the case of Jericho, since among the Palestinian cities and governorates, it is considered to be of crucial importance for agricultural production and water use. With a population of 22,609 inhabitants, Jericho district has been one of the main sources of agricultural production in Palestine. Moreover, located in the Jordan valley and being the oldest city in the world, Jericho is a main touristic attraction both for internal and international tourism. Hence, the need for water to support farmers, inhabitants and tourists remains high. However, over the past few decades there has been a significant decrease in land cultivation due to the general problem of water scarcity in the region. Not only are freshwater resources decreasing, but Palestinians also have no control over the limited available resources for their use due to the Israeli control over these resources. Introducing irrigation with treated wastewater from newly established wastewater treatment plant in Jericho represents a significant opportunity to improve food production. Thus, Jericho is considered to be an exemplary Palestinian city in the tourism and agricultural sectors that are facing the water scarcity dilemma, and it is a politically and socially relevant case to assess the governance of the reuse of treated wastewater.

Although wastewater reuse represents a significant potential to account for the scarcity of water in Jericho in particular and Palestine in general, the governance of the reuse of treated wastewater in Palestine remains understudied. There are no previous studies that investigate how the water and wastewater governance system influences the implementation of the reuse of treated wastewater in irrigation. This paper aims at bridging this knowledge gap by outlining the governance factors that facilitate or hinder the reuse of treated wastewater for irrigation in Palestine. Accordingly, the objectives of the paper are as follows:

- 1 identifying the key actors and understanding their roles and interactions in the governance of treated wastewater reuse
- 2 pinpointing the cross-sectoral issues that are related to the governance of treated wastewater reuse

- 3 identifying the obstacles and opportunities towards the implementation of treated wastewater reuse.

2 Materials and methods

2.1 Governance assessment tool

An abundance of papers in literature introduce different frameworks and models for the assessment and understanding of the governance of water. However, these models tackle three general components of water governance:

- 1 actors and institutions
- 2 governance principles
- 3 performance (Holtz et al., 2010; van de Meene et al., 2011; UNDP, 2013; OECD 2015).

The rationale for conducting governance assessments lies in understanding how well a governance regime is put in place, which stakeholders are participating in the decision making processes, which formal and informal institutions are involved, what laws and legislations facilitate governing water resources, etc. The assessments can also answer questions regarding transparency, accountability, and participation of a governance regime. Such systematic assessments can allow more informed policy-making and management functions of water resources (Holtz et al, 2010; van de Meene et al, 2011; UNDP, 2013).

For the purposes of this paper, we applied a governance assessment tool, which provides a comprehensive, user-friendly, and a transferable framework for conducting water governance assessment in different settings (Bressers et al., 2013, 2015). The tool covers the following dimensions of water governance:

- 1 levels and scales
- 2 actors and networks
- 3 problem perspectives and goal ambitions
- 4 strategies and instruments
- 5 responsibilities and resources.

These five dimensions are assessed on the basis of four criteria that reflect the quality and functionality of given governance system:

- Extent: are all relevant elements in a given dimension taken advantage of?
- Coherence: are the elements of a given dimension reinforcing each other, rather than contradicting?
- Flexibility: are multiple pathways to desired outcomes considered?
- Intensity: is there a sense of urgency to change the status quo?

As provided in Bressers et al. (2013), extensive lists of evaluative questions are answered to assess the extent, coherence, flexibility and intensity of the governance system. Based on the answers to these questions the evaluator reaches specific conclusions as to whether the governance system, through its five dimensions, has a supportive or restrictive influence on the given policy issue, project or program.

2.2 Sample selection and data collection

We purposively selected Jericho district as a case study to explore the water governance system in Palestine. The choice of Jericho allowed and in-depth exploration and understanding of the various components of the water governance systems in Jericho is representative of the socio-economic, demographic, political, and agricultural characteristics of Palestine as a whole. These representative attributes also allowed the generalisation of our findings from a single case (Gerring, 2004).

We collected qualitative data through in-depth interviews with key stakeholders and through document review. Based on the assessment tool, we designed an interview guide to facilitate data collection and analysis. The interviews were conducted by the first author. Each interview lasted on average 30 to 45 minutes. To ensure privacy, we interviewed respondents alone at their workplace. Before proceeding with the interview, we explained the aim of the study and sought informed consent to participate. All interviews were tape-recorded and in addition extensive notes were taken during the interviews.

In total, we conducted 12 in-depth interviews with the representatives from key stakeholders of wastewater reuse. Our interview respondents included the policy-makers in the water and agriculture sectors, namely the Water Sector Regulatory Council (WSRC), Palestinian Water Authority (PWA) and the Ministry of Agriculture, as well as local government representatives from the Jericho Municipality. Moreover, we interviewed water users and potential treated wastewater users: the Ministry of Tourism, Farmers Union, and managers of wastewater treatment plants. Finally, we consulted and met with religious scholars to identify and explain the social acceptance of the reuse of treated wastewater by the public.

We also reviewed the relevant policy documents, scholarly articles and reports regarding water in order to understand the interplay between the different stakeholders and sectors, thus triangulating our data collection methods.

2.3 Analysis of the collected data

We transcribed all interviews in Arabic, translated them into English, and then matched the transcripts with the notes taken during data collection. Further, we coded all the transcribed text based on the abovementioned three objectives of the paper. We identified the various governance factors affecting the reuse of treated wastewater, first based on the responses of the interviewees. Then, we corroborated the findings from the interviews in light of the reviewed policy documents and our knowledge and experience in the Palestinian water sector. For organising and reporting our findings, we did not apply the governance assessment tool as a strict theoretical framework, but rather as a theoretical lens, which we used to address the most influential dimensions and criteria for the specific context of the governance of treated wastewater reuse in Palestine.

3 Results and discussion

This section outlines the main factors influencing water governance in Palestine, presented in four sections:

- 1 overview of water status in Jericho
- 2 actors and their roles and interactions in the governance of water and wastewater
- 3 cross-sectoral issues related to the governance of treated wastewater reuse
- 4 obstacles and opportunities towards the implementation of treated wastewater reuse.

We present our findings and elaborate them in light of the four criteria and five dimensions of the governance assessment tool.

3.1 Overview of water status in Jericho

The Jericho district depends on only one freshwater source, the Ein Sultan natural spring that produces six million m³ of water per year. This water is allocated among three major user sectors: 50% is used for agricultural purposes, while the remaining 50% is directed for, mainly, domestic and touristic uses. Although the average water consumption is relatively high (281 L/c/d) and the cost per Litre is low (0.255 USD/L) compared to other Palestinian districts (70–80 L/c/d and 1 USD/L respectively), Jericho suffers from increasing water shortages and inequitable access to water among inhabitants and farmers. Our findings indicate that these dilemmas come as a result of several factors, which mainly include the private ownership of natural springs, the un-monitored drilling of wells by farmers and inhabitants, and the weakened management of the available water resources.

3.2 Actors and their roles and interactions in the governance of water and wastewater

There are various actors in the Palestinian water and wastewater sectors. For the sake of focus, we identified the main actors that have a direct role in the development, management, and use of water and wastewater. At the national level, the main actors in policy-making and overall management of the water sector are two governmental bodies, namely the PWA and the WSRC, which are established in 1995 and 2014, respectively. Municipalities are the main actors of the water sector at the local governmental level. PWA is also the main water provider to the Municipality, which in turn manages the provision of water services. The Ministry of Agriculture is both the main national actor of the agricultural policy-making, and it also regulates water uses by farmers. The Farmers Union and the Ministry of Tourism are the main end-users of water other than the domestic use. The Farmers Union, Ministry of Agriculture and Ministry of Tourism are main potential users for treated wastewater. The actual reuse of treated wastewater by these potential users is affected by social authorities such as religious scholars. Table 1 summarises all the actors involved in water and wastewater governance:

Table 1 Actors and their roles in water governance

<i>Sector</i>	<i>Actor</i>	<i>Role in water and wastewater governance</i>
Water policy and management	Palestinian Water Authority (PWA)	Managing water resources, preparation of water policies, strategies and plans. Proposing water allocations for the various sectors, protection of water sources, licensing of water resources, and drafting of bylaws and water regulations.
Water Sector Regulatory Council (WSRC)	Monitoring and regulation of water production, transportation, distribution, consumption, and wastewater management aiming at water and wastewater services quality and efficiency at affordable prices.	
Agriculture policy and agricultural water management	Ministry of Agriculture	Drafting of agricultural related laws and legislations; management; provision of agricultural services provision; regulation of irrigation water use; supervise of treated wastewater reuse.
Local governance	Jericho Municipality	Water service provider; management of local water and wastewater resources; implement water tariff setting; management of wastewater treatment plants' operations
Water users	Palestinian Farmers Union	Organisation of farmers; water user
Ministry of Tourism	Water user; management of water use in tourism	
Wastewater treatment plants	Water user; implementer of treated wastewater reuse	
Social authorities	Religious scholars	Religious interpretation of the use and social acceptance of treated wastewater, awareness and education

The findings from the interviews indicate several issues related to the distribution of roles and responsibilities among the multiple actors of water and wastewater governance. For instance, the role and responsibilities of PWA are overlap with the role and responsibilities of other actors such as WSRC and the municipality:

“PWA is the body responsible for policy making, planning, and monitoring of water-related service delivery, as well as providing water services. WSRC is responsible for the regulation of water services. The foreseen national water company is to be the water provider instead of PWA.” (WSRC, interview 4)

Moreover, there are unclear roles and responsibilities on the management level of the natural springs in Jericho district and its surroundings:

“The underlying problem of water availability and access in the district is water resource management. The natural springs are owned by individuals, not by the state. This leads to the exploitation of resources and makes management responsibilities unclear and roles unidentified. Thus, no one can be held accountable or responsible for the poor management of these resources.” (Jericho Municipality, interview 2)

Similarly, the responsibilities and accountabilities regarding the decision making, management and service provision processes in the water sector are unclear and fragmented. A major indication of this situation is the dominant role of PWA in most of these processes:

“PWA is a key player in policy-making, project planning and implementation, as well as water services provision... How can PWA monitor its own work against its own laws?” (Water and agriculture expert, interview 8)

Furthermore, the relevant laws aren't updated and modified according to the needs and changes in the sector:

“Until recently, water laws were not being updated regularly and are in conflict with each other. There were no specified or assigned roles and responsibilities in the laws to who should have the responsibility of management and provision of water resources.” (PWA, interview 3)

The same situation applies to the ownership rights regarding natural springs which are not dealt with in the new Palestinian water law:

“Although there are newly updated water laws, the out-dated Ottoman law regarding the private ownership of the water springs still holds in Palestine. The new laws do not tackle this issue which amplifies the mismanagement of water resources and the inequitable access to water.” (Municipality, interview 2)

Looking at the above findings, it can be observed that there are many actors, levels, responsibilities and legal instruments and thus the extent regarding these dimensions is assessed to be supportive to implement the reuse of treated wastewater. However, the coherence regarding the actors and the legal instruments is low, since there is an evident overlap of the roles and responsibilities of different actors as well as the provisions of different laws and regulations.

3.3 Cross-sectoral issues related to the governance of treated wastewater reuse

The actual use of treated wastewater by farmers is affected by three major socio-economic factors. First, there is very low acceptance by farmers to use treated wastewater to irrigate their agricultural lands. This is due to their belief that the use of treated wastewater is not religiously appropriate, and their perception that treated wastewater is harmful for their plants: “it is Haram in our religion to irrigate our lands using wastewater. Freshwater is healthier for our plants” (Farmers Union, interview 1).

However, interviewing an Islamic scholar at a leading Palestinian university showed that in Islam it is permissible to use treated wastewater for irrigation, provided that it is treated properly:

“Yes we can reuse it to irrigate all the crops in case it has been treated scientifically in a correct way. A decision was issued from the Council of Senior Scholars in Saudi Arabia, the highest scientific body as long as it is processed correctly and do not keep anything from impure and harmful substances and the decision also includes the possibility of reuse it for drinking as well as the purification was in a correct way and not have a smell, taste and colour.” (Academic Islamic scholar, interview 6)

Second, the pricing policy for treated wastewater is not flexible for encouraging its reuse. The cost of purchasing treated wastewater compared to freshwater for irrigation is significantly higher, which leads farmers to purchase freshwater for irrigation rather than treated wastewater. As reflected in several interviews, there is a need for the water providers and policy makers to take into account this pricing dilemma that hinders the reuse of treated wastewater by farmers for irrigation:

“The cost per cubic meter of treated wastewater is significantly higher than that of freshwater, especially in Jericho district where water prices are relatively low. This hinders farmers greatly from purchasing treated wastewater even if they accept to use it in principle.” (Farmers Union, interview 1)

“Water Regulatory Council faces a big challenge in the tariff of freshwater and treated wastewater in Jericho. Since freshwater is relatively cheap in Jericho, then the tariff on treated wastewater should be significantly decreased to encourage farmers to purchase this treated wastewater.” (PWA, interview 3)

Third, the use of treated wastewater by farmers is also hindered due to lack of legal and information-based policy instruments in the agricultural sector to change the *status quo* of using freshwater for irrigation. The agricultural share of freshwater could be directed to human consumption, if treated wastewater would be reused for irrigation. However, there is no policy or public awareness to incorporate the use of treated wastewater into laws, other policy instruments and water use practices.

“Jericho suffers but from poor management of water resources. Therefore private ownership of water springs should be abolished and laws and legislations should enforce using treated wastewater for agricultural purposes.” (PWA, interview 3)

“The use of treated wastewater by farmers can be encouraged if they were convinced that by the use of treated wastewater (secondary treatment) will substitute the need of fertilizers, given the cost remains higher than that of freshwater. Here comes the role of farmers union and Ministry of Agriculture to influence the farmers.” (WSRC, interview 4)

“Eventually farmers will have to use treated wastewater, because freshwater resources are diminishing, and they will be convinced of its good quality for irrigation, especially after the Palestine Standards Institution reported the excellent quality of treated wastewater in Jericho. However tremendous efforts are still needed to achieve this.” (Former agricultural minister, interview 7)

Interplay of cross-sectoral issues also shape the low intensity associated with the non-use of treated wastewater by farmers. The unwillingness of farmers to use treated wastewater comes as a result of a predisposed and inherited belief that this water is not appropriate for agricultural irrigation, which shapes their current behaviour, although it is lawful according to the Islamic Law (Farooq and Ansari, 1983). Moreover, the lack of flexibility in the existing pricing system and the lack of appropriate infrastructures and resources further augment the dilemma of the high cost of purchasing treated wastewater and the

lack of enforcement by laws and policies. Policy-makers and actors in all sectors involved in the governance of wastewater treatment and reuse should facilitate and provide an extensive, coherent and flexible environment for farmers to be able to use treated wastewater for irrigation (Sanz and Gawalik, 2014).

3.4 Opportunities and obstacles towards improving the implementation of treated wastewater

Our findings show that Palestinian water and treated wastewater policies and strategies do not specify water allocation for the various purposes: domestic, industrial, touristic and agricultural. It is one pool for all uses that creates conflict and affects accountability among stakeholders. Moreover, although there exists a strategy (Decree No.14, 2014), the guidelines on using treated wastewater remains missing in the Palestinian water law, thus hindering its implementation. Hence, the current instruments for governing the reuse of treated wastewater should be updated and enforced:

“There are no specific laws on the reuse of treated wastewater for irrigation, although our strategy is for treated wastewater to account for 25% of total water used for irrigation by 2017.” (WSRC, interview 4)

However, reviewing the strategies (Decree No.14, 2014), indicates that this treated wastewater is to be free of pumping charges for primary and secondary treated wastewater for irrigation. This is considered to be a flexible measure provided by policy-makers to encourage farmers of using treated wastewater for irrigation. This, however, remains a strategy that is not yet implemented. The policy-makers should work together to implement this strategy along with water providers to facilitate the reuse of treated wastewater.

Inter-sectoral laws can be pivotal instruments to bring together existing actors and their networks towards improving the implementation of treated wastewater reuse. Although the extent of Palestinian laws and strategies is well defined, their coherence remains an issue. The above results suggest conflicting strategies between water and agricultural sectors, as well as the absence of an enacted law for the reuse of treated wastewater. Hence it is important for policy and decision-makers to pool their efforts and establish inter-sectoral strategies and laws that allow flexible and transparent coordination and cooperation among stakeholders for the reuse of treated wastewater. The approval of the water and treated wastewater laws and strategies by the highest governing body, i.e., the Legislative Council, is crucial for the effective implementation of these laws and policies. The Legislative Council plays the role of the Palestinian Parliament by making the regulations in all sectors including water laws and legislations. No law can be passed without the approval of the legislative council in Palestine, however the Legislative Council is currently not functioning (PLC, 2015).

“Many water laws are in conflict with each other and some override others. Even if the newly updated law is in place (drafted), it cannot become a law to be implemented and enforced with the absence of the Palestinian Legislative Council”(WSRC, interview 4)

Given the water status in Palestine, suffering from resource scarcity, geopolitical constraints, weakness of the water sector, lack of inter-sectoral cooperation, as well as fragmented water laws and policies (Abu Lughud, 2013; Mized, 2013; Abu Madi, 2006), more efforts on improving the governance of water and wastewater are needed.

Furthermore, establishing a wastewater treatment plant undergoes complex procedures and processes that result from Palestine's lack of control over water and land resources due to Israeli occupation. To build a wastewater treatment plant in the Palestinian territories, Israeli approval and licensing is required, through the Joint Water Committee between Israel and Palestine that issues all permits and approvals for building water structures in the West Bank (Selby, 2013). This, however, is a lengthy and complicated process. Our results show that licensing procedures is an impediment for governing the reuse of treated wastewater:

“We applied for a license and approval to build a treatment plant in Jericho since 2010, and it took many years to receive the approval. ... Although the treatment plant is established, we still lack the appropriate infrastructure and wastewater collection system.” (Jericho Municipality, interview 2)

Another obstacle regarding the functioning of the wastewater treatment plants is the lack of appropriate infrastructure. A wastewater collection system is needed, which is still missing in Jericho district. Since no progress was made on building the infrastructure, the number of collection cesspits increased dramatically in the recent years. This, in effect, shows that the resources for governing the wastewater treatment and reuse are insufficient. Significant investments should be made collectively by the various stakeholders to provide the necessary infrastructure.

“Because we lack collection infrastructure, people had to build collection cesspits over the past years. This hinders our efforts towards treating wastewater in the district.” (Jericho Municipality, interview 2)

4 Conclusions

This paper has three objectives that are related respectively to the actors, cross-sectoral issues and the obstacles and opportunities regarding the governance of treated wastewater reuse in Jericho. To reach these objectives, we applied the criteria and the dimensions of the governance assessment tool. Our assessment reveals three governance-related factors that indicate a restrictive governance system, mainly in terms of the extent and coherence of the dimensions. First, there is weak coherence among the various actors that are involved in the water and wastewater sectors, reflected in their overlapping and unclear roles and responsibilities. Second, the extent and coherence of instruments is low, as indicated by the absence of updated and approved laws, especially dealing with treated wastewater reuse, and by the pricing mechanisms that do not encourage the farmers to use treated wastewater in irrigation. Third, there is low extent in terms of resources, since there is inadequate infrastructure and social acceptance towards using treated wastewater for irrigation.

Based on specific assessment results on the governance system of treated wastewater reuse in Palestine, policy- and decision makers should look into improving the separating and clarifying the roles and responsibilities of the actors involved in wastewater treatment and reuse, as well as providing the necessary legal, economic and informational instruments that can facilitate the reuse of treated wastewater by the end-users.

The design and conducting of this case study, including data collection, analysis and interpretation, in a district that reflects the Palestinian water status and governance regimes allows generalisation of results to the overall Palestinian context. The use of an

assessment tool and framework also allows transferability of the study approach in similar settings in the MENA region. Therefore, further research using the governance assessment tool for other local, regional or national cases on the governance of treated wastewater reuse would be highly relevant.

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