





## Collaborative water governance model for potable urban water supply in Riau Province, Indonesia

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### ABSTRACT

The literature suggests that collaborative governance is a promising framework for addressing complex public problems while some cases have also marked failure in its implementation. Furthermore, the complexities and factors of the collaborative governance context must be understood at the early stage, as they may affect its sustainability. Therefore, this study aims to understand 'what works and what doesn't' and the need for sustainability of urban potable water management in Dumai City, Rokan Hilir Regency, and Bengkalis Regency through cross-sectoral collaboration and develop the best model to be developed for this collaboration. This study uses a soft system methodology in the urban potable water supply system of Riau Province with a wide range of stakeholders through in-depth interviews, thematic analysis, and the creation of purposeful activity models and rich pictures to uncover and address complex issues. The study found that the implementation of collaborative water management in urban areas with the collaborative water governance approach has worked well in the short term. However, it has not enhanced organizational autonomy or fostered trust and reciprocity dimensions in the long term. Additionally, we emphasize the importance of a collaborative supervisory board that will open internal and external opportunities.

**Key words:** Collaborative water governance, Durolis regional, Soft system methodology

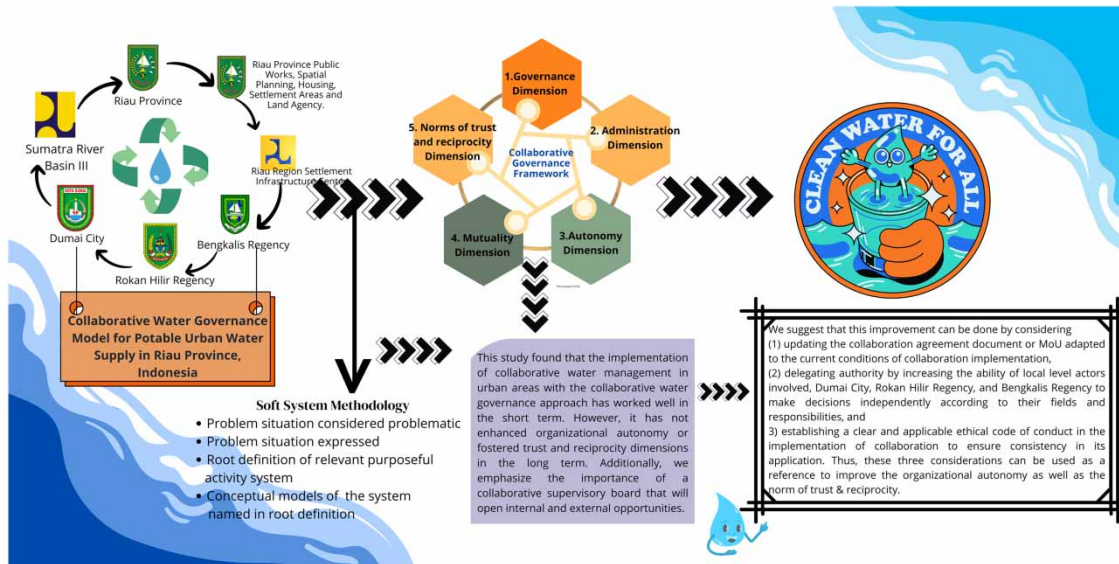
### HIGHLIGHTS

- This article addresses the major issue in metropolitan settings with high demand for water and limited resources of sustainable clean water management by promoting cross-sector collaboration.
- The models offer a practical alternative for achieving effective collaboration in water governance.
- This research provides a significant addition with its examination of the initial effects of collaboration on its long-term viability.

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## GRAPHICAL ABSTRACT



## 1. INTRODUCTION

In recent decades, the water crisis has consistently been identified as one of the top five global hazards (Pahl-Wostl, 2017). Collaborative water governance (CWG) has emerged as a promising response to water management challenges (Holley, 2015; Harrington, 2017). The literature suggests that well-designed and well-managed CWGs can support and address water management challenges that governments cannot address on their own (Page *et al.*, 2021). However, there is evidence that collaboration is fraught with challenges and does not always deliver the desired outcomes (O'leary & Vij, 2012). Collaboration is often quite slow and resource-intensive. Power struggles, the risk of misunderstandings, conflicting goals, and collaboration failures seem to be frequent and evident during the collaboration process, leading to the conclusion that collaboration is not a panacea, especially in water management.

We began this study with a preliminary observation of mapping the literature related to the use of CWG in the context of clean water management in urban areas. Collaborative approaches have been widely implemented since 2006, and urban water management has been extensively researched since 2012. However, there is little evidence of the integration of these fields (Ananda & Proctor, 2013; Margerum & Robinson, 2015; Cole *et al.*, 2018; Zandvoort *et al.*, 2019). This opens up space for us to fill the gap between theory and 'good' CWG practice in understanding the dynamics underlying the interaction of collaborative water management and provision in urban areas, especially in river basins.

Given the rapidly increasing contribution of urban areas to climate change, local governments play a critical role in policy actions and implementation across sectoral and geopolitical boundaries (Picavet *et al.*, 2023). As mentioned by the UNEP (2024), water shortages are currently exacerbated by uncontrolled urbanization, rapid population expansion, pollution, land development, and climate change. Similar cases are also mentioned by GWP (2021); because of intensive climate change, the occurrence and intensity of floods and droughts have become more frequent. These alterations not only endanger the ecology and the means of subsistence for individuals, especially because the high concentration of the population is indeed the primary driver demanding food,

energy, and water. The same picture emerged in Riau Province, Indonesia. Population growth in Riau is 6.8 million people, which covers an area of approximately 107.932 km<sup>2</sup>, one of the triggers of an urgent need for the government to provide potable water that can be consumed by the community (Harirah *et al.*, 2022). This is particularly true in the areas of Dumai City, Rokan Hilir Regency, and Bengkalis Regency.

Dumai City is an industrial hub within the province of approximately 752 km<sup>2</sup>, with a population of approximately 343.597 people. A city's economy is heavily dependent on oil refineries and port activities (Setiawan, 2021). The income levels here are slightly higher than the provincial average because of industrial employment. The Rokan Hilir Regency covers an area of approximately 8.881 km<sup>2</sup> and has a population of approximately 662.546 people. Fisheries are the predominant economic activity, followed by agriculture, palm oil, and rubber plantations (Effendi *et al.*, 2021). The income levels are generally lower than those in Dumai City and Bengkalis Regency. The Bengkalis Regency covers an area of 7.793 km<sup>2</sup> with a population of approximately 658.846 people. Agriculture is a major economic sector alongside fishing and small-scale industries. It is estimated that approximately 40% of the population in these regions lacks access to potable water. This lack of access significantly affects the quality of life and economic productivity (Harirah *et al.*, 2022). Based on our interviews in November 2023, it was determined that Dumai City and Bengkalis Regency have an urgent need for clean water because of a lack of adequate water supply, while Rokan Hilir Regency has sufficient river water sources, but has not been optimally utilized due to budgetary constraints.

To optimize the use of river water, regional autonomy has opened the door for local governments to take joint action in managing budgetary affairs. One prominent example is the implementation of the Durolis, which refers to the regional cluster 'Dumai City, Rokan Hilir Regency, and Bengkalis Regency' Strategic Water Supply Management locally known as *Sistem Penyediaan Air Minum* (SPAM). The Durolis Regional Water Supply Project illustrates the dimensions of transboundary cooperation by working together to solve problems of clean water management in Riau Province. The proposed project covers approximately 1.2 million people across three areas, covering an estimated total area of 29,000 km<sup>2</sup>. However, as the cooperation process progressed, several negative symptoms emerged, including primordial sentiments, interregional conflicts, conflicts between residents, over-exploitation of natural resources, and excessive 'regional self-interest' attitudes. As was the case in several cases of failed collaboration, such as building community resilience in disaster issues, the factors of insufficient government funding, absence of incentives, limited societal involvement, and inadequate private sector led to unsuccessful collaboration (Danar *et al.*, 2021). Similarly, Seo *et al.* (2023) point out that collaboration implementation in corporate cases is characterized by sluggishness, extensive resource consumption, and the potential for failure. At the same time, critical challenges within the implementation of CWGs have been reported in the literature: (i) power imbalances and lack of coordination among stakeholders; financial, time, and institutional constraints; the need for conflict resolution; and issues of transparency, accountability, and authority (Andrews & Entwistle, 2010; Fliervoet *et al.*, 2017; Rojas *et al.*, 2020).

Most previous studies have discussed infrastructure failures in the Durolis Regional SPAM (Alamsyah *et al.*, 2018; Rurianti, 2022), while others have discussed the key actors and their interactions in Durolis Regional water supply management (Suyeno *et al.*, 2024). Furthermore, the complexities and factors related to the context of collaborative governance need to be understood at an early stage, as they may affect its sustainability (Seo *et al.*, 2023). Therefore, understanding the structure and dynamics of collaborative governance can help to understand what works and does not work in the early stages of such initiatives. Thus, in this study, we adopted Thomson & Perry's (2006) theoretical framework to examine CWGs in Durolis Regional water management in urban areas.

We chose Thomson & Perry's (2006) framework because (a) it is well suited to the collaborative landscape of Durolis Regional water supply management and (b) its framework conditions allow us to understand the dynamics underlying the collaborative interactions of Durolis Regional water supply management in an urban

setting. Moreover, as a key feature of the framework is collaborative governance, it can be used to analyze the (complex) patterns of actions, behaviors, and dynamics that exist in the management of the Durolis Regional water supply, which in our case is of particular interest to stakeholders. Thus, this study reveals the kind of ambidexterity required in the large multi-actor collaboration of the Durolis Regional water supply management and how the ambidexterity model is best developed and managed.

## 2. LITERATURE REVIEW

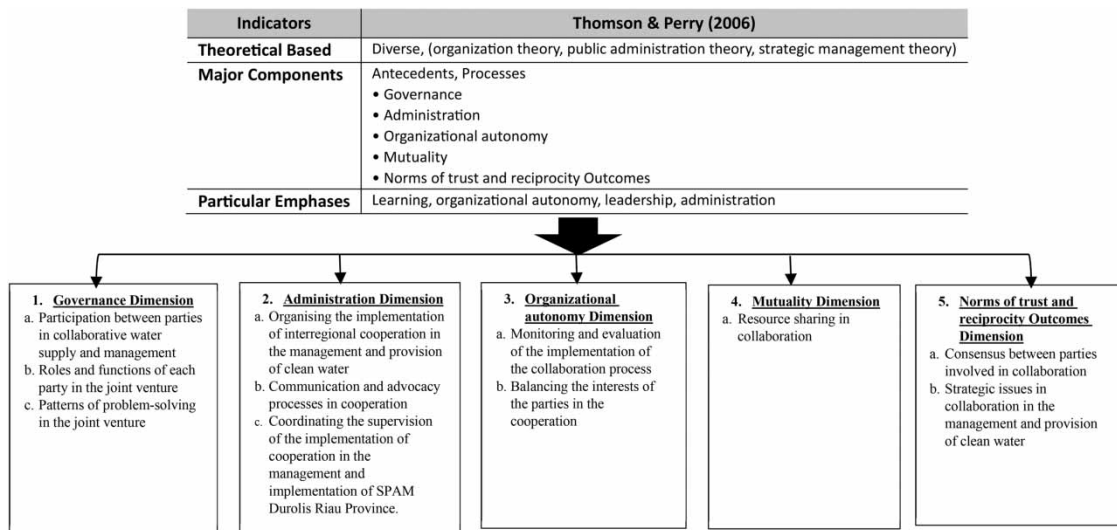
In recent decades, various forms of governance that involve non-state actors have received scholarly attention. [Head & Alford \(2015\)](#) mention that this is based on the tendency of overpoliticization and the failure of government, as well as criticism of the new public management ([Osborne, 2006](#)). Public administration is currently undergoing a shift from hierarchical governance to participatory policymaking. This, in turn, has led to the emergence of collaborative governance as a key approach to understanding this shift. Collaborative governance is increasingly being studied as a promising approach to solving complex problems ([Ansell & Gash, 2008](#)). This type of governance brings together governments and stakeholders to facilitate consensus-based decision-making.

[Bryson et al. \(2019\)](#) explain that the actual definitions of collaborative governance vary considerably. For instance, [Emerson et al. \(2012\)](#) described it as a process in which multiple stakeholders from different sectors come together to collectively solve societal problems. This definition emphasizes the collaborative nature of decision-making and problem-solving among diverse stakeholders. Similarly, [Ansell & Gash \(2008\)](#) defined collaborative governance as a mode of governance in which public and private actors work together in a coordinated and deliberative manner to achieve collective goals. This definition highlights the cooperative efforts and the importance of structured processes for achieving common objectives. On the other hand, [Sørensen & Torfing \(2011\)](#) proposed a broader definition of collaborative governance as a governance arrangement in which public and private actors share responsibilities, risks, and resources in addressing complex policy issues. This definition underscores the shared responsibilities and joint efforts required for effective governance in the complex policy domains.

In this study, we adopt [Thomson & Perry's \(2006\)](#) argument, which proposes a framework of cross-border collaboration dimensions, including governance, administrative, organizational autonomy, mutuality, and norms of trust and reciprocity. These five dimensions show the dynamics of the collaboration process and the potential constraints in managing the Durolis Regional water supply. [Figure 1](#) describes the role of the framework by [Thomson & Perry \(2006\)](#).

The key to success in this governance dimension, as per [Figure 1](#), is the willingness of collaborating partners to monitor each other and impose credible sanctions on non-compliant partners. When collaborative partners are unwilling to provide mutual oversight of agreed rules, their ability to build credible commitments is lost, and joint decision-making becomes impossible ([Thomson & Perry, 2006](#)). A shared vision and commitment to cross-organizational goals allow them to move toward problem-solving rather than blaming problems on one particular party ([Tawil et al., 2022](#)).

In the administrative dimension, the main functions identified in the top-down management literature are coordination and clarity of roles and responsibilities ([Coppola, 2015](#); [Heyden et al., 2016](#)). Most collaboration experts agree that the key to getting things done in collaborative settings is finding the right combination of administrative capacity through coordination and hierarchical elements, and social capacity to build relationships ([Thomson & Perry, 2006](#)). The organizational autonomy dimension is concerned with shared control. The willingness to share information for the common good even at the risk of sacrificing organizational autonomy is a characteristic to be considered in terms of improving partners' understanding of the issues they are trying to address together.



**Fig. 1** | Theoretical framework adapted from Thomson & Perry (2006) (Source: Data Proceed by Author, 2024).

The dimension of mutuality is rooted in interdependence. Mutuality refers to the shared understanding, goals, and values of collaborators, in which there is mutual recognition of each other's contributions and interests. A strong mutuality dimension ensures that collaborators are committed to shared goals and values (Sedgwick, 2017). This dimension emphasizes the importance of alignment in objectives and willingness to work together toward common goals. Interconnectedness underscores the interconnectedness and reliance among collaborators. In practical terms, interdependence means that the success of a collaboration depends on the collective effort and contributions of all involved parties, rather than individual actions, and ensures that their efforts are coordinated and mutually supported.

Collaborating organizations should be interdependent and mutually beneficial based on different interests (Thomson & Perry, 2006). Mutuality provides the basis for forging a common view of the differences that exist in collaboration. At this stage, the more consensus partners can accept differences based on their respective needs, the more likely they are to collaborate (Seo *et al.*, 2023). Reciprocity is the second facet of norms and trust, which can be defined as shared beliefs among a group of individuals. The process of integrating personal and group interests can be made possible by building commonalities across differences. The nature of cooperation is often interpreted as voluntary, but it does not mean arbitrary because cooperation has certain goals and targets that must be achieved by the cooperating parties (Thomson & Perry, 2006).

### 3. METHODS

This study uses a systems thinking approach to examine the relationship between problematic situations and real-world conditions (Reynolds & Holwell, 2010). Furthermore, the soft system methodology (SSM) used in this study was initiated by Checkland & Scholes (1990) as a framework for exploring complex and uncertain situations. SSM refers to a methodology that uses a versatile yet structured process to initiate action to enhance challenging situations (Marttunen *et al.*, 2017). In CWG in Riau Province, Indonesia, SSM facilitates structured dialogue among diverse stakeholders, including government agencies at the central, provincial, and local levels. By iteratively exploring and modeling the water governance challenges, SSM helps to align the interests of these stakeholders, leading to

the development of shared governance strategies that enhance the urban potable water supply. Through iterative discussion and comparison of these models with real-world situations, consensus was built, leading to actionable strategies that are collaboratively agreed upon by stakeholders. This approach ensures that the proposed solutions are not only technically feasible but also socially acceptable, thus improving the overall effectiveness of water governance in the region. In a more detailed look, [Kayaga \(2008\)](#) points out that SSM allows us to identify ‘wicked’ problems as tough to research due to their social and political elements. Thus, this method was chosen because it is considered suitable for analyzing complex systems of human behavior that are usually inseparable from social and political activities, particularly in the context of CWGs, to understand the dynamics underlying the collaborative interactions of the Durolis Regional SPAM water supply and management in urban areas.

### 3.1. Study design

We conducted a series of in-depth interviews between August and November 2023 with key people, such as the provincial government, representatives from local water supply agencies, and the central government. The interviews were conducted twice a month and lasted approximately half a day. The purpose of these interviews was to gain an initial understanding of the soft issues related to the fifth dimension of the collaboration framework in the Durolis regional water supply management. These dimensions include governance, administration, organizational autonomy, mutuality, and norms of trust and reciprocity. The interviews provided a platform for stakeholders to freely articulate their perspectives inside an enclosed environment. [Table 1](#) presents the data collection process.

According to [Table 1](#), the chosen respondent was identified using a textual network analysis of actor power. This actor power was derived from a document examination, which enabled us to ascertain the respondent’s influence at provincial, central, and local levels ([Suyeno et al., 2024](#)). Furthermore, the focus group discussion occurred on 23 November 2023, with all participants. In this discussion, participants engaged in the construction of rich pictures and later organized them to present the SSM models to the stakeholders and have them interrogate and take forward what they considered valuable. Then, the data obtained from the SSM interviews and focus group discussions were continuously analyzed using thematic analysis.

The SSM initially consists of seven stages. These stages began by thoroughly exploring the problematic situation through in-depth interviews and focus group discussions with key stakeholders, as shown in [Table 1](#). It identifies key issues, analyzes cultural dynamics, and understands the power relations among stakeholders ([Checkland & Poulter, 2006](#)). The second stage involves expressing the situation by mapping stakeholders, elaborating interviews and focus group discussions, and elucidating the problems they face in a rich picture. We then highlight the interconnections and relationships among stakeholders to uncover systemic issues. The next stage is to construct root definitions that define the core purpose of the activity system to be modeled. It utilizes the PQR formula, where P is the what, Q the how, and R the why, or, as [Checkland & Poulter \(2006\)](#) describe, ‘do P, by Q, to help achieve R’. This stage allows us to use CATWOE analysis to articulate the purposeful activity as a transformation. The fourth stage is to develop conceptual models based on root definitions, the PQR formula, and the CATWOE analysis. These models represent the ideal activities necessary for transformation, distinct from current realities ([Proches & Bodhanya, 2015](#)).

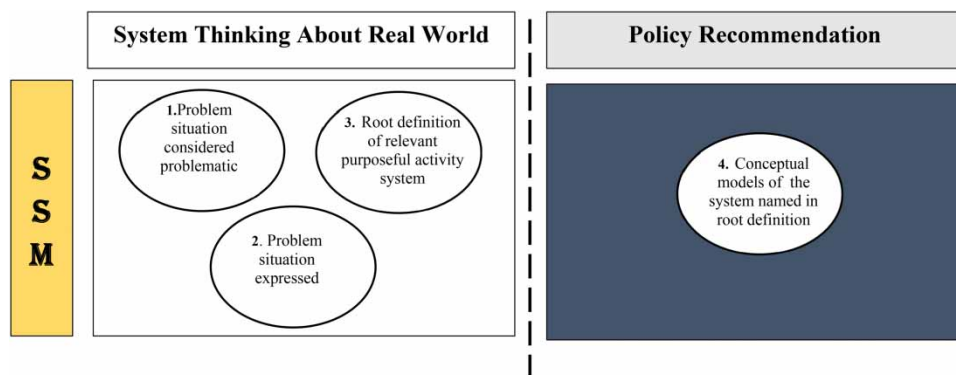
The fifth stage uses models to structure debates regarding the situation. Stakeholders engage in dialogue by comparing real-world practices with idealized models developed in earlier stages. The sixth stage defines and implements actions to identify desirable and culturally feasible changes. Changes should resonate with stakeholders’ histories and worldviews to ensure their acceptance and effectiveness. The final stage was to improve the problematic situation by implementing refined models. This final stage focuses on practical steps to enact changes identified through the SSM process. We based our reasoning on [Proches & Badhanya \(2015\)](#), who mentioned that the original SSM framework comprised seven stages but has now been simplified into four primary

**Table 1** | Detailed interview information.

Participant group	Engagement activity	Role in the study	Type of information
<b>Provincial level</b>			
1. Riau Provincial Government	Interviews, Document Review	Leading sector	Regulatory framework, negotiation process, permission access
2. Public Works Office of Spatial Planning, Housing, Settlement Areas and Land (PUPRPKPP)	Interview And Focus Group Discussion	Infrastructure developers	Construction of primary distribution pipelines to Dumai City, Rokan Hilir Regency, Bengkalis Regency
<b>Central Level</b>			
1. Directorate General of Water Resources (The Sumatera River Basin III)	Interview And Focus Group Discussion	Technical developers, and	Construction of water intake capacity, building raw water transmission pipeline network
2. Ministry of Public Works and Housing (Public Housing Officer)	Interview And Focus Group Discussion	Technical and managerial oversight	Detailed plans for constructing a production unit, specifically a general distribution network from the processing installation to the Reservoir
<b>Local level</b>			
1. Dumai City Government (Dumai City Regional Drinking Water Company (PDAM))	Interview And Focus Group Discussion	Beneficiaries	Technical planning for the distribution network, building a household network distribution, purchasing bulk water from Durolis Regional Water Supply
2. Rokan Hilir Government (Drinking Water Management Technical Implementation Unit)	Interview And Focus Group Discussion		
3. Bengkalis Regency Government (Bengkalis Regency Regional Drinking Water Company (PDAM))	Interview And Focus Group Discussion		

Note: PUPRPKPP, Pekerjaan Umum, Penataan Ruang, Perumahan, Kawasan Pemukiman, dan Pertanahan; PDAM, Perusahaan Daerah Air Minum.

stages. Therefore, we base this analysis solely on the four steps that are attached in [Figure 2](#), namely the problem situation considered problematic, the problem situation expressed, the root definition of the relevant purposeful activity system, and conceptual models of the system named in the root definition.



**Fig. 2** | SSM framework (Source: Data Proceed by Author, 2024).

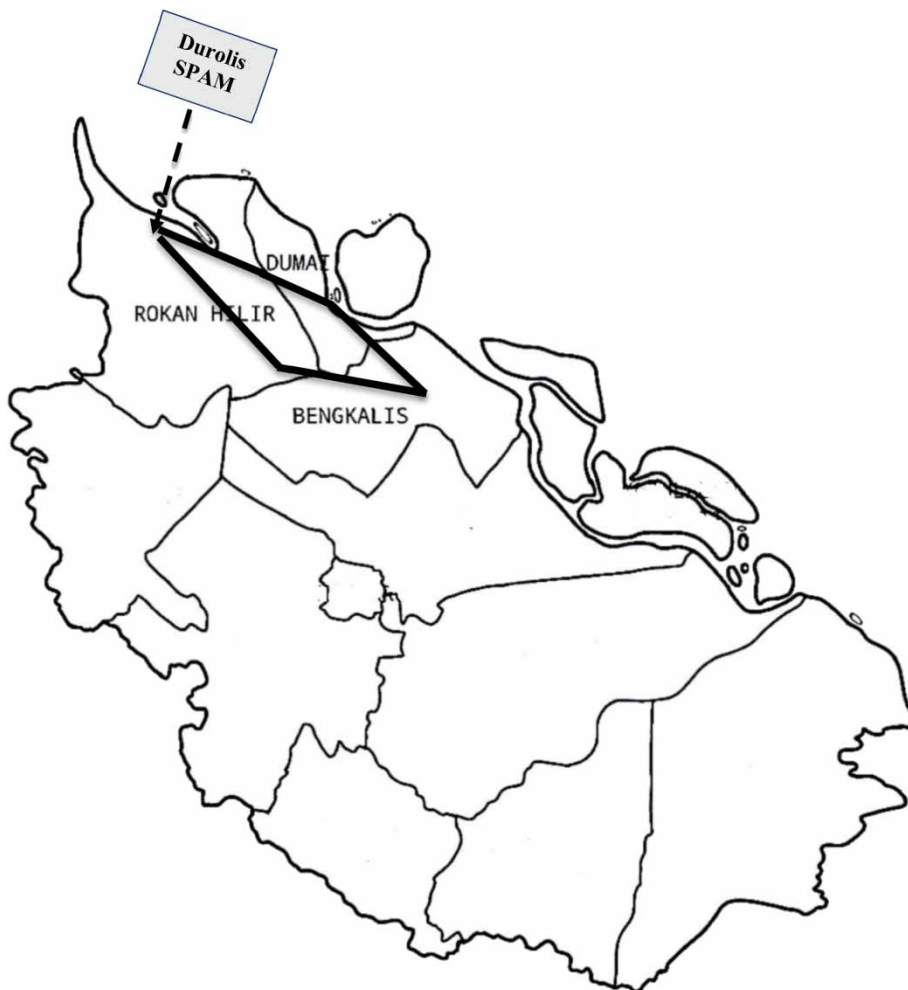
### 3.2. Study location

Figure 3 shows the study location of the Durolis Regional SPAM, which is located between Dumai City, Rokan Hilir Regency, and Bengkalis Regency, Riau Province, Indonesia. Collaborative water management at Durolis Regional SPAM was established in 2017.

As shown in Figure 3, the four points represent the coverage area of the Durolis SPAM region, indicating the geographical boundaries where the SPAM system is implemented. Each point corresponds to key locations within the Durolis SPAM region, that is, Dumai City, Rokan Hilir Regency, and Bengkalis Regency, demonstrating the extent of the water distribution network.

### 3.3. Ethical consideration

The respondents were informed that their support in the survey was voluntary. To encourage the collection of pre-, post-, and follow-up questionnaires, the participants were asked to form a pseudonym code following certain



**Fig. 3** | Geographical Durolis SPAM region in Riau Province, Indonesia (Source: Data Proceed by Author, 2024).



rules. Furthermore, under Indonesia Data Protection & Cyber Security Law No. 19 of 2016 (EIT Law), interviewees were informed that they could ask for cancellation, adjustment, or limitation of information handling by detailing the code to the comparing data protection officer. All participants provided verbal consent for their support prior to the interviews. In addition, we present information related to the codes representing each stakeholder. Each code signifies individuals from various service units and demographics, as shown in Table 2.

## 4. RESULTS

In this section, we discuss the four stages of SSM. The first stage outlined how issues were identified through a series of in-depth interviews. In this initial stage, it became evident that the challenges of implementing CWG in the Durolis Regional SPAM water management in urban areas exist at the macro-, meso-, and micro-levels. The second stage involved focus group discussions that produced a more structured representation of these issues through a 'rich picture,' revealing major themes underlying problems at each level (macro, meso, and micro). The third stage commenced with a thematic analysis of each stakeholder, leading to a conceptual understanding of potential solutions. The fourth stage entailed developing a conceptual model by synthesizing various previously obtained results.

### 4.1. Unstructured problems

At this stage, social analysis is conducted to identify elements such as the roles, norms, and values of the actors (Checkland & Poulter, 2006). In-depth interviews revealed that the problems of implementing CWG in Durolis Regional SPAM water management in urban areas lie at the macro-, meso-, and micro-levels. At the macro level, the problem that arises is a high level of sectoral self-interest, especially in terms of determining the price of water tariffs. This was conveyed by GK0 1: 'Rokan Hilir Regency, which consistently opposes water pricing because of its perception of being the custodian of water sources. Consequently, Rohil advocates for differentiated water tariffs into 50% off, considering that the Rokan River, which supplies raw water to the Durolis Regional SPAM, falls within the administrative jurisdiction of Rokan Hilir Regency'.

At the regional level, the Riau Provincial Government, as the leading sector of the Durolis Regional SPAM, has delegated the determination of water tariffs to the regional leader, but conflicts over water tariffs that have been determined by the Provincial Government have always been rejected. The results of other interviews also show that the water conflict in the Durolis Regional SPAM is always election campaign material for each candidate for a regional leader. This was expressed by GK0 5: the issue of water in Durolis was expected to be addressed during multiple local elections. However, when the regional leader was elected, they intentionally disregarded the program established by the previous leader. Instead, they displayed indifference, claiming that it was not their responsibility since the Durolis Regional SPAM was not initiated by them.

**Table 2** | Information on the respondents.

Code	Level	Gender	Age
GK0 1	Province	Male	50
GK0 2	Province	Male	53
GK0 3	Local	Male	56
GK0 4	Central (State)	Male	52
GK0 5	Central (State)	Male	54
GK0 6	Province	Male	47

Meanwhile, at the meso level, the problem lies in the inconsistency of pipe connection work from the Durolis Regional SPAM to regional facilities and community households. This was conveyed by GK0 3: ‘The construction of the pipe connection network by the Rokan River is not always done simultaneously. It may prioritize Dumai City because of its proximity, causing residents in the Bengkalis Regency to experience a longer wait for water supply. Additionally, residents in highland areas may have to wait for booster pumps, further extending the waiting time.’ On the other hand, we also found other institutional problems in the context of land acquisition for the pipes and booster pumps that run through the garden. This was reported by GK0 2: ‘Actually, the ministry is responsible for expenditures that cost a lot of money, but this has been delegated to the province. So, we in the Province have to increase the budget again and reallocate to cover the amount of the budget that has been spent.’

At the micro level, the problem lies in the low capacity and capability of human resources in the Bengkalis Regency and the Rokan Hilir Regency. This was explained by GK0 4: ‘Typically, it is the local people that are required to occupy strategic positions.’ However, the filling of certain positions is not adjusted to the abilities, both in terms of education and capacity, so some competent people who come from outside the region do not get the opportunity to occupy these positions, which seem to be randomly selected in certain positions by prioritizing local people. Problems are also well captured in terms of problem-solving at the local level.

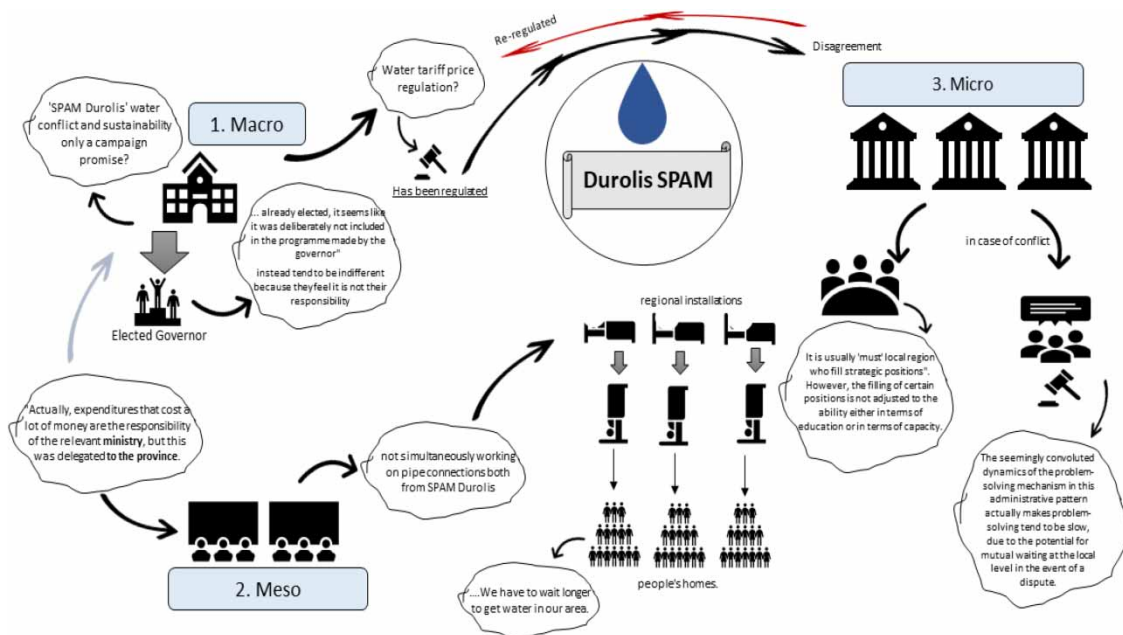
This was conveyed by GK0 6: ‘If there is a dispute between the parties, there is usually a discussion to reach consensus. However, if there is still no solution, the provincial government, as the leading sector, will step in and call the parties to discuss a solution. However, if the problem cannot be resolved by the provincial government, then the provincial government will coordinate with the central government representative in the region or ‘*Balai*’. The irony is that the central government representatives in the regions are not always on standby every day, so the dynamics of the mechanism, which appears to be complicated in this administrative pattern, and problem solving is delayed because of the need to coordinate among those at the local level when disputes occur.’

At this level, we found that, in the process of coordination and collaboration in the region, all actors involved have equally strong authority. At the macro level, authority as the leading sector of the Durolis Regional SPAM is held by the Riau Provincial Government. At the meso level, there is a representative of the Ministry of Public Works and Public Housing at the regional level called Balai Perumahan Rakyat, and a representative of the Directorate General of Water Resources called Balai Wilayah Sungai Sumatera III, who is authorized to build production units and facilitate the development of Durolis Regional SPAM. At the micro level, the Governments of Dumai City, Rokan Hilir Regency, and Bengkalis Regency are not only authorized to distribute water from their respective IPAs to the community but are also mandated to construct distribution networks for house connections using their respective regional budgets.

#### 4.2. Structured problem

In this second stage, the collection of problem exploration is organized into a more structured, understandable, and rich picture. Figure 4 shows a rich picture illustrating the problems identified. Several problematic situations were identified at the macro-, meso-, and micro-levels. At the macro level, the Provincial Government can find a solution to the fairness of water tariffs and a solution so that the sustainability of Durolis Regional SPAM is not limited to election promises; at the meso level, the inconsistent installation of pipelines became increasingly problematic, followed by a disagreement over the duties and functions at the beginning of the agreement. At the micro level, the problem is a problem-solving mechanism.

In this context, the cost of potable water fluctuates across different areas. Dumai City costs 2.850 m<sup>3</sup>, Rokan Hilir Regency costs 2.483 m<sup>3</sup> and Bengkalis Regency costs 2.895 m<sup>3</sup>. For many households, this represents a significant expenditure, consuming up to 10–20% of their monthly income. This percentage may be even higher for



**Fig. 4** | Rich picture of CWG Durolis regional SPAM at Riau Province (Source: Data Proceed by Author, 2024).

low-income families. Given the overwhelming evidence of the failure of existing pricing schemes, it is important to analyze the performance of such schemes to understand the adequacy of economic and sustainability policies in water management (Zetland & Gasson 2013). Furthermore, Al-Saidi & Dehnavi (2019) concluded that high water price levels are correlated with overall country development factors, such as higher GDP and better governance, but also with specific factors, such as lower per capita consumption, smaller population, lower water availability, higher demand, and lower risk of scarcity. In some similar cases, inadequate human resources at the local level have been found to make them vulnerable to political interference or ignorance in water resource management. This aligns with the findings of Rojas *et al.* (2020), who observed that local actors significantly influence the sustainability of water management.

#### 4.3. Adjustment of concept through root definition

At this stage, the root definition was constructed from the results of interviews with leaders as the problem owner. This stage is an extension of the rich picture diagram (see Figure 4). The insights into the structure and dynamics of collaborative governance can help to understand ‘what works and what doesn’t’ in the early stages of initiative (P), using the CWG approach in reviewing the clean water management of Durolis Regional SPAM, through the formulation of a collaborative governance model in a multi-actor collaboration scheme that is easy to develop and manage in the context of Durolis Regional SPAM (Q), ensuring the sustainability of Durolis Regional SPAM for clean water management in urban areas, in order to serve as recommendations for stakeholders and planners of similar SPAM initiatives (R). Furthermore, the root of the problem is explored using CATWOE (Customer, Actor, Transformation, Worldview, Owner, and Environmental) analysis. This analysis involves identifying the parties affected by the system (customers), the parties involved in running the system (actors), the process of change that occurs in the system (transformation), the worldview or perspective underlying the system (worldview),

the party that has authority over the system (owner), and the environmental constraints that affect the system (environmental). The CATWOE analysis at this stage is presented in [Table 3](#).

#### 4.4. Formulating a conceptual model

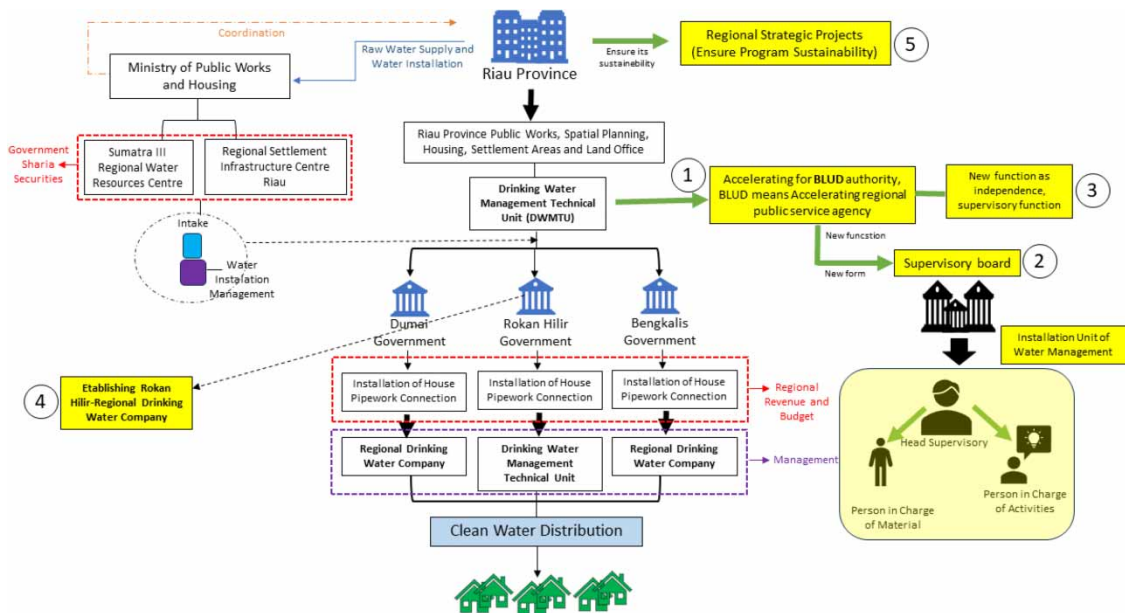
The conceptual model developed in this study ([Figure 5](#)) resulted in a collaborative governance model of the Durolis Regional SPAM of Riau Province for the management of clean water in urban areas. The conceptual model begins with a description of the activities carried out to achieve the desired transformation. This conceptual model was built on the basis of the root definition formulated in the previous stage. The model offered is an ideal form of sustainability for the Durolis Regional SPAM in the management of clean water in urban areas, involving multi-actor cross-sectoral collaboration.

First, in [Figure 5](#) (points 1–3), by granting the DWMTU authority as a regional public service agency, or locally called the *Badan Layanan Umum Daerah* agency, it will allow the DWMTU to be independent, along with financial and administrative independence, particularly in setting water tariffs. This will increase its independence in setting water tariffs without interference from the provincial government and/or regional leaders, which will facilitate the determination of a revenue-sharing scheme for the three regions in the implementation of the Durolis Regional SPAM collaboration. It is also expected that, through this model, the DWMTU will be empowered with a supervisory role in the water management of the Durolis Regional SPAM. Second (see [Figure 5](#) at point 4),

**Table 3** | CATWOE analysis of root definition.

Analysis	Findings
Costumer	People of Dumai City, Rokan Hilir Regency, Bengkalis Regency
Actor	<ol style="list-style-type: none"> <li>1. Riau Province (Provincial Land Settlement PUPR Office)</li> <li>2. Directorate General of Water Resources (The Sumatera River Basin III)</li> <li>3. Ministry of Public Works and Housing (Public Housing Officer)</li> <li>4. Dumai City Government (Dumai City Regional Drinking Water Company (PDAM))</li> <li>5. Rokan Hilir Government (Drinking Water Management Technical Implementation Unit)</li> <li>6. Bengkalis Regency Government (Bengkalis Regency Regional Drinking Water Company (PDAM))</li> </ol>
Transformation	The Durolis Regional SPAM collaborative governance model for urban water management addresses the challenge of understanding ‘what works and what doesn’t’ and the need for sustainability of water management through cross-sector collaboration
Worldwide	The collaborative governance model can provide a new perspective on multi-actor collaboration schemes that are easy to develop and manage in the context of Durolis Regional SPAM for clean water management in urban areas
Environmental constraint	<ol style="list-style-type: none"> <li>1. Budgetary constraints of the city district government in installing piped connections to community homes</li> <li>2. Low education level of human resources in Rokan Hilir and Bengkalis Regency (there is a tendency to require local people to fill certain positions)</li> <li>3. Sectoral self-interest in the collaboration process, especially in the aspect of determining water tariffs</li> <li>4. When problems occur, the problem-solving process tends to be slow because the parties involved are waiting for each other’s initiation and actions</li> <li>5. In the long term, the existing water management scheme has the potential to weaken the performance of local PDAM, because they are no longer managing water but only have the authority to distribute clean water of Durolis Regional SPAM</li> </ol>

Source: Data Proceed by Author, 2024.



**Fig. 5** | CWG model for potable urban water supply in Riau Province, Indonesia (Source: Data Proceed by Author, 2024).

we provide recommendations for the establishment of a Regional Drinking Water Company (PDAM) in the Rokan Hilir. Third (see Figure 5 at point 5), our model recommends integrating and shaping the Durolis Regional SPAM into the Regional Strategic Plan to maximize its sustainability.

#### 4.5. The nexus of collaborative dimension through SSM

First, in the governance dimension, the involvement of various governments in the Durolis Regional SPAM project highlights strong adherence to participatory principles in collaborative governance. Cooperation agreements, such as HK 0203-DA/381, ensure that each stakeholder has an equal opportunity to participate in the decision-making process. This reflects a firm's commitment to shared governance with each entity having a voice in the direction of the project. However, the SSM's exploration process also reveals that, while participation levels are satisfactory, a significant challenge has emerged in time management. The lack of attention paid to deadlines and project timelines has created inefficiencies, hindering overall progress. This suggests that, while participatory governance is strong, improving time management practices is crucial for optimizing collaborative effectiveness.

Second, the administrative dimension reveals a well-defined horizontal and vertical organizational structure designed to clarify the roles of the various local governments involved. This mirrors the SSM's focus on defining system purposes through root definitions and stakeholder roles (CATWOE). Structured role distribution was intended to reduce conflicts and ensure smooth cooperation among Dumai City, Rokan Hilir, and Bengkalis. However, the absence of a mediating body, such as a steering committee or an oversight council, has proven to be a major weakness. Without a designated intermediary or supervisory board, unresolved conflicts tend to escalate, threatening collaboration success. Moreover, communication issues between local governments, PDAM, and other stakeholders exacerbate the problem because delays and misunderstandings in conveying critical information disrupt the decision-making process. Ineffective communication not only slows progress but also fosters disagreements, further hindering collaborative efforts.

Third, the autonomy dimension reveals that they have not gone well, primarily due to differences in the understanding of monitoring standards between central and local governments. These discrepancies lead to inconsistent evaluations, affecting the quality of oversight and the overall sustainability of the SPAM Durolis project. Furthermore, sectoral egos, particularly those concerning divergence in priority settings, have emerged as an obstacle. This highlights the importance of the SSM's conceptual model-building stage in which stakeholders' independent roles and decision-making autonomy are considered. One prominent example is the disagreement over water tariff setting by Rokan Hilir, which threatens the alignment of shared goals between the regions involved. This indicates the need for a more coordinated approach to harmonize priorities and ensure that autonomy does not become a barrier to effective collaboration.

Fourth, the mutuality dimension demonstrates that a mutually beneficial relationship has been established through the equitable sharing of resources, risks, and benefits among stakeholders. During the SSM's stage of comparing the conceptual model with reality, this dimension shows a successful balance of shared risks and benefits among regions. Cooperation agreements, such as 170/PKS-SPAM/CA/VI/2017, clearly outline shared responsibilities, ensuring that each region contributes based on its capacity. Parties have demonstrated a commitment to equitably share risks, particularly in terms of funding, operational management, and infrastructure maintenance. In return, the benefits, primarily from the water supply system, are distributed fairly according to the agreements. This mutual understanding reinforces the sustainability of collaboration and indicates a deep recognition of the importance of fairness in interregional partnerships.

Fifth, the dimensions of norms and reciprocals indicate that they have not gone well. Despite a strong framework for collaboration, the norms and reciprocity dimensions reveal difficulties in achieving a solid consensus among stakeholders, such as the Provincial Government of Riau, Dumai City, Rokan Hilir Regency, and Bengkalis Regency. Divergent interests, values, and priorities among these actors have created a complex interaction dynamic, obstructing the realization of shared goals. The failure to reach a common understanding has hampered the overall effectiveness of the project. Each region has its own set of priorities or objectives that do not fully align with those of other regions, creating friction in collaborative efforts. The development of a more adaptive and responsive regulatory environment can address these discrepancies and support harmonious collaboration by accommodating the shifting dynamics and ensuring the rights and responsibilities of each region.

## 5. DISCUSSIONS

This study found that the organizational autonomy dimension and the norms of trust and reciprocity dimensions show a collaboration process that is still far from expectations. The complexity of the collaborative process involves many factors that simultaneously affect the nonperformance of the organizational autonomy dimension. We also find that the problem of water pricing remains unsolved during the collaboration process from 2017 to 2024. The disparity between regions is even more pronounced when there is a disagreement and rejection of certain regulations. The collaboration is weak when the sectoral self-interest of each region with its various interests influences collaborative governance in the urban potable water supply of the Durolis Regional SPAM.

More specifically, the organizational autonomy dimension is seen in joint control mechanisms, such as monitoring and evaluation of the implementation of collaboration in the Durolis Regional SPAM, which has not yet been implemented. This finding is consistent with Xu & Kim (2020), who found that violations of organizational autonomy tend to be more severe under conditions of formal and intersectoral collaboration. Given the multi-actor nature of collaboration in the water management of the Durolis Regional SPAM in this urban area, we also see several high sectoral self-interests in each local government, especially when it comes to determining raw water price tariffs. This further confirms the studies conducted by Andrews & Entwistle (2010), Fliervoet *et al.* (2017), and Rojas *et al.* (2020) that the collaboration process often encounters various problems related

to misunderstandings or struggles over resources, such as water in Rokan Hilir Regency, which results in higher self-interest of the collaborating parties as rich water owners.

To mitigate these conditions, Xu & Kim (2020) added that implementing collaboration with stronger norms, based on trust and reciprocity, and very specific administrative arrangements has greater potential to help increase the success of organizational autonomy in the collaboration process. Unfortunately, our findings also indicate that the norm of the trust and reciprocity dimension, which fundamentally influences the collaborative process, has not been properly implemented in the collaborative management of Durolis Regional SPAM.

However, Provan & Kenis (2008) and Berardo & Scholz (2010) stated that reciprocity indicates mutually beneficial collaboration. We support the arguments of Thomson & Perry (2006) and Thomson *et al.* (2007) that the reciprocity and mutuality dimensions are conceptually different. In our study, the mutuality dimension shows a review of the sharing of water resources between each collaborating actor, whereas the norms of trust and reciprocity dimensions are more inclined to equalize perceptions in collaboration ratings based on the belief that each local government acts in the same way through deliberation to reach consensus.

If we look further, our findings show that in the norms of trust and reciprocity, efforts are always made through consultation, as set out in the agenda of the cooperation agreement (MoU). In addition, efforts to equalize perceptions in this dimension are often carried out through correspondence mechanisms, which tend to take a long time to complete. Therefore, it can be said that the common thread of the norm trust and reciprocity dimension has not been well implemented. This is because the coordination process between stakeholders is often hampered by the lengthy process of working on the Durolis SPAM project carried out by the ministry's representatives in the region (Sumatera III River Basin and Public Housing Officer). Meanwhile, there was a waiting process between the parties involved and other problems related to interests and administrative processes that were too complex.

On the other hand, this study adds to the literature on collaborative governance with its explicit attention to the five dimensions of collaboration and interconnectedness to which some previous studies (Thomson & Perry, 2006; Ansell & Gash, 2008; Emerson & Nabatchi, 2015; Bryson *et al.*, 2019) have made important contributions, but none have explicitly or comprehensively addressed the various dimensions of collaboration, given the context and their interrelationships as part of the governance approach. In other words, whatever governance design is designed for a particular situation, attention should be paid to how the organizational autonomy dimension and the norms of trust and reciprocity dimensions are designed to be effective without overriding the overall dimensions such as the governance, administrative, and mutuality dimensions, especially when the implementation of collaboration involves multiple actors.

## 6. CONCLUSION

Our study highlights the importance of reaffirming the organizational autonomy, trust, and reciprocity norm dimensions of the Durolis Regional SPAM clean water management to urban areas. We suggest that this improvement can be achieved by considering (1) updating the collaboration agreement document or MoU adapted to the current conditions of collaboration implementation; (2) delegating authority by increasing the ability of local-level actors involved, Dumai City, Rokan Hilir Regency, and Bengkalis Regency, to make decisions independently according to their fields and responsibilities; and (3) establishing a clear and applicable ethical code of conduct in the implementation of collaboration to ensure consistency in its application. Thus, these three considerations can be used as a reference to improve organizational autonomy, as well as the norms of trust and reciprocity.

Additionally, our study offers a collaborative governance model for the Durolis Regional SPAM in urban water management. In this context, this model can address several problems at the macro-, meso-, and micro-levels in the management of SPAM Durolis. The model we offer provides recommendations for improvement to

meticulously craft the description of problems that occur during the collaborative process in the implementation of Durolis Regional SPAM. Third, our findings show that collaborations must be prepared to open opportunities through their internal efforts, and the same time emphasize the importance of external factors that create these opportunities. These opportunities include access to shared resources, such as the renewal of water tariff prices that accommodate the interests of the stakeholders involved, increased innovation through agreement document renewal, and enhanced problem-solving capabilities. By establishing a collaboration supervisory board, we hope to develop a structured approach for identifying and leveraging these opportunities, thereby maximizing the potential benefits of collaboration. We further recommend this supervisory board as the arbitrator and ultimate decision-maker if problems arise during the collaborative process in the management of Durolis regional SPAM in urban areas.

The findings of this study should be interpreted with caution due to its limitations. We recognize that the model we offer is still contextual; therefore, generalization of the model results to be applied to similar water management cases still requires contextual adjustments and specifications to the problem being addressed. Nevertheless, the model we offer can feasibly be used as a recommendation for transforming the Durolis Regional SPAM water management policy. However, further research is needed to test our model results in the fifth, sixth, and seventh stages of the SSM.

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## DATA AVAILABILITY STATEMENT

All relevant data are included in the paper or its Supplementary Information.

## CONFLICT OF INTEREST

The authors declare there is no conflict.

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