Journal of
Water & Climate Change

IWA PUBLISHING

Journal of Water and Climate Change Vol 14 No 10, 3891 doi: 10.2166/wcc.2023.412

Framing a social network analysis approach to understanding reputational power in the water governance of Johor, Malaysia

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ABSTRACT

The challenge of collaborative water governance often lies in the complexity of the networks involved in its processes, particularly in understanding the location of power and how the reputational power can be executed for policy decisions. A case study of the state of Johor, Malaysia, was done with the goal of figuring out a method for mapping out reputational powers in the network of actors involved in the water governance of the state. To achieve this goal, this study deconstructs the different facets of the state's water governance system by outlining the spatial, operational, and legal boundaries of various agencies. The fundamental issues identified through this step are the complexity that leads to fragmented water governance. A research framework is thus proposed, derived from a qualitative approach whereby through in-depth interviews, respondents are asked to rank the water-related agencies based on their perceived influence. These rankings derived from qualitative interviews are given weights and subsequently measured using parameters such as density and in-degree centrality to provide quantitative evidence of the reputational powers held by actors in the water governance network. The study supports the future use of the reputational power research framework to achieve collaborative water governance solutions.

Key words: Malaysia, reputational power, social network analysis, state of Johor, water governance

HIGHLIGHTS

- The deconstruction of the different facets of the state of Johor's water governance system.
- The overlaps and fragmentation of power in the water governance network as fundamental issues.
- Contribution to collaborative interactions in a water governance system.
- The development of reputational power research framework based on social network analysis.
- Measuring power from both qualitative and quantitative angles.

LIST OF ABBREVIATIONS

BAKAJ	Johor Water Regulatory Body
DID	Department of Irrigation and Drainage
EXCO	State Executive Committee
GSA	Group Settlement Act
IRBM	Integrated River Basin Management
IWRM	Integrated Water Resources Management
JRB	Johor River Basin
MBIP	Iskandar Puteri City Council
MBJB	Johor Bahru City Council

MBPG	Pasir Gudang City Council
MDKT	Kota Tinggi District Council
MDLabis	Labis District Council
MDMersing	Mersing District Council
MDSR	Simpang Renggam District Council
MDTangkak	Tangkak District Council
MDYP	Yong Peng District Council
MPBP	Batu Pahat Municipal Council
MPKluang	Kluang Municipal Council
MPKulai	Kulai Municipal Council
MPMuar	Muar Municipal Council
MPP	Pengerang Municipal Council
MPPontian	Pontian Municipal Council
MPSegamat	Segamat Municipal Council
PFR	Permanent Forest Reserve
PLANMalaysia	Department of Town and Country Planning, Malaysia
RMKe-12	12th Malaysia Plan
SPAN	National Water Commission
WSIA 2006	Water Services Industry Act 2006
WST 2040	Water Sector Transformation Agenda 2040

1. INTRODUCTION

Water governance is broadly defined as all social, political, economic, and administrative organisations and institutions and their interactions with water resource development and management (Tortajada 2010). Water governance is a topic that has been a focus and concern due to impending water security and sustainability issues faced by many regions globally, encompassing the water catchment to the supply and the treatment of wastewater (Tortajada 2010; Dellapenna *et al.* 2013; Gupta *et al.* 2013; Cooley *et al.* 2014; Warner *et al.* 2022).

A study of governance, including water governance, is often conducted based on scrutinising the actors (Lieberherr & Ingold 2019; Nabiafjadi *et al.* 2021) and the legislations (Delipınar & Karpuzcu 2017), policies (Gupta *et al.* 2013; Saimy & Yusof 2013; Akhmouch & Correia 2016; Meissner 2017; Di Gregorio *et al.* 2019), and strategies (Bates 2012; Muneepeerakul & Anderies 2017) involved. As a baseline, 'governance' refers to the procedures and standards guiding group decision-making, either formal and informal or visible and invisible. In addition, in the context of critical water governance, scholars have also examined the role of political dynamics and power relations among the actors involved (Zeitoun & Warner 2006). In many places, although there are many water agencies, they are often not connected either vertically or horizontally (Cacal & Taboada 2022).

The idea of water governance is often perceived as complex (Schnurr 2008), even more so in determining the power involved. Based on previous research by Lieberherr & Ingold (2019), we reintroduce the idea of reputational power, a way of measuring power substantiated by the perception of influence. It is derived from its fundamental form of 'reputation', described as a multidimensional concept which incorporates agenda-setting power, decision-making power, and problem-solving power (Fischer & Sciarini 2015; Aydin 2018; Takács *et al.* 2021). It is generally defined as an individual's or organisation's capacity to influence others based on their reputation or perceived standing within a specific community or society. Over time, it is built through continuous actions or behaviours that others may perceive as positive or valuable. In some cases, the reputation may be built due to the consistent actions that fit the actors' interests.

Very little research is being done on power in water governance – and even fewer research on reputational power and its importance in water governance. Water governance is often made of more than one specific actor involved: an individual or organisation within a community with a strong reputation for effective water governance is more likely to be trusted and respected by community members and stakeholders. The examination of the ability of the actors in water governance, either as individuals or organisations, who have established a reputation as reliable and trustable and that has given them a particular type of power to influence decision-making has received scant attention. Therefore, in the following sections, we explore the importance of distinguishing powers by measuring reputational power, which can be useful in many forms of governance, including in achieving more collaborative water governance.

1.1. Aims and novelty of the study

The paper's primary goal is to construct a framework that illustrates how reputational power, as a larger construct of the social analysis framework, can be utilised in the water governance of Johor. The objectives underpinning the proposed framework development include identifying and mapping key actors, developing a measurement quantifying reputational power, and analysing available water governance networks through stakeholder perceptions. This study is novel in combining two disparate ideas: reputational power, frequently viewed and valued through a qualitative lens, and social network analysis, which is more quantitative. The study offers a novel perspective on investigating network dynamics in water governance, shedding light on the interaction between social relationships and the perception of power in a given context.

The essential questions that we attempt to answer through this study include:

1. What are the main problems in water governance that can be reduced or resolved by strategic solutions through determining reputational powers?
2. How will measuring reputational power contribute to collaborative water governance?
3. How can a framework be developed to apply the same methodology to other networks, particularly to improve collaborative governance?

1.2. Structure of the paper

To attempt to answer these questions, we first present the idea of reputational power and its linkage to water governance. Then, we outline our methodology, utilising quantitative and qualitative data collection and analysis with methods such as actor mapping and social network analysis. Next, we present the results in which we explain the delineation of power in Johor's water governance and the overlap between different agencies in maintaining and managing areas under their jurisdiction, the different existing boundaries (i.e., legal, operational, and spatial), and where the role of reputational power could come in. We then present the research framework design based on our findings to facilitate future-related research. Finally, we present our results and discussion, followed by an overall conclusion.

1.3. Significance and context

The practical significance of the framework development is that it provides a basis for understanding power across different organisations in moving towards collaborative governance. Recognising this allows for better resource management and infrastructure planning while avoiding environmental degradation. Previous research has highlighted the need for more research on governance to mitigate natural disasters (Ali *et al.* 2020), and this should also include water-related natural disasters.

Before implementing the framework for other studies, the idea is to confirm the importance of utilising reputational power by studying the state of Johor's water governance system as the first step. The justification for selecting the case study area is because of Johor's relationships with internal and external parties. Johor's water relationship network can be described as extensive, even extending to its neighbouring country, Singapore. Internally, many agencies exist within the state itself under both the state and federal governments. We contend that varying organisational jurisdictions and boundaries are the primary cause of fragmentation in water governance. The water governance network in Johor is complex, and this study attempts to simplify it by deconstructing the different facets involved.

In the context of Malaysia, it is important to tackle the fragmentation of water governance because the collective aim is to move towards IWRM (Sukereman & Suratman 2014) and IRBM for river basins (Elfithri & Mokhtar 2018). The aim is further emphasised in recent Malaysian government policies such as the 12th Malaysia Plan (RMKe-12), Water Sector Transformation 2040 (WST 2040), and in the many levels of development plans, particularly the National Physical Plan 4, which will then be translated to the State Structure Plans and Local District Plans. To reduce this fragmentation, a framework that can identify reputational power is proposed to positively implement more collaborative and integrated water governance, especially leading to the effective application of Integrated Water Resources Management (IWRM) and Integrated River Basin Management (IRBM).

In a broader global context, the applicability of this framework transcends Malaysia's borders. The framework can serve as an objective tool to discern reputational power dynamics across diverse governance networks, facilitating insights and strategies. By using this framework, decision-makers, researchers, and other interested parties can promote efficient cooperation,

reduce fragmentation, and generally improve the governance of vital resources like water that extend beyond national boundaries.

2. THE CONCEPT OF REPUTATIONAL POWER AND WATER GOVERNANCE

Power studies started with recognising the existing network ties through social network analysis or measures. Social networks, in general, have a long history that dates back to the dawn of humanity. It has always existed, even largely unnoticed, since people began helping one another (Aydin 2018). Any interconnected ties between humans and their relationships are considered social networks, as network ties exist through means of communication or transmission of information between two or more actors and cannot happen at an individual scale (Morrison *et al.* 2017). In any circumstance, a social network exists when these two fundamental elements exist: individuals (nodes) and the relationships (social ties) between them (Fowler & Christakis 2008). Thus, social network analysis can be used to investigate strategically significant networks within an organisation, identify informal groups, and collaborate with significant groups to support efficient collaboration (Aydin 2018).

Due to the interconnectedness and interdependence between power and 'influence' on the actors, earlier social scientists such as Weiss & Jacobson (1955), Rogers *et al.* (1976), Tichy & Fombrun (1979), and Roberts & O'Reilly (1979) considered social network measures as an approach that is particularly appropriate to their studies (Brass 1984) on power. The research on networks and organisations continued to evolve. Over time, although still very limited – scholars have incorporated the measurement of reputational power via the social network to study the reputational influence that one (or more) actors may have in these network ties.

Reputational power can be regarded as how we perceive influence in decision-making that extends to sectors such as business and social relationships. It is also considered a soft power, which refers to the capacity to influence people by appeal, persuasion, and the ability to create agendas rather than force or coercion (Nye 2017). It can also identify how collaborations are made, which Takács *et al.* (2021) have justified that collaboration can be expanded beyond dyadic relationships when decisions are made cooperatively and are contingent on transmitted information (also known as 'reputation'). This shows that understanding the connection between reputation, the power associated with reputation, and cooperation is required to understand a governance process better. In some cases, the reputation may be built due to the consistent actions that fit the actors' interests. To simplify reputational power and understand the notion of 'reputation' in a decision-making process, Takács *et al.* (2021) noted that decision-making guidelines, like 'if someone told me that you cooperated with others in the past, I cooperate with you', are made possible by communication and the capacity to track reputation.

Alternatively, Gronow *et al.* (2020) posit that actors in a network system might derive their reputational power and influence from their resource endowments. One of the earlier concepts of power is the Weberian concept of power by Max Weber in his essays (Gerth & Mills 1946), which is the probability that a person or group can realise their will against the opposition. The research on power centred on this concept influenced the view that power is concerned with distributing scarce values. Relevant to water governance, water conflicts are often caused by the scarcity value of water rather than the physical scarcity of water. Ghosh & Bandyopadhyay (2009) argue that other than physical scarcity, it is the scarcity value that causes injustice and, therefore, induces conflict; it is defined as the value of scarcity, or more precisely, as the value of loss due to scarcity at the margin of production at a specific time. In simpler terms, it is the scarcity of the inability to access water due to reasons such as poor infrastructure, pollution, or no means to bring the water from the point of source to the place where the water is needed. This means that areas with lower endowments and governments with insufficient funds may be forced to engage in a water conflict with others who are more privileged. From the perspective of sociometric power choices, persons who hold executive positions in many organisations (inter-organisational) generally have more power over others. However, this means that power will only work with a network. Thus, it is recommended that beyond studying individual power, the inter-organisational ties need to be inspected.

Water governance greatly involves inter-organisational ties, and it encompasses allocative and regulatory politics in managing water and other natural resources and the formal and informal institutions through which authority is exercised (Batchelor 2007). Water governance incorporates many practices, including formulating policies, advice, decision-making, infrastructure construction, operation, maintenance, and rehabilitation tasks associated with water distribution and flood protection. It also includes licensing, monitoring, enforcement, and sanctions related to water (re)use, wastewater discharge,

water capture, treatment, distribution, and pricing nationally and internationally (Warner *et al.* 2022). Warner *et al.* (2022) described that there are numerous issues with the processes involved in water governance, including a lack of funding, elite capture, weak rule actionability and enforceability, interference by politicians, short-term functionary appointments, working at various scales, cross-border issues, and systemic corruption which are all related to the use of reputational power.

Therefore, to put forward strategic solutions for improving water governance, it is deemed important to determine who has the most influence in making decisions related to water governance. Determination of the influence or reputational power can be done through the mapping of actors and further analysed through social network analysis of the mapping. Actor mapping is a key component of any water governance assessment, regardless of the structure, method, or outcome (Figueroa-Benitez *et al.* 2023). Thus, any research framework to determine the existing powers needs to include actor mapping as part of the process. The next section explains how actor mapping can be used to understand reputational power in a governance network.

In determining the approach for the study, we refer to a notable previous study by Lieberherr & Ingold (2019). The study clearly outlines the importance of identifying reputational power in water governance in determining whether actors can serve as barriers or bridges. The study noted the significance of reputational power in water governance by observing that collaboration between actors was more significant when the actors in charge of water supply valued their potential coordination partners.

Similarly, another research has shown that reputational power has the most substantial relation with collaboration, having a highly significant coefficient: 'If Actor A perceives Actor B as powerful, the two also share a collaboration relation' (Herzog *et al.* 2022). Collaborative governance structures are important to achieve strategic goals, successful policy implementation, and sound engagements (Ansell & Gash 2007; Farazmand 2012; Bodin 2017). Thus, we reiterate the importance of understanding reputational power to allow for more future collaborative water governance structures.

3. METHODOLOGY

3.1. Research flow

The challenge is determining how to measure power in a complex water governance network. To overcome this challenge, we identify a mixed methodology of quantitative and qualitative data collection and analysis to develop a framework for understanding reputational power (Figure 1). We begin by employing the qualitative approach by methodically conducting interviews and workshops with individuals or groups of representatives from various water-related agencies. Using the interviews and workshops as a starting point, we analyse the agencies' jurisdictions and boundaries through three different lenses, which are spatial, legal, and operational. The interview process involves understanding each agency's (actor) roles and the powers that exist with their roles. We then use the information gathered through the interviews to compare and contrast the jurisdictions and boundaries of each actor and determine if there are any overlaps or conflicts among them. This helps us identify potential spatial, legal, and operational issues arising from different actors' overlapping jurisdictions and boundaries.

Following this, we collate the findings with available data that have been documented. To initiate the social network analysis of Johor's water governance, we perform the mapping of actors involved in a social network (in this case, the actors involved in water governance) and use the connections between them as a weightage to measure the reputational power. The findings from the actor mapping were used to establish boundaries in the jurisdiction and also provide a foundation for our analysis of reputational power. Next, we considered the inclusion of a quantitative approach to the study by identifying suitable parameters based on the social network analysis. Based on the findings, we later confirm the importance of using reputational power in water governance research.

Ultimately, the contribution from the study is a strategic solution for future research in the form of a research framework that focuses on reputational power. The research framework includes a quantitative approach that would help solidify the evidence gathered through the qualitative approach. For this framework, we refer to the methods by Lieberherr & Ingold (2019) that utilised the elements of social network analysis in studying the reputational powers of the municipalities in their research. We derive reputational power using centrality measures, which is especially effective in determining the 'how' and if novel information can successfully influence strategy implementation choices and, ultimately, an organisation's performance (Zamudio *et al.* 2014). The usage of social network analysis ultimately enables an easier dissection of the complexity of the existing water governance structure. There is a limitation in finding similar studies that can support our method.

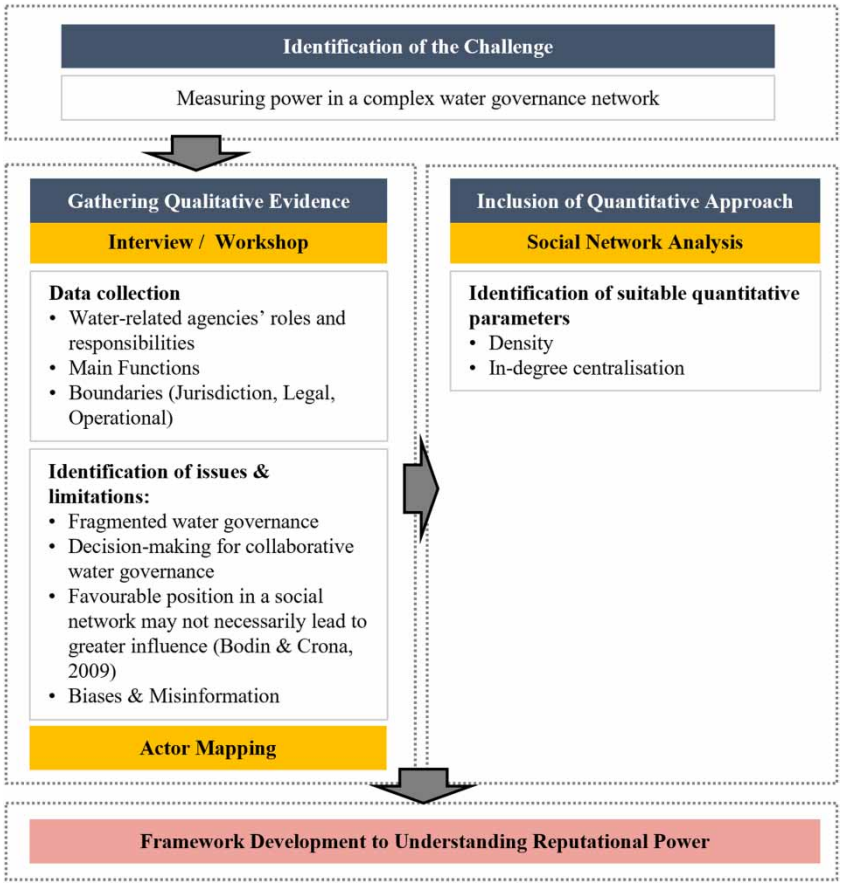

Figure 1 | Research flow.

However, as described in Section 3.2, the strengths of using reputational power as a measure are considered to produce the output of the study.

3.2. Strengths and limitations of reputational power as a measure

For areas where fragmentation is an issue, reputational power assesses the influence level and provides an idea of where the central decision-making power is. Reputational power as a measure has two main strengths: being close to reality and all-encompassing (Fischer & Sciarini 2015). Reputational power is based on the judgements of actors actively participating in the water governance system or decision-making process. The fundamental tenet of reputational power is that participants in a particular political system or decision-making process have the most accurate understanding of how power is allocated among actors involved in that system. Moreover, reputational power encompasses all aspects, from the resource (both aspects of water quantity and quality) to water supply and subsequent use to sanitation and wastewater systems. Given the range of aspects that fall under water governance, it is crucial to understand who has the most reputational power and at what stage of the decision-making process.

Despite the strengths, there are some limitations to reputational power. The first is the limit of the network. It can be quite difficult to define a network boundary, and the question that can be asked is, 'At what point does it end?'. While actors who play a role in water governance often come from water-related organisations, it is demonstrably difficult to identify actors who are indirectly involved in water governance processes. Two other weaknesses of obtaining the measure of reputational power through only a qualitative approach are self-representation and misperception (Fischer & Sciarini 2015). The actor may overestimate or underestimate their abilities, accomplishments, or access to control. Although already having a position in water-related agencies may contribute to this bias, Bodin & Crona (2009) subscribed to the idea that possessing a favourable position in a social network may not necessarily lead to greater influence. Thus, reputational power is not rigid or entirely

based on the organisational hierarchy or structure but is fluid and dependent on the actors involved. Another limitation is that the bias towards oneself or another party may render the data inaccurate. However, such risk is a normal circumstance in a qualitative approach.

Hence, we add the quantitative mechanism to the framework to provide a more objective and comprehensive understanding and further strengthen the findings from the output.

4. RESULTS AND DISCUSSION

4.1. Deconstructing the facets of Johor's water governance

Typically, the many actors involved in water governance have their aims and objectives defining the overall role of their organisation (Cooley *et al.* 2014; Nabiafjadi *et al.* 2021). In the case of Johor, there are many governmental agencies related to water governance. However, each agency may have different boundaries (e.g., spatial, legal, or operational boundaries). There are boundaries of power that overlap with each other, are embedded within each other, and may be tangential or even parallel with each other (Durano 2021). Identifying these boundaries will showcase a clearer overview of Johor's complex water governance and how reputational power is necessary to facilitate collaborative governance.

To provide a background on the country's administrative system, Malaysia is a constitutional monarchy that practices parliamentary democracy. At the state level, the Johor State Legislative Assembly exists, whereby its primary duty is to pass laws that apply to the entire state. Members can express their views on the state government's policies and how they are being implemented. The Privileges, Immunities, and Powers Ordinance of 1963 grant assembly members the freedom to speak openly about current events, including public complaints. Regarding budget and expenses, the Assembly approves government provisions and ensures that money is used properly and in the best interests of taxpaying citizens. Members of the State Assembly are selected to serve on the State Executive Council (EXCO). It serves as the Sultan's executive arm and reports to the State Assembly under the direction of the Menteri Besar (Chief Minister of the State). Based on the Federal Constitution of Malaysia 1957, three matters heavily pertaining to water governance are under the concurrent list (under both federal and state lists). These include drainage and irrigation, town and country planning, and public health and sanitation. The state government makes decisions for these matters within the state but is bound by the legislation applied at the federal level.

For example, resource protection and water supply decisions are made at the state level. However, the National Water Services Commission, a federal-level commission, oversees the water industry and is supported by the Water Services Industry Act 2006. Their main roles under the Act include advising the Minister of the Ministry of Natural Resources, Environment and Climate Change on all matters concerning the national policy objectives of water supply and sewerage services laws, as well as implementing and enforcing the water supply and sewerage services laws and to consider and recommend reforms to the water supply and sewerage services laws. By mapping out the actors at the different stages of the water services, Figure 2 displays the various agencies involved at varying levels of water management in Peninsular Malaysia.

As shown in Figure 2, many actors are involved in the different stages of water management. Some agencies are under the federal government, and some are under the state government.

Across borders, Johor has been involved in a transboundary water agreement with the state of Melaka and crosses the international border with Singapore. Due to the geographic proximity, Singapore and Johor have strong economic ties. Singapore also heavily relies on the Johor River Basin (JRB), which is one of its four main 'taps' (the others being recycled water, desalinated water, and water from local catchments) (Pak *et al.* 2021). Two agreements between Malaysia and Singapore were signed in 1961 (ended in 2011) and 1962 (ending in 2061). While Singapore depends on Johor for raw water, bilaterally, Johor also depends on Singapore for treating the raw water. Having bilateral agreements signifies the involvement of multiple local or international parties in water rights, particularly on the source and supply side (Ewing & Domondon 2016).

In geographical context, the spatial boundary may be the mode of choice in delineating the functions and roles of the actors involved (Karstens *et al.* 2007); however, in a similar spatial setting, there may be some legal and operational boundaries that may limit the power and influence of a certain agency or may overlap the jurisdiction of another agency (Figure 2). Therefore, we looked at separate boundaries, such as spatial, legal, and operational boundaries, to make a distinction between the agencies involved in water governance at the state level in Johor.

The spatial boundary is typically defined as the limit that separates and characterises one area from the other, particularly in the geographical context (Cummings *et al.* 2007). We describe the legal boundary as the jurisdiction of an agency according

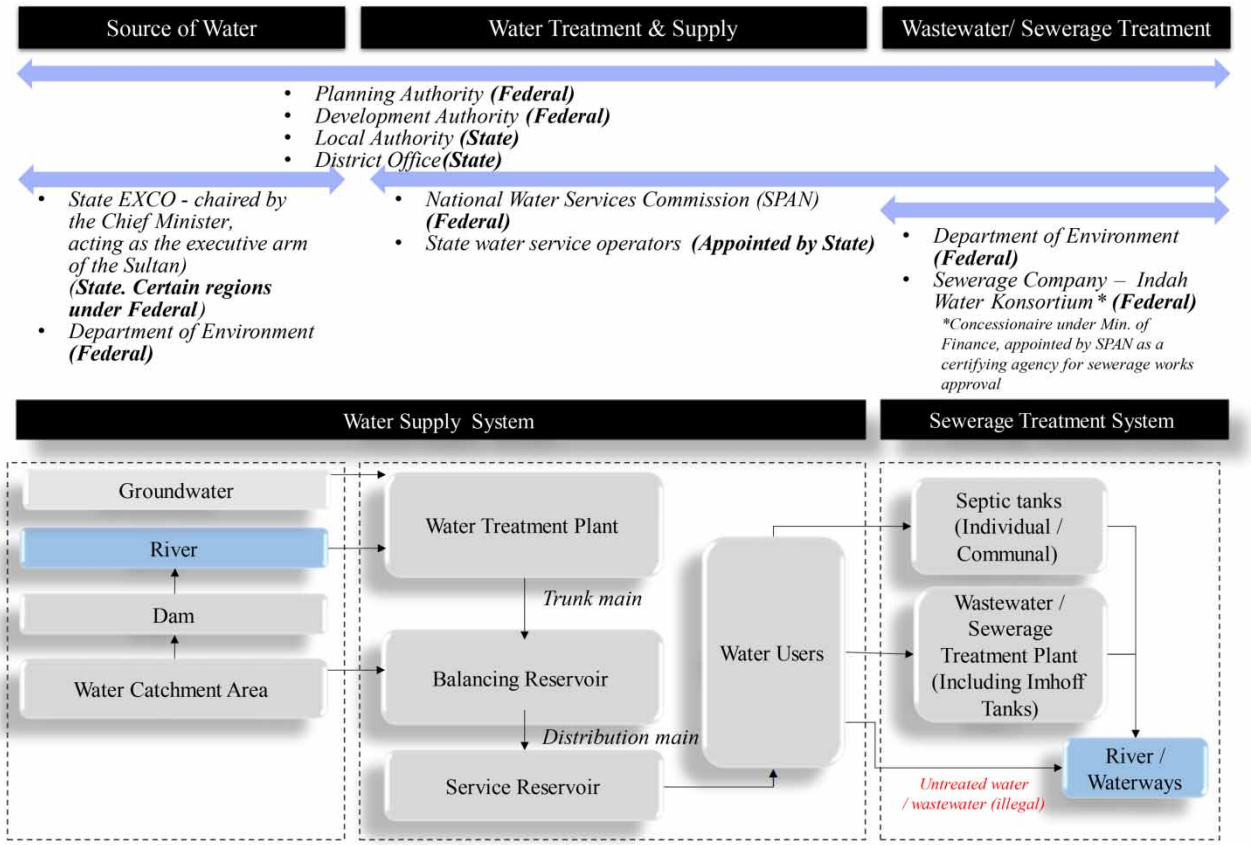

Figure 2 | Actor mapping of relevant water services agencies at different stages of water management in Peninsular Malaysia.

to existing legislation that underpins the creation of the agency. We also expand our definition to include the legislation that supports and explicitly contains the description of their jurisdiction of power. This consists of the limits and restrictions imposed on the agencies and ultimately determines the obligations and responsibilities as per the existing law. Next, we define the operational boundary as a term that specifies the scope and limits of the agencies, especially in the organisational context. The operational boundary is a way to define the limits of the organisation's activities, such as the types of services and processes that will be undertaken and the resources it will need to do so. It is also a way to identify which activities are within its scope and which activities are outside of its scope. These boundaries are important for understanding the differences between areas and their connections.

Figure 3 illustrates how complex identifying an agency's jurisdiction within Johor is. Within one district authority called the District Office, there could be a combination of different local councils. For instance, Johor Bahru City Council, Pasir Gudang City Council, and Iskandar Puteri City Council can be seen within the district of Johor Bahru, the state's main district. It needs to be noted that even though we can identify the boundaries of the different local authorities, within it, there is also another layer of area delineation called the 'operational area', which includes the areas where the residents pay the assessment tax to the local authority, and the local authority provides services and infrastructure. This means that the permanent forest reserves, as appeared in Figure 3, are excluded from the areas within the jurisdiction of local authorities. Additionally, areas that are not under the 'operational area' are mostly rural villages, areas landmarked as Group Settlement Areas (GSA) under the GSA Act 1960, which are usually plantation estates, and also areas gazetted as 'reserve' lands, including river reserves which are under the jurisdiction of state's water authority and also the federal government's Department of Irrigation and Drainage (DID). The areas outside the jurisdiction of local authorities do not receive services, and the power of local authorities cannot be enforced in these areas.

Understanding the different jurisdictions and boundaries is crucial in water governance because they define how much these actors can control others. However, the overlap and fragmentation may lead to uncertainty, particularly in identifying

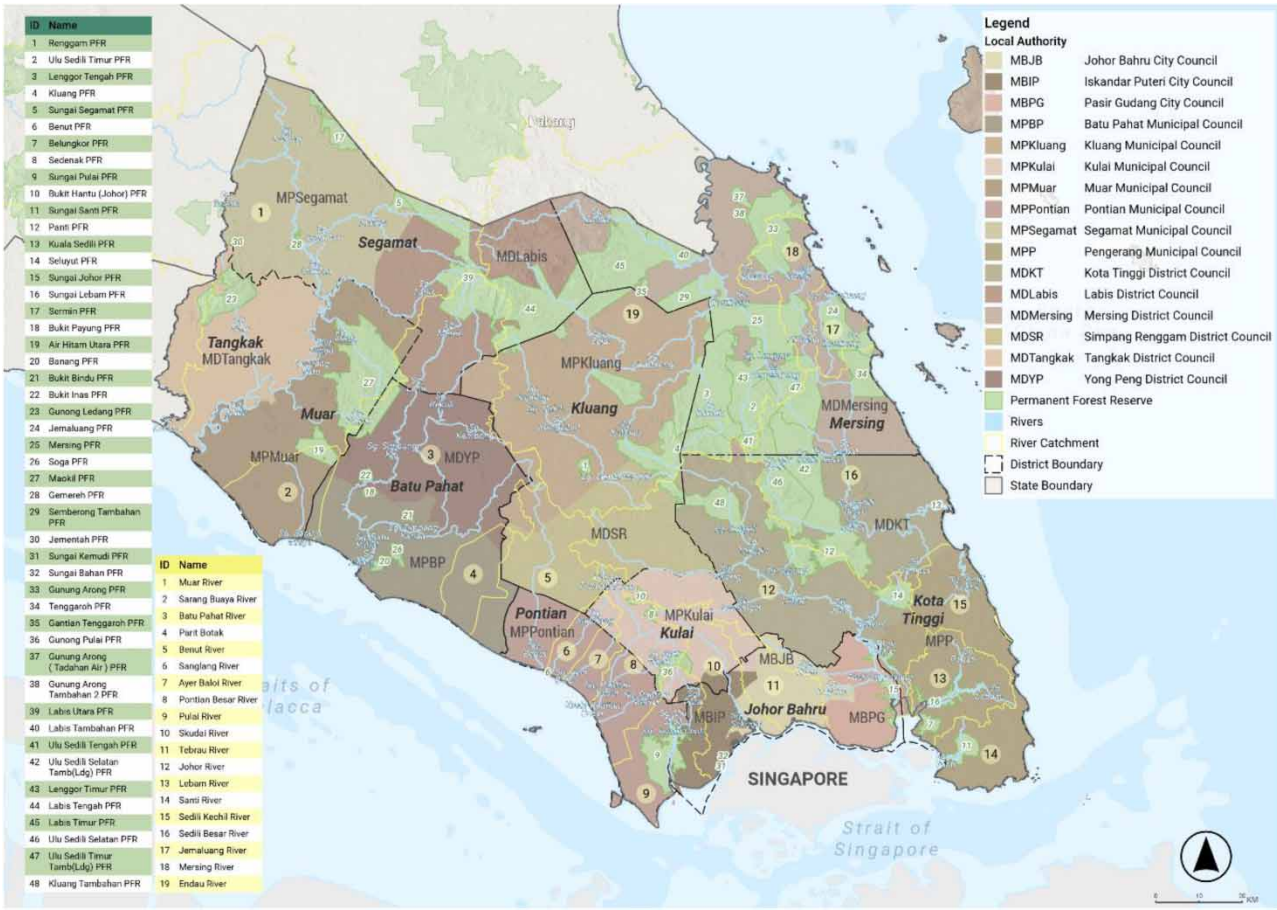

Figure 3 | Spatial boundary of Johor (showing Johor's 16 local authorities, 48 forest reserves, and 19 river basins).

whose decisions are heard. Hence, it is necessary to comprehend reputational power to establish the level of influence that may be obscured due to the overlaps and fragmentation. This is because reputational power can be used to influence decision-making in a subtle way, even when it is not overtly visible. Understanding the nature of reputational power can thus help to identify the true source of influence in decision-making. Therefore, we identified the existing jurisdictions and boundaries of different water-related agencies in Johor's water governance, as distinguished in Table 1.

From Table 1, it can be observed that there are many agencies involved in a particular area. Due to this complexity, it is, therefore, quite difficult to pinpoint who is the most influential in making water-related decisions. For example, at first glance, BAKAJ (Johor Water Regulatory Body) may seem the most powerful, but their power jurisdiction only covers the water resources to the dam. The different jurisdictions and boundaries, particularly the overlapping of water management between the federal and state governments and its implications, signify water governance fragmentation (Saimy & Yusof 2013).

In the local context, an area is 'fragmented' if it has many local government units, either absolute or per capita (Goodman 2019). This is further compounded by the fact that many of these agencies operate independently and may have their own interests or pursuits, making it difficult to understand the motivations behind their decisions and how they might affect the water governance of the state. Fragmented governmental jurisdiction can be seen as pervasive, whereby it has long been the focus of heated debate over the priority of local or regional interests (Feiock 2013).

For Johor, overlaps and fragmentation can also be observed, where one may work within the areas where other actors are working as well. For example, the local councils are known as the local authorities, but the operational service area does not cover the whole district. In these areas, the District Office may be perceived as more powerful.

Although different aspects of water are being taken care of by each actor, the water system is interconnected in a complex manner, thus may confuse the actors involved. Such issues can arise from unclear roles and responsibilities, resulting in

Table 1 | Actors in water governance of Johor and their jurisdictions, main functions, and boundaries

No	Agency/authority/ company	Jurisdiction		Main functions						Legal boundary (statutory)	Operational boundary
		Federal	State	Policymaker	Regulator	Implementer	Development	Monitoring	Licensee		
1.	Badan Kawalselia Air Johor (Johor Water Regulatory Body)		/		/					Johor Water Enactment 1921	Protection of water sources, the state licensing body for water supply, managing state's water dams, maintaining a relationship with Singapore
2.	Economic Planning Division, State Secretariat		/			/				The Privileges, Immunities, and Powers Ordinance of 1963 (on decisions made pertaining to budget at the state assembly)	Economic sector, planning the annual state budget
3.	Johor Land and Mines Office		/		/	/	/			National Land Code 1965, The Law of the Constitution of 1895 (*Undang-undang Tubuh Negeri Johor 1895*)	Land matters, gazettement of land reserves (including for rivers and dams)
4.	National Water Commission (SPAN)	/			/					Water Services Industry Act 2006, SPAN Act 2006	Water supply and sewerage treatment services
5.	Department of Irrigation and Drainage	/		/			/			Waters Act 1920 (Revised 1989)	Water resources management and hydrology, river basin management, coastal zone management, flood management, sustainable stormwater management, hydromechanical management, hydro infrastructure engineering, dam management, federal project management

(*Continued.*)

Table 1 | Continued

No	Agency/authority/ company	Jurisdiction		Main functions						Legal boundary (statutory)	Operational boundary
		Federal	State	Policymaker	Regulator	Implementer	Development	Monitoring	Licensee		
6.	Department of Works	/		/		/				Road Transport Act 1987	Roads, major infrastructure, transportation infrastructure, slope maintenance, special projects
7.	Department of Forestry	/	/	/		/				National Forestry Act 1984	Permanent reserved forest including water catchment forest, forest harvesting and forest revenue collection, protection of forests, wood-based industries
8.	Department of Fisheries	/	/	/		/	/	/		Fisheries Act 1985	Fishermen's livelihoods, fisheries production
9.	Department of Environment	/		/	/			/		Environmental Quality Act 1974, Environmental Quality (Industrial Effluent) Regulations 2009	Enforcement, hazardous materials, air quality, water and marine quality, green industry
10.	Department of Agriculture	/		/	/		/	/		Pesticide Act 1974	Enforcement, agricultural land
11.	Department of Sewerage Services					/				Water Services Industry Act 2006	Management of sewerage projects
12.	Department of Veterinary Services	/		/	/					Animals Act 1953 Abbatoir (Privatisation) Act 1993	Livestock/pets, slaughterhouses/ abattoirs, animal products, quarantine services, prevention of animal, and zoonotic diseases

(*Continued.*)

Table 1 | Continued

No	Agency/authority/ company	Jurisdiction		Main functions						Legal boundary (statutory)	Operational boundary
		Federal	State	Policymaker	Regulator	Implementer	Development	Monitoring	Licensee		
13.	Department of Mineral and Geosciences	/		/	/	/	/	/		Geological Survey Act 1974, Mineral Development Act 1994	Mineral resources, groundwater, geological hazards, heritage geological mapping, mines and quarries, marine geology, geophysics
14.	Department of Urban and Rural Planning (PLANMalaysia)	/				/	/			Town and Country Planning Act 1976, National Land Code 1965, Local Government Act 1976, Street, Drainage and Building Act 1974	Planning approvals and development plans, including land use and land developments
15.	Department of Health	/		/	/	/	/	/		Prevention and Control of Infectious Diseases Act 1988	Public health, provision of low-technology based sanitation infrastructure for prevention of infectious disease, overall management in the prevention of infectious diseases, vector-borne diseases, family health, health promotion
16.	Department of Marine	/		/	/		/			Merchant Shipping (Amendment) Ordinance 2016, Petroleum Safety Measures Act 1984, Merchant Shipping (Oil Pollution) (Amendment) Act 2011, Boat Rules 1953, Ports (Privatisation) Act 1990, Regional Sea Deed 2012	The marine area within the national boundary

(*Continued.*)

Table 1 | Continued

No	Agency/authority/ company	Jurisdiction		Main functions						Legal boundary (statutory)	Operational boundary
		Federal	State	Policymaker	Regulator	Implementer	Development	Monitoring	Licensee		
17–32.	Johor Bahru City Council, Iskandar Puteri City Council, Pasir Gudang City Council, Pengerang Municipal Council, Batu Pahat Municipal Council, Kluang Municipal Council, Kulai Municipal Council, Muar Municipal Council, Pontian Municipal Council, Segamat Municipal Council, Kota Tinggi District Council, Labis District Council, Mersing District Council, Simpang Renggam District Council, Tangkak District Council, Yong Peng District Council					/	/	/		Town and Country Planning Act 1976, Local Government Act 1976, Street, Drainage and Building Act 1974, Solid Waste and Public Cleansing Management Act 2007	Development control, planning and provision of services where the assessment tax is being collected by the council from the residents and commercial and industrial entities
33–42.	Johor Bahru District Office, Kota Tinggi District Office, Kulai Jaya District Office, Pontian District Office, Batu Pahat District Office, Muar District Office, Tangkak (formerly known as Ledang) District Office, Segamat District Office, Mersing District Office,		/			/	/	/		The Law of the Constitution of 1895 (*Undang-undang Tubuh Negeri Johor 1895*)	Development, tax collection, and land administration of areas under Johor Bahru District that are not under the operational area of councils (see no. 15–30)

(*Continued.*)

Table 1 | Continued

No	Agency/authority/ company	Jurisdiction		Main functions						Legal boundary (statutory)	Operational boundary
		Federal	State	Policymaker	Regulator	Implementer	Development	Monitoring	Licensee		
	Kluang District Office										
43.	Indah Water Konsortium Ltd	NA[a]							/	Water Services Industry Act 2006	Maintenance of public connected sewerage system, desludging service for non-connected sewerage within the operational boundary similar to areas under the jurisdiction of the local councils (city council, municipal council, and district council)
44.	Ranhill-SAJ	NA[b]							/	Water Services Industry Act 2006 Johor Water Enactment 1921	Water treatment plants, service licensee of water supply to consumers, common infrastructure for water supply
45.	Pengurusan Aset Air Berhad (Water Asset Management Company)	NA[c]							/	Water Services Industry Act 2006	Facility licensee and leasing of water assets

[a]IWK, wholly owned by the Ministry of Finance, is a sewerage concessionaire to states in Peninsular Malaysia. SPAN also appoints IWK as a certifying agency for sewerage infrastructure.
[b]As water supply is under the state's jurisdiction, the company is appointed by the state.
[c]Wholly owned by the Ministry of Finance as a holding company for the nation's water assets.

disputes and inefficient use of resources. Moreover, coordination and cooperation across different agencies can be difficult, leading to a lack of accountability and transparency. The overlap and fragmentation can make it difficult to hold any actor responsible for any part of the water-related processes. From the public and industries' perspectives, it could subsequently lead to a lack of compliance with regulations and a lack of enforcement of laws. Ultimately, this can result in a degradation of water quality and a decrease in the availability of water resources, threatening the state's water security.

Ideally, the aim and objectives of the agencies, who are also known as the actors, should be aligned, and there should be a clear distinction between jurisdiction and boundaries between these actors. The alignment can lead to more efficient use of resources and a more streamlined process of achieving water security goals. Consolidation, the opposite of fragmentation, allows actors to focus on their core activities and reduce the costs of running multiple operations. Consolidation can objectively be achieved through collaborative governance. Therefore, determining reputational power and understanding which actors are *actually* in power is crucial to addressing the issue of overlapping jurisdictions and essential in providing strategic solutions in the future.

4.2. Framing reputational power via social network analysis approach

The complexity of water governance is not exclusive to the state of Johor in Malaysia alone. Globally, the complexity of water governance appears in various forms and is especially political (Molle 2009; Zwarteveen *et al.* 2017), which forms our case that determining reputational power is particularly useful in the water sector. This importance is highlighted because the water sector often involves the interchangeable aspects of different environmental fields, such as land, ecosystem, and climate studies. In most cases, these aspects are divided into separate jurisdictions of various organisations. In three case studies done in the canton Basel-Landschaft, Lieberherr & Ingold (2019) discover that reputational power serves as a bridge among water provision actors because there is a high level of coordination when these actors value their potential coordination partners' reputational power in water governance. Using social network analysis helps to identify the areas in which each environmental field is interconnected and allows the identification of prominent figures with reputational power.

Based on our findings, we have formulated a framework for future research to identify reputational power using concepts borrowed from social network analysis methods. The important element in social network analysis and the identifier 'nodes' can be represented by the actors involved, and they may or may not have a mutual relationship with each other. The relationship (or non-relationship) is reflected through 'links'. A link can be directed or non-directed and carries certain information about the relationship. This proposed framework's two main social network analysis measures are density and in-degree centrality. Density is defined as the number of ties present divided by the number of possible ties (Mondal *et al.* 2022). A 'dense' network has a high level of connectivity; networks with low density have a low level of connectivity. Knowing the network's density enables the assessment of the overall structure and identifies the potential for information diffusion, collaboration, or influence within the network itself. On the other hand, in-degree centrality is how a network is focused on a certain actor (nodes). In the context of water governance, it indicates how often local actors, such as municipalities or waterworks, were mentioned as important and thus linked to the network's core (Lieberherr & Ingold 2019).

The framework will be able to outline how the water-related actors provide information on how they perceive others concerning them. Their response enables the understanding of who they are willing to listen to in the network. Mutuality and reciprocity can be observed. Using density and in-degree centrality, this can be done via ranking and scoring, and the measurement computed via social network analysis.

The basis of the framework starts with mapping actors involved in a social network (in this case, the actors involved in water governance). It uses the connections between the actors as a weightage to measure the reputational power. Research by Mondal *et al.* (2022) uses the main measures commonly used in social network analysis, such as degree, betweenness, isolates, reciprocity, density, centrality, and external-internal index, to understand multisectoral governance in district-level tobacco control implementation in India. While the method is used for a different sector, using social network analysis is recommended as extremely beneficial for visualising real implementation structures, such as important actors, their departments, and their interactions.

For this paper, references to past studies (Aydin 2018; Lieberherr & Ingold 2019; Jackson *et al.* 2021; Mondal *et al.* 2022) were made to produce Figure 4, which was constructed to illustrate a simplified method of identifying reputational power, presented in the form of a social network map.

In this simplified version, A, B, C, D, E, F, G, H, and J are identified as the nodes representing the actors involved in a social network. The arrows represent the direct link, also known as ties between actors, thus showing the influence or reputation.

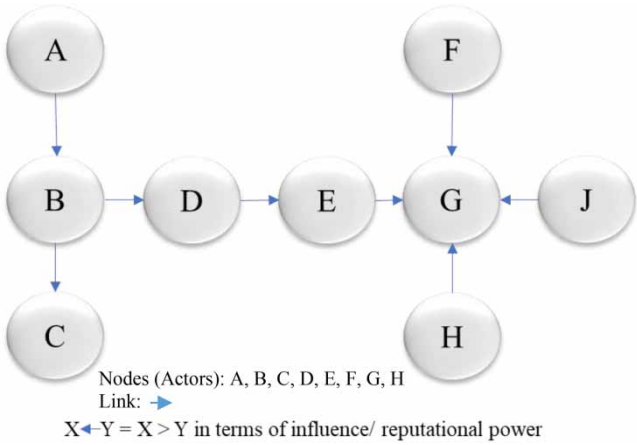

Figure 4 | Simplified illustration of determining reputational power in social network analysis (Adapted from Mondal *et al.* (2022) and Lieberherr & Ingold (2019)).

The arrow can have many definitions, but in this context, they point to where the actor is perceived as influencing the other actor. The link can be pointed out both ways in the real world, but we direct all links to move in a single direction for exemplification. From the network, calculating the influence, using the number of arrows as a unit of measurement of density, it can be concluded that actor G has significant reputational power over actors E, F, J, and H. However, actor E has more power over Actor G, and Actor D has more power over Actor E.

To put more weight on determining reputational power, approaches to establishing the actual definition of 'reputational' power may differ from one study to another, using different measures borrowed from social network analysis. Lieberherr & Ingold (2019) used in-degree centrality to identify actors with reputational power in water governance by illustrating how one node that may directly link with ten social connections (edge) is calculated as having ten degrees of centrality. A node with one edge has a degree of one. However, the idea of in-degree centrality as reputational power is that an actor is often reputed as having power based on others' perceptions. The connection must be directed to the nodes or the actor. Thus, in-degree centrality means that the incoming links or ties are considered in a directed network graph with nodes labelled with their in-degree centrality. In a directed network, the calculation is according to the number of arrows (reliance) directed to the nodes. The higher the in-degree centrality represents the higher reputational power (Figure 5).

4.3. The reputational power research framework

As shown previously, using reputational power as a measure via social network analysis allows for a quantitative measurement that can strengthen the findings obtained from the qualitative nature of interviews. To combine both qualitative approaches and to enable a comprehensive analysis of reputational power in water governance research, the proposed framework is reflected in Figure 6.

Returning to the original questions we intended to answer, we have identified the main problems in Johor's water governance. In the case of Johor, where there are too many actors involved in its water governance, important issues may be

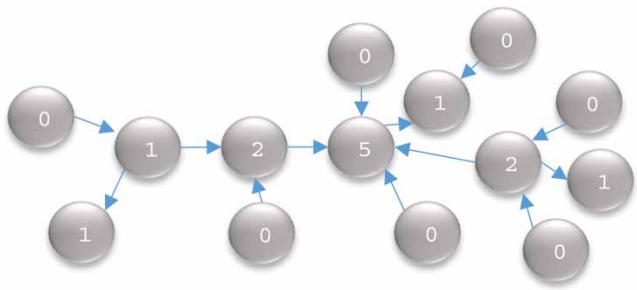

Figure 5 | In-degree centrality as a measure of reputational power. (Adapted from Mondal *et al.* (2022) and Lieberherr & Ingold (2019)).

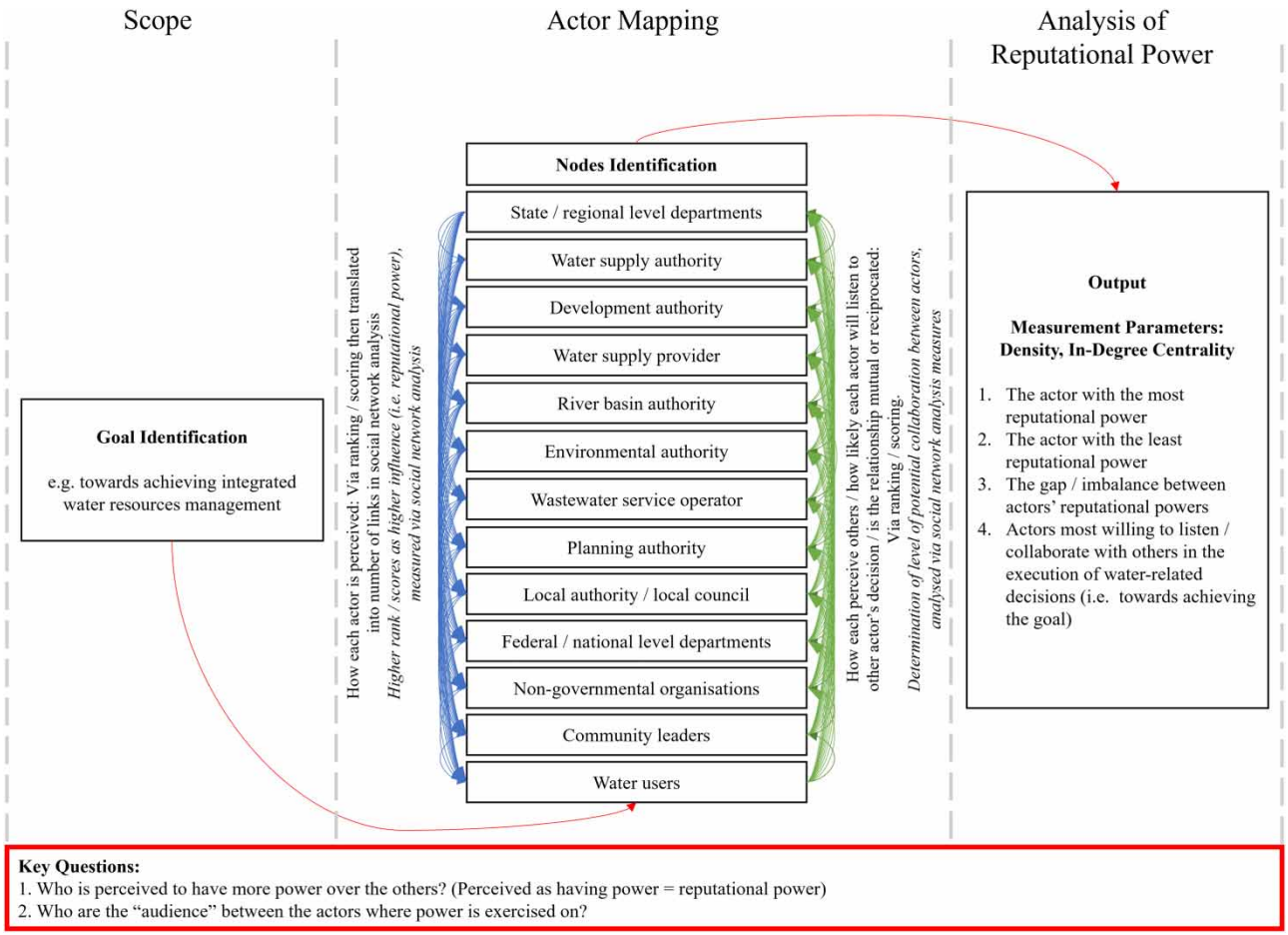

Figure 6 | Proposed reputational power framework for application in future research.

overlooked, and prioritisation may be misplaced if the source of influence is not determined accurately. The main and fundamental problem that necessitates using reputational power in analysing the power construct and improving collaboration in governance is the overlaps and fragmentation of water governance, which can be very complex to tackle, as observed through studying the jurisdictions and boundaries of Johor's water-related agencies. It is nearly impossible to overhaul the entire system rooted in Malaysia's colonial history, which has brought on different spatial, legal, and operational boundaries and perhaps other interests. Thus, identifying reputational power can help measure where the influence lies.

In the case of Johor, this is especially important towards achieving an integrated approach to water management. The policies have been created to facilitate IWRM and IRBM, but intricate details such as negative influence may hinder the fruition of such policy goals. Identifying reputational power can assist in ensuring that decision-making processes can be more integrated. Based on their area of reputational power, we can determine which strategy is better suited to be implemented by which actor. Therefore, the framework provides a step-by-step guide on how to simplify an already complicated network.

The framework (Figure 6) illustrates that the process involved in the reputational power research framework involves goal identification. The example shows that the research aims to look for ways to achieve IWRM. The variables in this framework design are interchangeable. For example, the goal and node identification (actors) are nominal variables that can be defined according to the regional context. However, to identify reputational power, the key questions should remain fixed and can be applied to any interchangeable goal. Key questions are 'Who is perceived to have more power over the others?' and 'Who are the audience between the actors where power is exercised?'. Next, to translate, the list of relevant actors needs to be identified, represented, and mapped to translate it to social network analysis methods. Two-way directionality needs to be applied, exploring how each actor is perceived on one end and how they perceive another on the other end.

From here, the mutuality of the perception can be observed. A ranking system can be used to enlist a rank of whom they perceive as important or place a score on the level of importance. Subsequently, each agency's ranking and weightage of influence can be calculated and computed via the density and in-degree centrality parameters of social network analysis, which translates the level of reputational power that these actors have. The output is critical to identify key decision-makers with the strongest influence, recognise where fragmentation occurs, plan future collaboration strategies, and strengthen the actors' roles (e.g., groups/organisations) by identifying where power can be used to achieve the goal.

4.4. Collaborative water governance through framework development

Collaborative governance brings public and private actors together in forums with public agencies to facilitate consensus-based decision-making (Ansell & Gash 2007). Once reputational power is understood, it opens the door to collaborations that can emerge through various interactions. Understanding reputational power first enables the identification of actors who are not being heard in the process. The way forward is to balance the existing powers. This balancing act can improve dynamics and mutual relations to ensure positive interactions such as shared decision-making and respectful communication. As a result, actors will be more invested in achieving the same results, leading them to work towards a common goal.

Research on collaborative governance frequently deals with dynamic networks of actors that operate implicitly or explicitly across sectoral, hierarchical, and geographic boundaries. As a result, gathering data on complex social interactions is frequently costly and time-consuming. Future research on collaborative governance based on a network approach should be simplified (Berardo *et al.* 2020). Social network analysis frequently involves various types of relationships. Focusing on reputational power, on the other hand, can simplify and improve the process. The preceding section's framework can be used to methodically guide the derivation of reputational power, particularly in assessing water governance, which is complex and involves multiple actors.

As a continuation of establishing the proposed framework, some key policy recommendations can be highlighted. First, to develop IWRM or IRBM strategies that incorporate insights gathered through the framework to streamline the institutional agendas and resource management processes. Secondly, integrated and cross-functional task forces can be established to promote collaborative water governance. Due to the complexity of delineating the boundaries, it is also recommended to reassess, if necessary, the legal aspects of water governance to minimise conflicts stemming from overlaps. Cross-agency collaboration can also be encouraged through legally binding agreements for efficient resource allocation and effective response during water-related emergencies.

5. CONCLUSION

The study defined the complex jurisdictions and boundaries that make up Johor's water governance landscape, noting the importance of the reputational power dynamic. Governmental agencies comprised the majority of the participants in this situation, and each was defined by the Federal Constitution's provisions on its jurisdiction and its spatial, legal, and operational restrictions. Notably, the study highlighted a serious problem caused by the overlapping and dispersed power structures in Johor's water governance framework.

Drawing inspiration from the assertion that effective collaboration happens when water supply entities value potential collaborative partners (Lieberherr & Ingold 2019), we devised the reputational power research framework that can be utilised for future works. This framework comprehensively considered bilateral perspectives, querying how one actor perceives another. Developing the reputational power research framework is crucial in identifying the most influential key decision-makers in water governance studies. It can also assist in identifying where fragmentation occurs, allowing the researcher to apply future fragmentation-reduction measures. Furthermore, future collaboration techniques can be developed to improve actors' responsibilities in water governance decisions and identify where power can be leveraged to achieve water governance goals. We propose that the output derived from the application of this framework be further analysed using a social network analysis, which can provide quantitative evidence of the reputational power held by actors in the water governance network. We propose future works to include the following: more studies on reputational power to scrutinise the validity of the framework; longitudinal analysis to study the impact of reputational power across time; comparative analysis on reputational power in various regions; the link between reputational power and overall sustainability; and exploration of the impacts of reputational power through policy analysis.

The impact of power can always be observable; however, power has often been seen as intangible. Finding a tool to measure the existence of power from both qualitative and quantitative angles is important to allow collaborative engagements

between actors. Thus, this study has shown how reputational power can be tangible when applied to water governance research. It is hoped that the more we understand power, the more we understand how to use it appropriately, minimise the impacts of negative use of power in water governance, and achieve water security.

ACKNOWLEDGEMENT

This work was supported by the Water Security and Sustainable Development Hub, funded by the UK Research and Innovation's Global Challenge Research Fund (GCRF) [grant number: ES/S008179/1].

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.

REFERENCES

Akhmouch, A. & Correia, F. N. 2016 The 12 OECD principles on water governance – when science meets policy. *Utilities Policy* **43**, 14–20. https://doi.org/10.1016/j.jup.2016.06.004.

Ali, R., Kuriqi, A. & Kisi, O. 2020 Human–environment natural disasters interconnection in China: a review. *Climate* **8** (4), 48. https://doi.org/10.3390/cli8040048.

Ansell, C. & Gash, A. 2007 Collaborative governance in theory and practice. *Journal of Public Administration Research and Theory* **18** (4), 543–571. https://doi.org/10.1093/jopart/mum032.

Aydin, N. 2018 Social network analysis: literature review. *AJIT-e: Online Academic Journal of Information Technology* **9** (34), 73–80. https://doi.org/10.5824/1309-1581.2018.4.005.x.

Batchelor, C. 2007 *What Is Water Governance?* Available from: http://pubs.iied.org/pdfs/G02523 (accessed 20 February 2023).

Bates, S. 2012 Bridging the governance gap: emerging strategies to integrate water and land use planning. *Natural Resources Journal* **52** (1), 1–39.

Berardo, R., Fischer, M. & Hamilton, M. 2020 Collaborative governance and the challenges of network-based research. *The American Review of Public Administration* **50** (8), 898–913. https://doi.org/10.1177/0275074020927792.

Bodin, Ö. 2017 Collaborative environmental governance: achieving collective action in social-ecological systems. *Science* **357** (6352), eaan1114. https://doi.org/10.1126/science.aan1114.

Bodin, Ö. & Crona, B. I. 2009 The role of social networks in natural resource governance: what relational patterns make a difference? *Global Environmental Change* **19** (3), 366–374. https://doi.org/10.1016/j.gloenvcha.2009.05.002.

Brass, D. J. 1984 Being in the right place: a structural analysis of individual influence in an organization. *Administrative Science Quarterly* **29** (4), 518–539. https://doi.org/10.2307/2392937.

Cacal, J. C. & Taboada, E. B. 2022 Assessment and evaluation of IWRM Implementation in Palawan, Philippines. *Civil Engineering Journal – Tehran* **8** (2), 290–307. https://doi.org/10.28991/CEJ-2022-08-02-08.

Cooley, H., Ajami, N., Ha, M.-L., Srinivasan, V., Morrison, J., Donnelly, K. & Christian-Smith, J., 2014 Global water governance in the twenty-first century. In: *The World's Water* (Gleick, P. H., ed.). Island Press/Center for Resource Economics, pp. 1–18. https://doi.org/10.5822/978-1-61091-483-3_1.

Cummings, J. N., Espinosa, J. A., Pickering, C. K., 2007 Spatial and temporal boundaries in global teams. In: *Virtuality and Virtualization*, Vol. 236 (Crowston, K., Sieber, S. & Wynn, E., eds). Springer, USA, pp. 85–98. https://doi.org/10.1007/978-0-387-73025-7_8.

Delipınar, Ş. & Karpuzcu, M. 2017 Policy, legislative and institutional assessments for integrated river basin management in Turkey. *Environmental Science & Policy* **72**, 20–29. https://doi.org/10.1016/j.envsci.2017.02.011.

Dellapenna, J. W., Gupta, J., Li, W. & Schmidt, F. 2013 Thinking about the future of global water governance. *Ecology and Society* **18** (3), art28. https://doi.org/10.5751/ES-05657-180328.

Di Gregorio, M., Fatorelli, L., Paavola, J., Locatelli, B., Pramova, E., Nurrochmat, D. R., May, P. H., Brockhaus, M., Sari, I. M. & Kusumadewi, S. D. 2019 Multi-level governance and power in climate change policy networks. *Global Environmental Change* **54**, 64–77. https://doi.org/10.1016/j.gloenvcha.2018.10.003.

Durano, M. 2021 Negotiating boundaries of power in the global governance for care. *Development* **64** (1–2), 39–47. https://doi.org/10.1057/s41301-021-00283-3.

Elfithri, R. & Mokhtar, M. B. 2018 Integrated water resources management in Malaysia: some initiatives at the basin level. *Water Resources Management* **78**, 231–244. https://doi.org/10.1007/978-981-10-5711-3_16.

Ewing, J. & Domondon, K. 2016 *Drought, Pollution and Johor's Growing Water Needs*. ISEAS. https://www.iseas.edu.sg/images/pdf/ISEAS_Perspective_2016_47.pdf

Farazmand, A. 2012 Sound governance: engaging citizens through collaborative organizations. *Public Organization Review* **12** (3), 223–241. https://doi.org/10.1007/s11115-012-0186-7.

Feiock, R. C. 2013 The institutional collective action framework. *Policy Studies Journal* **41** (3), 397–425. https://doi.org/10.1111/psj.12023.
Figueroa-Benitez, A., Nagheeby, M., Figueroa, A. & Amezaga, J. 2023 Disrupted water governance in the shadows: revealing the role of hidden actors in the Upper Cauca River Basin in Colombia. *Frontiers in Water* **5**. https://doi.org/10.3389/frwa.2023.801171.
Fischer, M. & Sciarini, P. 2015 Unpacking reputational power: intended and unintended determinants of the assessment of actors' power. *Social Networks* **42**, 60–71. https://doi.org/10.1016/j.socnet.2015.02.008.
Fowler, J. H. & Christakis, N. A. 2008 Dynamic spread of happiness in a large social network: longitudinal analysis over 20 years in the Framingham Heart Study. *BMJ* **337** (2). https://doi.org/10.1136/bmj.a2338.
Gerth, H. H. & Mills, C. W. 1946 *From Max Weber: Essays in Sociology*. Routledge. https://doi.org/10.4324/9780203759240.
Ghosh, N. & Bandyopadhyay, J. 2009 A scarcity value based explanation of trans-boundary water disputes: the case of the Cauvery River Basin in India. *Water Policy* **11** (2), 141–167. https://doi.org/10.2166/wp.2009.017.
Goodman, C. B. 2019 Local government fragmentation: what do we know? *State and Local Government Review* **51** (2), 134–144. https://doi.org/10.1177/0160323X19856933.
Gronow, A., Wagner, P. & Ylä-Anttila, T. 2020 Explaining collaboration in consensual and conflictual governance networks. *Public Administration* **98** (3), 730–745. https://doi.org/10.1111/padm.12641.
Gupta, J., Akhmouch, A., Cosgrove, W., Hurwitz, Z., Maestu, J. & Ünver, O. 2013 Policymakers' reflections on water governance issues. *Ecology and Society* **18** (1), art35. https://doi.org/10.5751/ES-05086-180135.
Herzog, L., Ingold, K. & Schlager, E. 2022 Prescribed by law and therefore realised? Analyzing rules and their implied actor interactions as networks. *Policy Studies Journal* **50** (2), 366–386. https://doi.org/10.1111/psj.12448.
Jackson, M. O., Rogers, B. W., Zenou, Y., 2021 Networks: an economic perspective. In: *The Oxford Handbook of Social Networks* (Light, R. & Moody, J., eds). Oxford University Press, pp. 534–562. https://doi.org/10.1093/oxfordhb/9780190251765.013.34.
Karstens, S. A. M., Bots, P. W. G. & Slinger, J. H. 2007 Spatial boundary choice and the views of different actors. *Environmental Impact Assessment Review* **27** (5), 386–407. https://doi.org/10.1016/j.eiar.2007.02.002.
Lieberherr, E. & Ingold, K. 2019 Actors in water governance: barriers and bridges for coordination. *Water* **11** (2), 326. https://doi.org/10.3390/w11020326.
Meissner, R., 2017 Water governance and management and climate change. In: *Paradigms and Theories Influencing Policies in the South African and International Water Sectors* (Meissner, R., ed.). Springer International Publishing, pp. 25–87. https://doi.org/10.1007/978-3-319-48547-8_2.
Molle, F. 2009 Water, politics and river basin governance: repoliticizing approaches to river basin management. *Water International* **34** (1), 62–70. https://doi.org/10.1080/02508060802677846.
Mondal, S., Bhojani, U., Lobbo, S., Law, S., Maioni, A. & Van Belle, S. 2022 Using social network analysis to understand multisectoral governance in district-level tobacco control programme implementation in India. *BMJ Global Health* **7** (1). https://doi.org/10.1136/bmjgh-2021-006471.
Morrison, T. H., Adger, W. N., Brown, K., Lemos, M. C., Huitema, D. & Hughes, T. P. 2017 Mitigation and adaptation in polycentric systems: sources of power in the pursuit of collective goals. *WIREs Climate Change* **8** (5). https://doi.org/10.1002/wcc.479.
Muneepeerakul, R. & Anderies, J. M. 2017 Strategic behaviors and governance challenges in social-ecological systems. *Earth's Future* **5** (8), 865–876. https://doi.org/10.1002/2017EF000562.
Nabiafjadi, S., Sharifzadeh, M. & Ahmadvand, M. 2021 Social network analysis for identifying actors engaged in water governance: an endorheic basin case in the Middle East. *Journal of Environmental Management* **288**. https://doi.org/10.1016/j.jenvman.2021.112376.
Nye, J. 2017 Soft power: the origins and political progress of a concept. *Palgrave Communications* **3** (1). https://doi.org/10.1057/palcomms.2017.8.
Pak, H. Y., Chuah, C. J., Yong, E. L. & Snyder, S. A. 2021 Effects of land use configuration, seasonality and point source on water quality in a tropical watershed: a case study of the Johor River Basin. *Science of The Total Environment* **780**. https://doi.org/10.1016/j.scitotenv.2021.146661.
Roberts, K. H. & O'Reilly, C. A. 1979 Some correlations of communication roles in organizations. *The Academy of Management Journal* **22** (1), 42–57. https://doi.org/10.2307/255477.
Rogers, E. M., Roger, G., Rogers, R., Agarwala, E. M. & Agarwala-Rogers, R. 1976 *Communication in Organizations*. Free Press. Available from: https://books.google.com.my/books?id=qZBBAAAAMAAJ
Saimy, I. S. & Yusof, N. A. M. 2013 The need for better water policy and governance in Malaysia. *Procedia – Social and Behavioral Sciences* **81**, 371–375. https://doi.org/10.1016/j.sbspro.2013.06.445.
Schnurr, M., 2008 Global water governance: managing complexity on a global scale. In: *Water Politics and Development Cooperation* (Scheumann, W., Neubert, S. & Kipping, M., eds.). Springer, Berlin, Heidelberg, pp. 107–120. https://doi.org/10.1007/978-3-540-76707-7_5.
Sukereman, A. & Suratman, R. 2014 The needs for Integrated Water Resource Management (IWRM) implementation progress assessment in Malaysia. *International Journal of Innovation, Management and Technology* **5** (6). https://doi.org/10.7763/IJIMT.2014.V5.563.
Takács, K., Gross, J., Testori, M., Letina, S., Kenny, A. R., Power, E. A. & Wittek, R. P. M. 2021 Networks of reliable reputations and cooperation: a review. *Philosophical Transactions of the Royal Society B: Biological Sciences* **376** (1838), 20200297. https://doi.org/10.1098/rstb.2020.0297.
Tichy, N. & Fombrun, C. 1979 Network analysis in organizational settings. *Human Relations* **32** (11), 923–965. https://doi.org/10.1177/001872677903201103.

Tortajada, C. 2010 Water governance: some critical issues. *International Journal of Water Resources Development* **26** (2), 297–307. https://doi.org/10.1080/07900621003683298.

Warner, J., Vos, J., Dewulf, A., Slinger, J., Vreugdenhil, H. & Vij, S. 2022 *Relaunching International Journal of Water Governance (IJWG 2.0)*.

Weiss, R. S. & Jacobson, E. 1955 A method for the analysis of the structure of complex organizations. *American Sociological Review* **20** (6), 661–668. https://doi.org/10.2307/2088670.

Zamudio, C., Anokhin, S. & Kellermanns, F. W. 2014 Network analysis: a concise review and suggestions for family business research. *Journal of Family Business Strategy* **5** (1), 63–71. https://doi.org/10.1016/j.jfbs.2014.01.001.

Zeitoun, M. & Warner, J. 2006 Hydro-hegemony – a framework for analysis of trans-boundary water conflicts. *Water Policy* **8** (5), 435–460. https://doi.org/10.2166/wp.2006.054.

Zwarteveen, M., Kemerink-Seyoum, J. S., Kooy, M., Evers, J., Guerrero, T. A., Batubara, B., Biza, A., Boakye-Ansah, A., Faber, S., Cabrera Flamini, A., Cuadrado-Quesada, G., Fantini, E., Gupta, J., Hasan, S., ter Horst, R., Jamali, H., Jaspers, F., Obani, P., Schwartz, K. & Wesselink, A. 2017 Engaging with the politics of water governance. *WIREs Water* **4** (6). https://doi.org/10.1002/wat2.1245.

First received 13 July 2023; accepted in revised form 1 September 2023. Available online 12 September 2023