



Water Governance for Urban Resilience Analysis of Key Factors and the Role of Stakeholders in Metropolitan Area

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Abstract

Water governance is critical for water security and as enabling condition to achieve urban resilience. Water governance involves multi-actor, multi-sector and multi-level. Water governance system is the foundation for all stakeholders involved in water management in urban areas. Clarity of roles and responsibilities of each actor and coordination at all levels can help to meet the goals of urban water security to be more efficient, effective and inclusive. This article highlights the current water governance in a metropolitan area with level analysis on policy, organizational and operational. This is a multidisciplinary perspective of environmental science and public policy. Bandung Metropolitan Area (BMA) is chosen as a case study. Data and information gathered from secondary sources. The output is an initial baseline of water governance in BMA including key factors shaping water governance and role of stakeholder. This result will be used for the further research on dynamic and adaptive governance on the urban water sector.

Keywords: multi-level governance; urban resilience; water governance

1. Introduction

Water is the key to sustainable urban development and the pillars of public health and social welfare (WHO, 2012). Inadequate water and sanitation threaten human and environmental health. Water has multiple functions in terms of social, economic and environmental, which are needed to support production process and contribute to economic growth and poverty reduction. Despite the increasing access to improved drinking water sources in the past two decades, many countries are still facing the challenges to meet the needs of drinking water as well as the target of Sustainable Development Goals (SDGs). If there is no significant change in water management, it will occur in urban water insecurity that led to environmental and socio-economic degradation.

Urban water systems refers to multi-faceted and closely related to a series of activities in the water cycle that involves a series of activities in the water cycle or each activity in water cycle starting from: 1) taking water from the source (groundwater and surface water), 2) purification of water into drinking water, 3) distribution of water drink to users, and 4) collection and disposal of waste and v) waste processing (van Monfort, Michels, & Frankowski, 2014).

The current water systems face several pressures due to increasing water demands, rapid urbanization pattern, high population growth, and increasing climate risk (van Leeuwen, Dan, & Dieperink, 2015). Climate change is expected to provide significant consequences for urban water systems. Changes in temperature and rainfall patterns will affect water availability, water quality, and access as well as flood risks and inundation patterns. Urban water infrastructures need to be adapted to cope with the new climate and hydrological conditions.

Many kinds of literature mentioned that water crisis is not related to water engineering, but it is the failure of governance (Gupta, Pahl-Wostl, & Zondervan, 2013; Nababan, 2012). Rogers & Hall (2003) as

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mentioned at Global Water Partnership background paper defines water governance as the range of political, social, economic and administrative systems that are in place to develop and manage water resources, and the delivery of water services, at different levels of society. There is a set of principle toward effective water governance: transparent, inclusive, equitable, coherent, integrative, accountable, efficient, responsive, and sustainable. In addition, OECD (2016) explains multi-level perspectives in water governance including the sharing of policymaking authority, responsibility, development and implementation at different administrative and territorial levels. Urban water governance involves many actors and many sectors at different jurisdiction levels. Policy and decision-making in one sector may contradict or duplication with policies and decisions in other sectors. With its multi-actor and cross-sector, water issue can be used as a tool to develop an integrated solution.

This article aims to highlight water governance in an urban area and exploring key factors and the role of stakeholders that may contribute to building resilience. The analysis focuses on public policy process including policy, organization and operational level. Bandung Metropolitan Area (BMA) is chosen as a case study. This results a preliminary baseline for further research. The rest of this article is structured as follows. In Section 2, a brief of BMA and method are provided. Section 3 provides key factors on water governance and the role of stakeholders. In Section 4 the conclusions of this article are provided.

2. Material and Method

2.1 The study area of BMA

Bandung, the capital city of West Java Province, is located about 140 km South-East of Jakarta. Bandung Metropolitan Area (BMA), widely known as Cekungan Bandung, covers a mountainous and elevated area of 3,436 square kilometers. It has delineated as one of National Activity Centre (PKN) in National Spatial Plan (RTRW). Administratively, BMA comprises two cities and three districts which are: Bandung City, Cimahi City, Bandung District, West Bandung District and Sumedang District which incorporates five neighboring sub-districts: Jatinangor, Sukasari, Pamulihan, Tanjungsari, and Cimanggung.

Bandung Metropolitan Area (BMA) has an urban population of 8.6 million in 2015 (Central Bureau of Statistics West Java, 2015) and accounted for 2.9% of the Indonesian population. It is the third largest metropolitan areas in Indonesia after Jakarta Metropolitan Area and Surabaya Metropolitan Area. BMA has benefitted from strong economic growth and contributes almost 3.3 percent to Indonesian economic.

An environmental condition in BMA is under increasing pressure due to rapid population growth and changing land use patterns. These conditions severely affected the provision of urban services and local infrastructures and threaten the sustainability of urban development. During the period of 1991-2012, the urban built-up area in BMA has expanded from 34,282 km² in 1991 to 65,812 km² in 2012 with the average growth of 4.92 percent (Ardiwidjaya, Soemardi, Suganda, & Temenggung, 2014) Ardiwidjaya, V. S., Soemardi, T. P., Suganda, E., & Temenggung, Y. A. (2014) Ardiwidjaya, V. S., Soemardi, T. P., Suganda, E., & Temenggung, Y. A. (2014) Ardiwidjaya, V. S., Soemardi, T. P., Suganda, E., & Temenggung, Y. A. (2014) Ardiwidjaya, V. S., Soemardi, T. P., Suganda, E., & Temenggung, Y. A. (2014) Ardiwidjaya, V. S., Soemardi, T. P., Suganda, E., & Temenggung, Y. A. (2014) although some lands are underutilized and abandoned. Urban land expansion had also a direct impact to hydrological areas that reduces surface area absorption and thus increasing the risk of flooding.

BMA is surrounded by mountains and active volcanoes and highly prone to various types of natural disasters such as earthquake, volcanic eruption, flood and landslide (Pribadi, Pertiwi, & Sjabri, 1998). BMA is also located in a seismically active zone classified as middle range of seismic hazard. According to the Indonesia's Disaster Risk Index 2013, most cities/districts in BMA are identified as the high disaster risk areas particularly to flood, landslide, and earthquake (Indonesia National Board for Disaster Management, 2013). Seasonal floods have rapidly increased in past years, notably in south Bandung due to massive built up area development (Tarigan et al., 2016). Local inundation often occurs after heavy rain in lower lying area in the south of Bandung city. Poor drainage system and inadequate municipal solid waste management practices are exacerbated local flooding.

The rising pressures of climate-related disaster risk are impacting cities increasingly. Based on the historical climate analysis, there is an increasing trend of extreme climate events in Bandung (Environmental Management Agency of Bandung City, 2014) and this will continue. Moreover, climate risk related to high rainfall intensity and volume, which could potentially cause flooding, is expected to increase in north and south Bandung. Climate change impacts and disaster risks will exacerbate the underlying risks of BMA such as issues closely link to water availability, access, and quality.

2.2 Method

This article is written based on the desk study to develop an initial baseline of urban water governance in the metropolitan area. Most data and information used in this article are coming from secondary data sources such as literature reviews, journals, statistical data, project reports, etc.

3. Result and Discussions

3.1 The Current Water and Wastewater Management

The provision of drinking water in Bandung Metropolitan Area (BMA) is still facing serious challenges

related to water shortage, access and service quality. Water has a pivotal role in ensuring public health and local economic productivity. However, there is still much to do in addressing unequal and inconsistent service provision.

In general, water provisions are coming from two main sources: 1) piped water system which is operated by the local water company, private operator and cooperative, and 2) non-piped water systems such as water hydrants, individual deep wells and other sources (surface water, rainwater harvesting). Piped water networks in BMA operated by three local water supply companies: 1) PDAM Tirta Wening for Bandung City, 2) PDAM Tirta Raharja for Bandung District, West Bandung District and Cimahi City, and 3) PDAM Tirta Medal served for neighboring sub-districts in Sumedang. These companies cover less than half (48.2%) of the BMA's population (Maryati & Humaira, 2015). In addition, PT. Tirta Gemah Ripah, a West Java Province owned company, supplies raw water to the PDAMs.

The access to piped water system in BMA is still limited. PDAM Tirta Wening covers only 62% of Bandung City households. In Bandung Regency, only 8.3% of households received piped water into their homes in 2010. For those who are not served by the piped network, they are still using individual deep well, private water operator or informal water vendors that are very risky due to water quality and its expensive price compare to piped water. Piped water services are not reliable and inadequate. Households that are connected to the piped water system experience frequent interruptions and unstable water pressure (Tarigan et al., 2016).

The BMA produced 267.06 million liters of clean drinking water daily in 2014. It slightly increased by one per cent since 2010 when it produced 264.04 million liters daily (MLD) (Central Bureau of Statistics West Java, 2015). During the same time, the BMA's water production capacity increased more quickly from 320.46 MLD to 331.52 MLD, which is equivalent to a clean water production rate of 81%. Bandung City sources 80% of its raw water supply from the Citarum River.

Bandung city has a centralized wastewater treatment system known as IPAL Bojongsoang. The plant only covers 35% of Bandung City population mostly in east Bandung (Prihandrijanti & Firdayati, 2011). A daily capacity is about 89,000 m³, but its effective capacity is only 40,000 m³ due to operational and maintenance problems.

BMA faces several issues on wastewater such as illegal extraction of wastewater and limited coverage. Households must install on-site septic tank systems to treat black water while grey water is discharged untreated into these open channels and eventually flow into local rivers. Only 38% of households have their owned-toilets in Bandung City.

3.2 Key Factors

The water sector is one of the most important sectors to be affected by climate change impacts in the form of water shortage (Suroso, Abdurahman, & Setiawan, 2010). Based on climate projection, most regions in Indonesia will suffer from a gradual decrease in water supply due to temperature increase and rainfall changes that will affect water balance. Combined with estimated population growth, increase water demand will cause severe water shortages to occur, especially in Jawa and Sumatera in the period of 2020-2030. The current water governance systems will not be appropriate to deal with these changes and uncertainties. It needs to transform the existing water governance system into more adaptive and dynamic toward urban resilience.

There are several factors that can influence the resilient of urban water governance. These can be external and internal factors. We discuss four key factors influencing urban water governance with regard to climate risks namely water infrastructure, policy and regulatory framework, institutional arrangement, and financial capacity.

- **Water Infrastructure**

Experiences from other countries shown that infrastructure is a major factor in urban water governance (OECD, 2016). The quality of water infrastructure will increase the efficiency and cost saving. Many countries are facing challenges in increasing water infrastructure since it needs a lot of investment. In Indonesia, the investment of PDAM assets was only increased 11% from US\$ 6.3 billion to US\$ 7 billion in the period of 2004-2009 (AUSAID, 2014). This increase was not enough to pursue the rapid population growth and expand service coverage to new urban areas. On the contrary, the drinking water service through piped networks is still limited. The existing infrastructure has not been optimally utilized due to some following reasons: the decreased capacity of raw water, low performance of production unit and unavailable local budget for the installment of distribution piped system and household connection (Ministry of Public Works and Public Housing, 2014). In addition, the drinking water services through non-piped water system are increasing, but need to be supervised and monitor in terms of infrastructure operation and maintenance.

The current water infrastructure system in BMA faces several challenges to fulfill the needs for safe drinking water. These challenges are related to the limited availability of raw water sources, un-integrated water supply system, high water leaks and lack of technical capacities. Many water installation plants are not optimally functioning due to fluctuated raw water sources. The non-revenue water (NRW) level in Bandung city is relatively high (50%) due to water leaks from the out-dated pipe network (Moersidik, Arifin, Soesilo, Hartono, & Latief, 2015). The uneven urban settlement pattern creates difficulty in developing efficient water supply system in Bandung District. However, there are huge of raw water sources from

water surfaces and ground water, but the piped distribution system could not reach the entire urban settlement areas.

- **Regulatory and Policy Framework**

Regulatory and policy frameworks are important in shaping urban water governance. Indonesia's national water and sanitation regulatory and policy framework is still being developed (Asian Development Bank, 2013) and continuously evolved. Many aspects of the current framework are required time to be appropriately adopted and implemented by all stakeholders. Some laws should be derived into more operational regulations by each respective ministry. In addition, the clarity of role and responsibility among government institutions is the main issue facing in policy implementation in the context of a decentralized system of government.

Water management system involves various sectors with their respective regulatory. At least, there are 4 (four) laws that are directly related to water management system in Indonesia among others are: 1) Law No. 7 Year 2004 on Water Resource (it has abolished by Constitutional Court in 2015 and returned back to Law No. 17 Year 1974 on Irrigation), 2) Law No. 32 Year 2009 on Environmental Protection and Management, 3) Law No. 36 Year 2009 on Health, and 4) Law No. 23 Year 2014 on Local Governance. Table 1 shows the laws and its mandatory regulations related to water management.

Table 1: Laws related to water management

Law	Remarks	Operational
Law No. 7 Year 2004 on Water Resource	Regulating water supply system development. This law was annulled by Constitutional Court and reinstated Law No. 17 Year 1974 on Irrigation.	All government regulations under this law were also annulled, such as Government Regulation No. 121 Year 2015 on Water Resource Exploitation and Government Regulation No. 122 Year 2015 on Water Supply Provision System (piped and non-piped system)
Law No. 32 Year 2009 on Environmental Protection and Management	Regulating the quality standard for water and wastewater as well as management of hazardous and toxic waste.	Government Regulation (draft) on water quality protection and management;
Law No. 36 Year 2009 on Health	Regulating the environmental health conditions and ensuring there are no risks for health coming from polluted water and wastewater. It is also mentioned the need for quality standards for environmental health.	Government Regulation (draft) Toxic and Hazardous Waste Management Government Regulation No. 66 Year 2014 on Environmental Health
Law No. 23 Year 2014 on Local Governance	Regulating the division of responsibilities on mandatory and non-mandatory tasks among different levels of government – national, province, city/district including drinking water, wastewater and drainage under the public works and human settlements.	Government Regulation (draft) on task division on central and regional

In 2015, the Constitutional Court annulled Law No. 7 Year 2004 on Water Resource and reinstated Law No. 17 Year 1974 on Irrigation. The court granted arguments that the law had encouraged privatization and commercialization of water resources at the expense of people's rights to water. This decision impacted to water privatization and private bottle water company as the Law 11/1974 does not recognize utilization of water for commercial purposes. However, the follow-up to this matter is still unclear for local government.

In order to ensure the people's right to water and access to drinking water, two government regulations have been issued such as as Government Regulation No. 121 Year 2015 on Water Resource Exploitation and Government Regulation No. 122 Year 2015 on Water Supply Provision System. These regulations refer to Law No. 11/1974 on Water. According to new regulations, private investment is only limited to raw water treatment and distribution system construction. The distribution of drinking water should be done by the State-owned company or locally owned company.

The Government Regulation No. 122 Year 2015 on Water Supply Provision System also endorses a coherence policy development framework on water sector among different levels of government. This will be done through the formulation of water policy and strategy at national, provincial and city/district level and the master plan of water sector (RISPAM) at national, across the province, across city/district and city/district level. Those documents become coordination tools for more integrated policy development toward the achievement of long-term development goals on universal access and medium term target of 100-0-100 for water and sanitation sector in 2019. Moreover, the RISPAM outlines all stages of water sector development in the next 15-20 years. All city or district government in BMA is now under the process to prepare their RISPAM that will be enacted by local regulation.

Water challenges in BMA are exacerbated by a shortage of water supply that hindered by a complexity of policy structure with regard to shared responsibility on a water resource. It is clearly stated that national government is responsible for water resource, while provincial government purchase this

water in bulk of treatment and city or district governments buy the treated water for distribution to end-users. This made difficult for city government to meet the increased water demand since the authority of water resource are in the hands of the national and provincial government. West Java provincial government has established a regional owned company, PT. Tirta Gemah Ripah, which responsible for supplying bulk water for local PDAMs.

In the decentralized system of government, local government has a greater role in providing public services. However, the role of local government is not yet optimal due to lack of budget capacity, lack of technical capacity as well as not conducive local political process. Several local governments attempt to find innovative financing solutions in public service provision, but it hinders by the absent regulatory framework to support the innovation.

Climate change will provide severe impacts to water availability, access, and quality. Policy changes are needed in order to cope climate risks and impacts to the future water sector. This can be done through the development of adaptive policy at various levels of government. National Adaptation Plan (RAN API) has outlined adaptation strategies in the water sector that will be mainstreamed in policies, plans, and program. However, the understanding and awareness of incorporating climate change impacts into water policy and strategy are not yet emerged in BMA. Climate change issue is only seen as the responsibility of the environmental agency.

- **Institutional Arrangement**

Water management is fragmented and involves various institutions at national, provincial and city levels. At national level, several line ministries are involved in regulating water services, including national development planning board (for setting up national policy and coordination); public works ministry (for policy implementation); environment ministry (for controlling and managing water pollution); health ministry (for setting and monitoring water quality standards); home affairs ministry (for capacity building and management), education ministry (for education and awareness building) and finance ministry (for budgeting and tariff regulation). In addition, a non-structural water regulator board (BPPSPAM) was established under the Ministry of Public Work and Public Housing, which has a function to support regulatory arrangement on water service provision. There is also Indonesia Water Supply Company Association (PERPAMSI), which served to support and improves the capacity of local water companies as the members. At provincial and city or district level, several agencies are involved in water provisions such as local development planning board; public works agency; environmental agency; health agency and education agency. Other stakeholders involved in the water sector are Non Government Organizations (NGO's), private water operators and village owned companies (BUMDES) spread out in the regions and they significantly contributed to providing water services. The characteristic of water management is multi-level governance involve various actors from national to community levels. Coordination and collaboration among actors at different levels of governance are the most challenging issues in achieving effective and efficient water governance.

For water supply and sanitation, there is a Working Group on Water and Sanitation (*Pokja AMPL*) as an ad-hoc institution that was established since 1997. These working groups established at national, provincial and city/district level. *Pokja AMPL* acts as coordination and communication forum to achieve better water and sanitation development starting from planning, implementation, monitoring and evaluation. It is also aimed to increase coordination among government institutions and other stakeholders in water and sanitation. In most regions, *Pokja AMPL* becomes the focal point in formulating the master plan of city/district water and sanitation sector. In BMA, each local government has also established *Pokja AMPL* for internal coordination purpose, but they have limited capacity to deal with external coordination in metropolitan areas.

Coordination among local governments in the metropolitan area is an interesting issue facing both in developed and developing countries. There is a mismatch to link jurisdictional and hydrological boundaries in water governance. Water resources flow across administrative boundaries and sometimes create a lot of tensions due to different interests among actors. The five local governments in the BMA use the same groundwater aquifer, which is under stress from high consumption from various activities. In order to avoid the depletion of water resources and ensure sustainable supply to the households and economic activities, all local government must agree together on a water supply and sanitation plan and adopt harmonized water extraction rules in the whole BMA.

West Java Provincial Government has enacted Local Regulation No. 12/2014 on the management of metropolitan areas and growth centers including BMA. This regulation mentioned three coordination entities in managing metropolitan areas, which are: Council on Metropolitan Area and Growth Centre, B-MPJB and Consortium of Metropolitan Development. Local government has a responsibility in managing local development in close coordination with those institutions at the provincial level. The establishment of the new body will be particularly useful to solve coordination problems among local governments in the BMA.

With regard to water sector, the collaboration has been established between Ministry of Public Work and Public Housing, West Java Provincial Government and local governments in BMA. This is stated in a joint agreement outlining the roles and responsibilities of each stakeholder. Ministry of Public Work and Public Housing has a responsibility in constructing water intake and transmission pipeline using a national budget. West Java Province has responsibility for the construction of water treatment plant and main distribution piped networks. The construction of city/district piped networks is the responsibilities of

PDAM's. PT Tirta Gemah Ripah acts as the manager of bulk water produced from regional water plant and sell to local PDAMs.

- **Financial Capacity**

The availability of funding is a key resource to implement effective and efficient water governance. Lack of financial capacity seems as cliché issue but it still remains a challenge for local government in Indonesia. The shifting from centralized into decentralized systems of government in 2001 has substantially changed the ways in managing urban development. The transition negatively affected continuity in infrastructure investment, causing what has sometimes been called the lost decade (World Bank, 2007). Investment in the water sector has been almost neglected. Water and sanitation sector is not highly prioritized at local government level and it is competing with other priority sectors. Most funding for water and sanitation sector development is coming from national government mainly from Ministry of Public Work and Public Housing. Another source of funding is coming from private sector participation. However, the current regulatory framework limits private investment on raw water supply and distribution networks.

According to the 2015 fiscal capacity index issued by the Ministry of Finance (MoF), the financial capacities of local governments in BMA are categorized as low capacity, except for Bandung city, which has the medium capacity. The index and category for each local government are as following: West Java (low; 0.27), Bandung City (0.90; medium), Bandung District (0.14; low), Cimahi City (0.49; low), West Bandung (0.19; low) and Sumedang District (0.14; low). The index calculated from local revenues minus personnel expenditure and linked by the number of poor people. The index is used for grant nominations and assessment of loans, matching funds and other by Ministry of Finance and other financial institutions. It will be more difficult for those have the low fiscal capacity to attract more investment for loans and other matching funds.

Financial problem is still facing by local water companies in Indonesia. Almost 25 percent (86 PDAMs) including Bandung city water company are considered unhealthy (Moersidik et al., 2015). Some factors have caused financial problems, such as difficulties in raising tariffs and low priority for water investment (OECD, 2016). Water tariff structure is regulated by the respective local government following the principles and criteria setting up by the Ministry of Home Affairs. The current water structure does not follow full-cost recovery principles, but also consider other principles such as affordability, service quality, etc.

3.3 The Role of Stakeholders

Identifying the roles and responsibilities of each stakeholder can help to meet the goals of urban water security to be more efficient, effective and inclusive.

- **Central government**

Central government plays an important role in urban water management. The role of central government is mainly related to policy making and regulatory for drinking water supply, wastewater management and other aspects (water quality standard, water pollution). In fact, line ministries also involve in several project implementations that have national interest. Based on their roles, the stakeholder's at the national level can be classified as following:

- a. Primary stakeholder: Ministry of Public Work and Public Housing
- b. Secondary stakeholder: National Development Planning Board (BAPPENAS), Ministry of Environment and Forestry, Ministry of Health, Ministry of Home Affairs, Ministry of Finance and Ministry of Education
- c. Tertiary stakeholder: Water Supply Regulator (BPPSPAM), Water Companies Association (PERPAMSI), Professional Association (IATPI)

- **Provincial government**

The main responsibility of provincial government is related to develop and manage water services provision across city/district and regional wastewater treatment system. Provincial government support can be done through de-concentration and provincial assistance. Stakeholder's involved are:

- a. Provincial Development Planning Board or BAPPEDA
- b. Public Work or Human Settlement Agency
- c. Health Agency
- d. Education Agency
- e. Environmental Management Agency
- f. University
- g. Non Government Organizations
- h. Regional Owned Company (PT. Tirta Gemah Ripah)
- i. Metropolitan Council

- **City or District government**

City or District governments are the primary stakeholder's that responsible for program implementation at local level. Their responsibilities include drinking water (distribution piped system and household connection), domestic wastewater treatment, drainage system and sewage collection. Stakeholders involved at city or district level are:

- a. Local Development Planning Board or BAPPEDA

- b. Public Work or Human Settlement Agency
 - c. Health Agency
 - d. Education Agency
 - e. Environmental Management Agency
 - f. Local University
 - g. Non-Government Organizations
 - h. Local Water Companies (PT. Tirtawening, PT. Tirta Raharja, PT. Tirta Medal)
 - i. Private Water Operator
 - j. Informal water vendors
- **Other stakeholders at local level**
 - a. Village-Owned Company (BUMDES) is a community-based organization in the rural area that has a responsibility to manage water supply provision. In Bandung District, there are more than 250 BUMDES have been established.
 - b. Private water operators are usually established by a private developer to manage water supply services for its residents due to the lack of access to piped water networks. They act as water supply companies and applying water tariff to the consumer.
 - c. Community initiatives. Bandung has strong culture as creative communities. There are several innovative actions related water sector such as biopore and clean river program. Such program can contribute to increasing city resilience.

4. Conclusions

Water crisis reflects the governance failure. Climate change will exacerbate the water shortage in an urban area and affect future water availability, water quality, and access. The future challenge is to develop urban water governance that is able to adapt and to cope with the changes and uncertainties in climate and hydrological conditions. Water governance involves multi-sectors, multi-actors and multi-level, in which coordination is needed. Water governance takes place in different scales (global to local) depend on the series of activities undertaken in water cycle that involve all stakeholders. It is important to ensure stakeholder engagement in multi-level government than can help to meet the ultimate goal of water security. A lot of factors contribute to shaping urban water governance. With regards to the policy process, there are four key factors that affect the effective, efficient and inclusive water governance namely water infrastructure, policy and regulatory framework, institutional arrangement, and financial capacity.

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