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A NATIONAL FRAMEWORK FOR INTEGRATED URBAN WATER MANAGEMENT IN INDONESIA

INTEGRATED URBAN WATER MANAGEMENT - IUWM




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ABBREVIATIONS

Bappenas	*Badan Perencanaan Pembangunan Nasional* (Ministry of National Development Planning)
B2B	Business to business
BPPSPAM	*Badan Peningkatan Penyelenggaraan Sistem Penyediaan Air Minum* (Supporting Agency for the Development of Drinking Water Supply System)
BKSP	*Badan Kerja Sama Pembangunan* (Local Government Development Cooperation Agency)
BNPB	*Badan Nasional Penanggulangan Bencana* (National Disaster Management Agency)
BOT	Build-Operate-Transfer
BUMD	*Badan Usaha Milik Daerah* (local government enterprise)
CCFI	Coca-Cola Foundation Indonesia
CEW	China Everbright Water
CSR	Corporate Social Responsibility
DAK	*Dana Alokasi Khusus* (special allocation fund)
DKI Jakarta	*Daerah Khusus Ibukota Jakarta* (Jakarta Special Capital Region)
GDP	Gross domestic product
GIS	Geographic Information System
IIGF	Indonesia Infrastructure Guarantee Fund (*PT Penjaminan Infrastruktur Indonesia*, PT PII)
IUWASH PLUS	Indonesia Urban Water, Sanitation and Hygiene *Penyehatan Lingkungan Untuk Semua* (a USAID project)
IUWM	Integrated Urban Water Management
IWRM	Integrated water resources management
JICA	Japan International Cooperation Agency
MAR	Managed aquifer recharge
MASP	Ministry of Agrarian Affairs and Spatial Planning
MOEF	Ministry of Environment and Forestry
MEMR	Ministry of Energy and Mining Resources
MOF	Ministry of Finance
MOH	Ministry of Health
MOHA	Ministry of Home Affairs
MOU	Memorandum of understanding
MPWH	Ministry of Public Works and Housing
MSS	Minimum service standard
NGO	Non-governmental organization

NRW	Non-revenue water
NUDP	National Urban Development Project
NUWAS	National Urban Water Supply Framework
O&M	Operation and maintenance
PDAM	*Perusahaan Daerah Air Minum* (local government-owned water utility)
PD PAL	*Perusahaan Daerah Pengelola Air Limbah* (local government-owned wastewater management utility)
PES	Payment for ecosystem services
PPP	Public-private partnership
PSP	Private sector participation
RBO	River Basin Organization
RDTR	*Rencana Detail Tata Ruang* (Detailed Spatial Plan)
RISPAM	*Rencana Induk Sistem Penyediaan Air Minum* (Drinking Water Supply Master Plan)
RPJMN	*Rencana Pembangunan Jangka Menengah Nasional* (National Medium-Term Development Plan)
RTRW	*Rencana Tata Ruang Wilayah* (spatial planning)
SCADA	Supervisory Control and Data Acquisition
SISDA	*Sistem Informasi Sumber Daya Air* (Integrated Water Resources Information System)
SOE	State-owned enterprise
SWRO	Seawater reverse osmosis
TKPPN	*Tim Koordinasi Pembangunan Perkotaan Nasional* (Inter-Ministerial Steering Committee for Urban Development)
UPTD	*Unit Pelaksana Teknis Daerah* (Technical Implementing Unit at Local Government)
USAID	United States Agency for International Development
WIMS	Water Information Management System
WSS	Water supply and sanitation
WTP	Water treatment plant
WWTP	Wastewater treatment plant

EXECUTIVE SUMMARY

Water insecurity is a major threat in many Indonesian cities, affecting economic stability, environmental quality, and the daily lives and livelihoods of communities. Many cities currently face a situation of severe interlinked water security challenges. They commonly face low access to safe sanitation and water services, declining ground and surface water availability and quality, persistent flooding, and, in some regions, dramatic land subsidence . Risks to health, safety, economic growth, and productivity are high. As a result of decentralization, local governments in Indonesia have the authority to play a leading role in water planning and management. However, fragmented water governance and uncoordinated planning processes are hindering the identification and implementation of integrated solutions at the local level.

Integrated Urban Water Management (IUWM) is an approach to water policy, planning, and management for cities and their surrounding regions. Under the IUWM approach, all water sources, all stages of the water cycle, all uses of water, and the protection of the urban water environment are coordinated, taking into account local conditions and priorities. IUWM encompasses a framework – of law and regulation, governance and institutions, planning and implementation, and information management and financing – that supports the design and application of specific IUWM interventions and projects at appropriate scales.

Evaluating the benefits of IUWM is an ongoing challenge, due to supplemental non-market benefits such as improved livability, equality, and biodiversity. However, most ex-ante cost-benefit studies of IUWM reveal overall positive social and environmental impacts. IUWM approaches have been adopted successfully in cities around the world, especially those confronted with water insecurity and resource constraints. Examples are presented in Chapter 3, and include urban river cleanups (Singapore), demand management efforts (Zaragoza City), and mitigation of land subsidence (Tokyo). Some of these examples precede the term "IUWM" but embody its spirit of managing water-related urban and environmental issues through a package of coordinated action.

For Indonesian cities, IUWM is appropriate and appealing for several reasons. Firstly, many Indonesian cities face cross-cutting water challenges – inadequate and inequitable access to water supply and sanitation services, flooding, poor environmental water quality, slum settlements, land subsidence – and these are exacerbated by climate change. This makes IUWM apt, as its framework incorporates urban water and non-water elements into urban water management and translates them into interventions on the ground. Secondly, the traditional, infrastructure-focused approach has not been able to resolve current urban water challenges. These issues call for a more comprehensive package of policy interventions, data management, and partnerships with public and private stakeholders. Thirdly, several laws and regulations concerning water are

in the midst of revisions, providing an opportunity to legislate some IUWM values to create an enabling framework for IUWM interventions. Regulations under revision include Law 17/2019 on Water Resources, Government Regulation 122/2015 on Drinking Water Supply Systems, and Government Regulation 28/2018 on Regional Cooperation. Lastly, consultations with policymakers and stakeholders from the central and local governments indicate an interest in IUWM as a water management framework and in direct IUWM interventions.

However, cities in Indonesia face several hurdles in implementing IUWM. These are analyzed in Chapter 4 of the report, which is organized into the five categories of the IUWM framework: law and regulation, governance and institutions, planning and implementation, and information management and financing.

For law and regulation, Law 17/2019 on Water Resources provides a solid basis from which to implement IUWM. This law mandates the responsibilities of government agencies related to water; however, there remain ambiguities in implementing regulations for some aspects of water management, including groundwater, surface water quality, and stormwater management. Additionally, water considerations are not taken into account in several non-water regulations – in particular, building and private residential and industrial estate regulations, which are important components in the urban fabric and which affect water management. For example, such regulations may set standards concerning surface runoff and water supply and sanitation services.

Governance for water in Indonesia remains fragmented. A map of urban water governance in Indonesia (figure 4) shown in Chapter 4 of this report shows horizontal fragmentation across water sub-sectors; vertical fragmentation between layers of government; and spatial fragmentation between administrative jurisdictions. There is a need for authority to be more clearly allocated, with adequate mechanisms and incentives for coordination and cooperation, without radical institutional restructuring. Currently, the central government predominantly plays the role of an infrastructure provider to local governments, which does not incentivize local governments to optimize and maintain infrastructure, nor to establish partnerships with neighboring jurisdictions. This relationship can be improved by transitioning the central government toward a more supervisory role, providing not only funding but also coordination, oversight, and enforcement of regulations within the scope of the decentralization policy. In many resource-constrained cities in Indonesia, public-private partnership (PPP) is a viable option but has been limited to only certain types of contracts related to water distribution infrastructure. There is scope to review PPP regulations and processes to enable different types of contracts, such as performance-based or service contracts that do not involve transfer of ownership of water resources.

Planning and implementation of water projects are influenced by the targets, planning processes, and performance evaluations of water-related government agencies. National-level medium-term targets form the basis for local government targets and plans. These targets are often complemented by priority action plans for rehabilitating degraded watersheds and expanding

strategic urban areas. However, the targets are ambitious and seldom achieved. Plans and planning processes are not coordinated among local government agencies managing water supply, sanitation, drainage, land use, solid waste, and transportation, despite interlinkages and interdependencies among these sectors. The plans are published on different timelines and schedules, with no mechanism to ensure consistency. For some planning documents, future population and demand projections are not accurately reflected.

There are numerous water-supply performance indicators that can potentially support IUWM approaches, but they are hindered by inadequate data and information management protocols. Due to a lack of incentives and standardization for data collection and reporting, data across water sectors in many Indonesian cities is incomplete or inconsistent. In terms of water resources, there are too few monitoring stations, and data on surface and groundwater quality is too infrequently collected, posing a challenge for effective policy formulation. Where data is available (for example, flood impact data), its reliability and accuracy can be of concern due to a lack of transparency and differences in calculation methods. The Water Resources Information System (*Sistem Informasi Sumber Daya Air*, or SISDA) is an ongoing central government effort, but it has not been actively managed and updated.

Financing for water supply and sanitation projects predominantly comes from the central government, providing an opportunity to incentivize local governments to adopt IUWM approaches and projects. A performance-based funding framework for water supply has recently started to incentivize local water supply agencies (*Perusahaan Daerah Air Minum,* or PDAMs) to improve operational performance. There is potential for local governments to tap into alternative financing sources from development agencies, local government revenues, partnerships with neighboring jurisdictions, and engagement with the private sector.

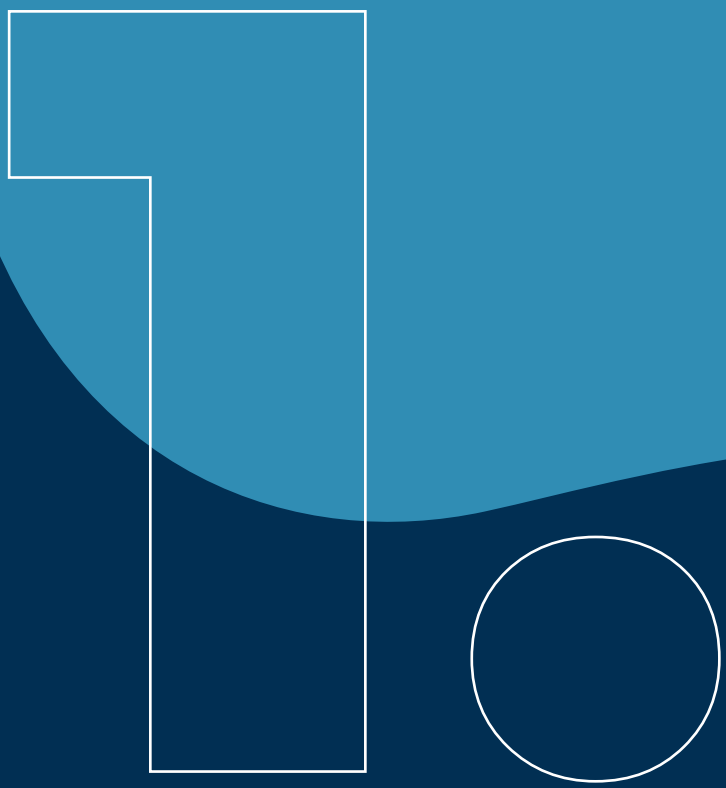
Despite these challenges, several initiatives in line with IUWM principles have taken place in Indonesia (see Chapter 5). Some are intra- and interjurisdictional initiatives by local governments; others are private sector partnerships. Intra-jurisdictional initiatives include city-scale blue-green projects such as infiltration wells, urban forests, and policies for runoff management. Interjurisdictional initiatives comprise cooperation among administrative zones (particularly in metropolitan areas, such as Greater Jakarta and Greater Yogyakarta) and payment for ecosystem services (PES) arrangements between upstream and downstream jurisdictions. Private companies, particularly those that rely heavily on water resources, have been involved through Corporate Social Responsibility (CSR) projects. Private real estate developers incorporate blue-green projects that also increase the attractiveness of their real estate. Although these IUWM initiatives have achieved various levels of success, they offer lessons and motivation to adopt IUWM across Indonesian cities.

Doing so calls for a National Framework for IUWM that provides government agencies with the authority, incentives, and capacity to adopt IUWM as a mainstream approach. The central

government should take the lead on establishing the implementing framework for IUWM. Priority actions include incorporating IUWM principles and practices into the implementing regulations of the 2019 Water Law and into new regulations for the governance of metropolitan regions led by the Ministry of Home Affairs (MOHA). In the medium term, the central government should provide reporting guidelines, benchmarks, and financial support mechanisms to incentivize subnational governments to engage in IUWM. Ongoing programs consistent with an IUWM approach, such as NUWAS and Citywide Inclusive Sanitation, should be pursued and expanded.

Given the context of Indonesia's decentralized governance system, local governments should take the leading role in planning and implementing IUWM principles and projects. They should begin immediately by coordinating water planning, spatial planning, and other urban sectors to avoid locking in inefficient practices, and should initiate collaborative actions with neighboring jurisdictions where appropriate. The World Bank and development partners have an important role to play in disseminating knowledge on IUWM to subnational governments and identifying opportunities to incorporate IUWM within existing urban and water projects. In the longer term, tailored financial structures can be developed to support subnational governments in IUWM design and implementation. With threats from climate change increasing, IUWM should incorporate mitigation efforts and other sound environmental management principles, including energy efficiency and circular economy for water systems.

Introduction



1. INTRODUCTION

Water insecurity in Indonesia imposes high costs on people, the economy, and the environment (World Bank, forthcoming). These costs are concentrated in the country's large and expanding urban regions, which face interlocking challenges in water resources, water and sanitation service provision, flood risk management, and the protection of the water environment. Currently, water management in Indonesia is fragmented across administrative boundaries and between the different elements of the water sector. The interrelationships between water and spatial planning, disaster risk reduction, and solid waste management are rarely taken into account, and opportunities to address problems efficiently and effectively may be missed as a result.

IUWM is well established as an approach to urban water policy, planning, and management. It has been successfully adopted in cities around the world but is not yet well known among local governments in Indonesia. It encompasses a framework of law and regulation, governance and institutions, planning and implementation, and information management and financing. Together, these action areas support IUWM interventions and projects at a range of scales, tailored to local priorities and capacity.

This report focuses on the potential for IUWM to address the severe and interrelated water security challenges faced by Indonesian cities. The report:

- Assesses the relevance of IUWM to Indonesia
- Identifies refinements and updates to the IUWM approach to take into account contemporary policy objectives
- Reviews the feasibility of IUWM in the Indonesian context and pinpoints barriers to its adoption
- Considers the demand for IUWM – that is, knowledge of and support for IUWM among policymakers at the national and local levels
- Recommends a set of actions that can be taken at the national level to support uptake of IUWM approaches in Indonesia

This report does not present an economic analysis of specific IUWM interventions. IUWM is considered here as an approach rather than a fixed set of actions. After local policy priorities and conditions have been assessed, specific IUWM actions can be selected and cost-benefit assessments conducted. In presenting a holistic view of IUWM and its potential in Indonesia, the report is intended to:

- Inform policymakers at national and local levels in Indonesia about IUWM
- Delineate a roadmap for reforms in the legal, regulatory, policy, and planning framework to support the adoption of IUWM
- Through the accompanying Practical Guide for Cities and other materials, engage local governments on IUWM and convey initial steps that cities can take to transition toward IUWM
- Provide a basis for more detailed city-level assessments of water security issues in specific cities, and for studies of potential IUWM interventions to address them

Beyond Indonesia, the report may also be of interest to other middle-income developing countries intending to strengthen their urban water management.

Data for this report were gathered from: a review of academic literature and international case studies of IUWM; an analysis of laws, regulations, planning documents, and primary data on urban water management in Indonesia; and a series of ideation and consultation workshops with government officials and other stakeholders primarily in the Greater Jakarta region held in 2019-2020. The data collection and analysis methods are described in detail in the accompanying report, *Pathways toward Integrated Urban Water Management for Greater Jakarta*.

The next section of the report introduces IUWM as an approach, distinguishing between the framework needed to support adoption and the individual projects and interventions that fall under the umbrella of IUWM. Section 3 provides examples of IUWM cases from around the world and draws out relevant lessons for Indonesia. Section 4 covers the drivers and challenges for IUWM adoption in Indonesia, while Section 5 presents small-scale experiences of interventions in Indonesia consonant with IUWM that may be replicated or scaled up. Section 6 presents the recommendations.

Integrated Urban Water Management 2.0

2. INTEGRATED URBAN WATER MANAGEMENT

2.1 Overview of IUWM

Integrated Urban Water Management (IUWM) is an approach in which the development and management of all water sources (ground, surface, storm water, recycled water, desalination, etc.), all stages of the water cycle (resource management, treatment, and distribution, and wastewater collection, treatment, and disposal), all uses of water and sources of demand, and the protection of the urban water environment and ecology are coordinated, taking into account specific local characteristics. Additionally, the IUWM approach implies horizontal coordination between the water sector and other urban infrastructure sectors and policy areas, including spatial development, solid waste management, and disaster management, to ensure that policies and plans in these areas take full account of their impacts on urban water. An IUWM approach does not replace analysis in each of these specific policy areas, but rather aims to use and complement sector analyses by incorporating them into overall urban planning to more efficiently use resources and more effectively deliver public services.

The scope of IUWM is illustrated in figure 1. The inner circle represents coordination within the water cycle, while the outer circle represents links with other sectors that interact with the urban water system.

IUWM can be thought of as the city-level application of integrated water resources management (IWRM), a framework that has been adopted by governments across regions and at all levels of economic development. IUWM shares with IWRM the goal of maximizing economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems (GWP 2000).

IUWM can be applied at varying scales, from a metropolitan region encompassing several river basins to a single neighborhood or even a single property development. As a flexible management approach, IUWM may be tailored to all categories of cities in Indonesia, from metropolitan areas crossing two or more administrative jurisdictions, to small but fast-growing cities commencing the construction of urban infrastructure (see box 1). In addition to horizontal coordination across sectors within a single jurisdiction, IUWM also requires vertical coordination between national, regional, and local levels of governments, and across upstream and downstream administrative jurisdictions within a metropolitan area.

Figure 1: Interlocking Elements of the Urban Water System

Source: Authors' elaboration, adapted from World Bank 2016.

Box 1: Urban Categorization in Indonesia

Government Regulation 26/2008 categorizes cities in Indonesia into four groups according to population size, as below. Some cities, including Greater Jakarta and Greater Surabaya, are categorized as metropolitan areas (*wilayah metropolitan*) made up of a primary city surrounded by satellite cities.

City category	Population size
Small cities	⩽ 100,000
Medium cities	100,001 - 500,000
Large cities	500,001 - 1,000,000
Metropolitan cities	>1,000,000

In keeping with the objective of maximizing economic and social welfare, IUWM emphasizes efficiency, optimizing the use of available resources and infrastructure and magnifying the effectiveness of structural and non-structural interventions through coordination. It is a flexible, adaptive, and participatory process. The involvement of stakeholders from civil society and the private sector in decision-making is one of its key characteristics.

In many cases, cities adopt IUWM in the aftermath of a severe water crisis, such as a prolonged drought or major flood, that prompts stakeholders to conduct a far-reaching review of governance arrangements and consider innovative policy options. Ideally, however, IUWM would be adopted as a preemptive strategy to address water security, reducing the risk of a future crisis.

2.2 IUWM Framework

While the design and implementation of individual IUWM interventions or projects generally takes place at the city level, a framework is needed at the national level to support cities in the adoption of IUWM. This is illustrated in figure 2, which delineates a framework of interventions with a primary focus on addressing water resources scarcity – a rising priority in metropolitan areas. The framework covers five areas: (1) law and regulation; (2) governance; (3) planning and implementation; (4) information management; and (5) financing.

Law and regulation: The legal framework touching on water issues (norms, decrees, regulations, and laws) must be consistent with IUWM. Laws and their implementing regulations lay the groundwork for water and sanitation service delivery modes, water resource allocation and management, and environmental protection. They also provide the basis for coordination between jurisdictions and levels of government, and they define the scope of private sector participation. Laws and regulations can be an effective instrument for setting minimum standards, such as improved piped water supply provision, and constraining unsustainable practices, such as groundwater abstraction. A legal framework that incorporates the principles of IWRM would usually be consistent with IUWM, but is not necessarily sufficient to create an enabling environment for IUWM.

Governance and institutions: The roles and responsibilities of government and non-government actors must be clearly allocated, gaps closed, and overlap minimized. The governance framework must include mechanisms to incentivize and ultimately enforce cooperation between sectors and jurisdictions. Although Indonesia legally mandates[1] regional cooperation for critical governance and management areas (including water supply, watershed management, and spatial planning), implementation of this mandate is lacking in some metropolitan areas. Rules and mechanisms are needed to encourage cooperation with the private sector and to enable the participation of stakeholders in decision-making processes. Institutional fragmentation, both horizontal and vertical, can be a bottleneck in IUWM implementation, as various departments have a stake in, or affect, how water is managed. These departments include water supply, sanitation, flooding, solid waste, land use, climate, environment, and health.

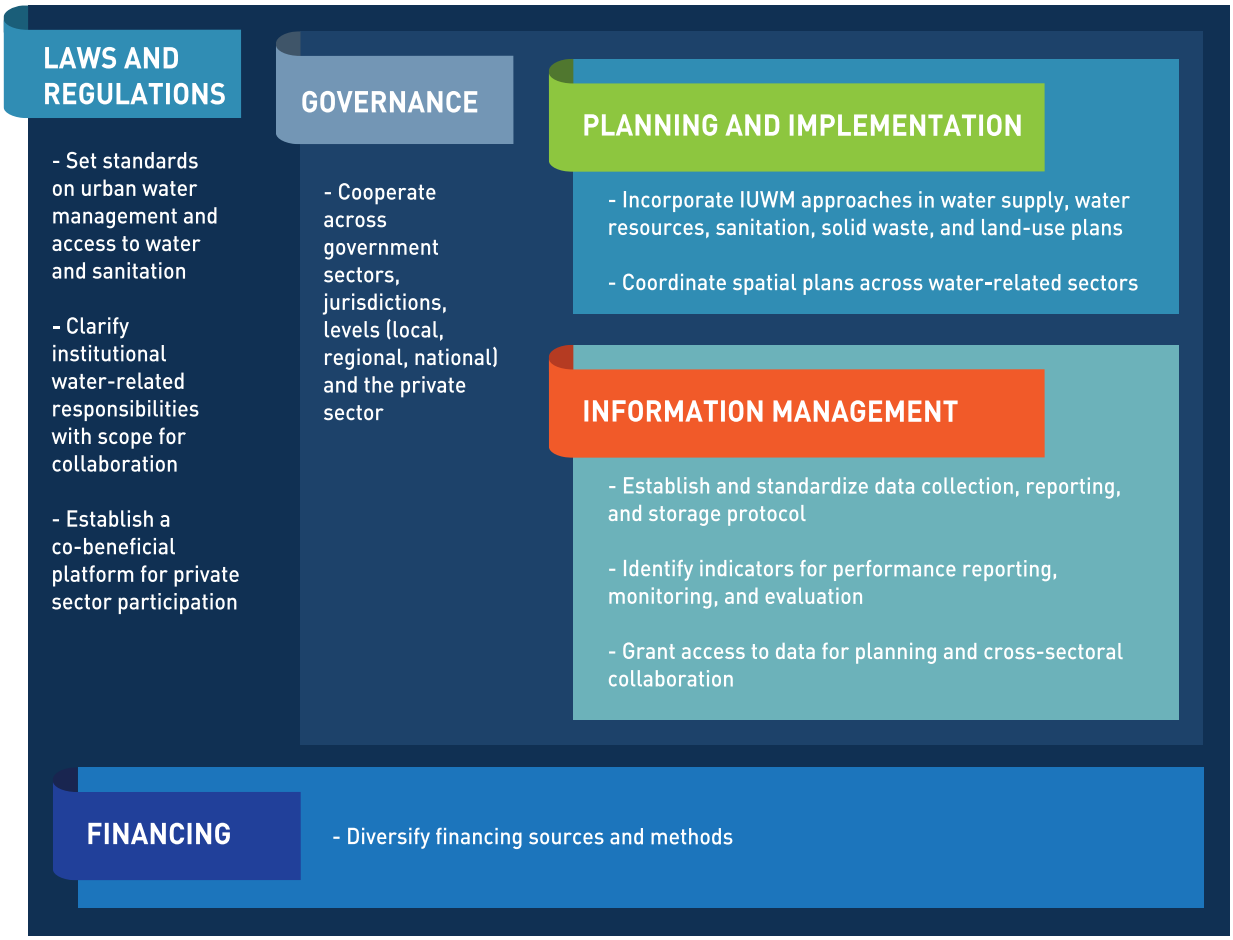
Planning and implementation: The planning process is a core part of IUWM and goes beyond traditional planning processes. In coordinating across sectors, jurisdictions, and government levels, planning ensures that resources are managed to maximize the efficiency and effectiveness of investments. With climate change exacerbating environmental threats, long-term planning for adaptation and mitigation is also important. The principles of energy efficiency and the circular economy are particularly relevant for IUWM. Other sectors must also consider water in their planning processes – particularly in spatial planning. The benefits of water-sensitive spatial planning may far outweigh additional costs (see section 3.2), and yet water concerns are not taken into account in many jurisdictions.

Information management: Data availability and quality is an important factor in facilitating and refining IUWM planning. Statistical and spatial data are required to visualize and analyze geographical trends and propose IUWM solutions. There is therefore a need to identify indicators for reporting, monitoring, and evaluating various water and water-related outcomes. These indicators should enable planners and policymakers to comprehend water issues holistically.

[1] Government Regulation 28/2018.

Financing: Financing IUWM is an important consideration, especially in resource-constrained cities and countries. To support IUWM, governments can consider diversifying funding sources, implementing cost-sharing mechanisms, and involving the private sector.

Figure 2: IUWM National Framework for Indonesia



2.3 IUWM Interventions

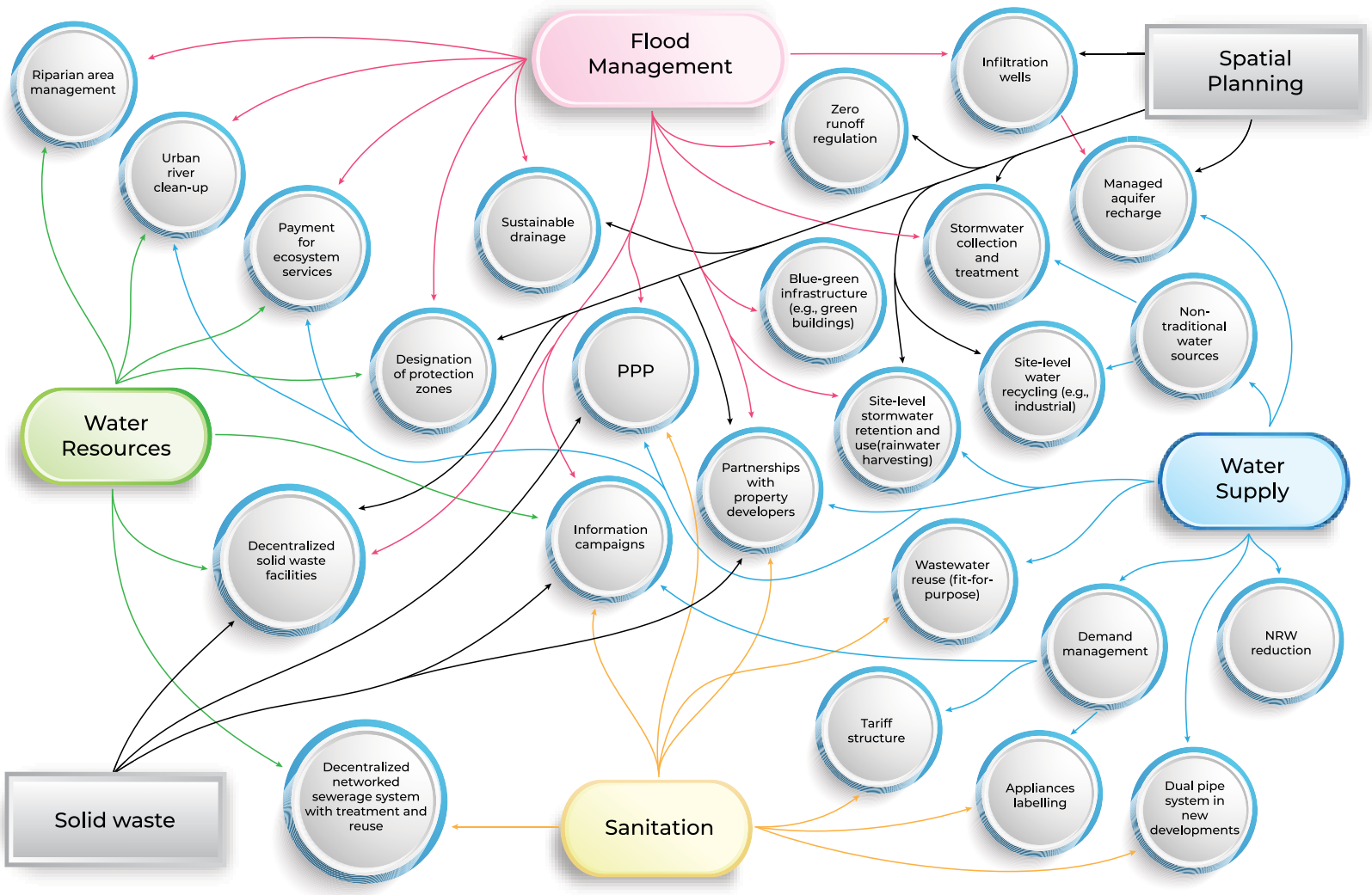
With a sound framework in place, local actors can design and implement IUWM interventions. The range of possible interventions is wide, and their suitability will vary according to the nature of the water security challenge and the availability of resources in a particular locality. Here, we provide examples to illustrate what IUWM can look like "on the ground." These examples should not be considered a checklist. One city would not be expected to apply all these interventions. Rather, they should be seen as a menu from which cities can identify an appropriate package of interventions. The lower bound of the cost range is indicated for each (see table 1). Investment costs will vary according to scale, technology, design parameters, and local conditions. Section 3.2 elaborates further on the economic costs and benefits of IUWM.

Table 1: Indicative Lower-Bound Cost Range for IUWM Interventions

IUWM FRAMEWORK OR INTERVENTION	FINANCIAL INVESTMENT RANGE (USD)
Interventions with a primary focus on addressing water resource scarcity	
Protect upstream catchments	> $10 million
Develop non-traditional water resources for public water supply (e.g., wastewater reuse, stormwater collection and treatment, groundwater recharge)	> $50 million
Implement site-level water recycling at residential, commercial, and/or industrial sites	> $10,000
Implement site-level stormwater retention and use ("rainwater harvesting")	> $10,000
Switch from piped water supply to non-potable water for urban greening and other municipal purposes	> $10,000
Interventions focusing on demand management	
Adjust tariff structure and level to incentivize efficient water consumption	–
Conduct information and communication campaigns on water efficiency	> $10,000
Institute water efficiency standards and labelling of sanitary fittings and household appliances	> $1 million
Set targets for water consumption efficiency by government entities	–
Benchmark water consumption efficiency of commercial, institutional, and industrial customers	> $1 million
Reduce non-revenue water (NRW)	> $10 million
Interventions focusing on flood risk management	
Integrate water considerations in urban planning	–
Improve solid waste management to reduce clogging in waterways	> $10 million
Manage upstream riverbank land to reduce velocity and sediment in waterways	> $10 million
Introduce building regulations on permeable surface area, on-site retention, and reuse of stormwater	–
Construct blue-green infrastructure/sustainable drainage (neighborhood scale)	> $1 million
Construct infiltration wells and vertical drainage	> $10,000

Many of these interventions can help address several challenges simultaneously and generate beneficial impacts on other elements of the urban environment – for example, by increasing permeable green spaces or raising river quality. Furthermore, as these examples illustrate, IUWM actions are not necessarily led by actors within the water sector. They can be taken up by agencies responsible for spatial planning, climate change adaptation, disaster risk reduction, transportation, or environmental protection, among others. It is central to IUWM that decision-makers across policy areas ensure that their actions do not compromise other sectors, and that they seek common solutions to problems with overlapping benefits or costs whenever possible. These interconnections are illustrated in figure 3.

Figure 3: Interrelationships between Urban Development Challenges and Co-Beneficial IUWM Interventions



Note: Challenges are represented in colored rectangles. IUWM interventions are represented in circles.

International Experience of IUWM

3. INTERNATIONAL EXPERIENCE OF IUWM

3.1 Overview

Numerous studies have shown that IUWM has the potential to contribute to multiple policy objectives: improved water security (van Beek and Arriëns 2013); enhanced social, ecological, and economic sustainability at various scales (Milly et al. 2008; Brown, Ashley, and Farrelly 2011; Kirshen et al. 2018); more resilient systems (Wong and Brown 2009); improved environmental quality (Rygaard, Binning, and Albrechtsen 2011); resource efficiency (Burn, Maheepala, and Sharma 2012); and economic development (Pahl-Wostl et al. 2011).

Empirical work, meanwhile, offers evidence of the benefits generated by IUWM at the micro and district scale (Furlong, De Silva, and Guthrie 2015; Mishra et al. 2020), and at the scale of the city in Australia (Mitchell 2006; Furlong et al. 2017), China (Wang et al. 2018), the Netherlands (World Bank 2016), Singapore (Tortajada, Joshi, and Biswas 2013), and the United States (Kirshen et al. 2018), among others. There are also a smaller number of examples at the scale of the metropolitan area, such as Seoul (Kim et al. 2018) and São Paulo (World Bank 2016; Gómez-Álvarez et al. 2017). IUWM approaches have been integrated into World Bank projects in African cities (Jacobsen, Webster, and Vairavamoorthy 2013 and in Brazil, with promising results (Closas, Schuring, and Rodriguez 2012). The policy drivers in these cases range from water resource constraints (Singapore), to increased climate variability (Melbourne), to flood risk management (Rotterdam) (Tortajada, Joshi, and Biswas 2013; World Bank 2016).

IUWM delivers direct and indirect social benefits, contributing to slum upgrading and improving environmental quality, urban resilience, and overall quality of life. For instance, in the São Paulo Metropolitan Region, low-income communities without proper sanitation facilities were residing in the catchment, leading to river water contamination. Under a World Bank project, a sanitation system was constructed to treat and discharge sewage safely, with a pipeline from the community to the main sewerage network. Not only did water resource quality improve, but the host community also benefited from increased access to safe sanitation service. In this case, the need to tackle a pressing water quality problem provided the basis for developing a community partnership that addressed multiple concerns.

In many cases, a crisis like a prolonged drought, major flood event, or drinking water contamination incident acts as a trigger for IUWM adoption. These dramatic events push water issues to the top of the policy agenda and open a policy space to reconsider strategy and reconfigure governance arrangements to take account of the interconnections between

the different facets of the water sector. For example, in Cape Town, Melbourne, and São Paolo, IUWM was adopted during long droughts that threatened the cities' water supplies; in the Netherlands, the United Kingdom, and the United States, cities have adopted IUWM after repeated and severe urban floods. However, IUWM may also be the result of a strategic deliberation on how to deal with multiple concurrent water challenges, as in the case of Singapore or the Seoul metropolitan region.

Singapore provides an example of the successful use of IUWM to address water resource scarcity. Under its "Four Tap" strategy, Singapore augments its water supply with stormwater, treated wastewater (known as NEWater), and desalination; maintains a high level of network efficiency; and uses a variety of initiatives to manage demand. This has allowed the city-state to radically improve its water security (Jensen and Nair 2019). From being reliant on imported surface water for 50 percent of its water supply before 2009, Singapore today is able to meet 70 percent of its water locally. By 2060, Singapore's national water agency, PUB, expects to be achieve self-sufficiency (PUB, n.d.). The government also takes an integrated approach to the urban water environment, coordinating efforts between housing, environment, and water agencies to raise the quality of the Singapore River and create a freshwater reservoir.[2] Singapore has also become a center for water technology companies, with a water sector that in 2018 generated US$1.87 billion per year in added value to the economy (Mahmud 2018).

3.2 Evaluating the Benefits of International IUWM Projects

Evaluating IUWM raises conceptual and practical challenges. These include difficulties in assessing the system-level effects of high-level changes in regulations, governance, or planning processes, and in evaluating ex ante the impact of innovative technologies and services. For cities facing severe water scarcity, the transformative nature of IUWM approaches makes it is difficult to establish a counter-factual, as in the example of Singapore.

Depending on the nature of the intervention, IUWM may also generate additional non-market benefits, such as improved quality of life (the "livability" of a community), better ecological status, increased biodiversity, aesthetic value, and reduced conflict between stakeholders within a catchment (Hien Wong et al. 2003; Molinos-Senante, Hernández-Sancho, and Sala-Garrido 2011; Heinz, Salgot, and Mateo-Sagasta Dávila 2011; Fan and Matsumoto 2019; Smith, McDonald, and Wilson 2010). Additional quantifiable benefits from IUWM strategies may include benefits over time in reduced flooding, increased tourism revenue, and lower greenhouse gas emissions. These intangible benefits may be challenging to incorporate into cost-benefit analysis, and considering them at the planning stage requires additional skills and resources. As a result, there is a limited number of ex-post comprehensive evaluations of IUWM at the city or metro level.

[2] Further information on Singapore's urban river strategies is presented in Annex 1.

Despite these difficulties, studies evaluating IUWM at the local or district scale show a range of net benefits. Catchment management and groundwater recharge projects can offer substantial cost savings over conventional water treatment plants (see table 2). Abell et al. (2017) finds that upstream catchment management programs have enabled about 16 percent of cities to reduce water treatment costs sufficiently to generate positive economic returns, and an additional 25 percent of cities to generate smaller but substantial savings. For example, in Brazil, the São Paulo Water Fund was established to restore 14,200 hectares of forest in critical catchment areas to decrease sedimentation and increase water provision for downstream users. In addition to increasing water availability, the project generates an estimated benefit of 942,500 tons of sequestered carbon[3] (Abell et al. 2017). Managed aquifer recharge (MAR) projects have also generated net benefits in projects worldwide (UNESCO 2021; Perrone and Rohde 2016). Not only do these projects use existing natural systems for water storage, but they prevent loss from evaporation and can help to prevent saltwater intrusion (see California case study, Annex 1.1).

Table 2: Cost-Benefit Estimates of IUWM Projects

LOCATION	PROJECT	COST
Lyon, France	Water utility invested in active source protection of a 375 hectare well field site.	€32 million/year, compared to €52–74 million/year for a conventional Water Treatment Plant (WTP) (Trémolet and Karres 2020).
New York, USA	Catchment management program	US$8–10 billion cost of a new WTP avoided. Cost estimates of IUWM program not available. 10% reduction in intake water sediment reduces operation and maintenance (O&M) costs for water treatment by 2.6% (McDonald and Shemie 2014).
Kumamoto, Japan	Payment for Ecosystem Services (PES) scheme for sustainable farming resulted in groundwater replenishment. Groundwater recharge was increased, groundwater extraction reduced.	Estimated equivalent value of groundwater recharged was US$27.15 million in the period 2004–2018. Payments of US$6.46 million were made to farmers (UNESCO 2021).

Ex ante assessments in Azerbaijan, Honduras, and Nairobi found IUWM to be cost-effective when comparing all water-related investments (Closas, Schuring, and Rodriguez 2012). However, off-grid water supply systems and blue-green drainage show mixed results. For example, a study of IUWM plans in Melbourne, Australia, found that IUWM plans incurred

[3] Equivalent to 3.46 million metric tons of CO_2.

total community costs (incorporating benefits) that were marginally or significantly higher those of conventional plans, but in several cases achieved better environmental outcomes (Furlong et al. 2017). Given the wide range of IUWM interventions and the variety of challenges they are designed to address, cost-benefit analysis of a specific intervention and location will be necessary and will need to incorporate both tangible and intangible benefits within and outside the water sector.

3.3 Cases and Lessons Learned

Table 3 provides examples of IUWM[4] designed to address a range of water security challenges (including water resource scarcity, stormwater management, and water environment quality) and their key lessons for IUWM application in the Indonesian context. We include examples relating to the five components in the framework – law and regulation, governance, planning and implementation, information management and finance. These cases demonstrate the great diversity in IUWM interventions around the world. This diversity is a core part of the approach, which recognizes that interventions should be tailored to local water-related priorities and capabilities.

Although these cases are not intended to be taken as examples for direct replication in Indonesia but rather to serve as inspiration for further exploration, they illustrate IUWM actions relevant to critical issues faced by Indonesian cities: degraded urban rivers (Case 1), water wastage in the network (Case 2) and by consumers (Case 5), land subsidence (Case 4), and surface flooding (Case 3). They also provide examples of good practices in information management (Case 7), certification (Case 8), and partnerships for planning and financing (Cases 6, 9, 10, and 11), which could be or are already being implemented in Indonesia.

These examples point to some factors that contribute to the success of IUWM. First, they demonstrate the value of engaging non-government stakeholders. Examples from Singapore and Melbourne, Australia, show different routes to engage property developers, while the case of Zhenjiang sponge city in China demonstrates how the private sector can provide design and management expertise and financing through a long-term collaboration. The example of demand management in Zaragoza, Spain, shows the value of engagement with customers as stakeholders in a collective effort to address water scarcity, using many aligned interventions to achieve a stretch target.

[4] The architects of these IUWM examples may not label their own approach as "IUWM," referring instead to "water sensitive cities," "sustainable urban drainage systems," etc., but these examples all share the characteristics of an IUWM approach.

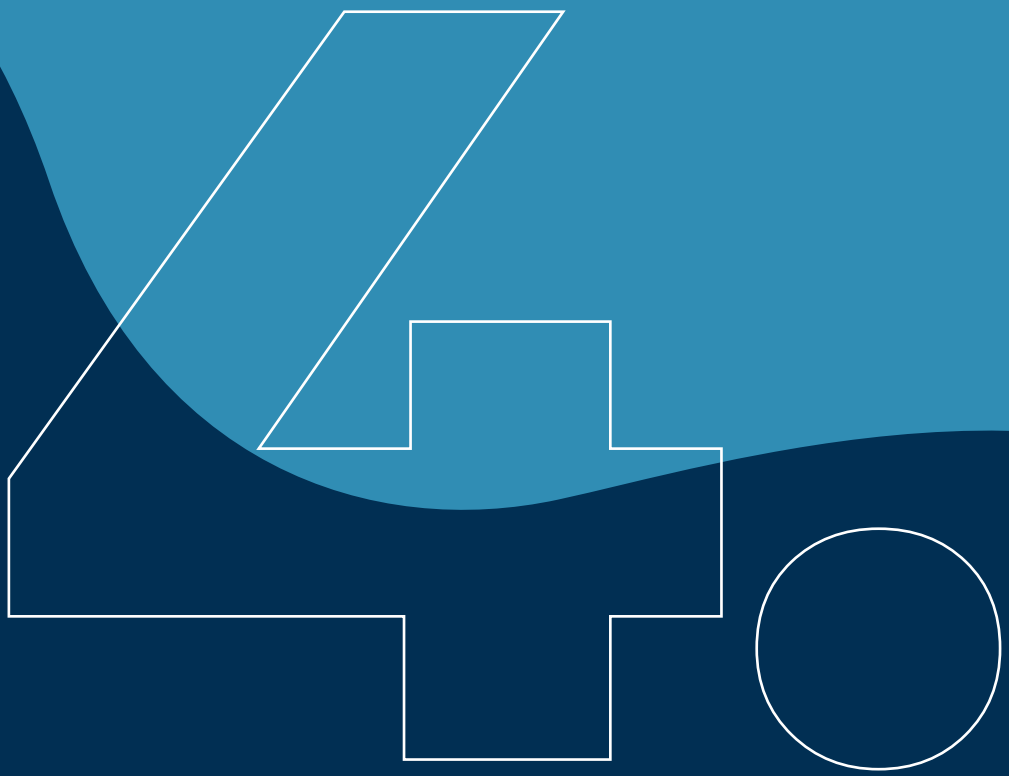
Table 3: Summary of International IUWM Experiences

	CASE	LOCATION	DESCRIPTION	LESSONS LEARNED
1	Multi-agency urban river cleanup	Singapore	Coordinated action across government agencies for spatial planning, housing, water, wastewater, and solid waste services to restore an urban river	Coordinate between water and non-water sectors to achieve policy objectives
2	Driving efficiency through NRW reduction targets	Denmark	Use of NRW targets and financial instruments to incentivize water utilities to improve efficiency	Use targets set by the national government to incentivize local government entities to use resources efficiently
3	Planning for blue-green infrastructure	Australia	Integration of water-related investment planning and spatial planning to prioritize actions	Link spatial plans with water plans to prioritize investments
4	Halting land subsidence in a coastal megacity	Tokyo, Japan	Combined regulatory action and investment in surface water supplies to arrest land subsidence	Combine action by national and local governments with a strong legal basis to address subsidence
5	Integrated policies to reduce water consumption	Zaragoza, Spain	Local government-led multi-faceted strategy to reduce water consumption by households and industry	Implement a comprehensive policy package with strong local leadership to manage demand
6	Public-private partnership (PPP) for sustainable drainage sponge city project	Zhenjiang City, China	Innovative PPP structure combining wastewater treatment, reuse, and stormwater management	Mobilize financing for IUWM projects under PPP models
7	National Sanitation Information System	Brazil	Consolidated water and waste information management at the national level linked to funding access	Reliable and comparable data provide evidence base for project selection
8	ABC Waters Certification scheme	Singapore	Water agency recognition initiative for private developers and public agencies incorporating sustainable water management design features in developments	Incentivize private developers to improve
9	Interjurisdictional cooperation	Kartamantul, Indonesia	Local government–led cooperation and joint investment planning and management for water and waste infrastructure	Cooperate across jurisdictions to achieve common policy goals
10	Private developer–led sustainable water practices	Greater Jakarta, Indonesia	Adoption of sustainable water management practices in private townships	Partner with private developers to scale-up initiatives

Cases from Denmark and Brazil demonstrate the value of linking clear targets with effective mechanisms for gathering and sharing performance information. Maintaining an information system with reliable, valid, and publicly available data plays a dual role: it supports the monitoring and evaluation process and provides additional reputational incentives to local governments and local-level service providers.

Challenges in IUWM adoption include stakeholder willingness, political resistance, lack of capacity or resources, and weak institutional settings. For example, Case 9 on interjurisdictional cooperation in Kartamantul is a bottom-up effort driven by the willingness of leaders under the same provincial government to cooperate, but similar coordination has not been achieved in other metropolitan areas in Indonesia. However, these cases also demonstrate the feasibility of adopting IUWM actions even in resource-constrained contexts (Cases 1, 5, 7, 9, 10, and 11) within and beyond Indonesia. The next section considers the Indonesian context in detail.

Drivers and Challenges for IUWM in Indonesia



4. DRIVERS AND CHALLENGES FOR IUWM IN INDONESIA

A variety of circumstances make the current moment an opportune one in which to adopt IUWM in Indonesia. The economic costs of water threats and urgent water insecurity problems are critical drivers encouraging a reimagined approach to water issues. In parallel, high political buy-in, legislative opportunities, institutional developments, growing capacity, and a governance structure favorable to the uptake of IUWM all make Indonesia an excellent candidate to take full advantage of IUWM's potential benefits. At the same time, there remain significant challenges. Legal ambiguities and fragmented governance could hamper the development an IUWM framework, while a lack of coordinated planning and patchy information management may constitute barriers to implementing IUWM interventions.

The following section explores how Indonesia's water insecurity issues make the country an ideal candidate for an IUWM approach; the remaining sections discuss the context and identify both the drivers and challenges to IUWM adoption in the five categories introduced in Section 2: (1) law and regulation; (2) governance; (3) planning; (4) information management; and (5) financing.

4.1 Water Insecurity as a Driver of IUWM Adoption

In Indonesia, cities are hotspots of water insecurity. They face challenges of low water supply and sanitation (WSS) service coverage, minimal or non-existent wastewater treatment, declining quality and quantity of water resources, flooding, subsidence, and degraded water environments. The interlinked nature of these challenges suggests that IUWM approaches could be of great value in Indonesia.

The severity of the water security challenge is increasing. Urban areas in Indonesia have expanded rapidly in the last two decades, with an urban population growth rate of 3.5 percent per year from 2000 to 2010 (World Bank 2015). This trend will continue, with 68 percent of Indonesia's population expected to be living in cities by 2025. The spatial footprint of cities has also undergone massive expansion: urban land area grew at an annual rate of 1.1 percent in 2000–2010, the highest absolute growth rate after China in this period. Across Indonesia, peri-urbanization and urban agglomerations are incorporating the regions around cities into the urban fabric. In Greater Jakarta and other coastal cities, urban expansion is spreading upstream into the catchment, exacerbating flooding and degrading water resources.

Infrastructure, meanwhile, has failed to keep pace with urban growth. Access to urban water and sanitation services is inadequate. Most alarmingly, only 5 percent of urban wastewater

in Indonesia is treated and disposed of safely, creating health risks and raising the costs of surface water treatment for downstream users. Piped water supply reaches only one-third of urban residents, implying that many households, commercial enterprises, and industrial establishments depend on groundwater. This in turn leads to over-abstraction and contributes to land subsidence, which is a particularly severe problem in northern Java. Cities are repeatedly affected by seasonal surface flooding, exacerbated by clogged drainage systems due to poor solid waste management. They also face growing risks from flash floods and coastal floods due to land use changes, subsidence, and climate change. These trends aggravate localized water resource scarcity and competing demands for raw water from other sectors.

The serious threats that water-related issues pose to Indonesia's people and economy are presented in detail in a water security diagnostic report, *Indonesia: The Path to Water Security* (World Bank, forthcoming). The diagnostic finds that, without the adoption of adequate measures, water-related threats may lead to an estimated reduction in GDP of up to 4.9 percent by 2030 and up to 7.3 percent by 2045, equivalent to US$40 billion and US$81 billion at Indonesia's 2019 GDP.[5] Conversely, decisive action to address water-related threats could increase GDP by as much as 3.2 percent by 2045. Six percent of Indonesia's river basins face an annual water deficit, and 35 percent face medium to severe water stress year-round. These medium-to-severe water-stressed rivers contribute more than two-thirds (70 percent) of Indonesia's annual GDP. This is an indication of the potential economic loss in a "no action" scenario in catchment management.

To avoid these losses, many of Indonesia's actions to address water-related threats will have to focus on the management of water in cities and their surrounding regions. The benefits of taking action on water security will also be most striking in urban hotspots where competition for water resources is acute, and where harm to people and property from water shortages, floods, and land subsidence will be concentrated. These are precisely the areas in which IUWM – which is focused on holistic approaches to water issues across urban sectors, integrated management of catchments, and creating enabling governance frameworks – proves most effective.

Indeed, policymakers in Indonesia have recognized the potential of IUWM, and there is considerable political buy-in for the approach. Consultations with stakeholders in central and local governments and in local government–owned water utilities (*Perusahaan Daerah Air Minum,* or PDAMs) conducted for this report indicated considerable interest in IUWM.

[5] These figures are derived from a Computable General Equilibrium (CGE) analysis on specific water-related threats. The analysis compared the impact of water threats on GDP in a scenario in which mitigative and adaptive actions are taken and in a scenario in which "business as usual" resumes. The threats analyzed are: (1) water pollution from inadequate sanitation; (2) effects from sea level rise; (3) subsidence caused by groundwater over-abstraction; (4) impacts from flood events; and (5) water shortages due to insufficient water storage.

Participants were interested in a range of interventions, including stormwater capture, groundwater recharge via infiltration wells, regulation of on-site retention, and recycling. They also recognized the need to coordinate on water issues with other local governments across the urban area, and some had positive experience of such cooperation.

As Indonesian policymakers begin to adopt IUWM interventions and approaches, they face a range of enabling circumstances and challenging hurdles in the areas of law and regulation, governance, planning, information management, and financing.

4.2 Law and Regulation

4.2.1 Law

The legal foundation for IUWM is provided by Law 17/2019 on Water Resources (2019 Water Law). The law allocates responsibility for different aspects of the sector between government ministries. Importantly for IUWM, the law's scope covers all water above and below ground (surface water, groundwater, rainwater, and sea water that is contained within a landmass). In particular, the law extends the responsibility of River Basin Organizations (RBOs) to include groundwater, which was not previously the case. However, the law leaves some areas of ambiguity that will need to be clarified in its implementing regulations. In three important areas for IUWM – groundwater management, surface water quality management, and stormwater – ambiguity still remains, particularly surrounding the allocation of rights and responsibilities and how the interests of upstream and downstream users will be balanced with regard to flood management and surface and groundwater replenishment.

The law establishes a hierarchy of precedence for the allocation of water resources: first to meet basic needs and public water supply enterprises, then to satisfy the demand of state-owned enterprises, private enterprises, and environment flows. The law recognizes water as an economic good and establishes the "beneficiary pays" principle. Licenses for resource abstraction are subject to water resource management fees and may only be granted if resource utilization is "environmentally sustainable." Groundwater abstraction is currently charged for through a tax, which may be synchronized with surface water abstraction licenses under the new law.

4.2.2 Regulation

Policy developments currently underway in Indonesia provide a window of opportunity to promote the adoption of IUWM approaches. The Government of Indonesia is in the process of drafting implementing rules and regulations (Government Regulations on Drinking Water Supply, *Peraturan Pemerintah* 122/2015) for both the 2019 Water Law and for the 2020 Omnibus Law, offering an opportunity to incorporate IUWM. Ongoing discussions with stakeholders demonstrate a transition toward more integrated approaches. The revised regulations are expected to enable local governments to implement IUWM more effectively.

Within the water supply sector, financing and regulation reforms supported by the World Bank under the National Urban Water Supply (NUWAS) framework are taking root and starting to show positive results in strengthening efficiency incentives for water utilities. The adoption of IUWM should be complementary to these reforms, building on the NUWAS framework where possible.

To incentivize IUWM in private developments, building regulations and licenses can serve as an important instrument. In Indonesia, private real estate developers are influential actors in the urban water cycle. They are responsible for the design, construction, and operation of water supply, sanitation, and drainage systems; roads; and security services. They also provide municipal services in industrial estates and to residents and businesses in "new towns" through "town management companies." In some cases, these privately developed areas are very large, with populations of 50,000–100,000 residents on plots of 100 hectares or more. In certain municipalities, private developments cover a significant proportion of the total land area. For example, in South Tangerang in the Greater Jakarta region, private developers are estimated to own 40 percent of the land (see the accompanying report, *Pathways to Integrated Urban Water Management for Greater Jakarta*). The quality of infrastructure and services in these developments often surpasses that of municipal governments. Some developers have also invested in systems that exemplify the principles of IUWM, for example by retaining and using stormwater, and treating and reusing wastewater for non-potable purposes. These projects can act as demonstration cases for municipalities and other private developers interested in pursuing IUWM.

However, while some new towns and industrial estates perform highly in terms of sustainable, integrated water management, developers in most jurisdictions are not required to meet specific standards and actual service levels vary widely. In some cases, infrastructure such as wastewater treatment plants do not meet standards and are poorly managed. There is a need for oversight and supervision of privately managed infrastructure. There is also scope for local governments to incentivize higher standards across the board by making good water practices (such as site-level water retention, water harvesting, or water recycling) conditions for abstraction, discharge, and building licenses. A small number of local governments, including South Tangerang, already do this. Additionally, local governments are able to provide financial incentives to private companies and community organizations for projects that fulfill criteria for sustainable and environmentally friendly infrastructure development. Incentives can take the form of local tax or levy deductions or exemptions (Government Regulation 24/2019). These can be used more extensively to promote IUWM.

Voluntary regulation, like certification programs, awards, and competitions, could be employed to enhance other regulatory instruments. The Green Building Council Indonesia provides a GREENSHIP certification for sustainable developments, which could be extended or used as a model for "blue" certification for sustainable water management.

4.3 Governance and Institutional Arrangements

Indonesia's underlying governance structure is in many ways well suited to the adoption of IUWM. Indonesia has a highly decentralized administrative structure, with considerable authority allocated to local governments. In relation to water, the scope of authority of municipal governments is broad and covers water supply; sanitation; allocation of abstraction permits for surface and groundwater and discharge permits for wastewater; spatial planning; flood management; and disaster protection. These responsibilities lie with local governments, within frameworks set out by the national government.

While decentralization can pose a challenge for IUWM, as it requires additional mechanisms for interjurisdictional coordination, it also means that spatial and water-related plans are currently prepared at the local level. These planning processes can therefore be coordinated without the need for institutional changes at higher levels of government. Indeed, there are already examples in Indonesia of local government initiatives that embody the principles of IUWM and that have the potential to be scaled up (see Section 5 of this report). Furthermore, the regulatory and institutional framework for governance of urban regions is under review by the Ministry of Home Affairs (MOHA), and water issues are recognized as an important area for cooperation between local governments within urban regions.

Coordination between ministries at the national level is also being strengthened under the National Urban Development Project (NUDP) supported by the World Bank. Within the NUDP framework, the Inter-Ministerial Steering Committee (*Tim Koordinasi Pembangunan Perkotaan Nasional*, TKPPN) will be re-structured and enhanced. The project aims to develop institutional capacity for coordination, planning, and implementation for infrastructure development at the city and national levels, in order to transition toward spatially informed infrastructure planning that enables governments to prioritize capital investments.

Under the 2019 Water Law, the Ministry of Public Works and Housing (MPWH) plays the leading role in policy, planning, and regulation for water resources management, drinking water supply, and domestic wastewater. As mentioned above, there is a gap in the current governance framework regarding allocation of responsibility for groundwater management. To support IUWM approaches, there must be close coordination between surface and groundwater resource management, which may be best achieved by allocating authority to the same ministry. Responsibility for surface water quality management has hitherto been shared between MPWH and the Ministry of Environment and Forestry (MOEF). These two ministries will need to cooperate in the revision of the Government Regulation Concerning Water Protection and Management and, if required, the development of additional implementing regulations relating to how quality standards are set, monitored, and enforced.

However, significant coordination and governance challenges remain – not only horizontally, across local jurisdictions and between national-level agencies, but also vertically, between various levels of government. Local governments depend heavily on funding from central governments to finance investment costs. Faced with resource constraints, municipalities in Indonesia also tend to look by default to higher levels of government to develop additional water sources, often in other jurisdictions, which gives rise to potential competition for water resources, environmental degradation, and high ongoing costs to operate and maintain assets. Large infrastructure projects may be financed by central government without clear agreement on how the ongoing operating costs of these projects will be covered.

Despite the positive changes in the governance of the sector under the 2019 Water Law, fragmented water sector governance is likely to prove a continuing challenge to both adoption and implementation of IUWM. Figure 4, which shows a map of urban water governance in Indonesia, illustrates how governance is characterized by horizontal fragmentation across water subsectors, vertical fragmentation between layers of government, and spatial fragmentation between administrative jurisdictions.

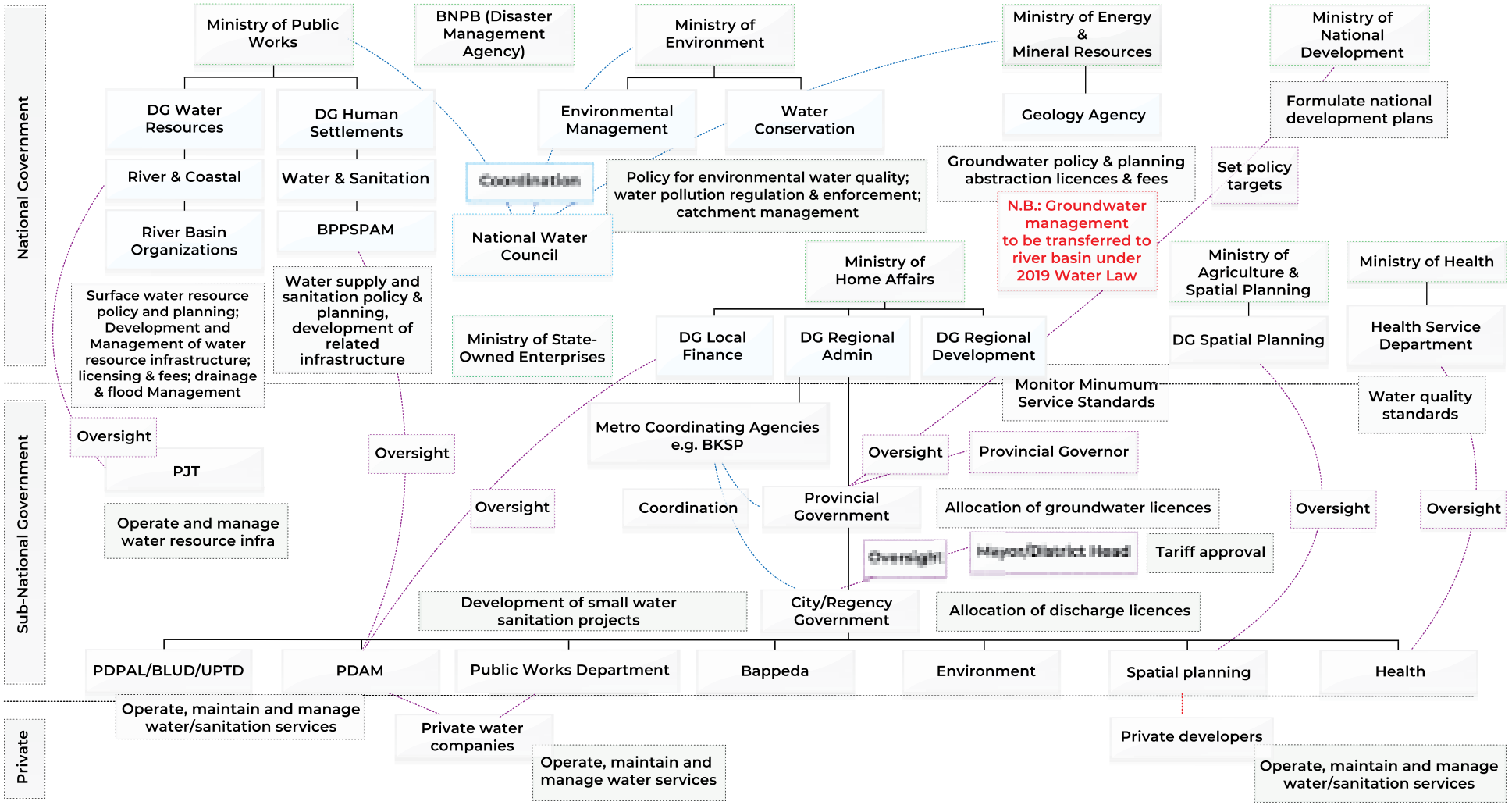
4.3.1 Fragmented spatial governance and metropolitan area governance

Spatial fragmentation poses problems for many cities that rely on raw water supplies from outside their jurisdiction and thus face risks to both the quantity and quality of the resource, and cities that are threatened by growing flood risks due to land use changes further up the catchments. Spatial fragmentation is complicated by multiple sets of boundaries: administrative, catchment, river basin, and groundwater basin. Each is associated with different reporting hierarchies.[6]

Fragmentation is a particular challenge in large urban regions in which multiple local government jurisdictions adjoin one another in a contiguous built-up area. The most striking example is the Greater Jakarta area, where nine local governments in three provinces are responsible for governing different parts of the metropolitan area. For Indonesia to receive the full benefits of IUWM, it is essential that there be stronger coordination between local governments within contiguous metropolitan areas, particularly in cases where several local governments have jurisdiction over an interconnected urban water system. While this issue is most urgent in the Greater Jakarta region (discussed in detail in the accompanying report), it is an emerging problem in other metro regions that have received less policy attention. Like Jakarta, other metro regions are vulnerable to flooding, landslides, water pollution, and water scarcity due to uncontrolled and uncoordinated development. Although River Basin Organizations (RBOs) exist in these areas, they do not have the authority over

[6] The accompanying Greater Jakarta report illustrates these overlapping boundaries for the Jakarta metro area and discusses the consequences for water management.

Figure 4: Urban Water Governance in Indonesia



local governments to enforce decisions. Establishing a framework for interjurisdictional cooperation focusing on water risks would help other metro areas to avoid some of the problems evident in Greater Jakarta.

Cooperation between local governments is supported by Ministry of Home Affairs (MOHA) under Government Regulation 28/2018. The regulations distinguish between areas of voluntary cooperation and mandatory cooperation. Cooperation is mandated between and among provinces and municipalities in particular sectors, either when there are cross-regional externalities or for the efficient provision of public services. Water supply falls under the scope of the mandatory regulations, along with spatial planning, public works, watershed management, transportation, and tourism.

However, the institutions and incentives to support coordination between local governments are not adequate. Governors and mayors have limited awareness of the benefits of cooperation and little experience in working together on policy issues. Scholars argue that decentralization has made local governments "inward-looking," focusing on local development and inter-local competition rather than cooperation (Firman 2014). Our review of planning documents for municipalities in the Greater Jakarta area found that two municipalities acknowledged the need for transboundary water management and interdepartmental coordination in planning documents such as the Municipal Spatial Plan (*Rencana Tata Ruang Wilayah*, or RTRW), but mention of coordination was absent from the other planning documents. Similarly, there are few existing coordinated catchment management initiatives. For example, Payment for Ecosystem Services (PES) schemes (see section 5.1.3) have not been widely implemented in Indonesia despite their potential to serve as effective mechanisms to coordinate upstream and downstream jurisdictions across the country.

The absence of PES arrangements and other coordinated approaches underscore the challenge of spatial fragmentation. In addition to low support from governors and mayors, barriers to regional cooperation include lack of local government awareness of the importance of cooperation and of the scope and requirements of the regulations, and limited forms of cooperation (for instance, cooperation agreements and Memoranda of Understanding do not provide a solid basis for ongoing cooperation). MOHA recognizes that existing institutional arrangements do not provide adequate incentives and support for local government cooperation, and is currently working to establish an effective platform and mechanisms for collaboration between local governments, with particular attention to urban areas.

Water management issues provide a suitable focus for stronger interjurisdictional cooperation, as the benefits of cooperation are readily apparent and quantifiable. These benefits could include reduced flood risk from upstream river management; the extension of water supply networks across jurisdictions where efficient to do so; optimizing efficiency

of water or wastewater treatment plants, especially those located close to administrative boundaries, to expand service coverage across these boundaries; and collaborative cleanup of rivers.

While institutional fragmentation raises considerable challenges, its potential negative effects can be overcome without radical institutional restructuring if authority is allocated clearly and if adequate mechanisms and incentives for coordination are put in place. These efforts can be aligned with the gradual shift in the role of the central government away from supplying infrastructure and toward a more strategic mission of establishing incentives and providing oversight. The current relationship between levels of government, in which infrastructure funding is provided by the central government, has resulted in challenges in implementation and maintenance, which can be particularly observed in sanitation infrastructure. Local governments may lack a sense of ownership over infrastructure funded by the central government, and therefore have little incentivize to optimize and maintain it (Alm 2015). There is a need for the central government to coordinate, oversee, and enforce sanitation interventions.

4.3.2 Private sector participation

National regulations allow private sector participation (PSP) in bulk water treatment and distribution and wastewater treatment and reuse. However, under current regulations, PSP is not permitted in water resource development or in the provision of customer services. PDAMs may contract with private parties for the construction and operation of treatment and distribution facilities under a "Business to Business" (B2B) structure, and governments can provide guarantees and viability gap financing for projects under the official public-private partnership program. Contract types currently in operation include Build-Operate-Transfer (BOT) and BOT+ models (construction and operation of treatment plant bundled with the construction of the water distribution network). Existing concession contracts for water supply in Jakarta are not expected to be renewed at the end of the contract period in 2023.

Performance-based management and service contracts would be permitted under existing regulations but have not been pursued. These could be employed to enhance efficiency, such through NRW reduction, or could include bundled output-based stormwater and wastewater management contracts, which would enable the mobilization of private management and technical expertise. The official PPP book of projects for tender published regularly by Bappenas focuses mainly on infrastructure development, but the scope of projects could be expanded to include other types of private sector involvement to support cities in designing and implementing IUWM and create room for innovation.

Private developers currently do not have the authority to partner with local governments or PDAMs to develop IUWM projects or to provide services to residents living adjacent to but not within their development zones. To facilitate the development of projects of this kind,

regulations on PPPs would need to be broadened to encompass management and service contracts.

4.4 Planning and Implementation

4.4.1 Targets

Indonesia has allocated substantial funding to achieve the water-related targets in the National Mid-term Development Plan (*Rencana Pembangunan Jangka Menengah Nasional,* or RPJMN) 2020–2024, indicating a commitment from the central government on the criticality of these issues. Water supply and sanitation feature prominently in the RPJMN 2020–2024, which includes national-level targets for increasing access to safe water and sanitation, and a specific target to increase the number of household connections to piped water supply.

Indonesia incentivizes local governments to explore innovative approaches to water management by stretching policy targets for water service provision, sanitation access, and flood risk reduction, among other areas. Key policy targets are set out in the RPJMN. The RPJMN 2015–2019 included the ambitious "100-0-100" goals for water and sanitation: 100 percent access to water, zero percent urban slum areas, and 100 percent sanitation access across the country. These targets were not met,[7] as acknowledged in RPJMN 2020–2024, and targets were revised to 100 percent access to improved drinking water, 30 percent access to piped water, and 90 percent access to improved sanitation. In addition, the plan includes specific targets to be achieved by 2024:

- 10 million new individual household water supply connections
- Nationwide Open Defecation Free status; 15 percent access to safely managed sanitation
- Nationwide non-revenue water (NRW) average of 25 percent

The current plan also identifies several "priority actions" relating to the urban water sector. It prioritizes integrated development of Java's northern coast, providing a national policy driver to improve sectoral coordination to address interlinked environmental and urban issues in this key region. Additional priority initiatives include the development and restoration of 15 priority watersheds – including the Citarum, Ciliwung, and Cisadane river basins, which run through the Jakarta metropolitan area – and the establishment of 18 multipurpose reservoirs for water storage, recreation, and flood management. These targets involve coordinated actions from various ministries, including MPWH, MOHA, and MOEF. For example, MOEF and MPWH are working together on one strategy to rehabilitate the critical watersheds, which includes the greening of 150,000 hectares of critical land. The RPJMN also specifies the

[7] The percentages achieved in the planning period 2015–2019 for access to improved water, housing, and sanitation were 61.3 percent, 54.1 percent, and 74.6 percent, respectively (RPJMN 2020–2024).

need for a more integrated approach to water management in key regions, including Greater Jakarta. There are also plans to expand key metropolitan areas in Palembang, Banjarmasin, Makassar, and Denpasar. Further details on these RPJMN plans are in Annex 3, along with their respective budget allocations.

4.4.2 Planning processes

Local governments have considerable authority to prepare plans for water supply, sanitation, drainage, land use, solid waste management, and transport. Water-related plans prepared by local governments are listed in Annex 4. In some respects, the devolution of planning authority should provide a good basis for horizontal coordination of planning across policy areas. However, there is currently no standard process for such coordination between local government departments. For example, in relation to flood management, the water resources department is responsible for drainage infrastructure; the spatial planning department approves and imposes license conditions for new developments and land use in catchments and on riverbanks; the solid waste management department is responsible for ensuring that refuse is not disposed of in waterways; and the disaster management department has authority over warning systems and disaster response. In central Jakarta, the situation is complicated by dual jurisdiction over drainage infrastructure, with half the canals under the RBO and the other half managed by the provincial government. It is not standard practice for these departments to consult with one another.

Multiple planning processes for water resources, flood management, water supply, and sanitation run in parallel under the guidance of the related parent ministries of the central government. The plans have different timeframes and planning cycles, and there is no requirement or process to ensure that the plans are consistent with one another. The departments contract out detailed planning to consultants, who prepare plans independently, often without a thorough understanding of local conditions. Pre-project evaluations do not systematically include co-benefits, such as a reduction in groundwater abstraction from increased piped supply, so the benefits of these types of interventions are underestimated. The central government recognizes the need for stronger incentives and mechanisms to support coordination at the local level, a need that was expressed by Ministry of National Development Planning (Bappenas) stakeholders during focus group discussions for this study.

Water plans in Indonesia tend to evince other gaps, as well. First, there is an emphasis on supply management through infrastructure over demand management through community initiatives. The Drinking Water System Masterplans (*Rencana Induk Sistem Penyediaan Air Minum*, or RISPAMs), prepared by local governments, and water supply Business Plans,

prepared by PDAMs, in Greater Jakarta were reviewed in detail for this report. Both RISPAMs and Business Plans were found to focus on investments to build or expand infrastructure to meet future demand projections based on extrapolations of current demand trends. Some documents mentioned non-revenue water (NRW) reduction,[8] but water conservation and demand management were rarely mentioned and were not a central part of water supply strategy. The plans of Kota Bogor and Kota South Tangerang acknowledge the role of the community in water conservation but do not specify strategies to incentivize water conservation. An analysis of the Jakarta Detailed Spatial Plan 2030 (*Rencana Detail Tata Ruang*, or RDTR) also revealed strategies to manage supply but no discussion of the demand side (Drestalita and Saputra 2019).

Second, the availability of water supply and distribution infrastructure is not taken into account in spatial plans. As a result, water supply managers find it difficult to plan for and meet demand from new developments and face the challenge of providing adequate drainage.

4.4.3 Performance evaluation

The central government uses performance indicators to provide signals and incentives to local governments to implement water policy targets. Currently, local governments and PDAMs report on a range of performance indicators.

PDAMs report on financial and operational performance to the local government and to MPWH. Performance indicators are now set by MPWH, but were formerly set by the Supporting Agency for the Development of Drinking Water Supply System – *Badan Peningkatan Penyelenggara Sistem Penyediaan Air Minum*, or BPPSPAM), which has now been disbanded. BPPSPAM used to categorize PDAMs as "healthy," "less healthy," or "sick." As local government-owned businesses (*Badan Usaha Milik Daerah*, or BUMD), PDAMs are overseen by the Directorate General Regional Finance of MOHA, and report to MOHA on a set of indicators that overlap in part with the MPWH indicators.

Altogether, PDAMs report on almost 60 indicators to MOHA and MPWH (see Annex 5 for a detailed listing). Adding further indicators to this list may unduly increase the regulatory burden on PDAMs. Although the current indicator set does not include any specific indicator of integrated management, several of the existing indicators could be used to identify cities with interlinked challenges where IUWM approaches may be of particular value when used in conjunction with data on sanitation and flooding. For example, areas that have low reservoir capacity but experience high flooding may consider managed aquifer recharge or other types of integrated water retention infrastructure; areas where treatment plant utilization and NRW are high can focus more on investment to reduce NRW rather than investment to

[8] NRW management strategies proposed in the RISPAMs include locating and measuring leakages by using area water metering, monitoring and repairing pipes, inspecting and replacing water meters, and curbing illegal connections.

increase water treatment production capacity. Existing indicators that may be of use in this vein include:

- NRW (target of 25 percent by 2024)
- Piped water quality
- Domestic consumption
- Customer growth
- Coverage
- Water treatment capacity
- Reservoir capacity
- Meter replacement (target of 20 percent annual meter replacement)

However, poor management of data – specifically, poor data reporting, management protocol, and data quality – remains a challenge.

4.5 Information Management

Currently, data collection at central and local levels is patchy, data management protocols are inconsistent, and data are little used in the planning process. Responsibility for data collection on surface water and groundwater quality and quantity lies with the MOEF and the Ministry of Energy and Mineral Resources (MEMR) respectively, but there are few monitoring stations and long delays in transmitting data. Groundwater conservation maps are incomplete and not always easily accessible. Local governments are therefore unable to refer to accurate and reliable data to calibrate surface water intake, discharge permits, and groundwater abstraction licenses.

The need to improve information management at the national level is recognized by the central government and highlighted as a recommendation in the Water Security Diagnostic. MPWH has developed a proposal for a nationally integrated water resources information system (*Sistem Informasi Sumber Daya Air*, or SISDA) which would involve establishing a modern monitoring system and improving analytical tools. Such a system would support local governments in making evidence-based decisions on licenses and permits.

Data on water and sanitation infrastructure, service delivery, and flood incidents are collected by local governments for transmission to relevant national agencies for collation. Focus group discussions conducted for this study revealed that the flow of information was unidirectional – local governments did not use the collated data to compare their performance with others or as the basis for coordinated planning with neighboring jurisdictions. This is likely due

to a combination of factors: data are not readily accessible or not in a form that allows for comparability, and the MOHA does not issue specific guidance on their format, storage, or use. The reliability and accuracy of the data reported by local governments is also a major concern.

As part of this study, data on water and sanitation services, flooding, and infrastructure were collected from local governments in the Greater Jakarta area, collated, analyzed, and visualized in a series of maps (see accompanying Greater Jakarta report). This effort demonstrated both the challenges and the potential of better data collection and management. The pilot database produced could form the basis for a regional water information system, which could ultimately provide a model for a national water information system.

4.6 Financing

The existing financing structure for urban water supply and sanitation in Indonesia provides scope to integrate incentives for local governments to adopt IUWM. Currently, the vast majority of funding for water supply investments comes from the central government: only 0.3 percent derives from local governments (Setiono 2015). The central government is seeking to leverage funds more effectively to achieve policy goals and to distribute funds more equitably.

The central government provides funds through several channels:

- Direct funding of water supply and sanitation infrastructure projects (e.g., water intake facilities and transmission pipes, water treatment plants, wastewater and septage treatment plants, and sewerage systems of different scales). MPWH builds the infrastructure and hands assets over to local governments for operation and maintenance.
- Debt restructuring program for PDAMs
- Central government guarantees and interest subsidies for commercial loans (Presidential Regulation 46/2019)
- Output-based grants for connections for the urban poor (water *Hibah*)
- Special allocation funds and grants from the Ministry of Finance (MOF) for water and sanitation under the Special Allocation Fund (*Dana Alokasi Khusus,* or DAK)

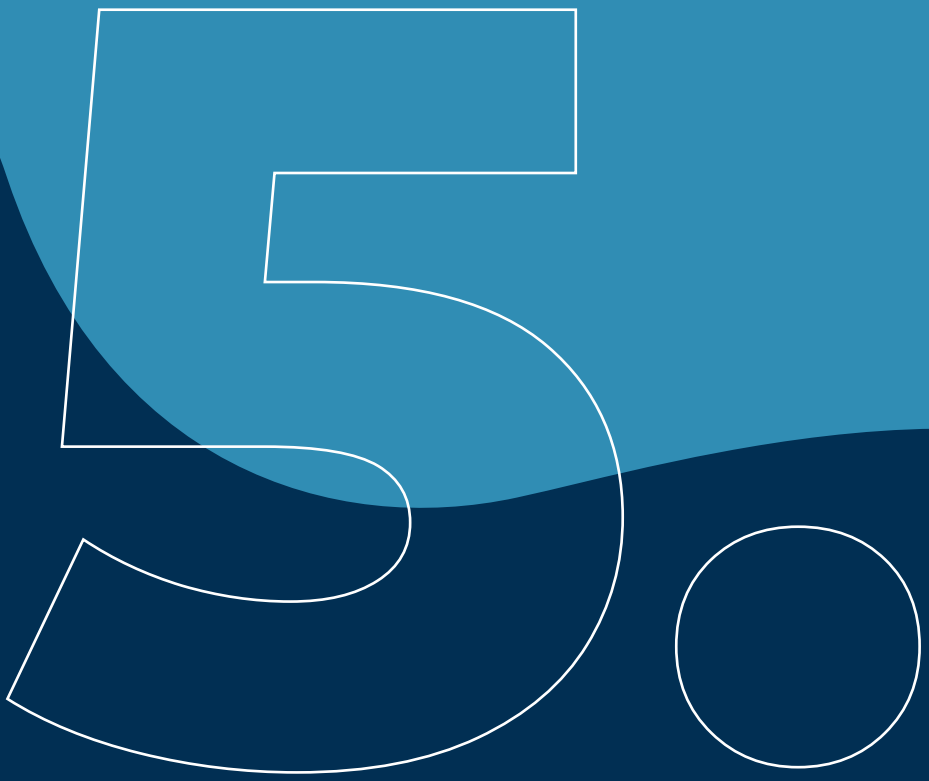
DAK funding is based on a formula that considers service coverage, aridity, and fiscal capacity. Access to several of the other funding streams is linked to operational and financial performance. In the water supply sector, these funding channels are coordinated under the overarching National Urban Water Supply (NUWAS) Framework, which is supported by the

World Bank. The Framework provides for a range of technical assistance, capacity building, and financing for urban water supply development. It offers differentiated packages of support for utilities at different performance levels in a stepwise structure that aims to bring the recipient to a higher level of performance associated with eligibility for the next support package.

Under the NUWAS Framework, the Central Government provides financing for investments in increasing coverage and improving operational efficiency (NRW reduction, utilization of idle capacity to extend coverage, and rehabilitation or uprating of existing water treatment plants). The principles and structure of NUWAS are directly in line with the IUWM approach and provide a basis for other performance-based financing streams.

As local governments progress from exploring the IUWM approach to designing specific interventions, additional financial support is likely to be required to fund ex ante evaluation studies for blue-green infrastructure, development of non-conventional water sources, and demand management projects. Financial support may also be needed for training and capacity building for PDAMs and local engineering consultants who are not yet familiar with these types of projects. To stimulate interest in IUWM, additional central government financing could be considered for pilot or model projects and for challenge funds to support innovative small-scale projects.

IUWM Experience in Indonesia



5. IUWM EXPERIENCE IN INDONESIA

IUWM approaches have been taken up in a number of projects in Indonesia, although they may not have been recognized or labelled as IUWM.[9] These projects range from micro-scale IUWM measures in urban villages (*kelurahan*) to cooperation between municipal and provincial governments on water issues, such as the Kartamantul Joint Secretariat and the Jabodetabekjur Development Cooperation Body (*Badan Kerja Sama Pembangunan Jabodetabekjur*, or BKSP). Although these existing IUWM efforts in Indonesia have achieved varying degrees of effectiveness, they indicate the range of actions that are possible in the current context and that can be scaled up, replicated, or adapted to different locales. IUWM actions in Indonesia include government initiatives, public-private partnerships, and private-led actions.

5.1 Public Initiatives

5.1.1 Ongoing local actions and interventions

Local governments are actively engaged in vertical drainage management projects, both as a flood management effort and for subsurface water recharge. Infiltration wells, infiltration ponds, retention ponds, and revegetation of riverbanks are quite popular in Indonesian cities and regencies. These actions are widely reflected in existing and planned projects in the RISPAMs. Examples include infiltration wells in the Special Capital Region (DKI) Jakarta, Kota Depok, and Kabupaten Bogor; infiltration ponds in Kota South Tangerang and Kota Bekasi; retention and detention ponds in Kota Bogor; vegetated banks or green belts along rivers in Kota South Tangerang and Kota Tangerang; and efforts to restrain development along rivers in Kota Bekasi and Kota Tangerang. Kabupaten Bogor is exploring strategically placing infiltration wells such that the percolated rainwater would replenish subsurface springs. Kota Bogor is also looking at reforestation and at restricting development that can affect infiltration or cause groundwater pollution. The scale of vertical drainage efforts is still limited for now, and its positive impacts are not yet officially quantified, apart from general observations that they have reduced localized flooding and recharged subsurface water.

Increasing the amount of permeable space in the form of open green areas is an ongoing effort. In accordance with Law Number 26 Year 2007 on spatial planning, municipalities are to create open green spaces occupying at least 30 percent of the land area within the municipality. DKI Jakarta has set out to achieve this target by 2030, and has included a stipulation that about 23 percent of this green area should comprise urban forests (Sundara et al. 2017). This is a

[9] To gather information on efforts taking place on the ground, we held discussions with local governments, conducted online searches, and reviewed planning documents, with particular reference to the RISPAMs.

challenging target in the densely developed and populated city and may need to be reviewed. In 2015, 646 hectares of the targeted 4,631 hectares of the urban forest area target was achieved (Sundara et al. 2017). An additional initiative, run by MOEF, is Adipura, a national competition that recognizes and incentivizes beautification projects and the improvement of environmental quality and management.

Although some efforts and plans to improve raw water quality exist, they are very limited in comparison to the scale of the problem. Kabupaten Tangerang has developed a three-pronged approach to improving water quality: preventing pollution at the water source, ensuring water quality during treatment and distribution by water operators, and preventing contamination or re-contamination of drinking water by consumers. Additionally, Kota Tangerang is exploring eco-tech gardens, which use ornamental plants to treat domestic wastewater before it enters the receiving water body. Among the intentions laid out in its Detailed Spatial Plan 2030 (RDTR), DKI Jakarta has included management of wastewater discharge and litter in water bodies, alongside waterfront development.

There are some efforts to adopt and apply new technologies to diversify raw water sources. Kepulauan Seribu, a chain of islands north of Jakarta's coast that is under the jurisdiction of DKI Jakarta, has several seawater reverse osmosis (SWRO) plants that convert seawater to fresh water for residents of the islands. These SWRO plants are small in scale, but there are plans to build a large-scale SWRO plant to transport treated water to other islands. Efforts are also underway to employ new technologies in wastewater treatment for reuse. DKI Jakarta's first Moving Bed Biofilm Reactor is scheduled to begin operation in 2021 (BizIndo 2019). Located in Krukut, the plant will be operated by PD Pal Jaya, DKI Jakarta's public sanitation service provider, and has the capacity to treat and recycle 100 liters of water per second. The recycled water will be utilized by neighboring buildings for toilet flushing, by the Forestry Department for watering plants, and by the Firefighting Department for extinguishing fires. There is also a similar initiative for the Daan Mogot area.

Donor-funded projects have been supporting targeted water issues and needs, aiding in funding and transfer of technology and skills. The Japan International Cooperation Agency (JICA) has been active in cooperating with the Indonesian government for projects such as groundwater monitoring in DKI Jakarta, flood management in Bekasi, and NRW and energy-efficiency training for PDAM staff in Kabupaten Takalar, Kabupaten Gowa, and Kota Makassar (Ahyar and Makita 2018). The Dutch Embassy has supported extensive studies relating to flood management and water resources in Jakarta (Dutch Embassy Indonesia 2019).

5.1.2 Trans-jurisdictional cooperation in metropolitan areas

Interjurisdictional cooperation exists within the Greater Jakarta and Greater Yogyakarta urban regions, with varying levels of success. The Jabodetabekjur Development Cooperation Body (BKSP) is a collaborative body comprising DKI Jakarta and surrounding local governments (Kota Bogor, Kabupaten Bogor, Kota Depok, Kota Tangerang, Kabupaten Tangerang, Kota South Tangerang, Kota Bekasi, Kabupaten Bekasi, and Kabupaten Cianjur). It is the only metropolitan agency in Indonesia and was established by the national government to improve coordination on problem areas including flooding, water supply, road transport, and solid waste management. Although BKSP is recognized by the local and regional governments of Jabodetabekjur as an official platform for transboundary collaboration, it functions only as a platform and has no authority or budget to implement projects (Firman 2014). Cooperation under BKSP has so far been limited (Silfiana 2018). However, BKSP's administrative status is being strengthened by MOHA in accordance with Government Regulation No. 28 of 2018 on Regional Cooperation, and water is likely to be a focus area for cooperation.

The Joint Secretariat of Kartamantul in Yogyakarta is another example of transboundary cooperation on water issues. The Kartamantul Metropolitan Region consists of Kota Yogyakarta, Kabupaten Sleman, and Kabupaten Bantul, three municipalities in the Special Region of Yogyakarta (DIY). In 2001, the Kartamantul Joint Secretariat was formed as a bottom-up initiative to manage and coordinate transboundary development in the three municipalities (Firman 2014). The leaders of Kartamantul agreed to coordinate planning and development of urban infrastructure, including for drinking water supply and transportation, and have since established interjurisdictional arrangements for solid waste disposal (Piyungan landfill), wastewater treatment, and sewerage (IPAL Sewon at Bantul). The three urban areas in Kartamantul face similar issues – namely, a growing urban population, an increase in demand for clean water and difficulty in sourcing new raw water sources, environmental degradation, and high demand from the public for basic services. The leaders also recognized that the neighborhoods at the municipal borders are "grey areas" that receive little attention, as it is unclear which municipality should be taking responsibility.

The Joint Secretariat creates opportunities for IUWM by enabling transboundary management of water services. The Secretariat's integrated approach involves stakeholders from different municipalities and government levels (regional and local) who manage different parts of water services and who potentially distribute financial responsibility through cost-sharing mechanisms. More detail on the Kartamantul case study is found in Annex 1.

Another emerging key economic metropolitan region is Sarbagita in Bali Province, with Kota Denpasar as its core, surrounded by Kabupaten Badung, Kabupaten Gianyar, and Kabupaten Tabanan. Sarbagita was a key national strategic area in RPJMN 2015–2019, and collaboration in this metro region is driven by strong leadership and strong appetite for cooperation from

the provincial government, which established a regional Technical Implementing Unit (*Unit Pelaksana Teknis Dinas*, or UPTD) to manage regional infrastructure facilities. Sarbagita has established mechanisms for cooperation for water supply, wastewater, transportation, and solid waste management.

Other trans-jurisdictional mega-urban regions in Indonesia are Gerbangkertasusila (Greater Surabaya), Bandung Raya, Kedungsapur (Greater Semarang), Mebidangro (Greater Medan), and Maminasata (Greater Makassar); none have yet established mechanisms for coordination.

5.1.3 Cooperative initiatives

Despite the barriers to achieving coordinated planning, stakeholder consultations for this study revealed a number of small-scale initiatives involving horizontal coordination, demonstrating that projects of this kind are possible, if not common, under the existing regulatory framework. Local government interagency coordination occurs in the form of taskforces (*Kelompok Kerja*, or *Pokja*), typically on an initiative or project basis. These are ad hoc teams comprising representatives from different local government agencies that work together on specific projects or targets. For example, infiltration wells are being constructed in upstream areas of Greater Jakarta to reduce flood impacts and replenish groundwater supplies; the project is jointly financed by two local governments (Kota Bogor and Kabupaten Bogor), with support from a donor program (USAID IUWASH PLUS) and the central government. Further examples of existing initiatives are given in Section 5.

River cleanup initiatives, such as *Gerakan Ciliwung Bersih* and *Citarum Harum,* are long-standing multi-stakeholder efforts involving national and local governments, civil society, and private parties, for the Ciliwung and Citarum river respectively. *Citarum Harum,* for example, is a collaborative effort between cities, led by the West Java provincial governor, with participation from the army. Although it has not yet generated substantial water quality improvements, it is a positive IUWM-type initiative that can be expanded and replicated for other rivers.

Other opportunities for coordinated initiatives involve Payment for Ecosystem Services (PES) arrangements, which can be used as a financing mechanism in catchment management schemes. In a PES system, downstream water users make payments to upstream communities to conserve their land or develop it sustainably. In Indonesia, PES is not yet widely implemented. However, an example of a successful and sustained PES arrangement is the Cidanau watershed, where the downstream water supply company makes payments to farmers to maintain tree cover (see Annex 1.2). Stakeholders involved in PES are typically the government (local, regional, and/or national), non-governmental organizations (NGOs), RBOs, local communities such as farmers' groups, private entities that benefit from ecosystem

services, and donor organizations. PES mechanisms involve sellers, buyers, and usually also an intermediary organization who negotiates the agreement between the seller and buyer and implements the PES mechanism, among other tasks.

5.2 Private Sector Partnerships

Private sector engagement in IUWM-related projects generally comprises large firms' Corporate Social Responsibility (CSR) activities and real estate developers' initiatives. Formal PPP contracts hold potential as a route for IUWM but have not yet been tried in Indonesia. Existing private-led IUWM initiatives in Indonesia may be small in scale, but they demonstrate that cooperation and coordination is possible within the existing legal and regulatory framework, and they provide valuable examples for local governments interested in IUWM. Supportive regulatory reforms and incentive schemes will help to expand the scale and number of these projects. In Japan, for example, private property developers are mandated to construct retention basins for flood mitigation in large-scale developments.

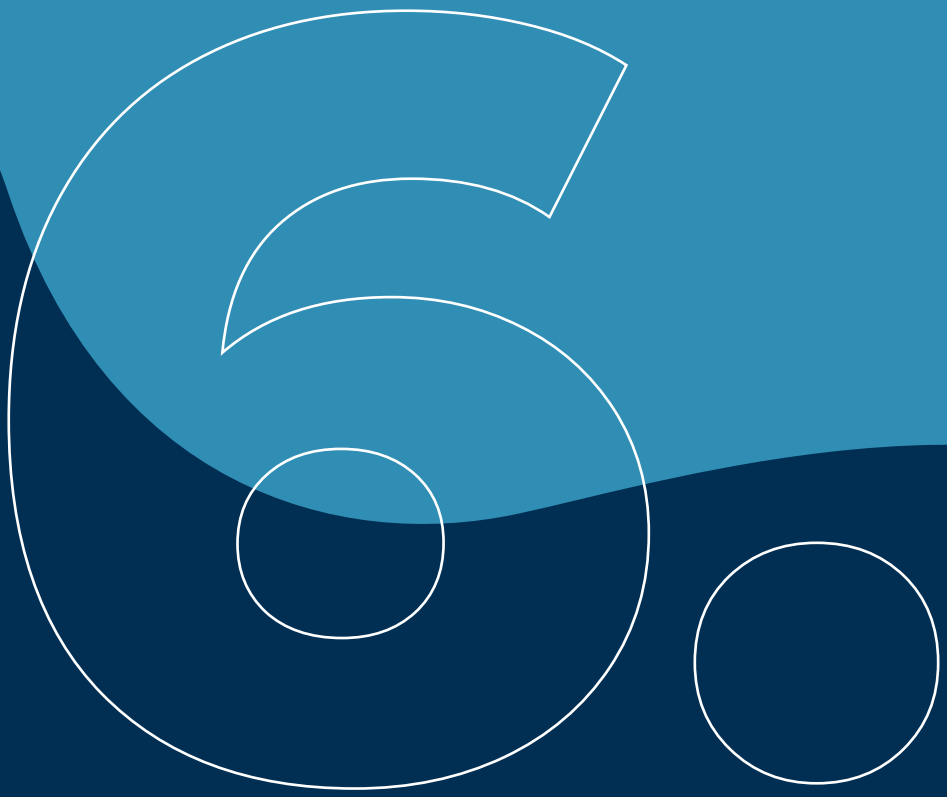
Currently, in the CSR category, the Coca-Cola Foundation Indonesia (CCFI) has been active in water-related projects throughout the country (Coca-Cola 2017). In particular, under the CCFI "Lumbung Air" Infiltration Well program, which received support from the US Agency for International Development (USAID), more than 4,000 infiltration wells have been constructed to restore aquifers nationwide.

Some private real estate developers have adopted IUWM approaches voluntarily, while others have done so to comply with conditions of their business licenses. For example, one of Indonesia's major developers, PT Lippo Karawaci Tbk (LPKR), has incorporated small-scale IUWM schemes such as retention ponds within its townships. In Kemang Village, a LPKR development, a rainwater retention pond collects and treats rainwater, which is recycled for non-potable purposes. Partnership arrangements between local governments and private developers remains an area for further exploration, as we were not able to identify any current examples.

In relation to formal PPP arrangements, water treatment plants (WTP), wastewater treatment plants (WWTP), and bulk water supply and transmission projects under BOT and BOT+ models are regularly included in the PPP Book, but only a small number have reached award and commissioning. Concession-type contracts awarded before regulatory changes, including the two large concessions in Jakarta, continue to operate, but will need to be restructured to exclude customer service. Several water projects are in the construction phase, including Umbulan Spring, a bulk water supply project, and the Bandar Lampung water supply project, which incorporates viability gap funding from the central government and a guarantee from the Indonesia Infrastructure Guarantee Fund (IIGF). PPPs have also been awarded for sanitation, including a WWTP BOT project for the city of Makassar in 2020.

There is potential to develop management and service contracts to address access and service quality for water services and sanitation, small-scale water recycling, installation and maintenance of septic tanks, treatment and disposal of septage, and stormwater management. However, this potential has not yet been realized.

National Framework Recommendations



6. NATIONAL FRAMEWORK RECOMMENDATIONS

6.1 Recommendations

This section develops a set of policy recommendations based on the above review of urban water governance and policy in Indonesia and on international experience with IUWM.

In recent years, many new policies and processes relating to different aspects of water management have been implemented in Indonesia. These efforts are starting to show positive results and should continue to be supported. Concurrently, the ongoing process of drafting implementing regulations for recent laws provides numerous windows of opportunity to promote and facilitate the adoption of IUWM. The set of recommendations proposed here therefore includes actions that can be taken immediately by sector stakeholders, as well as actions that require regulatory changes or additional resources and should therefore be adopted in the medium and longer term.

The recommended actions are categorized into the five IUWM pillars, as show in table 4, and into two types of actions: those relating to the enabling framework, which should be led primarily by the central government, and those relating to practical interventions, on which local governments should take the lead.

The central government's core role lies in establishing a legal and regulatory framework consistent with IUWM, and putting in place regulations, mechanisms, and incentives to support and incentivize coordination across policy areas and cooperation between administrative jurisdictions. This will involve several different ministries – in particular, MPWH, historically the leading central government agency for urban water management, and MOHA, which has a critical role to play in setting and monitoring standards and codes for local governments and in overseeing cooperation between lower tiers of government.

As the key actors in planning and policy implementation in Indonesia, local governments need to play a leading role in mainstreaming IUWM through their ongoing investment planning, service delivery, and licensing functions. They will also take the lead in coordinating with other stakeholders, communicating with the public, and establishing partnerships with local private sector actors, educational and training institutions, and civil society organizations.

Development partners can also play a crucial part. They can provide guidance to government on the development of the legal and regulatory frameworks for urban governance and IUWM; develop suitable indicators and procedures to monitor and evaluate progress toward IUWM

across the country; build and make accessible a body of knowledge on IUWM appropriate to local conditions through practical guides, case studies, and continued engagement with stakeholders at all levels; provide technical and financial support for demonstration projects with local champions; and develop financing mechanisms to support IUWM projects led by subnational governments.

Several of the recommendations relate to strengthening implementation and enforcement of plans, policies, and regulations that are already in place, like the minimum service standards for water supply and sanitation, Citywide Inclusive Sanitation, and MOHA regulations on tariffs and subsidies. As noted in previous chapters, the institutional and regulatory context in Indonesia is very fluid, and changes are often introduced before previous rounds of reforms have been able to gain traction. The recommendations therefore emphasize the need for continuity in areas of water policy that have undergone recent reforms consistent with the principles of IUWM.

In the short term, the priority is to ensure that IUWM principles are integrated into the implementing regulations and regulatory guidelines currently under development and review. In particular, the draft regulations on urban governance, guidelines on interjurisdictional cooperation, and implementing regulations of the new Water Law relating to groundwater must be consistent with the IUWM approach.

Immediate actions to drive forward IUWM can also be taken within the context of existing policies and programs. In water supply, IUWM can be promoted through the NUWAS Framework, which links access to finance with performance indicators, and through Citywide Inclusive Sanitation initiatives. Existing requirements for data sharing by local governments can be developed into effective mechanisms for performance tracking and incentivization through the adoption of clear and consistent reporting protocols and transparent data management.

In the medium term, integrated water-cycle projects similar to those identified in the case studies can be scaled up and replicated. These include blue-green infrastructure projects to address stormwater management while improving the quality of the urban environment and recharging groundwater; combined stormwater, wastewater, and water reuse projects to tackle localized pollution and water availability issues; and catchment management projects incorporating PES mechanisms to simultaneously tackle upstream and downstream water and urban development challenges.

On the same timescale, IUWM principles need to be integrated into mandated planning processes for spatial planning and other urban sectors. As plans for sectors such as urban development, solid waste, disaster management, or climate adaptation and mitigation come up for revision, water impacts should be incorporated into the planning process.

Over a longer timeframe, blue-green infrastructure projects can be designed and piloted, and dedicated financing mechanisms can be developed for integrated water cycle interventions.

Different ministries and agencies in the national and local governments can take the lead on aspects of the IUWM program, allowing the recommendations to be pursued concurrently and collaboratively.

Table 4: IUWM Recommendations

CENTRAL GOVERNMENT–LED | LOCAL GOVERNMENT–LED | ACTIONS FOR BOTH CENTRAL AND LOCAL GOVERNMENTS

OBJECTIVE	LAW & REGULATION		GOVERNANCE & INSTITUTIONS		PLANNING & IMPLEMENTATION		INFORMATION MANAGEMENT		FINANCING	
	Enabling Framework	*Intervention*	*Enabling Framework*	*Intervention*	*Enabling Framework*	*Intervention*	*Enabling Framework*	*Intervention*	*Enabling Framework*	*Intervention*
Improve and expand water supply and sanitation services	Develop guidelines and establish incentive mechanisms for local governments to encourage water conservation and to adopt demand management through tariffs and/or other mechanisms **Leading agency: MPWH and MOHA**	Enforce implementation of the minimum service standards on water supply and sanitation. Identify options for providing services to vulnerable and overlooked populations located in hard-to-access zones. **Leading agency: MOHA and MPWH**		Support uptake of Citywide Inclusive Sanitation through regulations and standards for: (1) Household-level containment, septage collection, treatment and safe disposal; (2) Wastewater collection and treatment (black and grey water); (3) Fit-for-purpose reuse and recycling of septage and wastewater.					Strengthen and build on the existing NUWAS Framework for performance-based access to finance for local governments and PDAMs, incorporating performance indicators relating to IUWM and incentivizing and mainstreaming Citywide Inclusive Sanitation (CWIS). **Leading agency: MPWH and MOF**	Adopt MOHA Regulations on Tariff and Subsidy to support utilities in improving their performance, sustainable operation, and creditworthiness to access funding sources that will enable investments to expand services.
				In water supply plans (RISPAM), systematically assess off-grid or small-scale distribution systems and alternatives to new water intakes and treatment infrastructure. Include NRW reduction, demand						

OBJECTIVE	LAW & REGULATION		GOVERNANCE & INSTITUTIONS		PLANNING & IMPLEMENTATION		INFORMATION MANAGEMENT		FINANCING	
	Enabling Framework	*Intervention*	*Enabling Framework*	*Intervention*	*Enabling Framework*	*Intervention*	*Enabling Framework*	*Intervention*	*Enabling Framework*	*Intervention*
				management, provision of fit-for-purpose water for non-potable uses, and better use of existing infrastructure. Only invest in new intake and treatment facilities if other options are not viable.						
Secure water sources and improve water conservation	Strengthen regulatory framework to protect water sources through the implementing regulations of the new Water Law. Develop the monitoring and enforcement framework. **Leading agency: MPWH and MOEF**			Issue local-level policy to improve the water use efficiency of public agencies. For example, track water consumption by department or agency; replace potable water with fit-for-purpose water where appropriate (urban irrigation, street cleaning, bus washing, etc.).	Track local governments' records of enforcing discharge permits and develop additional incentives for enforcement where necessary. **Leading agency: MOEF**		Establish protocols for local governments to share data in a complete, consistent, and timely manner. Address gaps in the data and populate and validate historical data in the Water Information Management System (WIMS). **Leading agency: Bappenas and MPWH**	Harmonize tariffs and fees for water abstraction (ground and surface), water supply, direct wastewater discharge, and discharge to sewer to ensure aligned incentives. Incorporate user-pays and polluter-pays principles to incentivize efficiency and recover costs. Study potential for PES mechanisms to be used for upstream-down stream projects to manage water flow and water quality. **Leading agency: Bappenas**		

OBJECTIVE	LAW & REGULATION		GOVERNANCE & INSTITUTIONS		PLANNING & IMPLEMENTATION		INFORMATION MANAGEMENT		FINANCING	
	Enabling Framework	*Intervention*	*Enabling Framework*	*Intervention*	*Enabling Framework*	*Intervention*	*Enabling Framework*	*Intervention*	*Enabling Framework*	*Intervention*
Improve groundwater management	Adopt implementing regulations that clarify authority for groundwater management, including by designating groundwater protection zones and setting fees and penalties. Adopt timebound policy targets to reduce abstraction. **Leading agency: MPWH and MEMR**	Enforce regulation to halt issuance of new groundwater abstraction licenses for water supply services. Phase out existing groundwater licenses in at-risk areas.		Integrate groundwater management with other urban water services.				Improve and strengthen groundwater control and monitoring by installing meters and monitoring groundwater consumption.		Establish tariff and fees structure to disincentivize groundwater consumption.
Incorporate the water cycle as part of the improvement of urban governance and urban development	Prepare regulatory guidelines on interjurisdictional cooperation agreements between local governments for: (a) water supply; (b) flood management; and (c) water quality management, incorporating nature-based solutions and incentives for ecosystem services where applicable. **Leading agency: MOHA and MPWH**	For urban green space, explore broader interpretation of Law 26/2007 on spatial planning mandating 20% + 10% open green space to allow for cooperation between jurisdictions to achieve targets jointly. **Leading agency: MASP and MOHA**	Reform urban governance to ensure consistency with Law 23/2014 on regional governance. Specify the water cycle as a priority area for regional cooperation and coordination under the new governance structure. Strengthen incentives for systematic inclusion of water issues in urban planning. **Leading agency: MOHA**		Improve coordination between water subsectors in local government planning processes. Systematically include water drivers and impacts in the urban spatial planning process and in spatial plans. Assess potential for projects with co-benefits in two or more subsectors.	Develop a set of urban water security indicators in consultation with local governments. Carry out a water security assessment for all metro areas and other higher-priority urban areas as a basis for objective-setting and project prioritization and to build engagement in IUWM among stakeholders. **Leading agency: Bappenas**	Share maps, data, studies, and strategic documents on urban spatial planning and infrastructure development across local government departments and entities (Bappeda, public works, environment, PDAM, etc.) to support the "planning with water" approach.	Catalog IUWM initiatives by local governments and identify ways to scale up existing initiatives, design pilot projects, and establish new benchmarks accordingly. **Leading agency: Bappenas**	Build on existing fiscal transfer mechanism to incentivize local governments to invest in projects addressing two or more aspects of the urban water cycle. **Leading agency: MOF and MPWH**	Coordinate water, wastewater, and septage investment plans with neighboring jurisdictions. Explore interjurisdictional network interconnections where feasible to avoid overlapping and inefficient investments.

OBJECTIVE	LAW & REGULATION		GOVERNANCE & INSTITUTIONS		PLANNING & IMPLEMENTATION		INFORMATION MANAGEMENT		FINANCING	
	Enabling Framework	*Intervention*	*Enabling Framework*	*Intervention*	*Enabling Framework*	*Intervention*	*Enabling Framework*	*Intervention*	*Enabling Framework*	*Intervention*
						Develop the IUWM Practical Guide for Cities into a manual for local governments on the design and implementation of IUWM projects. **Leading agency: Bappenas**	Set up a water information management system (WIMS) as an open and accessible online platform. Explore innovative information and communication technologies to share and visualize data and connect with a broad audience. **Leading agency: MPWH and Bappenas**			
							Map water bodies and water retention areas (green open spaces, permeable areas) to identify interventions and surface and groundwater abstraction points. This information can be collated in the WIMS.			
Improve flood risk management and community preparedness					Develop guidelines to systematically assess and incorporate blue-green infrastructure options, including infiltration wells	Implement blue-green infrastructure (infiltration wells and vertical drainage, permeable surfaces for transport and		Coordinate the collection and management of flood incidence data between MOHA, local governments, and national disaster management		

OBJECTIVE	LAW & REGULATION		GOVERNANCE & INSTITUTIONS		PLANNING & IMPLEMENTATION		INFORMATION MANAGEMENT		FINANCING	
	Enabling Framework	*Intervention*	*Enabling Framework*	*Intervention*	*Enabling Framework*	*Intervention*	*Enabling Framework*	*Intervention*	*Enabling Framework*	*Intervention*
					and vertical drainage, in city infrastructure developments to replace or complement investments in grey infrastructure for flood risk management. **Leading agency: MPWH**	pedestrian infrastructure and city parks, capture and use of stormwater for water reuse and to replenish subsurface water). Improve community preparedness and adaptation in flood-prone areas by incorporating flood adaptation measures in slum upgrading and housing projects and developing or improving early warning systems.		agency BNPB. Establish a clear protocol for reporting data. Ensure consistency in the definitions and calculation methods of indicators to establish a unified dataset for reference, monitoring, evaluation, and planning. Update or develop local flood risk maps, incorporating historic flood incidence data. **Leading agency: MOHA and BNPB**		
Stakeholder and private sector engagement	Explore feasibility of PPP for IUWM projects (e.g., "sponge city" or urban river restoration projects). **Leading agency: Bappenas and MPWH**	Incorporate requirements for on-site integrated water management in private developments (water management plans, zero run-off) in building and development permits and licenses.			Conduct a detailed review of economic and regulatory instruments to incentivize uptake of pilot-level IUWM actions by private developers, incorporating international experience. **Leading agency: Bappenas**	Collaborate with private developers to share information and best practices on pilot-level IUWM, including on-site recycling of grey water and stormwater for non-potable uses, and develop a regional competition to showcase best practices.		Develop a public communication strategy to inform and engage the public on urban water risks (including poor practices related to groundwater abstraction, land subsidence, solid waste management, and sanitation) and appropriate household-level actions to reduce the risks.	Identify models for co-financing/cost allocation of small-scale partnership projects between local governments and the private sector for flood management, groundwater recharge, and water quality improvement.	

Table 5 lays out a proposed timeline of the recommendations. Immediate priority actions (highlighted in boxes 2 and 3 below) can be implemented in the near term in the context of ongoing policies and regulations, while phased actions may entail lengthier preliminary actions (such as data collection, consultations, and the development of new regulations) and can be implemented in the short, medium, or long term. The suggested phases for implementation are as follows:

- Immediate: within one year
- Short-term: one to five years
- Medium-term: five to 10 years
- Long-term: 10 years and beyond

Some recommendations are conditional upon others, and this is implicit in the phasing of recommendations. For example, clarifications to the legal framework on groundwater management, improving water efficiency, and implementing fit-for-purpose water for non-potable uses are immediate actions, while halting groundwater abstraction can only be realistically and effectively enforced in the medium term. This underscores the necessity of implementing both immediate and medium-to-long-term actions. Some of the recommendations – such as the maintenance of infrastructure and Water Information Management Systems (WIMS) – require sustained, adaptive, and iterative effort; these are indicated in the roadmap.

Box 2: Implementing Framework: Immediate Priority Actions

1. Incorporate the following into ongoing development of implementing regulations:

a) Interjurisdictional cooperation
b) Groundwater management
c) Urban regional governance

2. Build on existing frameworks:

a) Incentivize better enforcement of discharge permits
b) Establish water information sharing protocols
c) Incorporate IUWM indicators in performance measures for access to finance under NUWAS

Box 3: Interventions: Immediate Priority Actions

1. Drive progress towards IUWM objectives at the local level:

a) Implement minimum service standards for water and sanitation services

b) Support uptake of Citywide Inclusive Sanitation

c) Align incentives through water tariff and subsidy calibration

2. Share information and build capacity:

a) Deploy the IUWM Practical Guide for Cities

b) Catalogue local IUWM initiatives

c) Set up a water information management system

3. Track progress:

a) Develop urban water security indicators and conduct city assessments

b) Incorporate IUWM indicators in performance measures under NUWAS

Table 5: Roadmap of Recommendations

IMPROVE AND EXPAND WATER SUPPLY AND SANITATION SERVICES | SECURE WATER SOURCES AND IMPROVE WATER CONSERVATION | IMPROVE GROUNDWATER MANAGEMENT | INCORPORATEWATER CYCLE AS PART OF IMPROVEMENT OF URBAN REGION GOVERNANCE AND URBAN DEVELOPMENT | IMPROVE FLOOD RISK MANAGEMENT AND COMMUNITY PREPAREDNESS | STAKEHOLDER AND PRIVATE SECTOR ENGAGEMENT

PHASE	LAW & REGULATION		GOVERNANCE & INSTITUTIONS		PLANNING & IMPLEMENTATION		INFORMATION MANAGEMENT		FINANCING	
	Enabling Framework	*Intervention*	*Enabling Framework*	*Intervention*	*Enabling Framework*	*Intervention*	*Enabling Framework*	*Intervention*	*Enabling Framework*	*Intervention*
Immediate action	Prepare regulatory guidelines on interjurisdictional cooperation agreements between local governments for: (a) water supply; (b) flood management; and (c) water quality management, incorporating nature-based solutions and incentives for ecosystem services where applicable. **Central Government: MOHA and MPWH** Adopt implementing regulations that clarify authority for groundwater management, including by designating of groundwater protection zones and setting fees and penalties. Adopt timebound policy targets to reduce abstraction. **Local Government**	Enforce implementation of the minimum service standards on water supply and sanitation. Identify options for providing services to vulnerable and overlooked populations located in hard-to-access zones. - Prioritize targeted investments to achieve MSS - Track performance in meeting MSS in WIMS and link it to access to funding from NUWAS - Explore performance-based contracts with private contractors to meet MSS **Central Government: MOHA and MPWH**	Reform urban governance to ensure consistency with Law 23/2014 on regional governance. Specify the water cycle as a priority area for regional cooperation and coordination under the new governance structure. **Central Government: MOHA**	Issue local-level policy to improve the water use efficiency of public agencies. For example, track water consumption by department or agency; replace potable water with fit-for-purpose water where appropriate (urban irrigation, street cleaning, bus washing, etc.).Explore and pursue a circular economy of water to achieve a closed water loop. **Local Government**	Track local governments' records of enforcing discharge permits and develop additional incentives for enforcement where necessary. **Central Government: MOEF**	Support uptake of Citywide Inclusive Sanitation through regulations and standards for: (1) household-level containment, septage collection, treatment, and safe disposal; (2) wastewater collection and treatment (black and grey water); (3) fit-for-purpose reuse and recycling of septage and wastewater. Map out sanitation infrastructure and services (including Sanimas) to be uploaded on WIMS. **Local Government**	Establish protocols for local governments to share data in a complete, consistent, and timely manner. Address gaps in the data and populate and validate historical data in the Water Information Management System (WIMS). **Central Government: MPWH**	Establish protocols for local governments to share data in a complete, consistent, and timely manner. Address gaps in the data and populate and validate historical data in the Water Information Management System (WIMS). **Central Government: MPWH**	Strengthen and build on the existing NUWAS Framework for performance-based access to finance for local governments and PDAMs, incorporating performance indicators relating to IUWM and incentivizing and mainstreaming Citywide Inclusive Sanitation (CWIS). **Central Government: MPWH and MOF**	Adopt MOHA Regulations on Tariff and Subsidy to support utilities in improving their performance, sustainable operation, and creditworthiness to access funding sources that enable investments to expand services. **Local Government**

PHASE	LAW & REGULATION		GOVERNANCE & INSTITUTIONS		PLANNING & IMPLEMENTATION		INFORMATION MANAGEMENT		FINANCING	
	Enabling Framework	*Intervention*	*Enabling Framework*	*Intervention*	*Enabling Framework*	*Intervention*	*Enabling Framework*	*Intervention*	*Enabling Framework*	*Intervention*
		For urban green space, explore a broader interpretation of Law 26/2007 on spatial planning mandating 20% + 10% open green space to allow for cooperation between jurisdictions to achieve targets jointly. **Central Government: MOHA and MASP**		Integrate groundwater management with other urban water services. **Local Government**		Develop a set of urban water security indicators in consultation with local governments. Carry out a water security assessment for all metro areas and other higher-priority urban areas as a basis for objective-setting and project prioritization and to build engagement in IUWM among stakeholders. **Central Government: Bappenas**		Catalog IUWM initiatives by local governments and identify ways to scale up existing initiatives, design pilot projects, and establish new benchmarks accordingly. **Central Government: Bappenas**		
						Deploy the IUWM Practical Guide for Cities into a manual for local governments on the design and implementation of IUWM projects. **Central Government: Bappenas and MPWH**		Set up a water information management system (WIMS) as an open and accessible online platform. Explore innovative information and communication technologies to share and visualize data and connect with a broad audience. **Central Government: MPWH**		

PHASE	LAW & REGULATION		GOVERNANCE & INSTITUTIONS		PLANNING & IMPLEMENTATION		INFORMATION MANAGEMENT		FINANCING	
	Enabling Framework	*Intervention*	*Enabling Framework*	*Intervention*	*Enabling Framework*	*Intervention*	*Enabling Framework*	*Intervention*	*Enabling Framework*	*Intervention*
Short term (1–5 years)	Strengthen regulatory framework to protect water sources through the implementing regulations of the new Water Law. Develop the monitoring and enforcement framework. **Central Government: MPWH**		Strengthen incentives for systematic inclusion of water issues in urban planning. **Central Government: MPWH, MOHA, and MOF**		Improve coordination between water subsectors in local government planning processes. Systematically include water drivers and impacts in urban spatial planning process and in spatial plans. Assess potential for projects with co-benefits in two or more subsectors. **Local Government**				Build on existing fiscal transfer mechanism to incentivize local governments to invest in projects addressing two or more aspects of the urban water cycle. **Central Government: MPWH and MOF**	
	Develop guidelines and establish incentive mechanisms for local governments to encourage water conservation and to adopt demand management through tariffs and/or other mechanisms. **Central Government: MPWH and MOHA**				Conduct a detailed review of economic and regulatory instruments to incentivize uptake of pilot-level IUWM actions by private developers, incorporating international experience. **Central Government: Bappenas**				Study potential for PES mechanisms to be used for upstream-downs tream projects to manage water flow and water quality. **Central Government: Bappenas**	

PHASE	LAW & REGULATION		GOVERNANCE & INSTITUTIONS		PLANNING & IMPLEMENTATION		INFORMATION MANAGEMENT		FINANCING	
	Enabling Framework	*Intervention*	*Enabling Framework*	*Intervention*	*Enabling Framework*	*Intervention*	*Enabling Framework*	*Intervention*	*Enabling Framework*	*Intervention*
Medium (5–10 years) to long term (>10 years), depending on development level of city		Enforce regulation to halt issuance of new groundwater abstraction licenses for water supply services. Phase out existing groundwater abstraction licenses in at-risk areas. **Local Government**				In water supply plans (RISPAM), systematically assess off-grid or small-scale distribution systems and alternatives to new water intakes and treatment infrastructure. Include NRW reduction, demand management, provision of fit-for-purpose water for non-potable uses, and better use of existing infrastructure. Only invest in new intake and treatment facilities if other options are not viable. **Central (MPWH) and Local Government**		Develop a public communication strategy to inform and engage the public on urban water risks (including poor practices related to groundwater abstraction, subsidence, solid waste management, and sanitation) and appropriate household-level actions to reduce these risks. **Local Government**		Coordinate water, wastewater, and septage investment plans with neighboring jurisdictions; explore interjurisdictional network interconnections where feasible to avoid overlapping and inefficient investments. **Local Government**
		Incorporate requirements for on-site integrated water management in private developments (water management plans, zero run-off) in building and development permits and licenses. **Local Government**				Implement blue-green infrastructure (infiltration wells and vertical drainage, permeable surfaces for transport and pedestrian infrastructure and city parks, capture and use of stormwater for water reuse and to replenish subsurface water).		Map water bodies and water retention areas (green open spaces, permeable areas) to identify interventions and surface and groundwater abstraction points. This information can be collated in the WIMS. **Local Government and Central (MPWH)**		Establish tariff and fees structure to disincentivize groundwater consumption. **Local Government**

PHASE	LAW & REGULATION		GOVERNANCE & INSTITUTIONS		PLANNING & IMPLEMENTATION		INFORMATION MANAGEMENT		FINANCING	
	Enabling Framework	*Intervention*	*Enabling Framework*	*Intervention*	*Enabling Framework*	*Intervention*	*Enabling Framework*	*Intervention*	*Enabling Framework*	*Intervention*
						Local Government				
						Improve community preparedness and adaptation in flood-prone areas by incorporating flood adaptation measures in slum upgrading and housing projects and developing or improving early warning systems. **Local Government**		Improve and strengthen groundwater control and monitoring by installing meters and monitoring groundwater consumption. **Local Government**		
						Collaborate with private developers to share information and best practices on pilot-level IUWM, including on-site recycling of grey water and stormwater for non-potable uses, and develop a regional competition to showcase best practices. **Local Government**				

6.2 Concluding Remarks

IUWM has great potential to address interlocking water risks and build resilience in Indonesia's urban regions, from metropolitan areas spread over multiple jurisdictions to small but fast-growing cities across the archipelago. While IUWM is not yet well known among local governments in Indonesia, there are excellent examples of cities integrating elements of water policy with other urban sectors, a track record of interjurisdictional cooperation on water, and examples of partnerships with non-government actors. These initiatives embody the principles of IUWM, and many are well suited to scaling up and replication if the appropriate enabling framework can be put in place.

The IUWM approach is also gaining traction at the central government level, where, with the support of the World Bank and other development partners, policymakers are seeking to promote greater cooperation between neighboring local governments, to integrate spatial planning, and to incentivize investment and operating efficiency in the water sector. The Government of Indonesia is in the process of drafting the implementing regulations for the 2019 Water Law, and regulations regarding governance of metropolitan regions is under review by MOHA, creating a window of opportunity to embed IUWM in the institutional and regulatory framework.

Moving the IUWM agenda forward will require continued engagement with stakeholders to maintain the momentum created by the workshops conducted during this project. The Greater Jakarta region is among the most challenging urban areas in Indonesia in which to design and implement water-related policies, but it is also among the places facing the most severe and urgent water security challenges, with the most to gain from IUWM. The data collection, analysis, visualization, and sustained stakeholder engagement undertaken in Jakarta for this study needs to be translated to other urban regions and priority cities. The IUWM Practical Guide for Cities is a first step in this process.

The IUWM approach has evolved since its original conception to incorporate sustainability, circular economy, and resilience. As it is applied in the Indonesian context, it will evolve further to deal with the dramatic interlinked challenges faced by the country's urban areas, and to incorporate innovations that build on the local culture, indigenous knowledge, and unique resources and skills found across the nation. Further work is now needed to design incentives for policymakers at all levels to adopt IUWM in Indonesia. The knowledge and commitment of development partners will be vital to realize this vision.

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Annexes

7.0

ANNEX 1: CASE EXAMPLES

This annex presents case studies from all around the world (three from Indonesia) that were selected and summarized as a source of inspiration and applicable lessons for IUWM in Indonesia (table 3 in the report). This annex provides additional information on implementation and costs (where available) of IUWM examples. Sources are also referenced for further information and exploration.

Some of these efforts might already have been launched in Indonesia to varying extents and with varying success. These case studies originate from different institutional, political, and economic contexts – some may be similar to Indonesia, and others less so. Actions adapted from other countries may be implemented and financed differently in Indonesia. In some cases, institutional bottlenecks need to be resolved before actions can be implemented, (e.g., PPP for sponge city projects). In these cases, policymakers may reflect on the institutional changes needed and pursue them, particularly via the recommendations put forth in Chapter 6, while simultaneously putting actions drawn from other countries into the pipeline, where they can serve as motivation to drive institutional shifts.

These case studies show that IUWM takes time to conceptualize, implement, and demonstrate results. Many of these cases, such as land subsidence management in Tokyo, do not show instantaneous results but rather consist of months to years of discussion and implementation culminating in deliberate actions, with ongoing monitoring and enforcement to this day. This time gap also offers an opportunity, as it illustrates that planning for IUWM can begin immediately.

Annex 1.1: International Examples

1) Multi-agency urban river cleanup: Singapore[10]

Singapore's strategy, which combines urban planning, pollution control, and water and solid waste management around the Singapore River, is a leading example of an integrated approach that preceded the "IUWM" label. The cleanup took place over a decade, from 1977 to 1986. Prior to the cleanup, the Singapore River was a locus of commercial activity, bordered by pig and duck farms, hawkers and vegetable merchants, and boat construction and restoration services. Heavy boat and human traffic along the river coincided with the presence of squatters (informal housing), disposal of garbage and sewage into the river, and oil spills. The Singapore government at the time recognized the social, economic, and environmental costs, as well as the potential of the river to contribute to broader goals of

[10] Source: Tortajada, Joshi, and Biswas 2013.

urban development. Plans were developed to relocate residents to public housing in other areas, to phase out some polluting activities, and to redevelop the riverbanks for recreational and office use. When the river quality had improved sufficiently, the mouth of the river was dammed, and Marina Bay was developed as a recreational area and freshwater reservoir.

Apart from political will, data collection and analysis were crucial in the planning and implementation of the cleanup. The government's first step was to collect data on pollution sources in and around the river. This revealed that the main polluters were riverbank residents in the catchment area, who were disposing solid and liquid organic waste into the river and environment without treatment.

With the involvement of multiple government agencies and stakeholders, five priorities were identified: i) resettlement of residents and removal or relocation of industrial polluters; ii) construction of housing and commercial premises with proper water and sanitation facilities for resettled residents; iii) public engagement on the project; iv) stringent enforcement of discharge regulations; and v) cleaning and dredging of the riverbed and banks and the relocation of the port within the national land-use plan. Relocation of businesses, industries, and settlements was conducted gradually, with compensation, with time built in to overcome resistance and construct alternative housing. The Ministry of Environment was tasked to lead the cleanup, but other government agencies involved included the Drainage Department, the Housing Development Board, the Port of Singapore Authority, the Ministry of National Development, and the Ministry of Finance.

Legal and regulatory reforms supported the river cleanup, and water management in general. The Housing and Development Act of 1960 enabled the removal of informal settlements and the provision of affordable housing. In 1968, Singapore passed the Environmental Health Act, which enabled prosecution of persons found to be polluting rivers and water bodies.

Estimated expenditure: S$200–300 million (Joshi, Tortajada, and Biswas 2012).

2) Driving efficiency through non-revenue water reduction targets: Denmark[11]

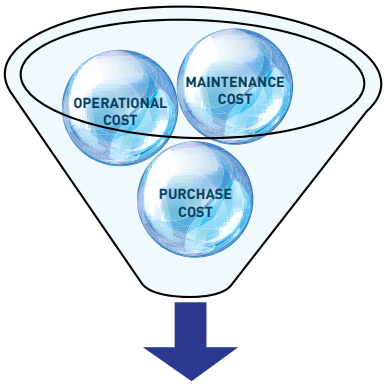
Denmark's approach to NRW reduction illustrates how the central government can use financial and regulatory tools to incentivize local actors. Over the period of the initiative, water utility companies in Denmark achieved substantial reductions in NRW to less than 10 percent in most Danish cities.

In 1994, the government introduced an NRW target of 10 percent (Danish EPA, n.d.). Water utilities that exceed this level are subject to additional taxes on water consumed and water lost. National regulations also require that certified meters be installed for all consumers.

[11] Source: State of Green, n.d.

These incentives have led water utilities to be innovative in their strategies to increase distribution efficiency.

Clear and accurate performance indicators are needed for the incentive scheme to be effective. The government considered ways to improve on the standard calculation of NRW, which is the volume of water not billed as a percentage of water supplied to the network. This measurement is influenced by various local factors and may not accurately reflect losses in water distribution. The recommended indicator for NRW in Denmark is cubic meters per kilometer of pipe per day, which can be complemented with losses per connection in liters per day.



Total Cost of Ownership

Source: Original figure for this publication.

At the local level, utilities adopt NRW programs or masterplans to entrench the understanding and importance of NRW reduction at all levels of the organization, from upper management to procurement teams and technicians. Technicians are trained in tools such as Geographic Information Systems (GIS), Supervisory Control and Data Acquisition (SCADA), hydraulic modelling, noise loggers, smart meters, and online leakage monitoring platforms.

High-quality components are found to be more cost-effective, since repairs and replacements tend to be more costly than the upfront cost of the component itself, especially for underground pipes. Utilities in Denmark are required to use "total cost of ownership" and "lifetime cost" as the basis for procurement and product selection, a requirement that is designed to increase the sustainability and reliability of investments on equipment such as pipes, joints, and valves.

3) Planning for blue-green infrastructure: Australia[12]

Australian cities have been at the forefront of blue-green infrastructure development, supported by a clear process for spatial planning that enables the costs and benefits of innovative projects to be fully assessed with extensive participation of community members.

Extreme weather conditions, such as the protracted Millennium Drought and repeated flood and wildfire events, have driven greater attention to water issues in Australia. In parallel to climate drivers, city residents increasingly demand green spaces and urban livability features. These factors have stimulated the adoption of blue-green infrastructure solutions at various scales, not only for their aesthetic value, but as a necessity in urban management. Within the context of a national vision for water-sensitive cities, therefore, many municipal governments in Australia have developed projects to address localized water challenges such as surface flooding, water resource availability, and degraded ecology in urban water bodies.

[12] Source: DELWP 2017a.

Municipalities in Australia follow a detailed planning process for blue-green infrastructure that links water investment planning to the spatial planning process. This requires input from various local government departments, such as spatial planning, water, and parks and recreation, which share data, prepare reports, and engage stakeholders in the community. An example of the outcome of this process is shown in the opportunity map for the Maroondah district of Melbourne, which is used as a reference for future blue-green projects. The opportunity map shows point locations throughout the district that have potential for various IUWM-type projects, such as blue-green infrastructure and alternative water sources.

Another spatial-based approach is the urban forest strategy for the City of Melbourne. The city conducted a comprehensive tree audit to obtain information on tree age, placement, and condition. This dataset was mapped out, uploaded online, and made open-source. The tree audit map served as the basis for a heat map that illustrated the vulnerability of the community to extreme heat. This analysis in turn provided an evidence base that could be used to prioritize urban forest investments.

4) Halting land subsidence in a coastal mega-city: Tokyo

Beginning in the early 1900s, Tokyo start experiencing severe land subsidence due to industrialization and urban development, which relied on untrammeled groundwater abstraction to meet the surge in demand. Subsidence exacerbated flood risks, particularly in the lowland area or "Tokyo Zero Meter Area," where ground level is below the average high tide sea level. Earthquakes pose an additional threat, with the potential to damage flood protection infrastructure such as coastal dikes and thus exacerbate coastal flooding.

To address these acute risks, a two-pronged approach was adopted: the Industrial Water Law (1956) was enacted to limit and ultimately halt groundwater abstraction, and surface water sources outside the metropolitan area were developed to ensure reliable supply. Within the scope of the Industrial Water Law, the national government demarcated zones for groundwater abstraction limits, and some industries were mandated to move to a different location. At the local government level, enforcement was carried out to prohibit new pumping wells and phase out existing wells that did not meet the requirements or limits set out by the law. Beginning in the 1970s, the groundwater levels started to rise again and subsidence was stabilized.

Estimated expenditure: approximately ¥30 billion (approximately ¥7.7 billion at 1960 currency rates and ¥22 billion at 1963 rates) for wastewater treatment plants for industrial reuse (Aihara et al. 1969).

5) Integrated policies to reduce water consumption: Zaragoza, Spain[13]

The city of Zaragoza, Spain, with a population of 700,000, illustrates a multi-faceted approach to reducing water demand in response to increased water scarcity. In 1997, the local government launched the Water-Saving City campaign in partnership with a local civil society organization, the Fundación Ecologica y Desarollo (FED). This initiative aimed to decrease water consumption by 1 billion[14] liters in one year as a way to kickstart the entrenchment of water conservation habits and technology in the community. The project took an integrated approach involving various stakeholders: the general public, mass media, and water-saving product manufacturers. The Zaragoza Water Commission was set up to coordinate the effort and provide guidance. The initial campaign was a clear success: 1.176 billion liters of water were saved in 1998, and further phases were launched and sustained over the next decade. By 2010, water consumption per capita stood at 100 liters per day, up from 136 in 2000.

The campaign comprised a mass awareness-raising component to stimulate the community to adopt water-saving habits and technologies. Promotional content was disseminated in the print media and on TV, and through posters on public transportation, on stickers, and via other media. Content was tailored to particular groups of water users. For households, part of the outreach message encouraged people to switch to water-saving versions of domestic appliances such as taps and washing machines. An online portal and telephone hotline was set up to field enquiries from the public about water-saving technologies and how to purchase them. Large consumers such as hotels and industries were educated on the environmental and fiscal benefits of water conservation. An initiative for students included a "Water Savings Book" for students to note, track, and compare monthly water bills.

A market for water-saving technology, sanitary hardware, and domestic appliances was also created in the city. In collaboration with manufacturers, the city promoted a kit of water-efficient appliances to households at a subsidized cost, with additional discounts on installation prices. These efforts, among others, resulted in a 15 percent rise in sales of household appliances with water-saving features. Two-thirds of households in Zaragoza city adopted water-saving measures after the campaign, compared to one-third before it.

Additional economic incentives were provided through the tariff structure. The city introduced volumetric tariffs, with subsidies for low-income households. Domestic consumers who decreased their yearly water consumption by at least 10 were also eligible for discounts on their water bill, and penalties were issued for excessive water use. Although an evaluation found that these adjustments did not significantly reduce water consumption, they increased the utility's revenues, enabling further improvements in water infrastructure.

[13] Sources: Kayaga, Smout, and Bueno 2007; Climate-ADAPT 2021.
[14] Note: American billion, i.e., 1,000 million.

Infrastructural improvements were also made in the form of pipe rehabilitation and pressure controls, and the water utility repaired leakages in apartment building storage tanks. This required substantial investment and consistent effort over many years, and was pursued not only to reduce water and financial losses, but also in an effort to gain consumer support and confidence by proving that the water service providers were committed to continuous improvement.

Support from city leaders and regulatory mechanisms was a key factor in sustaining water conservation efforts. Water-saving policies and plans were included in the city's strategic plan and Agenda 21 directives, which enabled regulatory commitments and access to funding, and also fostered citizen identity and pride. To trigger and sustain political commitment to water conservation, in 2011, the Municipal Bylaw for Water Saving and Efficiency was passed. This bylaw commits to specific targets for total water consumption in the city, total consumption per capita, and domestic consumption, and includes efforts to increase efficiency in municipal water use.

Estimated expenditure: 483,000 at 1997 currency rates (European Commission, n.d.)

6) Public-private partnership for sustainable drainage: Zhenjiang Sponge City, China[15]

The Zhenjiang Project was one of 16 "sponge city" pilot projects in China selected to receive central government financial support and designated as a PPP demonstration project by the Ministry of Finance. The project involves construction, renovation, and operation of water management infrastructure on a site comprising 22 square kilometers of land and 11.5 square kilometers of water bodies in Zhenjiang city, in the province of Jiangsu in eastern China.

Under the 23-year contract, the private-sector party is responsible for investment and financing, construction, and operation of the following new infrastructure:

- a 200,000 m^3/day reuse-grade WWTP and a 75,000 m^3/day wastewater treatment expansion project (discharge standard 1B) and pipe network
- green stormwater capture, diversion, and reuse infrastructure

After a process of competitive negotiation involving both local firms and state-owned enterprises (SOEs), the contract was awarded in 2016 to China Everbright Water (CEW). CEW is an environmental services company under the ultimate ownership of the Everbright Group, a large SOE under the central government. The project company has a joint venture structure, with 70 percent owned by CEW and 30 percent by the Zhenjiang City Water Industry Corporation, a SOE under the municipal government.

[15] Sources: InfraPPP 2016; China Everbright 2016; Zhang 2016.

Total investment value is expected to be ¥2.585 billion (US$405 million), of which ¥1.2 billion is covered by a central government grant and ¥1.385 billion by the project company. The central government grant specifically covers the ecological and non-revenue generating elements of the project: low-impact development and transformation, ecological restoration, pipe network engineering, and drainage ("waterlogging") management. The revenues of the project company will come from a wastewater treatment fee paid by government. The fee is based on 75,000 cubic meters per day of wastewater treatment at 1B standard and 150,000 cubic meters per day treatment at 1A standard.

In addition to the wastewater treatment plants, the project company investment also includes drainage pipes, rainwater storage tanks, and river renovation works. CEW estimates the project will capture over 16 million cubic meters per year of rainwater for reuse, leaving just 30 percent to be drained to the river. This goal is in line with the national targets outlined in sponge city guidelines from the State Council in October 2015, whereby 20 percent of urban areas in China would collect and reuse 70 percent of their rainwater by 2020, and 80 percent of cities would do so by 2030.

As a pilot sponge city project, the Zhenjiang PPP has faced numerous challenges, both during construction and as it continues to operate. Firstly, since the area is a brownfield site, the project had the potential to inconvenience residents during the construction period. Channels of coordination with residents were established, and clear communication is seen as an important aspect of successful implementation. Secondly, the construction work involved the use of materials and equipment (such as permeable surfaces, pipeline materials, and backfill materials) that had not been used in Chinese cities before, raising technical risk. Finally, the project includes multiple different components, many of which are non-revenue generating. This complexity called for a robust financial structure that incorporates both service fees and a government subsidy. Since its commissioning, the Zhenjiang sponge city PPP has generated amenity benefits in addition to reducing inconvenience and damage from floods. The project will help the city achieve its goal of being fully compliant with national Sponge City standards by 2025.

7) National Sanitation Information System: Brazil[16]

In Brazil, the Ministry of Regional Development, via the National Sanitation Secretariat (SNS), manages the National Sanitation Information System (SNIS) under Law 11.445/2007. Every year, municipalities and utilities collect data on: i) water and wastewater services; ii) management of solid waste; and iii) drainage and stormwater management. This data is submitted to SNIS, which organizes, analyzes, and publishes the data and diagnostics on its website.

[16] Source: SNIS, n.d.
[17] Source: PUB 2018.

SNIS sets standards on the data to be collected (indicators), terminologies, definitions, calculations, and units of measurements. Additionally, based on assessments made from the data, SNIS provides advice on public policies and consultations with the water and sanitation sector. Although the participation of municipalities and water and sanitation service providers in the system is voluntary, it is incentivized by access to investment plans by the Ministry of Regional Development. Data must be provided to SNIS regularly as a pre-requisite for selection, rating, and funding.

8) Building certification in Singapore[17]

In 2010, Singapore's national water agency, PUB, launched a certification program under the Active, Beautiful, Clean (ABC) Waters Programme. Private developers and public agencies can apply for certification for developments that incorporate ABC Waters Design Features. The scheme provides recognition for developers embracing sustainable water management and ensures that the design features incorporated within developments achieve a minimum design standard. Design features aim to increase detention and retention of stormwater onside and include features such as rain gardens, swales, sedimentation basins, constructed wetlands, and cleansing biotopes. To further incentivize IUWM, developers of projects or buildings which are "ABC-certified" may gain subsidized access to international expos, conferences, and seminars to deepen their expertise. Singapore's Building Construction Agency (BCA) also runs a Green Mark certification scheme to recognize projects and buildings with other environmentally sustainable features.

Annex 1.2: National Examples

1) Interjurisdictional cooperation in Kartamantul, Indonesia[18]

The Joint Secretariat of Kartamantul in Yogyakarta is an example of transboundary cooperation on water issues. The Kartamantul Metropolitan Region consists of Kota Yogyakarta, Kabupaten Sleman, and Kabupaten Bantul, three municipalities in the Special Region of Yogyakarta (DIY), of which Kota Yogyakarta is the economic centre. In 2001, the Kartamantul Joint Secretariat was formed to manage and coordinate transboundary development in the three municipalities. This was a bottom-up initiative on the part of the local governments (Firman 2014).

The leaders of Kartamantul recognized that urban expansion in the region was occurring across administrative boundaries, and that urban infrastructure, such as drinking water and transportation, should therefore be coordinated. The urban areas in Kartamantul are part of a single hydrological system and face similar issues – namely, providing housing for a growing urban population, an increase in demand for clean water and difficulty in sourcing

[18] Source: Stakeholder presentation.

new raw water sources, environmental degradation, an increase in urban burdens, and high demand from the public for basic services. The leaders also recognized that the areas around administrative borders are "grey areas" that receive less attention from policymakers, as it is unclear which municipality they belong to.

These issues motivated the creation of a transboundary institution to address shared concerns collectively and develop urban infrastructure for the Kartamantul urban region in an integrated and seamless manner. By having a joint secretariat and an integrated urban management system, the resources of each municipality can be optimized and their limitations minimized, and the region can engage in functional, coordinated land-use management.

The Kartamantul Joint Secretariat creates opportunities for IUWM by enabling transboundary management of water services. The integrated approach involves stakeholders from different municipalities and government levels (regional and local), who manage different parts of water services.

This is exemplified by a project for a regional wastewater treatment plant (IPAL) at Sewon. This project was driven by domestic and industrial pollution in water bodies, limited coverage of the centralized WTP, poorly optimized WTP services, and low community awareness of basic sanitation practices. IPAL Sewon brought about an increase in household connections, from 10,800 to 24,171 connections, with an extended pipe network. There are plans for further expansion to achieve a target of 25,000 connections. The three municipalities also collaborate on solid waste management, with an integrated regional solid waste management facility (*Tempat Pengelolaan Sampah Terpadu*, TPST) at Piyungan.

These initiatives were supported by the regional government of DIY (PEMDA DIY), which manages WTP installation, primary and secondary pipes, and disposal of waste, while municipal governments oversee service network expansion, connections, and environmental monitoring. Costs are shared between the governments: PEMDA DIY bears 70 percent of the cost, while the municipal governments of Kartamantul bear the remaining 30 percent, based on number of household connections.

2) Private developer–led sustainable water practices: Greater Jakarta

Private developers are taking the lead on introducing sustainable water management approaches in some of the integrated property developments in the Greater Jakarta region. These developments comprise residential and non-residential properties, and water, wastewater, and waste facilities and operations, as well as transportation. Town management companies play an ongoing role in managing and operating water and wastewater services, billing, collection, infrastructure, and utilities.

PT Lippo Karawaci (LPKR) is one of the prominent developers in the region. It owns and manages Lippo Village in Kabupaten Tangerang (60,000 residents) and Lippo Cikarang in Kabupaten Bekasi (55,000 residents). LPKR purchases bulk water from government agencies, treats it, and distributes it, and also collects and treats wastewater. At Lippo Village, water resources come from the Cisadane River; at Lippo Cikarang, water is sourced from the Citarum River and is allocated by the irrigation authority.

Environmental sustainability is a key pillar in LPKR's developments, and the company aims to integrate developments with the surrounding environment, pursue environmentally friendly practices, and ensure community engagement. Its developments incorporate stormwater retention and use for non-potable purposes and public information campaigns to encourage water conservation. In 2019, LPKR received nine awards for its Corporate Social Responsibility (CSR) activities. This included the Indonesia Green Award 2019, awarded to Lippo Cikarang for saving water resources through its WWTP, its WTP, and pond retention.

3) Payment for Ecosystem Services in the Cidanau watershed[19]

The Cidanau watershed in West Java has a long-standing catchment management scheme that incorporates payments for ecosystems services. Upstream areas in the Cidanau watershed are occupied by smallholder farmers' groups, who converted land from forests to agricultural paddy fields and residential plots. This land conversion led to bank erosion and sedimentation downstream, increasing flow variability and blocking and damaging water supply infrastructure.

The catchment management scheme was initiated by the Coordination Forum for Cidanau Watershed (FKDC), an NGO-led multi-stakeholder body. FKDC acts as an intermediary between farmers' groups and state-owned water service provider Krakatau Tirta Industri (KTI). A PES agreement was negotiated, under which KTI pays farmers a fee per hectare per year for sustainable land management, to maintain a certain number of trees on the land and to replant any trees removed. The initial PES agreement covered a five-year period, from 2005 and 2010, and has since been renewed and expanded to include erosion prevention and livestock management.

The Cidanau watershed scheme was the first formal PES arrangement in Indonesia. At that time, there were no laws and regulations governing PES. Over time, several laws have incorporated PES – namely, Law 32/2009 on Environmental Management, Law 37/2014 on Soil and Water Conservation, and Government Regulation 37/2012 on Watershed Management. While the Cidanau watershed case demonstrates the applicability of PES in catchment management in Indonesia, it remains one of the few long-standing schemes in the country (Amaruzaman, Rahadian, and Leimona 2017; Suich et al. 2016).

[19] Amaruzaman, Rahadian, and Leimona 2017; Suich et al. 2017.

ANNEX 2: SELECTED EXAMPLES OF IUWM BENEFITS AND RELEVANCE TO INDONESIA

IUWM project	Scale	Project detail	Results (selected)	Relevance to Indonesia
River rehabilitation, Futian River, Shenzhen City, China[20]	Medium to large cities	To improve flood drainage and improve water quality: • Creation of a retention area upstream, as downstream floodplain cannot be widened • Use of vegetated embankments • Pedestrian pathways, used for recreation during dry weather and flooded during wet weather • Water purification technology to improve water quality Financing: Central and local governments and PPP	• Reduced flood risk • Increased property values in proximity to the project • Carbon fixation • Improved air quality • Reduced investment in water storage infrastructures by maintaining surface water level and groundwater level • Increased biodiversity • Added recreational and tourism value	Catchment/river-scale nature-based approach; blue-green infrastructure for flood management that brings about multiple tangible and intangible co-benefits
Stormwater harvesting and fit-forpurpose water, Sunbury Town, Melbourne, Australia[21]	Small to medium cities	To increase water supply through stormwater harvesting and fit-for-purpose wastewater treatment, and to improve and maintain environmental water quality in view of increased development and population: • Regional stormwater harvesting scheme as a raw water source • Fit-for-purpose recycled water for environmental flows in winter and for irrigation in summer Financing: Western Water, Melbourne Water, PPP (stormwater harvesting manager), developers, agricultural users, and households	• Nitrogen abatement • Avoided costs of sewage treatment plant upgrade • Avoided waterway restoration costs • Increased agricultural value • Protection of downstream waterways that have high environmental value	Town-scale investments to increase water supply and improve downstream environmental water quality

[20] Sources: Wishart et al. 2021a; Wishart et al. 2021b.
[21] DELWP 2017b.

IUWM project	Scale	Project detail	Results (selected)	Relevance to Indonesia
Multi-pronged approach to improving water supply and sanitation services, Sergipe state, Brazil[22]	Large to mega cities	IWRM approach to achieve sustainable and efficient use of water: • Promote and build capacity for IWRM and environmental management by improving integration in regulations, coordination across stakeholders, and monitoring and evaluation • Improve land-use efficiency for crops and irrigation by providing technical assistance, promoting better soil management practices, and strengthening institutional capacity • Improve and expand water supply and sanitation infrastructure and services in urban areas Financing: World Bank loan, governments	• Developed integrated processes and tools for environmental licensing and water rights • 29% improvement in irrigation efficiency • Provision of improved sanitation services to 459,075 people • Rehabilitation of 266ha of protected zones related to water resources • Classification of rivers to enforce effluent discharge limits • 593 farmers benefitted from improved irrigation systems; 1,090 farmers and 40 technicians were trained on water and soil conservation technologies and practices • 102,309 additional connections to wastewater collection services • 290,000 people benefitted from improved water supply system	Integrated approach and bundled investments in regulation, capacity building, and infrastructural improvements to achieve targets and efficiencies across sectors
Groundwater Replenishment and Seawater Intrusion Prevention Project, Santa Cruz Groundwater Basin, California, USA[23]	Coastal, groundwater-reliant cities	• Restrictions on groundwater abstractions to sustainable levels based on demand projections • Aquifer recharge of 1,850,220 m^3/year at three wells to replenish groundwater supply and increase groundwater levels to prevent saltwater intrusion • Pumping amounts redistributed between wells to optimize project benefits	• Annual volume of clean water available increased by 6,414,096 m^3/year, for residential and commercial use • Benefits 72,500 people • An estimated 950,000 kg of mass contaminants removed per year	Systematic aquifer recharge and abstraction control to replenish groundwater supply and prevent saltwater intrusion

[22] World Bank 2020.

[23] California State Environmental Protection Agency State Water Resources Control Board 2019

ANNEX 3: WATER-RELATED TARGETS IN RPJMN 2020–2024

Sector	Targets	Ministries	Investment
Drinking water	• 10,000,000 new household connections across 34 provinces • Secure piped water supply of 50 m^3/second • Reduce NRW to 25% • Achieve nation-wide access to water: 30.45% piped water and 69.55% non-piped water • Improve health and access to improved and safely managed water resources to manage stunting • Achieve 100% "healthy" status for PDAMs	MoPWH, PDAM, MOH, MOHA, regional and local governments, state-owned enterprises (BUMN)	Rp 123.4 trillion Breakdown: • APBN: Rp 77.9 trillion • APBD: Rp 15.6 trillion • KPBU (PPP): Rp 29.9 trillion
Sanitation	• Achieve 90% access to improved sanitation, including 15% access to safely managed sanitation • 0% open defecation rate • Reduce stunting due to poor sanitation to below 10% • Expand connections to offsite wastewater treatment plants (SPALD) (311,760 new connections for Kota-scale SPALD and 1.4 million new connections for residentential-scale SPALD) • 505 new Kota-scale SPALD	MoPWH, MOH, MOHA, provincial and local governments, private entities, local community	Rp 140.9 trillion Breakdown: • APBN: Rp 73.5 trillion • APBD: Rp 1.7 trillion • Community/private: Rp 65.7 trillion
Multipurpose reservoirs	• 18 multipurpose reservoirs: 10 APBN, 6 KPBU (PPP), 2 • private/BUMN Reservoirs to reduce flood risk, as raw water storage, for hydroelectric power, and for agricultural purposes	MoPWH, private entities	Rp 92.9 trillion Breakdown: • APBN: Rp 12.96 trillion • KPBU (PPP): 20 trillion • Private/BUMN: RP 60 trillion
Watershed rehabilitation	• Improve water quality monitoring by installing 566 telemetric meters • Greening of 150,000ha of critical land • Expansion of Centralized Off-site Domestic Wastewater Treatment Plants (SPALD-T) to 509,492 households • Increase flood management infrastructure: 36 retention ponds and 52 check dams • 122 km of river normalization	MOEF, MoPWH, provincial and local governments	Rp 30.9 trillion APBN
Expansion of metropolitan areas: Palembang, Banjarmasin, Makassar, and Denpasar	• Expansion of public mass transportation • Provision of water supply • Establishment of sanitation amenities: on-site wastewater treatment plants (SPALD-S) and SPALD-T • Expansion of solid waste management amenities • Publication of data: Metropolitan Statistical Area	MoPWH, Ministry of Transportation, Ministry of Communication and Information Technology, MEMR, MOHA, BPS, provincial and local governments, BUMN, private entities	Rp 222.9 trillion APBN, APBD, KPBU (PPP), Private

ANNEX 4: PLANS RELEVANT TO IUWM

The following plans, at varying levels of government, have a bearing on the adoption of IUWM in Indonesia:

- National medium-term development plan: RPJMN (5 years)
- Regional/Local medium-term development plan: RPJMD (5 years)
- National long-term development plan: RPJPN (*Rencana Pembangunan Jangka Panjang Nasional*) (20 years)
- Regional/Local long-term development plan: RPJPD (*Rencana Pembangunan Jangka Panjang Daerah*) (20 years)
- Spatial plan: RTRW (*Rencana Tata Ruang Wilayah*) (local, regional, national)
- Detailed spatial plan: RDTR (*Rencana Detil Tata Ruang*)
- Public works and housing plan: Renstra PUPR (*Rencana Strategis Kementerian Pekerjaan Umum dan Perumahan*)
- Water supply plan (local): RISPAM (5 years)
- Sanitation plan (local): SSK (*Strategi Sanitasi Kota*), which covers wastewater, micro-drainage, and solid waste management (5 years)
- Environmental plan: Renstra KLHK (*Rencana Strategis Kementerian Lingkungan Hidup dan Kehutanan*), which covers forests, water bodies, and biodiversity
- Health plan: Renstra Kemenkes (*Rencana Strategis Kementerian Kesehatan*) (5 years)
- Disaster management plan: Renstra BNPB (*Rencana Strategis Badan Nasional Penanggulan Bencana*)
- Transport plan: Renstra Kemenhub (*Rencana Strategis Kementerian Perhubungan*)

The national medium-term development plan, RPJMN, is translated into provincial and district or municipality development plans (RPJMD, *Rencana Pembangunan Jangka Menengah Daerah*), which are then broken down into annual work and budgeting plans. RPJMD are prepared by subnational governments in consultation with MOHA. Sector plans are prepared by relevant ministries. Each national ministry prepares a Strategic Plan (*Rencana Strategis – Renstra*) to set out how they will achieve the RPJMN targets. These five-year plans are also then broken down into annual work plans.

At the local government level, in addition to the RPJMD, RISPAM, and RTRW, the municipalities or districts usually also prepare the SSK or City Sanitation Strategy. The SSK includes wastewater, micro-drainage, and solid waste management. In general, most cities already have a SSK, although the quality varies. Many contain information on the existing situation, identification of hotspot areas, and "wish-lists" of what programs or activities the city will use to achieve the universal-access-to-sanitation target, but do not provide specific targets and plans for implementation.

In most cities, plans for water supply, sanitation, and stormwater management and flooding are prepared by different municipal departments. In the standard approach, plans are based on projections of population and economic growth, which are used to forecast demand or exposure based on a standardized per-capita consumption estimate of 60 liters per day. Plans are then prepared to meet demand, focusing by default on expanding supply (i.e., through the construction of a new water treatment plant or the uprating or rehabilitation of existing treatment plants), with some attention to NRW reduction. Almost no local governments or PDAMs include demand management in their plans or consider utilizing alternative modes of delivery, such as bulk services to private developers of commercial, industrial, or residential zones, or collaborations with community-based or small-scale service providers for off-grid services. Nor do they consider potential alternative water sources within their city boundaries, such as water recycling or reuse from wastewater management or stormwater management, or large-scale rainwater harvesting. Furthermore, there is still very little awareness about the importance and the utility of having good infrastructure asset management.

ANNEX 5: WATER SUPPLY PERFORMANCE INDICATORS

The IUMW column indicates parameters that are relevant to IUWM and could be included in a future IUWM performance index.

INDICATOR	MOHA (EXISTING)	MOPWH (EXISTING)	IUWM (PROPOSED)
PROFIT TO PRODUCTIVE ASSETS RATIO	x		
PROFIT TO SALES RATIO	x		
CURRENT ASSET TO CURRENT DEBT RATIO	x		
LONG TERM DEBT TO EQUITY RATIO	x		
TOTAL ASSET TO TOTAL DEBT RATIO	x	x	
OPERATING RATIO	x	x	
PROFIT TO DEBT REPAYMENT RATIO	x		
PRODUCTIVE ASSET TO SALES RATIO	x		
RECEIVABLES COLLECTION RATIO	x		
COLLECTION EFFICIENCY	x	x	
ROE		x	
CASH RATIO		x	
SERVICE COVERAGE	x	x	x
DISTRIBUTED WATER QUALITY	x	x	x
CONTINUITY	x	x	
PRODUCTIVITY RATIO	x	x	x
WATER LOSSES	x	x	x
METER CALIBRATION	x	x	
TIME TO CONNECT NEW CUSTOMERS	x		
RESPONSE TO COMPLAINTS	x	x	
CUSTOMER SERVICE ACCESS	x		
STAFF/1000 CUSTOMERS	x	x	
CUSTOMER GROWTH		x	
DOMESTIC CONSUMPTION		x	x
WATER PRESSURE AT TAP		x	
TRAINING RATIO		x	
TRAINING EXPENDITURE RATIO		x	
CORPORATE PLAN	x		x

INDICATOR	MOHA (EXISTING)	MOPWH (EXISTING)	IUWM (PROPOSED)
ORGANISATION PLAN AND DETAILED TASK	x		x
STANDARD OPERATING PROCEDURES	x		x
AS BUILT DRAWINGS	x		
GUIDELINES FOR EMPLOYEE EVALUATION	x		
WORK PLAN AND BUDGET	x		
INTERNAL REPORTING PROMPTNESS	x		
EXTERNAL REPORTING PROMPTNESS	x		
INDPT AUDITORS COMMENTS	x	x	
FOLLOW UP ON INSPECTION RESULTS	x		
AVERAGE TARIFF		x	
AVERAGE O&M COSTS		x	
AVERAGE TOTAL COSTS		x	
AVERAGE TARIFF-AVERAGE TOTAL COST		x	
CURRENT DEBT		x	
LONG TERM DEBT		x	
MAINTENANCE COSTS		x	x
ADMIN COST RATIO		x	
WATER SOURCE CAPACITY		x	x
DESIGN CAPACITY (TREATMENT?)		x	
PRODUCTION CAPACITY (TREATMENT?)		x	
BULK METER IN WORKING ORDER		x	
CAPACITY RATIO (RESERVOIR)		x	
LENGTH OF PIPE RATIO		x	
ELECTRICITY USAGE		x	
TOTAL NUMBER OF CUSTOMERS		x	
TOTAL POPULATION		x	
TOTAL POPULATION IN SERVICE AREA		x	
SERVED POPULATION		x	
TOTAL NUMBER OF CUSTOMERS		x	
TOTAL NUMBER OF STAFF		x	
MASTER PLAN, BUSINESS PLAN		x	x

ANNEX 6: USEFUL IUWM REFERENCES: WORLD BANK

Title	Year	URL
Water in Circular Economy and Resilience (WICER) Initiative	2021	https://circularwaterforall.com https://openknowledge.worldbank.org/bitstream/handle/10986/36254/163924.pdf
Valuing the Benefits of Nature-Based Solutions : A Manual for Integrated Urban Flood Management in China	2021	https://openknowledge.worldbank.org/handle/10986/35710
From Waste to Resource: Shifting Paradigms for Smarter Wastewater Interventions in Latin America and the Caribbean	2020	https://openknowledge.worldbank.org/handle/10986/33436
Reform and Finance for the Urban Water Supply and Sanitation Sector Working Paper	2019	https://openknowledge.worldbank.org/handle/10986/32244
Water Scarce Cities: Thriving in a Finite World Report	2018	https://openknowledge.worldbank.org/han- dle/10986/29623
Building the Resilience of WSS Utilities to Climate Change and Other Threats: A Road Map	2018	https://openknowledge.worldbank.org/handle/10986/31090
The Use of Performance-Based Contracts for Nonrevenue Water Reduction	2018	https://openknowledge.worldbank.org/handle/10986/30433
Mainstreaming Water Resources Management in Urban Projects: Taking an Integrated Urban Water Management Approach	2016	https://openknowledge.worldbank.org/handle/10986/29613
Confronting Climate Uncertainty in Water Resources Planning and Project Design: The Decision Tree Framework	2015	https://openknowledge.worldbank.org/handle/10986/22544
World Bank Open Learning Campus: Integrated Urban Water Management (podcast)	2014	https://podcast.app/integrated-urban-water-management-e1004630/
The Future of Water in African Cities: Why Waste Water?	2013	https://openknowledge.worldbank.org/handle/10986/11964

ANNEX 7: USEFUL IUWM REFERENCES: EXTERNAL RESOURCES

Title	Organization	Year	Content	URL
UN World Water Development Report 2021: Valuing Water	UNESCO	2021	Guidelines and overview of methods of valuing water	https://www.unwater.org/publications/un-world-water-development-report-2021/
Water Sensitive Cities	Collaborative Research Centre for Water Sensitive Cities	2020	Water Sensitive Cities Index Water Sensitive Cities Scenario Tool INFFEWS Benefit-Cost Analysis Tool	https://watersensitivecities.org.au/water-sensitive-cities-index-tool/ *(not open access)* https://watersensitivecities.org.au/water-sensitive-cities-scenario-tool/ *(not open access)* https://watersensitivecities.org.au/wp-content/uploads/2021/10/INFFEWS-BCA-Tool-2021.05.zip
City Water Resilience Approach	ARUP, SIWI & Rockefeller Fdn.	2019	Diagnostic approach and online tool	https://www.resilienceshift.org/campaign/city-water-resilience-approach/
Action Agenda for Basin-Connected Cities	International Water Association	2018	Best practice framework for IWRM between cities and their basins. Identifies challenges and solution pathways	https://iwa-network.org/projects/basin-action-agenda/
Principles on Water Governance	OECD	2018	12 principles for governments to design and implement effective, efficient, and inclusive water policies	https://www.oecd.org/governance/oecd-principles-on-water-governance.htm
Political and Social Awareness on Water Environmental Challenges (POWER) Best Practices in Water Management Report	POWER (EU)	2017	Best practices used by global cities in managing extreme weather events, drinking water consumption, water conservation, and water quality	https://www.power-h2020.eu/wp-content/uploads/D3.1_best-practices-in-water-management.pdf
IUWM Toolkit for Indian Cities	ICLEI	2017	Step-by-step IUWM implementation process and tools for the process developed from experiences in Indian cities	https://iuwm.urbanwatermanagementindia.org/fileadmin/user_upload/IUWM_Toolkit_21_March_2017_Small_file.pdf
Principles for Water Wise Cities	IWA	2016	17 principles for endorsement by city leaders	https://iwa-network.org/projects/water-wise-cities/
City Blueprint	Watershare (EU)	2015	Diagnostic tool (Trends and pressures framework, City Blueprint framework and Governance Capacity framework) to assess and benchmark cities' performance on sustainable water management.	https://www.watershare.eu/tool/city-blueprint/ Videos, reports and reports for individual cities.
IUWM Training Overview and Case Studies	Global Water Partnership (GWP)	2014	Tools and global case studies of IUWM implementation	https://www.gwp.org/contentassets/d57b65ff36804dbcb6a8ff98abe8214a/iuwm-training-overview-and-case-studies.pdf
IWRM Tool Box (urban sections)	GWP	2014	Assessment instruments (C2) Urban water management plans (C4.05) Communication (C5) Promoting Social Change (C8) Related case studies	https://www.gwp.org/en/learn/iwrm-toolbox/Management-Instruments/

Title	Organization	Year	Content	URL
Catalogue of Technologies for Integrated Urban Water Management (Technology selection tool)	GWP	2014	Comprehensive list of IUWM technologies including water, greywater and sludge treatments, at various scales from households to centralized systems	https://www.gwp.org/contentassets/d57b65ff36804dbcb6a8ff98abe8214a/catalogue-of-technologies-for-iuwm.pdf
Integrated Urban Water Management Background Paper	GWP	2012	Introduction to the IUWM approach	https://www.gwp.org/globalassets/global/toolbox/publications/background-papers/16-integrated-urban-water-management-2012.pdf
SWITCH Project	SWITCH (EU)	2011	Decision support tools for sustainable water management SWITCH Transition Manual Other manuals and handbooks on specific aspects of IUWM	http://www.switchurbanwater.eu/research/26.php#pubs http://www.switchurbanwater.eu/outputs/pdfs/W1-3_GEN_MAN_D1.3.4_SWITCH_Transition_Manual.pdf http://www.switchurbanwater.eu/outputs/results.php?pubtype_select=19&pt=Manuals%20and%20handbooks
Integrated Urban Water Management Planning Manual	CSIRO	2010	Step-by-step IUWM planning process with global case studies	https://publications.csiro.au/rpr/download?pid=csiro:EP10449&dsid=DS1