OECD Studies on Water

Water Financing and Disaster Risk Reduction in Indonesia

HIGHLIGHTS OF A NATIONAL DIALOGUE ON WATER

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Foreword

Getting the management of water resources right is critical for achieving economic growth, globally and in Indonesia, and must be underpinned by robust financing mechanisms. Investments in water management can both spur economic development and at the same time avoid economic losses. To illustrate this, in Indonesia water-related disasters still cause economic losses of 2-3 billion US dollars per year. Moreover, losses associated with water risks and their health impacts are estimated to account for two to three percent of national GDP.

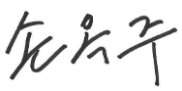
It is therefore no surprise that water financing and flood disaster risk reduction emerged as key topics of the National Dialogue on Water in Indonesia. The Dialogue welcomed stakeholders from Indonesia's water sector and beyond, representing all levels of government, state-owned enterprises, the private sector, and development partners. The Dialogue showcased state-of-the-art technologies to combat floods, such as artificial intelligence-based flood forecasting and Information Communication Technology (ICT) for more accurate and efficient risk-prevention measures. The dialogue also provoked discussions on how to combine traditional sources of water financing, such as tariffs and taxes, with novel methods like Land Value Capture.

The Dialogue generated a number of concrete recommendations for policy reforms, financing instruments and technological solutions, inspired by case studies from across the world. They have been collated in this report.

The National Dialogue on Water in Indonesia benefitted from the strong engagement of and collaboration amongst the Indonesian Ministry of Public Works and Housing (PUPR), the Ministry of National Development Planning (BAPPENAS), the Asia Water Council (AWC), and the Organisation for Economic Cooperation and Development (OECD). It also benefitted from the active contribution of partners in Japan, Korea and Thailand. The financial support of the Ministry of Environment of Korea is gratefully acknowledged.

AWC and OECD hope that the Dialogue has sparked partnerships across different levels of government, sectors, and countries. This report aims to support Indonesian decision-makers and practitioners in their efforts to leverage water and water policies and deliver on Indonesia's economic growth objectives. We trust it is valuable for other countries as well.

Yongdeok Cho
Secretary General
Asia Water Council



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Abbreviations and Acronyms

ADB	Asian Development Bank
ANN	Artificial Neural Network
AWC	Asia Water Council
BAPPENAS	Ministry of National Development Planning of Indonesia
BNPB	National Agency for Disaster Countermeasure of Indonesia
CEPACs	Certificados de Potencial Adicional de Construção, or Certificates for Potential Additional Construction
COD	Chemical Oxygen Demand
DRG	Disaster Risk Governance
Eau de Paris	Parisian Water Company
ERSAR	Portugal Water and Waste Services Regulation Authority
ESCAP	United Nations Economic and Social Commission for Asia and the Pacific
GDP	Gross Domestic Product
ICT	Information Communication Technology
K-water	Korea Water Resources Corporation
LID	Low Impact Development
LVC	Land Value Capture
MoEF	Ministry of Environment and Forestry of Indonesia
LMAN	National State Asset Management of Indonesia
NUWAS	National Urban Water Supply
NBS	Nature-based solutions
NRW	Non-Revenue Water
OODC	Outorga Onerosa do Direito de Construir, or Charges for Additional Building Rights
PDAM	Local Water Supply Company of Indonesia
PUPR	Ministry of Public Works and Housing of Indonesia
ANA	National Water Authority of Peru
PPP	Public-Private Partnerships
SEPA	Scottish Environment Protection Agency
BUMD	Specialised region-owned enterprises of Indonesia
TSS	Total Suspended Solids
UNDRR	United Nations office for Disaster Risk Reduction
UO	Urban operations
USAID	United States Agency for International Development
UUPB	Undang-Undang Penanggulangan Bencana, or special law on Disaster Prevention
WB	World Bank
WSS	Water Supply and Sanitation
ZEIS	Special Zones of Social Interest

Executive summary

Getting water resources management right, underpinned with appropriate financing mechanisms, is a prerequisite for realising Indonesia's ambitious national economic growth agenda to become one of the top five global economies by 2045. After all, flood damage and inadequate access to clean water supply and sanitation can curb economic growth.

In the last decades, Indonesia has achieved impressive results in increasing access to improved water supply. However, important challenges persist to deliver high-quality services to all users across the country. Some of the barriers to delivering water supply and sanitation services are the financial and operational distress of water services providers, coupled with limited opportunities for generating revenues. The first prerequisite to unlock commercial finance are operational efficiency and stability of revenue. For water supply services, this translates to efficient water utilities and stable revenue through water tariffs, which could be achieved through the following recommendations:

- The current discussion on a nationwide, uniform water tariff may be a breakthrough in securing a stable revenue stream and setting tariffs at cost recovery levels. Moreover, it may reduce water supply inequalities between urban and rural populations, and between islands, when it concerns a uniform tariff for bulk water. However, it could equally pose a greater threat to the sector when service providers lose a price-incentive that drives their performance, or when the system of cross-subsidisation among bulk water service providers is malfunctioning. Introducing a national independent economic regulator that supervises and reviews tariff reforms can address this risk. Systematically increasing tariff collection and creating trust in tap water from water service providers also contribute to securing a stable revenue stream.
- Independent economic regulation in Indonesia may be an effective response to some of the challenges in the water sector, including the inadequate the tariff setting process, poor service delivery, fragmentation of roles and responsibilities in the sector and public distrust in drinking water services. Ultimately, it can increase the creditworthiness of service providers and attract finance. Apart from DKI Jakarta, Indonesia does not have an independent economic regulator. Setting up such regulation could build upon and expand existing good practice of annual performance review of the local water supply enterprises (PDAMs).
- Limited enforcement of pollution charges and demand management instruments are undermining Indonesia's water resources, both in terms of quantity and quality. Setting up such environmental charges could contribute to broad policy objectives and increase revenues for operations and maintenance of water systems. In spite of existing regulatory and economic tools for managing pollution, such as wastewater effluent standards, water quality standards and pollution charges, these are underutilised instruments in Indonesia. Implementation, monitoring and enforcement mechanisms need to be strengthened, particularly at local level. Introducing and enforcing abstraction charges that reflect water scarcity and that cover the administrative costs of managing the system can reduce over-abstraction. To reflect Indonesia's cultural understanding that water should not be sold, charges should not be considered as water sales, but as payments for water supply services. In addition, water allocation regimes or strict enforcement of water permits should be considered.

In addition to strengthening the conventional water financing mechanisms, the Dialogue recommends the utilisation of Land Value Capture (LVC) as an additional source of financing water. Land value capture is the recovery and public utilisation of uplifts in land value that result from public planning and infrastructure investments. Recovered revenues can be used to fund infrastructure for urban water, irrigation and flood protection, including nature-based solutions. LVC can also meet the need for sustainable land use and management and strengthening tax revenues and subnational government fiscal autonomy. The legislative framework for LVC in Indonesia is relatively mature, yet Indonesia still struggles with LVC implementation due to the lack of an enabling framework. The following recommendations can support in rolling out LVC to finance water:

- Several LVC instruments can be used to finance water infrastructure. Which one suits best depends on the characteristics of the infrastructure and the local development context. Promising instruments in the context of Indonesia's water infrastructure development are developer obligations and charges for development rights, land readjustment, infrastructure levies and LVC through expropriations and the strategic management of public land.
- The enabling framework and local government capacity for LVC still needs to be strengthened for proper implementation. This includes the capacity to manage the development and monitoring of spatial planning and land-use regulations, define and negotiate with affected landowners and developers, and determine the specific implementation rules for LVC instruments. Second, maintaining accurate and detailed land registries is a crucial prerequisite, particularly outside of Jakarta. Also, land acquisition legislation may need to be reformed, to clarify rules for landowner compensation and settlement procedures, with the aim to reduce legal disputes and streamline LVC proceedings for water infrastructure.

Reducing flood disaster risk is a key enabler for growth in Indonesia. In Indonesia, water-related disasters cause economic losses of 2-3 billion US dollars annually. More than 100 million people, about 38% of the population, are exposed to flood risk, and 325 cities and regions are classified as high-risk areas. The number of flood events almost tripled between 2006 and 2017. Non-structural measures cost effectively supplement grey infrastructure:

- The integration of disaster management functions is desirable to strengthen the role of a control tower that can manage various disasters in an integrated manner. The disaster response system should be best established for each island. It is not efficient to manage various disasters in one government organisation. While establishing disaster response measures for each department, the roles of individual departments should be adjusted to closely align to those of the central government's control tower. Land use system adjustment is one of the most efficient proactive measure for disaster prevention. It consists of establishing a disaster-resistant land use plan reflecting the likelihood and the degree of impact of a disaster. Based on the experience so far, it is necessary to evaluate the impact by disaster type, focusing on areas vulnerable to disasters.
- Flood forecasting is one the most useful non-structural measures for flood disaster mitigation. It combines hydrological and meteorological data collection for flood forecasting, spatial flood forecasting based on flood hazard maps, and artificial intelligence-based flood forecasting. The process of flood hazard mapping and how the flood hazard maps are utilized in Korea are offered as a source of inspiration. A hybrid approach for accurate river flow forecasting that combines a physical hydrodynamic simulation model and a deep learning model is recommended.
- Adaptation to climate change can minimise the burden on both human and nature by activating non-structural measures. Early warning systems are one of the core frameworks initiated by many international organisations. In this regard, the ICT-based smart early warning system is recommended to realise "last mile or must have" more effectively. In addition, it is recommended to increase the efficiency of water resource and disaster risk management by integrating water-related information systems that are dispersed among various ministries and agencies in Indonesia. ICT-based cloud computing technology can be an efficient solution for Indonesia.

1 The National Dialogue on Water in Indonesia

The National Dialogue on Water in Indonesia focused on two pillars: 1) financing water infrastructure; and 2) non-structural measures for flood disaster risk prevention. Stakeholders from inside and outside Indonesia's water sector participated in the Dialogue, representing all levels of government, state-owned enterprises, private sector, and development partners. This chapter also provides a readers' guide for the rest of the report.

This document reports on the National Dialogue on Water in the Republic of Indonesia (hereafter: Indonesia), which took place between June 2022 and March 2023. The Dialogue aimed to support actions to address Indonesia's water sector challenges by identifying:

- Policy priorities, including priority areas for water-related investment,
- Options to address financing needs and enhance financing capacities, and
- Technologies and innovation in line with policy priorities, financing strategies and capacities.

The Dialogue was led by the Ministry of National Development Planning (BAPPENAS) and the Ministry of Public Works and Public Housing (PUPR). It has been facilitated by teams of experts from Asia Water Council (AWC) and the Organisation of Economic Co-operation and Development (OECD), who prepared this report. The report is a result of a literature review, a questionnaire filled out by various government institutions, workshops, stakeholder interviews and focus group discussions. The strong engagement with stakeholders from across the country made the National Dialogue on Water a true *dialogue*.

Water policies around the world are in urgent need of reform and water challenges cannot be resolved all at once. This is also the case in Indonesia, with a range of policy and institutional challenges (Chapter 2). The Dialogue therefore centred around two priority areas, which were defined by BAPPENAS and PUPR, in consultation with their stakeholders:

- **Pillar 1: Financing water infrastructure.** Stakeholders showed a strong interest in developing a robust financing and funding mix for water, consisting of existing financing strategies and additional sources for capital, operation and maintenance. A robust financing mix has the potential to attract private finance. There is an opportunity to make better use of existing finance, such tariffs for drinking water supply services and water abstraction and pollution charges (Chapter 3). Land value capture can be an innovative source of funding water infrastructure that inherently increases the value of land, such as green and grey infrastructure for flood risk reduction or improved water supply (Chapter 4).
- **Pillar 2: Non-structural measures for disaster risk prevention.** Flood disasters have been one of the most serious catastrophes in the last two decades in Indonesia. Stakeholders showed a strong interest in non-structural measures to mitigate flood risk, such as water-related disaster forecasting and early warning systems by using satellite information. To support disaster risk management, Indonesia aims to strengthen its water resources information systems (Republic of Indonesia, 2020[1]). Chapter 5 discusses policy pathways to implement integrated flood information systems and early warning services.

To keep the momentum of the National Dialogue on Water, particularly in light of the development of the National Medium-Term Development Plan, the National Long-Term Development Plan, and the forthcoming Presidential Decree on Land Value Capture, a tentative action plan that emerged from the Dialogue is presented in Chapter 6.

Reference

Republic of Indonesia (2020), *The National Medium-Term Development Plan for 2020-2024 Narration Republic of Indonesia. Appendix Presidential Regulation N0 18 of 2020.*. [1]

2 Water resources management in Indonesia

Managing freshwater resources is a key priority for Indonesia’s sustainable development and social wellbeing. Challenges posed by floods, land use, water supply and sanitation, and finance, are a barrier to the country's economic growth. A growing population, fast urbanisation and climate change make water management increasingly challenging. This chapter provides key figures on water and describes the state of play of water policy implementation in Indonesia.

The effective and efficient management of water resources and water services remains a challenge for OECD countries and non-OECD countries alike (OECD, 2016[1]). Indonesia is no exception and getting its water resources management right, underpinned with appropriate financing mechanisms, is a prerequisite for realising the ambitious national economic growth agenda.

2.1. Indonesia's freshwater resources and water-related threats

The Ministry of National Development Planning (BAPPENAS) recognises three strategic issues of water management in Indonesia: water availability, water disasters and water productivity.

Water scarcity is projected to intensify by 2045 due to climate change, land degradation and unsustainable water usage (Republic of Indonesia, 2020[2]). Already in 2016, most of Java, Bali, Nusa Tenggara, Sulawesi experienced water shortages (BAPPENAS, presentation 2022). Water scarcity may hinder economic development as 67% of economic activity is projected to be in water-scarce regions by 2045 (World Bank, 2021[3]). Indonesia ranks among the ten largest groundwater-consuming countries (based on abstracted volume), abstracting groundwater primarily for domestic use (ADB, 2016[4]).

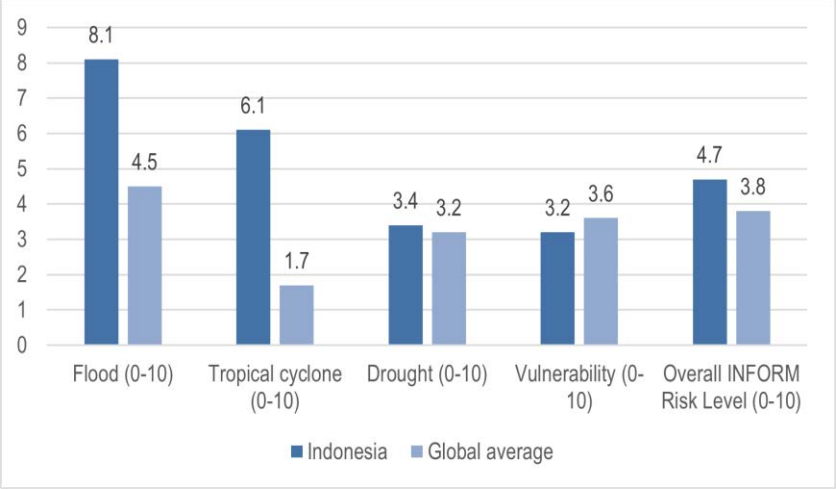
Indonesia is one of the most disaster-prone countries in the world (World Bank and Asian Development Bank, 2021[5]). More than 75% of the country's disasters are classified as meteorological or hydrological disasters. The frequency of flood events has increased in the past 20 years (World Bank, 2021[3]). Flood occurrence is not limited to a specific area; it is a nation-wide phenomenon. Flood events with a 50-year return period are expected to lead to a decline of GDP by up to 1.65 per cent.

Water productivity is among the lowest in Asia. Around 80 per cent of water is consumed by irrigation, mostly by low-value crops. In addition, water loss in irrigation is relatively high, with almost half of the irrigation system classified as "damaged" (Republic of Indonesia, 2020[2]).

In addition to the three strategic issues of water management, deteriorating water quality is often raised as a threat to water resources. More than half of the country's rivers are heavily polluted, caused by a mix of activities such as open defecation, poor wastewater treatment infrastructure, expansion of plantations for palm oil, deforestation, and emission of pollutants from agriculture and sanitation (World Bank, 2021[3]). Saltwater intrusion further threatens water quality.

Indonesia faces a high climate risk, ranked 59th out of 191 countries on the INFORM 2019 Risk Index (World Bank and Asian Development Bank, 2021[5]). Figure 2.1 presents several climate-related risks in Indonesia. The country's projected exposure to riverine and coastal flood risk is one of the highest in the world (ranked 17th). Climate change is also likely to trigger water stress and droughts, although droughts are unevenly spread in terms of intensity (episodes of El Niño-induced droughts, shifting wet seasons) and geography (some regions are more affected than others). Water deficits are projected in regions such as Java, Bali, East Nusa Tenggara and some areas of Sulawesi.

Figure 2.1. Climate risks scores in Indonesia, compared to global average score



Note: 0 - lowest score; 10 - highest score.
Source: World Bank and Asian Development Bank (2021[5]), based on the INFORM 2019 Index for Risk Management for Indonesia

The overall trend of population growth, interconnected with increasing levels of urbanisation, puts additional pressure on the country's water resources whilst shifting water demands towards urban centres. Population projections range from 292.5 million to 294.1 million people in 2030, and 311.6 million to 318.9 million people in 2045 (Bappenas, BPS and UNFPA, 2018[6]) There is a strong urbanisation trend. At the national level, the urbanisation rate is projected to reach almost 73 percent in 2045. For some provinces, especially provinces in Java, Bali, Sumatera and Kalimantan, the urbanisation rate is higher than the national average. The level of urbanisation will reach above 80 percent in seven provinces, namely Riau Islands, DKI Jakarta, West Java, DI Yogyakarta, Banten, Bali and East Kalimantan (Questionnaire, 2022[7]). Although the proportion of urban population reached above 70 per cent in Java, the rate of urban population growth in Java is relatively low compared to the outside of Java. However, the level of services in many cities outside of Java is less efficient and effective compared to those in Java. There is thus a regional development imbalance of urban-rural or city-village; Java and outside-of-Java; and western and eastern Indonesia (Questionnaire, 2022[7]).

2.2. Water supply to households

Indonesia has achieved impressive results in increasing access to 'improved water supply' in the last decades. In 2018, 20.14 per cent of all households in Indonesia had access to piped water supply (Republic of Indonesia, 2020[2]). Important challenges persist to deliver high quality services to all users.

The lack of reliable water supply services pushes users into using groundwater resources. Groundwater abstraction for domestic use is a major issue, with environmental and economic impacts. The effects of groundwater over-abstraction are estimated to reduce GDP by up to 1.42 per cent by 2045. Currently, only 9 per cent of total domestic water demand is provided by water utilities; private groundwater wells are the dominant water source. Even with access to piped water, services are often intermittent. Many urban utilities (PDAMs) cannot provide 24/7 service and service interruptions may last several days (World Bank, 2021[3]).

Discrepancies between bulk water supply and demand poses a challenge to water services providers. Nationwide, 24 per cent of bulk water available for water supply is not used, whilst – paradoxically – only 30 per cent of the total national raw water demand can be provided with current bulk infrastructure. Many

water utilities provide intermittent services due to lack of bulk supplies. Concurrently, other bulk water supply systems are not in use as there is no demand (World Bank, 2021[3]). The report will dive deeper into this issue in Chapter 3.

2.3. Land and water

The interconnections between land and water makes water management increasingly challenging. Forests and other ecosystems with important hydrological functions, such as wetlands, peatlands and mangroves, are in decline. It is projected that Indonesia's total forest cover will reduce from 50 per cent of total land area in 2017 to 38 per cent in 2045 (Republic of Indonesia, 2020[2]). A continuing deforestation trend has an impact on water resources and can worsen water-related hazards such as landslides and water scarcity, and contribute to significant greenhouse gas emissions in the case of peatland losses. Nevertheless, after a peak in 2015, deforestation rates have decreased considerably.

Land is a crucial constraint in water infrastructure development, both in the realm of water financing and in mitigating water-related disasters. First, land acquisition is one of the major obstacles for infrastructure development as it delays project implementation by years or even decades. What is more, land acquisition is a major cost for many water infrastructure projects. Secondly, riparian zones are increasingly developed for agriculture and human settlements. These activities along the river provide opportunities in times of normal flow, but are also a source of exposure and vulnerability to floods and landslides. Lastly, groundwater over-abstraction is a major cause of high rates (approximately 1–15 cm/year, with peaks up to 20–28 cm/year) of land subsidence in cities such as Jakarta (Abidin et al., 2011[8]).

Still, land is a promising resource to finance the country's water agenda as it is one of the most valuable forms of capital. Utilising even a portion of this value towards infrastructure development, by applying instruments such as Land Value Capture, can help achieve Indonesia's water resources development plans. Chapter 4 explores this option in depth.

2.4. Policy reforms

The Government has implemented several water management reforms. The reforms include the revisions of the legal and regulatory framework following the promulgation of the 2019 Water Law and the 2020 Omnibus Law. Four draft government regulations on drinking water, water sources, water resource management and irrigation were planned to be adopted in 2021 but the reform process is still ongoing. Once the four regulations are adopted, the Ministry of Public Works and Housing will fill in the details through technical regulations (Questionnaire, 2022[9]).

A National Water Resources Council was established in 2017. The Council is a multi-stakeholder coordinating platform at national level. The Council's mandate is to provide suggestions and considerations to the President in implementing national-level water resource management policies, as well as coordinating the making and the execution of national policies on water resource management. The Council coordinates the following legal reforms (Questionnaire, 2022[7]):

- Formulating the Presidential Regulation on the Water Resources Policy
- Formulating the Presidential Regulation on Strengthening and Developing Hydrology, Hydrometeorology, and Hydrogeology System Management Policy
- Formulating the National Water Resiliency Index Policy

Lastly, major reforms are ongoing to facilitate the financing of infrastructure, including a regulation on Public Private Partnerships in the water sector and a decree on Land Value Capture. Through the Presidential Regulation No. 38/2015, the public-private partnership framework is expected to help achieve the nation's

infrastructure investment target of USD 429 billion between 2020 and 2024. In addition, the government is exploring innovative financing sources such as the Sovereign Wealth Fund and Land Value Capture schemes. A Presidential Regulation to pave the way for Land Value Capture is under preparation (Questionnaire, 2022[7]).

2.5. Financing water

Natural resources are a backbone of Indonesia's economy, accounting for more than 20 per cent of GDP and 50 per cent of exports in 2017 and providing the livelihoods of a large share of the population (OECD, 2019[10]). The National Development Planning Agency (BAPPENAS) is aware that water resources can be a limiting factor to the country's ambition of becoming among the global top five largest economies. BAPPENAS and the World Bank applied a water lens to Indonesia's economic growth in the report "Vision 2045, Toward Water Security" (World Bank, 2021[3]). This document acknowledges that work needs to be done in the water sector to be able to facilitate the country's economic agenda, and it provides several ways forward.

Indonesia's water ambition is supported by a national financing agenda. Indonesia has allocated substantial funding to achieve the water-related targets in the National Mid-term Development Plan 2020–2024 (RPJMN). Water supply and sanitation feature prominently in the RPJMN 2020–2024, which includes national-level targets to increase access to safe water and sanitation, and a specific target to increase the number of household connections to piped water supply (World Bank, 2021[11]; Republic of Indonesia, 2020[2]).

Public expenditure on the water supply sector has increased threefold in real terms over 2001-2016 and now accounts for 1.7 per cent of total national spending for the entire water sector. Yet, Indonesia is among the countries with the lowest spending on water and sanitation, spending 0.2 per cent of the national GDP (2016), which is below the recommended levels for East Asian Countries (0.5%) and the level recommended by the United Nations (1%) (World Bank, 2021[3]). The RPJMN 2020–2024 foresees an investment need of more than US$470 billion in infrastructure, with around 42 per cent coming from the private sector through private public partnerships and business to business schemes (World Bank, 2021[3]).

The environmental tax revenue is comparatively low in Indonesia. Estimates suggest that it is equivalent to less than 1 per cent of GDP, compared to an average of 2.3 per cent across OECD and non-OECD economies (Lewis, 2019[12]). This figure corresponds with Indonesia's overall low tax burden, at 11.1% of GDP in 2019, which is among the lowest of Southeast Asian countries (Asian Development Bank, 2018[13]).

Local governments depend heavily on central government funding to finance investments. For example, only 0.3 per cent of funding for water supply investments comes from local governments (World Bank, 2021[11]). Yet, district governments have the authority to collect several water-related revenues, such as groundwater and surface water abstraction charges or fees. Faced with resource constraints, municipalities depend on higher levels of government to develop large infrastructure projects, but this is often without clear financial arrangements for the operating costs of these projects (World Bank, 2021[11]).

The recent policy reforms on Public Private Partnerships give more room for private sector financing. National regulations allow private sector participation in bulk water treatment and distribution as well as wastewater treatment and reuse. However, under the current regulations, private sector participation is not permitted in water resource development and in the provision of customer services. Water utilities may contract private parties for the construction and operation of treatment and distribution facilities under a Business-to-Business structure, and governments can provide guarantees and viability gap financing for projects under the official Public Private Partnership Programme. Contract types currently in operation include Build-Operate-Transfer and similar models (World Bank, 2021[11]).

2.6. Institutional arrangements for water management

Table 2.1 presents the institutions for water resources management, and Table 2.2 presents the institutions involved in the delivery of water supply services.

Table 2.1. Institutions involved in water resources management

Institution	Level of governance	Main responsibilities
Ministry of National Development Planning (BAPPENAS)	National	Coordinating, synchronizing the implementation of planning, monitoring-evaluation, and budgeting policies. Preparation of thematic, holistic, integrative, and spatial national development plans in the determination of multi-institution programmes and activities for water resources.
Ministry of Public Works and Housing (PUPR)	National	Formulating and implementing water resources management policies in accordance with the provisions of the legislation.
Ministry of Energy and Mineral Resources (ESDM)	National	Conducting research, investigation, and services for groundwater geology and the environment (responsibilities relating to water resources management).
Ministry of Environment and Forestry (MoEF)	National	Formulating and implementing policies to increase the carrying capacity of watersheds and protected forests, pollution and environmental degradation.
Ministry of Agriculture (MoA)	National	Formulating and implementing policies for the provision of infrastructure and facilities in agriculture
National Agency for Disaster Management (BNPB)	National	Coordinating and implementing general policies for disaster management in pre-disaster and community empowerment.
Meteorological, Climatological and Geophysical Agency (BMKG)	National	Formulating and implementing technical policies, providing technical guidance, coordinating functional activities and cooperation, managing and providing information to the public.
State-owned enterprises and region-owned	National Regional	Managing, operating and maintaining water infrastructure works
River Basin Organisation	Basin	Developing and managing water resources at a river basin scale. Technical implementing unit in developing and managing infrastructures for enhancing water conservation and utilisation as well as controlling water related disasters.

Source: Questionnaire for the National Dialogue on Water (2022[7])

Table 2.2. Institutions involved in delivery of water supply and sanitation services

Institution	Level	Main responsibilities
Ministry of National Development Planning (BAPPENAS)	National	Preparing national WSS management plans, policies, budgeting plan and strategies. Supporting institutional strengthening and collaboration between ministries, partners and other stakeholders in the WWS sector. Identifying national and global funding support and resources. Monitoring and evaluation
Ministry of Public Works and Housing (PUPR)	National	Developing of infrastructure and technology for water and sanitation service facilities. Increasing the capacity of implementing water and sanitation providers. Providing technical support Serving as technical implementing ministry and coordinating with each province.
Ministry of Health (MoH)	National	Formulating rules, regulations and guidelines on water quality and environmental sanitation. Supervising and capacity building for sanitarian implementation at the regional level. Water quality surveillance Advocacy for community behaviour change
Ministry of Home Affairs (MoHA)	National	Providing guidance to Regional Development. Strengthening advocacy to improve the leadership of local government. Advocacy to local governments in achieving national targets. Tariff setting
Ministry of Village, Development of Disadvantage Region, and Transmigration (MoVDDT)	National	Encouraging policies on the use of village funds for national priority programs in accordance with village authority. Advocacy in stages to Village Heads and BPD and sub-districts regarding the use of Village Funds for accelerating the achievement of drinking water and sanitation targets. Organizing trainings Monitoring and mapping community empowerment issues that need follow-up from the central and/or provincial governments.
Ministry of Finance (MoF)	National	Formulating, determining and implementing the budgeting field, financial balance, and financial risk management.
Ministry of Environment and Forestry (MoEF)	National	Monitoring effluent from wastewater treatment.
Regional Development Planning Agency	Province	Preparing regional sanitation management plans, policies, and strategies.
Public Works and Public Housing Department	Province	Formulating, determining, and implementing regional sanitation policies and strategies.
Environmental Department	Province	Monitoring the effluent from wastewater treatment facilities under provincial government authority.
Health Department	Province	Formulating, implementing, and providing STBM guidance to community.
Community and Village Department	Province	Fostering Local Community and Village Department in facilitating the handover of assets Strengthening institutional management of water and sanitation facilities and infrastructure assets. Formulating a provincial strategy for capacity building of associations for managing rural SPAMS in districts/cities in their area. Coordinate with Local Community and Village Department in community empowerment. Cooperating with the Local Community and Village Department in monitoring and mapping community empowerment issues that need follow-up from the provincial governments.
Regional Water Utility Company (PDAM)	Region-owned enterprise	A type of region-owned enterprise (BUMD) responsible for drinking water supply and distribution.

Source: Questionnaire for the National Dialogue on Water (2022[7])

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3 Robust water tariffs and charges

Indonesia has achieved impressive results in increasing access to improved water supply and sanitation. However, the financial and operational distress of water services providers, and the water sector as a whole, prevent universal access to water supply and sanitation. This chapter argues that commercial finance for the water sector can be unlocked through national tariff reforms, economic regulation, and enforcement of charges for pollution and abstraction. It discusses the advantages and disadvantages of a nationwide, uniform water tariff, and it concludes that such a reform is to be implemented with caution.

Water financing of drinking water supply services is a major agenda for Indonesia. As regards drinking water supply, the costs (including financial, environmental and resource costs) of water services are not fully recovered. As a consequence, many local water supply enterprises (PDAMs), are in financial distress. Limited opportunities for revenues, or "revenue risk", constrain the access to private financing, such as PPP schemes, that could improve water services delivery. This chapter provides international examples and recommendations that Indonesia could consider in developing a robust system of tariffs and charges in the drinking water supply system.

3.1. State of play: funding drinking water supply services in Indonesia

In the last decades, Indonesia has achieved impressive results in increasing access to 'improved water supply'[1]. However, barriers remain to delivering high quality services to all users across regions. In 2020, 90 per cent of the population had access to improved water supply, but only 23 per cent of Indonesians had access to piped water and only 11.9 per cent had access to "safe water"[2] (World Bank, 2021[1]). Based on the 2020-2024 National Medium Term Development Plan, the Indonesian government aims to increase piped water supplies to 30 per cent by 2024 (Republic of Indonesia, 2020[2]).

Access to "improved water" varies across regions and has a positive correlation with regional income levels. As an illustration, Java, the region with the highest income level, also has the highest improved water coverage (95 per cent); whilst Papua, the region with the lowest income level, has the lowest access coverage (66 per cent) (World Bank, 2021[1]).

3.1.1. Limited capacity of water utilities to deliver drinking water

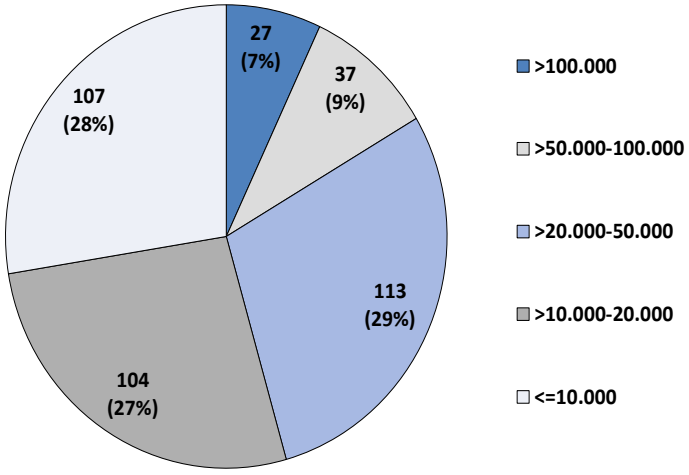
Drinking water is supplied by 388 water utilities (PDAMs). These are specialised region-owned enterprises (BUMDs) focusing on water supply. In the 2021 annual performance assessment, out of the 388 PDAMs, 225 were assessed as "healthy", 104 "unwell" and 59 "sick" (Ministry of Public Works and Housing, 2021[3]).

Inefficient operation and maintenance as well as limited access to bulk water supply aggravate service provision. Water supply systems are often inefficient, with low utilisation capacity and high rates of non-revenue water due to physical or commercial losses. One-third of the water that enters the distribution supply system ends up as non-revenue water (World Bank, 2021[1]).

Poor service provision, in combination with low tariffs (section 3.1.2) has led to low creditworthiness of PDAMs, therefore limiting access to commercial finance. Indeed, the PDAMs' financial sustainability is affected by low operation and maintenance efficiency, non-revenue water, ageing infrastructure, inefficiencies and mismanagement, as well as the lack of skilled operators (World Bank, 2021[1]).

In addition, some PDAMs are too small to reach economies of scale, affecting their ability to recover costs and deliver adequate services (Figure 3.1) (World Bank, 2021[1]). USAID has conducted a detailed study on the consolidation of PDAMs, therefore this issue is not discussed in this report.

Figure 3.1. Number of Household connections per PDAM (2021)



Note: Number of PDAMs that serve >100.000 households; >50.000-100.000 households; >20.000-50.000 households; >10.000-20.000 households; <=10.000 households. Total number of PDAMs: 388.
Source: Ministry of Public Works and Housing (2021[3]) *Buku kinerja bumd air minum 2021. Executive summary.*

3.1.2. Low tariffs lead to unsustainable water service delivery

Tariffs for water supply services for industrial and domestic use are in place. However, they inadequately contribute to cost recovery. By law[3], tariffs are based on the principles of affordability and fairness, service quality, cost recovery, efficient use of water, raw water protection and transparency and accountability. The tariff can be used for operations and maintenance as well as on the return on previous investments (Questionnaire, 2022[4]). Regional authorities, commonly the mayor, oversee tariff setting, making tariffs prone to politically motivated decisions. Tariff setting can be delegated to PDAMs.

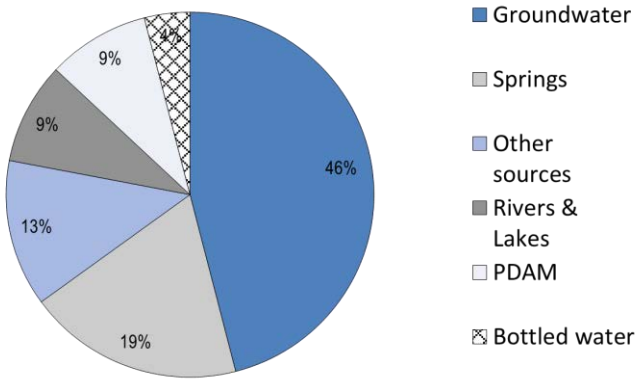
Drinking water tariffs in Indonesia range from Rp. 2,553/m^3 to Rp. 8,239/m^3 (Ministry of Public Works and Housing, 2021[3]). The PDAM tariffs increased on average 11 per cent per year from 2011 to 2015, twice the average rate of inflation in the same period. The MoHA Regulation No. 21/2020 on Tariff for Water Supply Services was intended to 'force' subnational governments to approve full cost recovery tariffs for PDAMs (World Bank, 2021[1]).

Without sufficient revenue to maintain, renew and extend water infrastructure, meeting the water supply development targets will remain a challenge as water service delivery falls into the hands of vicious circles of decline (Rouse, 2013[5]):

1. The inability to generate a solid revenue stream through tariffs hinders access to commercial finance of PDAMs. The Ministry of Finance indicated that the biggest issue facing PPP models and contracts in the water sector are tariff setting, collection and regulation. Financially healthy PDAMs are a requirement for advancing PPPs in the sector (Ministry of Finance, 2019[6]):
2. Limited revenue generation from PDAMs impact reservoir operators upstream, such as PJT. With unreliable revenues from PDAMS and other water users, reservoir operators resort to additional sources of income to recover costs, such as electricity production from hydropower, solar panels on the surface of reservoirs and sediment sales.
3. Low service provision discourages consumers to connect to the water supply system. This leads to lower revenues, and consequentially to lower levels of service in the long term. The drinking water supply service being considered unreliable, households use alternative water sources, mainly

groundwater, being free and in practice not regulated by a permit system. Many urban users resort to groundwater and bottled water for drinking (Figure 3.2). PDAMS are also constrained by low water demand: only a fraction of all potential users is connected to the central water supply system.

Figure 3.2. Water sources for domestic consumption (2019)



Source: Republic of Indonesia (2020[2]) *The National Medium-Term Development Plan for 2020-2024*

An additional pressure is that some bulk water supply systems are not in use, as there turned out to be no demand within the distribution zones of these systems. Moreover, low-income households face challenges in connecting to the water supply system as they cannot afford the connection fees, and direct household subsidies, payment plans or micro-credits are mostly absent (World Bank, 2021[1]). Subsidies from local governments to PDAMs are in place to increase coverage to low-income households (Ministry of Home Affairs, 2016[7]).

3.1.3. An inadequate regulatory framework for water services

Currently, Indonesia does not have an economic regulator for water services. An economic regulator is normally tasked with assessing the performance of utilities, reviewing tariff methodologies and decisions, and reviewing expenditure programmes of utilities (OECD, 2015[8]). The 2019 Water Law does not contain provisions on how water services should be regulated. Water supply services are currently regulated through Government Regulation 122/2015, which provides only limited guidance on water utilities regulation. At the time of writing this report, it is not known if the new regulation on Clean Water includes a provision to establish an independent economic regulator (World Bank, 2021[1]).

Public performance reviews can be an incentive to improve operations. An annual performance assessment of PDAMS is carried out by the Ministry of Public Works and Public Housing and the Financial and Development Supervisory Agency (Ministry of Public Works and Housing, 2021[3]). The annual performance assessment comprises four aspects: finance, service, operations, and human resources (Table 3.1). The performance assessment ranks PDAMs according to their 'health' level, i.e. their performance on each of the four aspects, but does not have a formal role as economic regulator. Altogether, PDAMs report on almost 60 indicators to both entities. Drinking water quality, however, is regulated by the Ministry of Health (MoH) (World Bank, 2021[1]).

Indonesia has some experience with an economic regulator for water, namely in the Province of DKI Jakarta which has its own independent water regulator: "Badan Regulator Pelayanan Air Minum DKI Jakarta" (Jakarta Water Supply Service Regulatory Body). The independent Regulatory Body reports to the Governor of Jakarta (Badan Regulator, 2023[9]).

Table 3.1. Performance criteria of PDAMs

Financial	Service	Operational	Human Resources
1. ROE 2. Operating Ratio 3. Cash Ratio 4. Billing Effectiveness 5. Solvability	1. Technical service coverage 2. Customer growth 3. Complaint settlement rate 4. Water quality test 5. Domestic water consumption	1. Production Efficiency 2. Water loss rate (NRW) 3. Service operating hours 4. Customer water pressure 5. Replacement of water meters	1. Employee ratio 2. Employee training ratio 3. Employee training expense ratio

Source: Ministry of Public Works and Housing (2021[3]) *Buku kinerja bumd air minum 2021. Executive summary.*

3.1.4. Absence of water fees and charges also affect the drinking water supply chain

Environmental taxes and charges remain largely underutilised in Indonesia at national as well as local level (ADB, 2022[10]; Lewis, 2019[11]). The low uptake of environmental taxes, water abstraction charges or pollution charges, affects the drinking water supply chain in several ways:

1. The absence of water permits and user charges leads to an inefficient use of water supply. This includes groundwater over-abstraction in areas where surface water could have been used. Moreover, raw water demand is expected to increase in the future (World Bank, 2021[1]), increasing the need for instruments that phase out overuse of water resources, address water scarcity and promote water use efficiency.
2. The absence of pollution charges can drive up operational costs for drinking water supply as more pollutants will need to be removed to make water fit for drinking (OECD, 2017[12]). While exact estimates of additional treatment costs have not been made in Indonesia, the Ministry of Finance recommended in 2019: "*[…] to forecast raw water quality. This may impact significantly on chemicals cost and sometimes it also requires additional capital cost for additional treatment systems*" (Ministry of Finance, 2019[6]).

The regulatory framework for implementing the 'polluter pays' principle is in place: by law[4] polluters are obliged to cover the costs of wastewater treatment and they can be held accountable for the environmental and human health damage they caused. However, the enforcement of the polluter pays principle is weak (World Bank, 2021[1]).

Similarly, there is a regulatory framework in place to charge surface water uses. Large users must have an abstraction permit, but awareness and enforcement of this requirement are low. Groundwater abstraction also requires a permit, upon which a groundwater tax is triggered, but such a permit is only sporadically issued (ADB, 2022[10]). Illegal wells are common, and industrial water abstraction is not monitored (OECD, 2019[13]). Water abstraction permits are issued by district governments, unless the permits concern inter-jurisdictional water bodies, in which case the responsible authority is at the higher administrative level. (OECD, 2016[14]). Small water users are not regulated, which – given their overall number – could jeopardise groundwater resources in the long term (OECD, 2019[13]).

The Water Resources Law allows state-owned-enterprises to collect a Water Resources Management Service Fee in river basins[5]. To date, only two state-owned-enterprises managing infrastructure in six river basins introduced a Water Resources Management Service Fee to meet the costs of operations and maintenance of water infrastructure such as dams. In other words, all other 121 river basins do not make use of a Water Resources Management Service Fee to recover costs. Besides a missed opportunity for cost recovery, these river basins miss an opportunity to send price signals to incentivise water use efficiency.

3.2. Recommendations focussing on stable revenue streams and efficient operators

Indonesia has a strong ambition to attract public-private partnerships (PPP) in the water sector. The first criteria to unlock commercial finance are operational efficiency and stability of revenue though water tariffs (Leckie, Smythe and Leflaive, 2021[15]). This section therefore discusses three recommendations:

1. A stable revenue stream: untangling the discussion on a nationwide, uniform water tariff Recommendations (Section 3.2.1)
2. Systematically increase tariff collection (Section 3.2.2)
3. Economic regulation to supervise tariffs and operations of service providers (Section 3.2.3)

In Indonesia, the appropriate pricing strategy for water supply services is best designed and implemented as part of a wider strategy of water demand management, which also includes charges for water abstraction from groundwater sources, pollution charges and wastewater treatments tariffs, water permits and possibly a water allocation regime. PDAMs would not be able to increase their coverage if groundwater is available for free, whilst their own water supply services are perceived as unreliable, and whilst raw water sources are too polluted to be treated at reasonable cost. This is discussed in the next Section (3.3).

3.2.1. A stable revenue stream: untangling the discussion on a nationwide, uniform water tariff

Water tariffs set by municipalities should ensure sustainable cost recovery. An appropriate tariff formula safeguards a combination of various objectives: economic (robust allocation of water and discouraging wastage), environmental (conservation of the resource), social (addressing affordability concerns) and financial (ensuring utilities' capacity to finance the operation of the service, now and in the future) (OECD, 2022[16]).

Indonesia is considering the option of setting a nationwide, uniform water tariff. As the tariff methodology is still on the drawing table, this section presents the pros and cons of a national water tariff. But before doing so, it is important to untangle what a nationwide, uniform water tariff entails. During the Policy Seminar, organised as part of the Dialogue in January 2023, it appeared that stakeholders have different interpretations of a nationwide, uniform water tariff. Are we discussing a uniform tariff level, a uniform tariff structure, a uniform tariff-setting process, or all of the above? Does this concern bulk water only, or will tariffs also be uniform at every household connection? The points below can help untangle the discussion:

- Is the discussion about a uniform **tariff level**? This can be interpreted in several ways. It could imply a uniform water *tariff level* (per m^3) for every Indonesian, regardless of location and water supply service provider. Alternatively, a uniform *tariff formula* can still result in different *tariff levels* for every Indonesian, as the formula is based on technical and geographical factors that influence the cost of water supply.
- Is the discussion about a uniform **tariff structure**? Uniformity in *tariff structure* entails a flat volumetric tariff for households and legal entities. The tariff has no sophisticated structures, such as increasing blocks. A uniform tariff structure may still result into divergent *tariff levels*, depending on the tariff formula adopted.
- Is the discussion about a uniform **tariff setting process**? Uniformity in *tariff setting process* implies that tariffs are centrally set and approved, for example by the Minister of Public Works and Housing, the Ministry of Home Affairs, or the economic regulator (see Section 3.2.3).
- Uniformity **throughout the water supply chain, or for bulk water supply only**? The tariff can be uniform throughout the country for bulk water supply distribution, but still be differentiated at

distribution for drinking water supply (see the case of Korea in Box 3.1), or (theoretically) vice versa: a pluriform bulk water supply tariff, with uniform drinking water supply tariff levels.

There are several considerations to be made regarding each of the four above-mentioned aspects. In principle, a nation-wide, **uniform water tariff level** (i.e., every Indonesian pays the same price for a m^3 of water at the tap) is not recommended as it does not deliver on ecological, economic, financial and social sustainability of water services. Tariffs ideally cover the operation, maintenance and renewal costs of infrastructure (OECD, 2021[17]). As these costs differ per PDAM, and are highly influenced by factors such as scarcity and distance from source to tap, a nation-wide uniform tariff is likely to be too high for some utilities, and too low for others. A central fund, or other mechanism, could be established to cross-subsidise utilities to ensure cost-recovery for all utilities. Another risk linked to the nation-wide uniform tariff is "cherry-picking" of low-cost utilities by private financiers, as the profit margins are relatively high when the excess tariff revenue is not properly redistributed. This puts additional pressure on public budgets to fund the less bankable utilities. Lastly, a nationwide, uniform tariff does not provide any incentive to utilities related to the management of cost levels. While a uniform tariff level is not favoured, a **uniform tariff formula** can be appropriate. This formula will result into a different tariff level for each utility, as the formula factors in the costs of operation, maintenance and renewal costs of infrastructure.

A **uniform tariff structure**, i.e. a flat volumetric tariff, can be of help to address affordability issues, particularly when coupled with targeted social subsidies. The literature has established that sophisticated tariff structures – such as increasing block tariffs – are usually socially regressive as they fail to reflect family structures and water consumption patterns. Tariffs that reflect the true cost of connection (fixed part) and consumption (variable part) are to be preferred, in combination with social measures targeting households that face affordability issues (Leflaive and Hjort, 2020[18]). This combination only works where public authorities have the administrative capacities to design and implement such targeted social support. Another advantage of a flat tariff structure is its administrative and financial feasibility, as flat tariffs require less information on water use and customer characteristics (Leflaive and Hjort, 2020[18]).

A **centralised tariff-setting process**, that is not subject to political interference, is appropriate. A centralised process can still result in different tariff levels per water service provider, depending on performance of the provider and the production costs of water based on technological and geographical parameters. Typically, an economic regulator sets the tariff formula and oversees that the tariff-setting process has been conducted according to the rules of the game. As an economic regulator is highly recommended in Indonesia, the details of developing such an institution are discussed in Section 3.2.3.

Lastly, experiences from Korea, Scotland and New Zealand show that a **single, nationwide tariff for bulk water supply** can work. It should be noted that this tariff only covers bulk water supply: the tariff for drinking water at retail level is still variable and based on the operations of the utility. A single tariff for bulk water promotes equity in water access, particularly in countries where the cost of bulk water supply highly diverges, such as due to topography. There are two requisites that apply to a single tariff for bulk water supply: 1) the tariff is redistributed among bulk water suppliers to ensure sustainable cost recovery of all utilities within the national bulk supply system, and 2) an economic regulator is in place to review and approve the bulk water tariff, as well as to evaluate the efficiency of operation of each service provider (see Section 3.2.3). Box 3.1 discusses the pros and cons of the Korean experience, where a single bulk water tariff is applied to facilitate equal economic development across the country.

In addition to tariff revenues, fiscal transfers can be justified to cover part of the cost of water services. Public authorities must pay attention to which fiscal instrument is most appropriate. For example, in touristic areas property taxes can be used to cover the additional cost of building and operating infrastructures for seasonal or peak water uses, and to capture some of the value added by reliable water supply and sanitation services (Leflaive and Hjort, 2020[18]). Portugal has experience in applying a seasonal tariff during tourism peaks. It operates a two-part water tariff structure that consists of an availability tariff (fixed component) and a usage tariff (variable component). The availability tariff aims to cover the fixed

investment cost of water infrastructures. The usage tariff is to cover operation cost, manage social welfare considerations for low-income groups, and large families vulnerable to progressive increasing block tariff scheme. In addition, seasonal tariffs can be applied during tourism high seasons in areas with water scarcity, as a measure to prevent water shortages in those regions (Albuquerque, 2023[19]).

Box 3.1. Korea's two-part water tariff structure: a uniform bulk water tariff and a variable local retail tariff

The water tariff framework in Korea consists of two parts: a single uniform tariff for bulk water supply and a differentiated and variable tariff applied at retail to households, industries and other users. The bulk water tariff is uniformly applied across the country and applies to all inter-regional waterworks providing clean bulk water. The tariff is proposed by K-Water (Korea Water Resources Corporation responsible for national water resources management and inter-regional water supply), approved by the Ministry of Environment, and monitored by the Ministry of Finance. The retail tariff is set and levied by local government and approved by the local ordinance. It reflects locally specific conditions, including scarcity and operation and maintenance cost of the local water supply network.

The bulk water revenues are redistributed across bulk water service providers, as a form of cross-subsidisation, to improve water supply capacity of rural areas for a balanced inter-regional development. In principle, bulk water tariffs could be differentiated by basin but there is a strong perception in Korea that the cost of water should be the same for everyone (principle of water equity) (OECD, 2018[20]).

The pros of a nation-wide, uniform bulk water tariff

Korea's differentiated bulk and local water tariff framework is a legacy of its economic development strategy aimed at creating spill-over effects from wealthy and water abundant regions to underdeveloped and water scarce areas. During its fast economic development period in 1960-70s, the government heavily invested in constructing various water infrastructures such as multi-purpose dams, reservoirs, and inter-regional water pipelines to secure sufficient water supply to urban areas and industrial parks. These large-scale infrastructure developments boosted economic development.

From an equity point of view, Korea's policy has been to set bulk water tariffs nationally so that every user has access to water under the same condition (OECD, 2018[20]). The single tariff alleviates the disparity between urban and rural and upholds the principle of universal public service. This tariff is estimated based on the total expenditure on all water infrastructure investments in the country.

And the cons of a nation-wide, uniform bulk water tariff

The current uniform tariff scheme (river water charges and the bulk water tariff) does not reflect basin features or local conditions, such as water scarcity. As a consequence, these fees do not signal any water-related risks (scarcity) and do not encourage water use efficiency, particularly when water resources are scarce (OECD, 2017[21]). Moreover, the tariffs do not reflect operational costs. The cost of bulk water supply varies considerably depending on the location of the delivery point within the bulk water supply infrastructure system. From an efficiency point of view, it is therefore not appropriate to apply a uniform bulk water tariff to all water supply service providers. Tariffs are ideally set at a level that reflects the costs of supply at the abstraction point in the bulk service provider's system. Reflecting costs is central to securing sustainable finance for service providers (OECD, 2018[20]).

Sources: Lee (2019[22]); OECD (2017[21]); OECD (2018[20])

3.2.2. Systematically increase tariff collection

Tariff collection is a requirement to ensure sufficient revenue for PDAMs, which in its turn is a requisite to attract investments in the water sector. A basic requirement for tariff collection is to have reliable water services, and so tariff collection should go hand-in-hand with cyclical performance reviews of utilities (see Section 3.2.3). The Indonesian government has pointed out that the major barriers to the sustainable finance of water services is the low coverage of household connections due to a lack of willingness to connect and ability to pay for a connection. The four recommendations for increased revenue collection are: 1) increase the number of household connections, in particular those connections that can be realised at low marginal costs, 2) introduce revenue collection tools and instruments, 3) avoid free substitutes that are a negative externality, in particular groundwater abstraction, and 4) increase trust in tap water.

Increase the number of household connections

Increasing the number of household connections can support in revenue collection, particularly the household connections that can be realised at low marginal costs. The “last mile” connections can put pressure on sustainable cost recovery as these areas are relatively more expensive to connect, although these users should not be left behind in gaining access to safe water supply and sanitation.

High and upfront connection charges pose a significant barrier to connecting low-income households. Whilst connection costs cannot be free, direct subsidies or arrangements with low-income households could be considered through public, aid or philanthropic funding. One option can be to modify the payment conditions, such as an instalment scheme, for low-income households. For example, Manila Water Company in the Philippines extended the payment deadline for connection fees from 1 year to 2 years or even 3 years, allowing an increase in the number of low-income households’ connections. ADB advanced the connection fee to Manila Water Company through an interest free loan, which customers then repaid to Manila Water Company upon connection. Manila Water Company deposited the community’s repayments into a revolving fund[6] that was used to connect other low-income areas in a similar way (Asian Development Bank, 2008[23]). Micro-credits are another option. For example, Indonesia has good experience with a 6 to12-month loan scheme to connect low-income households to the water supply grid, alongside capacity building programmes for PDAMs (BAPPENAS and UNICEF, 2022[24]).

Other options could be reviewing the existing regulation to reduce the cost of connection for low-income households. Usually, connection costs increase with the distance to the pipe network, which generally disproportionately affects low-income households. Examples implemented in other countries are: 1) requesting service providers to connect all low-income households under their area, regardless of the distance to the pipe network, 2) providing the materials to reach households up to their location (or a fixed number of meters) or, 3) defining a maximum connection fee.

Revenue collection

Once households are connected, consistent billing and revenue collection ensure a reliable revenue stream. Privatising bill collection could be an option. Strict monitoring and enforcement of revenue collection, monitored by an economic regulator, is another way. For example, in Israel every user pays its water bill, including the poor. Those who are not able to afford the water bill receive government subsidies that are distributed to the user through the national water company.

Avoid free substitutes for water

As long as groundwater is a free alternative for treated water supply, there is low incentive to purchase water from PDAMs. This would not be an issue if groundwater abstraction did not have any negative impacts. However, groundwater abstraction also contributes to land subsidence in cities such as Jakarta. Section 3.3.1 further discusses regulations and charges for groundwater abstractions.

The new law (No. 259/2022) on Standards for the implementation of Groundwater Permits is a positive development in this context. It stipulates that business entities applying for groundwater use are required to make a Certificate of Availability of Surface Water from the River Basin Organisation and PDAM. If surface water and water supply is available, the permission will be denied (Questionnaire, 2022[4]).

Increase trust in tap water

Households' trust in service delivery and water quality is an essential requisite in any effort to increasing connections and tariff collection. Therefore, solutions to ensure water quality and service continuity should be prioritised. The economic regulator plays a key role in enforcing the good performance of utilities (see Section 3.2.3). Communication campaigns to increase trust in tap water could be implemented, such as public education, replacing aged pipelines and real-time water quality information sharing to end-users. Examples from Korea and Paris, France, are presented in Box 3.2 and Box 3.3. The 225 out of the 388 PDAMs that were assessed as "healthy" could start with such communication campaigns.

Box 3.2. Increasing trust in Korea's tap water

Korean citizens' trust in tap water safety is low, despite the high quality of tap water. The direct drinking rate of tap water remains at around five percent of all customers, even though all tap water meets the stringent National Health and Water Quality Standards. This public mistrust came from experience with past incidents like the 1991 Nakdong River phenol contamination and concerns about aged distribution pipelines.

The Korean government is aware of the importance to rebuild public trust in tap water safety in order to improve the tap water direct drinking rate. It has therefore taken several measures:

- Public education on tap water safety and the lower costs of tap water use compared to bottled water consumption;
- Open blind tests for consumers to compare the taste of tap water and bottled mineral water;
- Replacing aged distribution pipelines;
- Real-time tap water quality information sharing to end-users through a mobile application and electronic bulletin boards in towns and apartments.

Sources: OECD (2017[25]) *OECD Environmental Performance Reviews: Korea*; K-water (2017[26]) *An In-depth Study for the Health Promotion Plan of Tap Water*

Box 3.3. Encouraging Parisians to drink tap water

Eau de Paris (literally translated as "Water from Paris") is the drinking water company of Paris, France. Over the past ten years, Eau de Paris has launched several campaigns to increase customer's trust in drinking tap water, and successfully so: over 76 per cent of Parisians even serve tap water to their guests.

Besides water quality and delivery standards, customer satisfaction is one of the key service indicators for Eau de Paris, as the company believes that their customers pay for the *service* of water delivery rather than the water itself. Customer satisfaction is monitored through annual surveys, monthly committee gatherings on client satisfaction, and direct client feedback collected by ground technicians.

Eau de Paris has launched several public campaigns promoting safe and tasty tap water:

- "Product placement", such as visibly putting a glass of tap water on the mayor's table in public appearances;
- Working with offices, restaurants, and 600 shops to make tap water easily accessible for clients;
- Placing hundreds of public drinking water fountains across the city of Paris;
- Campaigns on social media, billboards, radio, etc.;
- Promoting tap water at cultural events, sports events, etc.

Figure 3.3. Eau de Paris billboards

Note: The billboard says: "I choose the water of Paris"
Sources: Eau de Paris (2022) *Customer Satisfaction report of Eau de Paris*; and personal correspondence

3.2.3. Economic regulation to supervise tariffs and operations of service providers

Economic regulation can support in setting appropriate tariffs and improving efficiencies of water service providers. Economic regulation in the water sector protects the public interest by making water service providers accountable for their performance and by establishing an independent price-setting process

(OECD, 2015[8]). The regulator independently oversees the sector. It also builds public trust in the administration as an effective rule maker (OECD, 2015[8]).

Economic regulation in Indonesia may be an effective response to some of its water sector challenges, including the limitations of the tariff setting process, poor service delivery, fragmentation of roles and responsibilities in the sector and public distrust in drinking water services. Ultimately, economic regulation can increase the creditworthiness of the water sector and attract investments. Economic regulation can also improve planning and expenditure on water infrastructure, which encourages better spending of scares financial resources. For instance, by reviewing and comparing the plans and investment programmes of different utilities, a regulator can detect synergies with other sectors, opportunities for combining of investments, guide on the consolidation of utilities, or advise on more economical alternatives for the proposed investments. The regulator could support in the phasing out of unhealthy PDAMs and guide on consolidation of PDAMs if appropriate.

It is worth mentioning that an economic regulator is not just there to supervise PPP contracts. Economic regulation is equally relevant to ensure service provision by public utilities. In this context, the Portuguese regulator ERSAR is a good example, as it regulates both public and private service providers and it has different procedures for each category.

Indonesia has some experience with regulation of the water sector. The annual public performance assessment of PDAMs by the Ministry of Public Works and Public Housing and the Financial and Development Supervisory Agency is a regulatory practice. Moreover, an independent regulatory body was established for the DKI Jakarta service area (Ministry of Public Works and Housing, 2021[3]; Badan Regulator, 2023[9]). Economic regulation at national level would be a valuable addition to the current practice. The following section discusses how Indonesia's water regulation could mature towards a framework of economic regulation.

Functions of economic regulation

The key functions of economic regulation are to (see Table 3.2 for a more extensive list):

- **Set performance standards of water service providers**, including metrics such as leakages, bursts, pollution incidents, and unplanned outages. The Portuguese regulator ERSAR assesses the following metrics for water supply: service interruptions, mains failures, water losses, customer complaints, and an affordability metric (OECD, 2022[16]). For wastewater, it assesses flooding incidents, sewer collapses, compliance with discharge permits, customer complaints, and an affordability metric. Note that these standards are in addition to performance standards set by health and environmental authorities, regulating water safety.
- **Collect, analyse, and communicate data on actual performance of service providers**. Performance of service providers is compared and can be benchmarked against, for example, the most efficient operator. Comparative performance data is commonly made public as an incentive for improvement. If Indonesia is considering a nationwide, uniform tariff for bulk water or retail water, performance reviews are especially important to provide incentives for good service delivery.
- **Set rules for tariff-setting and charges**. This concerns the methodology, design, and the eventual tariff for each service provider. Regulators have a particular role in shielding the tariff from political interference, for example by providing a binding opinion on the tariff proposal by the municipality or operator. When the opinion of the regulator is non-binding, the municipality or utility should justify any deviations from the regulator's recommendation.
- **Review expenditure programmes of service providers**. The regulator can be involved in assessing the investment opportunities and expenditure programmes developed by local authorities and service providers (OECD, 2022[16])

- **Provide incentives for consolidation if appropriate**. If there are opportunities to reach economies of scale through consolidation, the regulator can provide guidance on this process, e.g., by conducting public consultations, assessments and providing opinions. This is particularly relevant to Indonesia as the consolidation of some PDAMs could provide substantial efficiency gains for operation and investment in the long term. Consolidation of PDAMs could take several forms and merger on a geographical basis is only one of them. Other options are the mutualisation of functions that can build trust across PDAMs and lead to more coordination or coordinated development and investment. Based on other countries' experience, consolidation can contribute to addressing challenges, and help to make better (efficient) investment decisions which lead to economies of scale, decrease operation costs, and improve water supply efficiency and decrease leakage (OECD, 2022[27]). USAID has conducted a detailed study on the consolidation of PDAMs, therefore this issue is not discussed in this report.

Institutional embedding of a regulator

Different types of regulatory models exist. Aside from self-regulation, major regulatory models include: regulation by government; regulation by contract, which specifies the regulatory regimes in legal instruments (the French model); independent regulation (Anglo-American model); and the outsourcing of regulatory functions to third parties, which makes use of external contractors to perform activities such as tariff reviews, benchmarking and dispute resolution (OECD, 2015[8]).

The third model, "independent regulation", involves the establishment of a dedicated regulatory body for water services. Over the past two decades, independent regulation has accompanied the reform of the water industry in many countries, in particular in the corporatisation of water operators and the consolidation of water service provision.

While a regulatory function is always independent from local and national authorities, it does not need to be a stand-alone institution. Economic regulation for water services can be bundled with a regulator covering other sectors, such as sanitation, energy supply, or a competition authority. For example, the Portuguese water regulator ERSAR regulates both wastewater and water supply services. The regulatory body can also be hosted as a unit within a Ministry, provided it is shielded from interference by that same Ministry. Indonesia currently does not have a regulatory body for the energy sector. ADB (2020[28]) has written a resourceful report on 'How better regulation can shape the future of Indonesia's electricity sector', which includes recommendations that are relevant for the water sector too.

A regulator requires specific expertise. The institution should be able to perform economic analyses to set appropriate levels of ambition in terms of operational efficiency and cost effectiveness; to review the appropriate tariff process and level; to review investment plans and financing strategies; to review operational performance; to set incentives, rewards and sanctions based on actual performance; to engage with service providers and users.

Economic regulators for water services interact with a broad range of institutions, at national or subnational level. This framework typically involves line ministries in charge of water policies, the Health Department in charge of water quality standards and Ministries of Environment in charge of effluents. It also involves Treasuries and Ministries of Finance (as regards tariff setting, expenditure programmes, and allocation of revenues) and Ministries of the Economy (in relation to competition policy). Various public agencies, e.g. environmental protection agencies, also play a role in specific issues of water regulation (OECD, 2015[8])

Table 3.2. Typology of economic regulatory functions for water and sanitation services

Regulatory functions	Definition
Tariff regulation	Establishing a tariff methodology and/or setting and updating prices or supervising the tariff setting process, determining tariffs by consumer group, establishing caps on revenues or rate of return on investment
Defining public service obligations/social regulation	Setting public service obligations (including requirements on access to services) and performance requirements for operators.
Defining technical/industry and service standards	Developing the standards that underpin the technical modalities and level of service delivery.
Setting incentives for efficient use of water resources	Establishing incentives or specific schemes to promote efficient water resource use.
Setting incentives for efficient investment	Establishing incentives or specific schemes to promote efficient investment.
Promoting innovative technologies	Establishing incentives or specific schemes to promote innovative technologies.
Promoting demand management	Establishing incentives or specific schemes to promote reduced water demand.
Analysing water utilities' investment plans/business plans	In some cases, the regulator may be asked to approve the business plan or the investment plan of utilities
Information and data gathering	Collecting data from operators and undertaking market research to identify trends and potential risks
Monitoring of service delivery performance	Monitoring of the performance of water services against a set of targets or of performance indicators. This can involve the benchmarking of water utilities.
Licensing of water operators	Granting or approving licenses for the operation of water systems.
Supervision of contracts with (public or private) operators	The obligations granted by public authorities to a specific utility may be detailed in a specific contract (it is usually the case when a private actor is brought in). The regulator may be tasked with the supervision of the contract.
Supervising utilities' financing activities	Monitoring the financial schemes of water utilities (e.g. bond issuance, equity investments).
Carrying management audits on utilities	Auditing and/or approving the business plans of utilities.
Customer engagement	Consulting with customers on regulatory issues; communicating regulatory decisions to the public.
Consumer protection and dispute resolution	Handling consumer complaints about regulated entities.
Advice and advocacy	Providing advice for policy making and project implementation; identifying opportunities for reforms; encouraging improvements to the regulatory framework.

Source: OECD (2015[8]) *The Governance of Water Regulators*

3.3. Recommendations to strengthen policy instruments that manage water demand and pollution

Water charges or taxes can help to promote efficient water use as well as pollution control and prevention. At the same time, charges can raise revenues to cover the costs of resource management, such as water treatment or reservoir management, thus saving scarce public funds. Moreover, charges that are set at the right level discourage water users from over-abstraction or discharging harmful effluents, saving on costs for water resources management such as treatment (OECD, 2017[29]). This paragraph discusses opportunities for abstraction charges and pollution charges in Indonesia.

The point of departure is that charges should at least reflect infrastructure costs, environmental costs and opportunity costs of using water (Box 3.4). Water charges should not be confused with "water sales" by the government or private entities. Water charges are a service charge for the supply and conservation of water resources. These services may include treatment, storage in reservoirs, distribution through canals or pipes, monitoring of flows, quality, and biodiversity, maintaining an environmental flow, administrative costs, etc.

Taxes can also generate public revenue. The OECD Working Paper on raising public revenue in Indonesia notes that there "is scope to broaden taxation of other environmental "bads" to simultaneously reduce

harmful behaviour and raise revenue" in Indonesia (Lewis, 2019[11]). The Working Paper recommends introducing sub-national taxes for environmental externalities that are local, such as water pollution. It also recommends introducing taxes on specific products such as chemicals and pesticides, following the polluter-pays principle. It should be noted that, in many OECD countries, pollution and resource taxes play a minor role in generating environment-related tax revenues (OECD, 2022[30]) and additional revenues, such as tariffs and land value capture (Chapter 4), will strengthen the sustainable financing of water services and infrastructure.

Box 3.4. Determining the right level of charges

From an economic theory point of view, water charges should reflect infrastructure and transaction costs, environmental costs, and opportunity costs; however, in practice the three costs are not always fully represented. The design of the charge scheme should, to the extent possible, consider these costs.

- **Infrastructure and transaction costs** can include costs of irrigation and storage infrastructure, wastewater treatment plants, sewerage networks, energy, and administrative, monitoring and data analysis costs. They depend on technological choices, infrastructure design and financing, operation and maintenance, and asset management. Revenues from water charges do not usually cover the cost of investment or operation and maintenance (this is typically the role of tariffs for water-related services). However, where an asset benefits several sectors - such as a multipurpose reservoir for water supply, industry, agriculture and energy - it would be appropriate for abstraction charges to cover the operational and financing costs. Charges can also cover the administrative and technical costs of managing and regulating water resources for the benefit of all users.
- **Environmental costs** correspond to the damage induced by water abstraction or pollution. For example, too much groundwater abstraction may cause land subsidence, saltwater intrusion in coastal aquifers, or reduced river flows. Excessive surface water abstraction may result in reduced environmental flows and ecosystem functioning. Note that the same level of pollution can generate different levels of externalities, depending on features of the receiving water body (e.g., dilution capacity, instream water quality levels) and potential uses downstream (recreational, drinking water, or other uses). Industry and public water supply can incur significant treatment costs to ensure that the abstracted water meets the quality standards.
- **Opportunity costs** of using water represent the lost opportunities of alternative water uses. These costs are incurred when one water user affects the water availability to another (potential) user. For example, higher water withdrawals by a city might affect the quantity of water available to downstream irrigators, thus imposing costs on the irrigators. The same holds for polluters as a water user. When a user pollutes water, making it unsuitable for use, it excludes other potential users that need good water quality for their use, such as aquatic animals or drinking water. The opportunity cost of water is defined as the highest value alternative use. The lower the opportunity costs are, the more efficiently water is being used. Opportunity costs are typically higher where water is scarce and competition to access is fierce. They are also higher when water is being used for low value uses, preventing access for higher value uses. If property rights are in place and tradable, the market value of water would reflect opportunity costs.

Source: OECD (2017[29]) *Water Charges in Brazil: The Ways Forward*

3.3.1. Water demand management of surface water and groundwater

There are several policy instruments for water demand management, including water charges and allocation regimes.

Water abstraction charges

Abstraction and groundwater charges, combined with water abstraction permits, exist in Indonesia (Table 3.3). The 2019 Water Law limits the granting of abstraction licenses for drinking water exclusively to state/region/village-owned enterprises. (World Bank, 2021[1]). International practice shows that water abstraction charges are commonly managed at sub-national levels, as is the practice in Indonesia (OECD, 2017[29]).

However, the enforcement of water taxes and charges is low (ADB, 2022[10]). For example, groundwater abstraction taxes are calculated based on groundwater permits. However, since such permits are rarely being issued, there is no base to collect the groundwater tax (ADB, 2022[10]). Moreover, the charges are below the levels of environmental effectiveness and uniform across users. A good international practice is to differentiate the level of the water charge by water source (groundwater or surface water) and by the type of user (residential, industry, agriculture) (OECD, 2017[29]).

Table 3.3. Regulatory and economic instruments for groundwater and surface water abstraction in Indonesia

	Relevant authority	Charge calculation or permit restrictions	Exemptions
Groundwater tax *Law No. 28/2009 on Local Tax and Retribution*	Districts Cities	a. type of water source; b. location of water source; c. purpose of removal and/or usage of water; d. volume of water removed and/or used; e. quality of water; and g. level of damages to the environment caused by the removal and/or usage of water.	Basic household use Irrigation Aquaculture Religious needs (On the condition of environmental preservation)
Groundwater abstraction and utilisation *Ministry of energy and mineral resources regulation 31/2018* *Misappropriation covered in Water Law no. 17/2019*	River basin organisation, PDAM	Business entities applying for groundwater use are required to make a Certificate of Availability of Surface Water from the RBO and the PDAM through evaluation process based on ground water conservation zones	
Groundwater permits *Ministerial Decree of Energy and Mineral resources No.259.K/GL/01/MEM.G/2022*	River basin organisation PDAM	Business entities applying for groundwater use are required to make a Certificate of Availability of Surface Water from the RBO and the PDAM	
Water resources permits *Ministry of Public Housing regulation no. 1/2016*	River basin organisation BUMN	Four types of water users (PLTA, PDAM, Industry, PLTA <10 MW) are required to make a permit application and obtain a technical recommendation from RBO	Basic household use Small scale agricultural cultivation
Surface water tax *Law No. 28/2009 on Local Tax and Retribution*	Provincial (50-80% of the tax is submitted to the district/town)	Calculated by considering a portion or all of the following factors: a. type of water source; b. location of water source; c. purpose of removal and/or usage of water; d. volume of water removed and/or used; e. quality of water; f. surface area of location for removal and/or usage of water; and g. level of damages to the environment caused by the removal and/or usage of water.	Basic household use Irrigation Aquaculture (On the condition of environmental preservation)
Water Resources Management Services Fee *Ministerial Decree of Exploitation and Maintenance of Watersheds*	Central or regional governments State-owned enterprise (In case of assignment of authority from central or regional governments)	Applied to 4 types of water users: Hydropower generator, Drinking water supplier, Industries, Agricultural business(plantation, fisheries) Common components for calculation a. Natural resource management cost required b. Value of economic benefit Specific component for each water user type c. Hydropower: Total Electricity Production (kwH) d. Drinking water: Volume of Water usage (m^3) e. Industry: Volume of Water usage for business activities (m^3) f. Agricultural business: Business area (ha)	Services Fee is applicable to all basins, but is currently applied in 7 river basins only. Basic household use Irrigation

Sources: ADB (2022[10]), Lewis (2019[11]), Law 28/2009 Concerning Local Taxation and Charges (2009[31]), Republic of Indonesia (2009[32]; 2022[33]; 2015[34])

Introducing and enforcing abstraction charges that reflect water scarcity (i.e., environmental and resource cost, see Box 3.2) and that cover the administrative costs of managing the system can reduce over-abstractions. At the same time, these charges increase tax revenues for operations and maintenance of

water systems. This paragraph suggests adjusting the water taxes based on scarcity and collecting taxes from a broad range of water users, including irrigation.

While all users should be charged in principle, start with and focus attention on the ones who have the more severe impacts on water quantity and quality. The following groups should not be overlooked:

- **Irrigation** is currently exempted from surface and groundwater tax, though fees may be charged for the maintenance of irrigation infrastructure. Various stakeholders explained that the exemption intends to keep the business of smallholder farmers viable. Traditional systems of water allocation ensure equitable water supply to all farmers, such as the *subak* irrigation system in Bali. Nevertheless, water demand for irrigation continues to grow, sometimes beyond the carrying capacity of the river (World Bank, 2021[1]). Abstraction charges that reflect water scarcity may incentivise a more efficient use of water resources. While irrigators may claim that water charges would significantly affect their competitiveness and put them at risk, such claims can be challenged when underpinned by solid research. For example, in Brazil it was estimated that a water charge equal to charges for other users (irrigation, drinking water supply), would represent 2% of farmers' overall costs. When farmers would pay 5% of the normal user charge, the charge would equal 0.1% of their overall costs (OECD, 2017[29]). In other words, the affordability issue is not self-evident and is worth studying, especially in water scarce basins where the condition of “environmental preservation” clearly applies (Table 3.3). It should nevertheless be acknowledged that farms are very diverse (ranging from small subsistence farming to large-scale commercial farms), and the capacity to pay and their impact on water resources varies markedly.
- **Drinking water utilities, or PDAMS**. Asking PDAMs to structurally pay for water abstractions may seem counter-intuitive given the financial distress of PDAMs. However, the upstream raw and bulk water supply providers are also in financial distress and in need of resources for operations and maintenance, such as through the Water Resources Management Services Fee. Strengthening upstream water infrastructure will also benefit PDAMs in the long run, as it secures a reliable water supply.
- Explore **household** charges for groundwater abstraction. Many small users make one large user, and this is also the case for individual boreholes, particularly in densely populated areas such as cities. It would be key to focus on the large users, and account for the cumulative effects of large numbers of small users, including household groundwater consumption (see Box 3.5 and Section 3.2.2). Ideally, volumetric abstraction charges for groundwater that exceed water tariffs, should be developed. However, this recommendation may not be fully in line with Indonesia’s cultural understanding that water should not be sold. As the infrastructure for groundwater abstraction is commonly privately owned and operated by property owners, charging the cost for abstraction and treatment does not provide an incentive to lower abstractions either. It is noteworthy that groundwater abstraction charges deliver best in combination with other measures, such as volumetric permits capping abstracted volumes, or taxes on pumping equipment or energy inputs for pumping.

Box 3.5. Water abstraction charges for small users: International examples

In **France** water users are exempt from paying abstraction charges below certain thresholds. These thresholds vary per water agency, the type of resource (groundwater/ surface water) and the scarcity of water. For example, in the Rhône-Méditerranée Corse River basin, water users abstracting less than 10 000 m^3 per year are exempted from paying abstraction charges. The threshold is reduced to 7 000 m^3 in areas facing water scarcity problems.

In **England and Wales**, some classes of small user have been exempted from charging, e.g., a borehole for household use only. Small volume users with a low water charge rate are viewed as a mere bureaucratic exercise, as the charge does provide any incentive to water use efficiencies. A charge should also reflect a service, and most small users will get little or no service other than knowing that their abstraction has been registered. They will not be inspected (or should not be — enforcement should be risk-based and small users will almost always be low risk).

In **Portugal**, the abstraction charge for surface and groundwater water is applied regardless of the purpose of the water use and public or private nature of users. However, there is a threshold related to the means of extraction. If the abstraction is done by a pumping system with a power of less than 5 HP, no payment is required, unless otherwise established in the river basin plan and justified by the special sensitivity of the affected area. This exemption essentially contemplates small farmers.

In **Spain**, at the central level, the competent authority (Ministry of Agriculture, Fisheries and the Environment, Central Government of Spain) may include some exemptions. River basin authorities shall issue within three months, in a mandatory way, and prior to the resolution to be adopted, a motivated report to provide the rationale for whatever exemption.

As per the new groundwater management, **Peru** is currently discussing a service tariff (not a use tariff) that levies those water users with a well of their own and that excludes agricultural groundwater users.

Source: Taken from OECD (2017[29]) *Water Charges in Brazil: The Ways Forward*

It is recommended to differentiate tariffs for groundwater and surface water based on scarcity (see for example Korea, Box 3.6). In those areas where groundwater resources are critically low, groundwater use is likely to become more expensive than the extension of piped water supply or construction of non-centralised solutions (OECD, 2019[13]). To reflect the geographical and temporal variations in water levels, water abstraction charges can be flexibly adapted across regions. For example, in France the threshold under which water users are exempt from paying abstraction charges depends on the water agency, the type of resource and the scarcity of water (OECD, 2017[29]). In another example in Portugal, a legislated scarcity coefficient for different river basins is applied to reflect different levels of water scarcity geographically and temporarily throughout the year (OECD, 2015[35]). Spatial and seasonal variation can be particularly important in agriculture. For instance, in Greece, water pricing is differentiated by region, while in Hungary, pressure multipliers are applied to raise prices in groundwater bodies facing water risks. In Indonesia, the implementation of water charges could, for instance, start in basins under pressure.

Water allocation regimes

Water allocation regimes are a combination of policies, laws and mechanisms to help determine who is able to use water resources, how, when and where. Water allocation regimes help in promoting water use efficiency, particularly important during periods of drought. Allocation regimes can exist at different scales within national contexts: some are set at national level (e.g. Costa Rica, Estonia, Luxembourg, Slovenia,

Switzerland), others at province/state level (e.g. Canada, Brazil), or at river basin scale (e.g. Australia, Colombia, Spain).

Indonesia has a practice of water allocation based on annual water entitlements. In absence of a water permit system, water allocation plans are submitted by the Irrigation Commission to the Ministry of Public Works on an annual basis. The Minister makes the final decision on annual water allocation based on the compiled water demand. Note that annual entitlements do not provide any security on water availability in the medium term, and thereby deter investment in perennial crops or efficient water-use technology. The Water Evaluation and Planning (WEAP) model is used for water allocation, and the Ministry has access to relevant data and advanced technology for reservoir operations, meteorological forecasts, hydrological models, hydraulic models, and satellite imagery. Actual water uses and return flows are not factored in the annual allocation entitlement plans. A ladder of priority water uses during water scarce periods is in place. Some additional tools can be considered as an addition to Indonesia's water allocation practice: water abstraction cap based on permits, enforcement and compliance mechanisms, local allocation practices and efficiency promoting instruments[7].

Most allocation regimes impose an overall limit ("cap") on water that can be abstracted from a resource pool; although in practice this limit may not be respected (OECD, 2015[35]). There is variation in terms of how that cap is defined. Some regimes put a limit on the volume of water that can be abstracted, some put a limit on the share of water that can be abstracted, while some others restrict who can abstract water, but without limit on how much water can be abstracted (OECD, 2015[35]). For groundwater, setting an abstraction limit requires consideration of the amount of water that should be left in the aquifer to meet non-extractive uses (e.g. flows for ecosystem needs, protection of water quality) and future uses. Examples from Denmark, Mexico, United States (Texas) and France illustrate approaches to limit the long-term abstraction of groundwater (OECD, 2017[36]). Allocation regimes commonly have an established sequence of priority uses to determine which sectors or uses will be allocated available water prior to others. In many OECD countries, domestic and human needs rank as the highest priority (e.g. Australia, Brazil, Colombia, Israel, Portugal) (OECD, 2015[35]). In some countries, water permits or water entitlements can be traded, leased or transferred. This occurs in formalised water markets such as in Australia (Murray-Darling Basin), Chile or Spain, or through an abstraction licensing system such as in the United Kingdom.

An allocation regime works best when coupled with instruments that provide incentives for efficient resource use and that remove perverse incentives for inefficient use. This can be done through appropriate abstraction charges or fees, which have been discussed earlier in this chapter.

Communities may already have allocation practices in place. Where these exist, valuing traditional knowledge through the recognition of indigenous peoples' stewardship of land and water and customary water arrangements can potentially be an effective means to enhance sustainable development in a basin. The Balinese Subak system is an example of a local water allocation practice in Indonesia.

Compliance and enforcement of water allocation regimes can build public confidence in the management of water resources, discourage illegal activity, and drive positive action. Monitoring of water withdrawals and return flows is an important element of compliance and enforcement. Metering agricultural water withdrawals poses a challenge in some countries. In some countries metering, monitoring and reporting activities for agriculture are undertaken only in areas where significant abstractions occur. A declaration of water consumption could be an alternative way of monitoring agricultural water use. Compliance mechanisms can include sanctions for non-compliance with the rules and regulations of allocation regimes.

3.3.2. Pollution charges

The cost of water pollution is estimated at around IDR 45 billion per year (ADB 2018), yet pollution charges remain an underutilised economic instrument in Indonesia. What is more, the current level of charges is far from correcting externalities. More importantly, pollution charges can incentivise polluters to reduce

dirty effluent loads, which leads to cleaner raw water sources, and ultimately to reduced treatment costs for drinking water supply.

Pollution charges are rarely a stand-alone policy. They are typically combined with regulatory instruments (effluent standards on treatment requirements for wastewater) and information instruments (on water quality and the performance of utilities and service provided) (OECD, 2021[17]). Regulatory instruments are particularly important, as these set environmental quality standards that ensure that the total pollution load does not breach ecological or human health limits (OECD, 2017[29]).

Table 3.4 presents the water pollution-related instruments in Indonesia. While policy instruments are present, implementation, monitoring and enforcement mechanisms need to be strengthened, and close coordination with environmental authorities is a critical factor for successful implementation (Lewis, 2019[11]). Local authorities have a critical role to play in collecting pollution charges and enforcing compliance with water quality standards (ADB, 2022[10]). An example of an integrated approach of stakeholder involvement, monitoring and enforcement in tackling pollution, is the Scottish Environmental Protection Agency's strategy to manage diffuse pollution from agriculture (Box 3.6).

Table 3.4. Available policy instruments to address water pollution in Indonesia

	Type of instrument	Authority
Wastewater discharge licenses	Regulatory	Regulation No.P102/MENLHK/SETJEN/KUM.1/11/2018, MoEF and No.32/2009, MoEF
Protection and management of water quality	Regulatory	Regulation No. 22/2021, MoEF
Water quality standards	Regulatory	Regulation No. 22/2021, MoEF
Wastewater quality standards	Regulatory	Regulation No. 22/2021, MoEF
Water Quality Index: pollution standard for companies	Regulatory	MoEF
Continuous Industrial Emission Monitoring Information System	Regulatory	Regulation No. 13/2021, MoEF
Polluter pays principle	Economic principle	Regulation No.13 Tahun 2011, MoEF
Water pollution charges	Economic	Government Regulation No. 46/2017

Sources: Questionnaire for the National Dialogue on Water (2022[4]); World Bank (2021[1])

Box 3.6. Tackling diffuse pollution in close cooperation with stakeholders: lessons from Scotland

The Scottish Environment Protection Agency (SEPA, a non-departmental public body and environmental regulator) is responsible for enforcing the 2003 Water Environment and Water Services Act 2003. The Scottish strategy to tackle diffuse pollution builds on three key orientations: (i) the need for a meaningful engagement of stakeholders; (ii) the use of evidence and data in compliance monitoring enforcement; and (iii) the widely shared sense from the sector that shifting to sustainable farming practices is the only way to ensure farmers' livelihood in the longer run.

A Diffuse Pollution Management Advisory Group was set up to include a wide range of interest groups. It developed a strategy to reduce diffuse pollution focusing on 14 priority catchments and focus areas.

The Scottish approach has been highly cooperative. Since 2001, the engagement with interest groups in public participation was established and maintained throughout the implementation process of the Act. During a period of two years, SEPA organised meetings with representatives of each policy sector to discuss new regulatory decisions and licenses, where stakeholders were able to bring arguments and evidence to have SEPA proposals modified. These discussions have created support for the adoption of the regulatory framework and reduced conflicts over binding measures through the development of trust between interest groups. SEPA also established a National Advisory Group engaging all key interest groups and providing a mechanism to resolve conflicts arising throughout the implementation process. In collaboration with professional organisations and farmers unions, the Scottish Government and SEPA worked with individual farmers to gain their trust and drive acceptability.

SEPA has developed interactive maps and tools to make the collected data on pressures and water quality more accessible. SEPA has used data and evidence to establish a common understanding of the status of the environment and on the level of commitment required to reduce water pollution. Scientific and photographic evidence of breaches and polluting practices has been presented to the farming sector representatives in dedicated meetings to convince the farming sector that diffuse pollution from agriculture is the main polluting source.

SEPA and the Scottish government have been clear from the outset that they would adopt a strict regulatory approach. Based on the results of the individual farmers' audits, SEPA requires farmers and land managers to adopt measures to reduce polluting activities. Any issue of non-compliance identified during an initial visit would be addressed through subsequent revisits, followed by fixed monetary penalties if the non-compliance persisted. For the first cycle, the initial visits revealed a compliance rate of 34 per cent. At the end of several rounds of visits, 98 per cent of farmers carried out the required actions.

Source: OECD (2022[37]); De Vito, Fairbrother and Russel (2020[38])

It is recommended to increase pollution charges in Indonesia to correct externalities. Pollution charges are usually calculated based on volume and pollution content, and differentiated according to the sector, e.g., industries or agriculture (Acteon, 2010[39]). Other instruments, such as regulatory and voluntary instruments, need to support any economic instrument to effectively tackle pollution (Table 3.4).

Table 3.5. Policy instruments to address water pollution

Regulatory	Economic	Voluntary
• Pollution discharge permits • Non-compliance penalties – non-renewal of resource permits or greater restriction on current permits • Non-compliance fines	• Pollution taxes (on inputs) • Pollution charges (on outputs) • Tradable pollution permits • Payment for Ecosystem Services	• Information and awareness campaigns • Farm advisory services for improved farming techniques (to minimise negative impacts on water quality) • Contracts/bonds (e.g. land retirement contracts) • Best environmental practices • Environmental labelling – products that meet certain environmental standards can be marked and sold at a premium and/or subsided

Source: OECD (2017[29]) *Water Charges in Brazil: The Ways Forward*

However, examples of pollution charges for diffuse sources of pollution remain limited (OECD, 2017[12]). The heterogeneous impacts and damage costs of diffuse water pollution make their management more difficult than point source pollution. Additional reasons for the slow uptake of pollution charges in the management of diffuse water pollution may include: political resistance from polluters; limited data on the costs of environmental degradation; difficulties in measuring diffuse sources of pollution and attributing them to landowners; and the complexities of ambient pollution concentrations, which are a function of both point and diffuse pollution sources, natural background levels, watershed characteristics, fate and transport parameters, and stochastic environmental variables (OECD, 2017[12]; Shortle and Horan, 2001[40]). Because it is not economical to observe individual diffuse water pollution sources directly (i.e. fixing a water quality meter to a discharge pipe), the design of diffuse pollution charges must build upon one of three alternative management options:

- **Attach charges to certain land use practices and inputs as proxies to pollution**. For example, intensive livestock farming, extensive non-permeable pavements, excessive fertiliser use and unsustainable tillage practices can lead to diffuse water pollution. However, such an approach can limit land use practices and innovation, and can be less effective at reducing pollution in some instances (OECD, 2010[41]).
- **Charge polluters collectively for their jointly determined impacts on ambient pollution levels at particular receptors**. This approach transfers the burden of asymmetric information and the difficulties of the measurement of ambient diffuse pollution and predictions under certain management scenarios from regulators to individual polluters.
- **Attach charges to estimated diffuse emissions via modelling**. Computer modelling offers an opportunity for individual land parcels to be managed as part of a wider catchment to achieve water quality objectives. Pollution charges to incentivise diffuse pollution can be set at a level directly proportional to the amount of estimated pollution generated or reduced. It allows land managers to innovate farm and land management practices within a pollution limit without being restricted by the inputs and land use practices they use. The approach relies on a robust calibrated and validated model and reliable input data.

3.3.3. Earmarking and collecting revenues from water taxes and charges

Contrary to what this chapter may imply, water taxes and charges are not primarily meant to mobilise funding for water infrastructure investment and maintenance[8]. Rather, the main economic rationale of water taxes and charges is to make users internalise the costs of water abstractions and pollution. Water taxes and charges are thus grounded on behavioural responses from users rather than on creating revenue

from charging abstraction and pollution. However, in addition, abstraction and pollution charges do raise revenues from water users and polluters. From that perspective, they deliver best as water policy instruments if the revenues are used to cover expenditures that contribute to water management, possibly in the basin where they originate.

Public finance economists usually do not favour earmarking revenues collected from taxes (i.e. spending revenues from the taxes on specific projects related to the original purpose of the tax) for several reasons. First, they argue that public finance efficiency will be improved if the revenues from the tax are used to cut existing distortionary taxes (for instance, a wage income tax makes labour more expensive and may thus discourage work). This refers to the so-called double-dividend hypothesis: the environmental tax or charge (such as a tax per unit of pollution) addresses the environmental problem by sending signals on the damage caused (first dividend), and the revenues raised by this tax or charge can help reduce the distortions associated with existing taxes (the second dividend). Second, the revenue collected can finance any public spending not related to water management that is considered a priority, e.g. investment in infrastructure or, more generally, the provision of public goods and services such as education, national defence and security. Moreover, earmarking distorts budget allocation decisions since decision makers are not free to allocate spending on the basis of need or the value of public money, but have to accept predetermined allocation rules. Other examples of criticisms on earmarking is that scrutiny and control of governance may be weakened since spending does not have to be justified, there may be fluctuations in programme funding, and no necessary link between the earmarked tax and the provision of the good (ITIC, 2013[42]). For instance, on the one hand, a rise in revenues from earmarked taxes may lead to excessive spending; on the other hand, in case of a decrease, the earmarked taxes may only partly finance the programme; the link between the collected revenues and the cost of the programme is lost, with the effect that people may misperceive the cost of the programmes.

Nevertheless, earmarked taxes or charges can be defended based on political economy arguments. When revenues from the charge are earmarked, individuals “can make “private” choices on the basis of some reasonably accurate comparison of the costs and benefits of the specific public services, one at a time (Buchanan, 1963[43]). Moreover, other arguments in favour of earmarking include: the “benefits principle of taxation” (i.e. taxes should be borne by those who benefit from the associated expenditure); weak control and weak internal incentives in bureaucracies; mitigating erratic financing decisions of programmes; and the fact that budgeting with general fund financing (i.e. non-earmarking) may not be periodically reviewed to ensure that spending is allocated according to need and the value for money (Teja, 1988[44]).

Several measures can be adopted to compensate the drawbacks mentioned above from earmarking revenues from water charges or taxes. Typically, expenditures should be somehow related to revenues. The action plan adopted for public expenditure must be commensurate with the revenue collected. If not, stakeholders would not see the benefit from taxation either because the action plan is not implemented, or because the contribution of water charges to the plan is insignificant. It does not mean that the action plan should be strictly tied to revenues. Additional sources of funding could be considered, such as budget transfers. Moreover, the revenues and expenditures should be of the same magnitude for the water action plan to be realistic. Differences of one or more orders of magnitude undermine feasibility and credibility of the programme of action, and the legitimacy of the water charges. The rules for matching revenues to spending should be transparent and effective to improve the ‘benefit principle of taxation’. Earmarked revenues should be regularly reviewed, to ensure efficiency and relevance, with a view to phase out earmarking once the priority programme has been implemented.

Box 3.7. International examples of spending revenues from charges

Many countries opt to earmark water charges for pollution or abstraction. Charges can be earmarked for different types of environmental expenditures, and revenues can be shared across government (national, regional, local).

In **Costa Rica**, the water pollution levies for chemical oxygen demand and total suspended solids have been earmarked as follows:

- 70%: investment in sewer networks and household wastewater treatment;
- 15%: promotion of technology and clean production sources aimed at reducing contamination;
- 10%: monitoring by the entities of the Ministry of Environment and Energy;
- 10%: administrative costs;
- 5%: environmental education activities.

In **Poland**, 100 per cent of the water effluent charges are earmarked to finance water treatment programmes. Abstraction charges for groundwater and surface water, however, are allocated as follows (with the condition that local governments may only use the revenues for environmental objectives):

- 20% for the municipal government;
- 10% for the county government;
- 46% for the provincial ecological fund;
- and 24% for the national ecological fund.

Peru applies water abstraction charges (Retribuciones Económicas por el Uso del Agua, REUA), and uses the revenues for the following actions:

- Formulation of water resource management plans per basin; management and administration of water resources in natural sources of water; integrated water management in less-favoured watersheds; and preservation of water resources in basin headwaters.
- Control and monitoring measures to ensure the protection of water quality, an increase of water availability, conservation of sources of production and efficiency of water use.

In **Turkey**, the registration fee of water pollution control charge goes to the financing of municipalities.

Source: OECD (2021[45]) *Pine database* https://pinedatabase.oecd.org/, (accessed 8 December 2022);

Collection of water taxes and charges

Collection of taxes and charges is a major challenge in Indonesia. Given the dire need of funding for the water sector, it may be worthwhile to introduce financial development targets for water charges and tariffs in the next Medium Term Development Plan. There are many ways of collecting charges, and different institutions can be tasked with collection simultaneously. For example, Peru applies different methods of collection of water abstraction charges, depending on the rights granted for the use of water (see Box 3.8).

Box 3.8. Water revenue collection in Peru

In Peru, all water abstraction revenues (Retribuciones Económicas por el Uso del Agua, "REUAs") are allocated to one budget, namely the budget of Peru's National Water Authority (ANA). However, different actors are responsible for the collection of water abstraction taxes, depending on the rights granted for the use of water (Head Resolution No. 083-2019-ANA):

- Users of surface water for agricultural purposes that receive the water supply service pay their charges to the hydraulic infrastructure operators:
  - After water use, for the volume of water used.
  - Prior to the use of water, for the volume of water requested.
- Users of surface water other than farmers, users of groundwater, users of seawater and users with their own supply system pay to ANA annually, according to the volume of water used during the previous year. In case of failure of reporting, the volume used to calculate the charge is equal to the volume granted in the right of use.
- Users with authorisation to discharge treated wastewater pay to ANA annually and in advance depending on the volume of the authorised discharge.
- Users with water use authorisations pay to ANA annually based on the volume of water used. In case of failure to submit the reports, the volume used will be equal to the volume granted in the right of use.

Source: OECD (2021[45]) *Water Governance in Peru*

3.4. Recommendations on the enabling environment for water investments

A favourable investment climate can channel more investments towards water infrastructure in Indonesia. As part of the National Dialogue on Water, a Focus Group Discussion was conducted to discuss the enabling environment for water investment in Indonesia (November 2022). The enabling environment can be characterised as a set of policies, regulations and institutional arrangements that facilitate investment in activities that contribute to water security. This includes sector-specific policies, regulations, and institutional arrangements as well as those relating to the regulation of the financial sector and capital markets.

The Focus Group discussed investment in water as a resource used by several sectors, such as water supply and sanitation services, agriculture, environment, disaster risk mitigation (flood protection), energy (hydropower) and industry. The Group discussed four dimensions of the enabling environment: the investment environment, channelling investment to water, projects sustainability, the water lens on investment in the wider economy (see Box 3.9).

The Focus Group agreed that the Indonesian water sector is considered as a promising investment opportunity. It has untapped business opportunities for foreign investors and commercial banks. Population is steadily growing, the economy is rapidly developing, and (treated) water demand is on the rise. Despite this bright prospect, the Indonesian water sector is still looking for foreign investment and private financiers to meet its everlasting financing demand for water infrastructure investment. Four critical priorities and strengths emerged from the focus group:

3.4.1. Limitations

- **Water sector regulation**: Indonesian stakeholders evaluated their water sector regulation as poorly attractive for domestic and foreign investors in terms of revenue generation and operation efficiency of PDAMs. One of the main reasons is the limited opportunities for a robust business case, as the prevailing low water tariffs are insufficient to cover operations and maintenance costs of water treatment and supply. The role of a water service regulator to monitor and control the tariff setting process and operational performance is especially important to make the water sector attractive to domestic and foreign investors and private financiers. Indonesia has not established a national independent economic regulator that oversees the performance of service providers, guides on investment programmes, assesses customer service and reviews the tariffs (see Section 3.2.3). In addition, a governmental guarantee by central government agencies, such as the Indonesian Infrastructure Guarantee Fund (IIGF) is a key part of attracting private finance (ADB, 2020[46]). This poses a barrier in attracting investments in many low- and middle-income countries, as cash for de-risking is not readily available or sufficient, and risks and revenues are not always fairly allocated.
- **Decentralised for policies and investment decisions**: Indonesia has an ambitious and well-designed Medium Term Development Plan and a Vision 2045 Toward Water Security. However, decentralised policies and investment decision making processes by local governments hinder or delay implementation of this ambitious blueprint. The lack of a clear roadmap for implementation of the National Master Plan is also indicated as an obstacle.
- **Data for decision making**: The absence of comprehensive project data management among Ministries, public organisations, and the private sector affect the capacity to document the track record of water-related PPP, a crucial feature to attract domestic and foreign investors. Comprehensive data management, including on the performance of local PDAMs, is helpful to gain trust in the water sector from the private sector and stimulate the supply of private finance.

3.4.2. Strengths

- **Financing availability**: Foreign investors consider Indonesia as untapped PPP market full of business opportunity. Singapore, Malaysian and Chinese companies have participated in several hydropower and drinking water supply PPP projects. The Indonesian government issued a Green Fund to facilitate infrastructure development including water projects. Furthermore, the Indonesian government launched the Green Infrastructure Bond to facilitate climate resilient infrastructure development including water infrastructure. Indonesia has a solid local financial market, able to meet financial needs for various PPP projects. The pending issue on financing availability is how to secure the repayment capability of local governments to domestic and foreign private financiers. In a nutshell, local water supply is solely administered by local governments. It means that guarantors of PPP projects on local water supply are local governments. Therefore, sound financial stability and strong commitment of local governments to pay back commercial loans are key to facilitate private financiers' engagement in water projects.
- **Access to affordable finance**: As a result of a business-friendly investment policy, ample PPP project opportunities, and overall national economic development, the Indonesian water service providers can access affordable finance. However, financiers are still concerned about local governments' capacity to pay back loans or capital, which is a key barrier for financing water in Indonesia as this is largely led by local governments.
- **The National Development Strategy**: The National Development Strategy of Indonesia stipulates that improving water security is one of its main goals and acknowledges the importance of the Water-Food-Energy Nexus. In addition, this masterplan considers the correlation between water and climate change.

Box 3.9. The enabling environment for water investments: four dimensions

1. A sound investment environment

This dimension focuses on the enabling conditions required for providing opportunities for all investors (public and private, large and small, and foreign and domestic) in the country. This dimension consists of a set of macro-economic indicators defining the national investment environment from external data sources and series of questions.

2. Channelling investment to water

This dimension focuses on the specificities required to attract investment to water sectors. A sound investment environment will attract and grow the scale of investment at a national level, however water sectors attractiveness also depends on particular elements such as sector specific policy and regulation, the business model and revenue stream elements.

3. Sustainable projects

This dimension focuses on the projects requirements to ensure the sustainable of the investment, meaning the project value, impact, and the support required, which relates to the ideation and investigation phases of the projects and its operation and monitoring.

4. An economy wide water lens

This dimension focuses on how the wider economy considers water, in particular how economic sectors manage their impact on water resources and consequently, support or undermine water security.

Source: OECD (forthcoming) *Enabling environment for water investments - score card*

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Notes

[1] Improved water sources include drinking water from piped water sources and drinking water from non-piped improved water sources, e.g., boreholes or tubewells, protected dug wells, protected springs, rainwater, and packaged or delivered water. This definition was derived from the SDG 6.1.1 data portal: https://sdg6data.org/en/indicator/6.1.1 (accessed on 21 February 2023).

[2] Drinking water from an improved water source which is located on premises, available when needed and free from faecal and priority chemical contamination, is considered as a safely managed drinking water service. This definition was derived from the SDG 6.1.1 data portal: https://sdg6data.org/en/indicator/6.1.1 (accessed on 21 February 2023).

[3] Ministry of Home Affairs Regulation 71/2016: Guidelines for Setting Tariffs of Drinking Water

[4] Regulation 22/2021

[5] River Basin Authorities, as a government entity, are not allowed to incur any charges on water. This is an exclusive right of non-government entities.

[6] A revolving fund is a financing mechanism that allows a fund to be replenished through the repayment of loans, rather than relying on external sources of funding. In the context of water utilities, revolving funds are often used to finance the provision of water and sanitation services in low-income areas. Water utilities may use revolving funds to provide loans or subsidies to low-income households or communities to help cover the costs of connecting to the water supply network or improving their sanitation facilities. As households or communities repay the loans, the funds are replenished, allowing the utility to provide assistance to additional households or communities.

[7] The following section is based on the OECD (2021) Toolkit for Water Policies and Governance: Converging Towards the OECD Council Recommendation on Water.

[8] This paragraph originates from the OECD (2017) report on Water Charges in Brazil: The Ways Forward.

4 Land value capture as an innovative funding source for water infrastructure

The Dialogue recommends the utilisation of Land Value Capture (LVC) as an additional source of financing water in Indonesia. Land value capture is the recovery and public utilisation of land value gains that result from public planning and infrastructure investments. This Chapter discusses several LVC instruments that can be used to finance water infrastructure in Indonesia. It emphasises that, while the legislative framework is mature, Indonesia still needs to strengthen the enabling framework for LVC. Local government capacity to implement LVC and the maintenance of land registries require particular attention.

4.1. Land Value Capture as an infrastructure financing tool

Governments increasingly struggle with financing key infrastructure and services. In Jakarta for example, the lack of adequate piped water is the root cause of persistent groundwater extraction, which is causing parts of the city to sink by up to 12 centimetres per year. Often overlooked however is the fact that public investments in infrastructure lead to higher land prices. Left untouched, this newfound wealth is in fact a direct transfer of public funds in the form of windfall gains to private landowners.

This unearned wealth is an untapped resource that, when recovered for public use, has the potential to be reinvested in much needed infrastructure and services. Land is one of the most valuable forms of capital. In the OECD, land makes up approximately 40% of the total capital stock, amounting to USD $152 trillion (OECD, 2017[1]). Utilising even a portion of this value towards infrastructure provision can help in improving our built environments and transitioning societies towards a climate-friendly future.

4.1.1. Conceptualisation of Land Value Capture

The premise of Land Value Capture (LVC) is simple: public action should generate public benefits. LVC refers to policies that enable governments to recover windfall gains arising from government actions for public benefit. These actions include tangible developments such as the provision of water, energy, and housing, and intangible developments such as rural to urban land conversion, flexible land-use regulations, and more generous building density permits. Increases in land value stemming from such interventions can be large. For example, Smolka (2013[2]) finds that an investment in piped water provision of USD $1.02 per square meter of land increased land prices by USD $11.10 per square meter in locations within 10 kilometres of city centres in Latin America. Land values can increase by up to 600% when converting rural land to urban uses, depending on local market conditions (Borrero, 2016[3]).

Beyond its substantial revenue potential, LVC is a valuable funding tool for the following reasons:

- It can be an economically efficient revenue source. Land value gains which result from public infrastructure are windfall profits for private landowners rather than a return from their economic activity, such as own investment. When governments tap windfall gains, they do not generate efficiency losses that typically result from taxing economic activity. They may not discourage investment, for example.
- The time profile of LVC revenues is also beneficial. Land value gains typically materialise upfront, when a public investment project is announced or carried out, reducing borrowing needs. This is particularly attractive for countries that pay a high price for access to international capital markets.
- LVC can be an inclusive instrument, as it can redistribute land value gains accrued by affluent landowners to be shared with the community. As the landowners who benefit most tend to be the wealthiest, LVC can be progressive in nature. Furthermore, revenues from LVC instruments can serve to finance infrastructure that benefits the poor (Wolf-Powers, 2012[4]).

LVC can also promote environmental sustainability. Reaching biodiversity protection and greenhouse gas emission reduction targets as well as climate adaptation objectives requires upfront investment, including for water infrastructure. Land-use planning is central to reaching these objectives and is also central to LVC. LVC can contribute to green infrastructure (such as to harness the carbon sink and biodiversity potential in wetlands) and more sustainable land-use practices (for example densification around existing water supply infrastructure). LVC can also encourage policymakers and developers to use land in more efficient ways, avoiding wasteful land-use practices.

4.1.2. Limitations and barriers to Land Value Capture adoption

LVC needs to be used well to encourage equitable and sustainable land development. LVC can lead to overdevelopment and unnecessary increases in built-up area, especially when local governments rely too heavily on LVC revenues as a source of income and develop land purely for fiscal gains. LVC can therefore also result in unstable and cyclical fiscal revenues during macroeconomic boom-bust cycles, as revenues are highly dependent on changes in land values and overall demand for land (Kim and Dougherty, 2020[5]). Equity benefits from LVC depend heavily on how the resources mobilised by LVC are used, and whether they are sufficiently targeted towards marginalised groups. Earmarking LVC gains towards specific geographic areas needs to be either avoided or compensated with other public funding to provide infrastructure for poorer areas. LVC is attractive where the potential for land value gains is large, which risks biasing infrastructure provision towards wealthy areas.

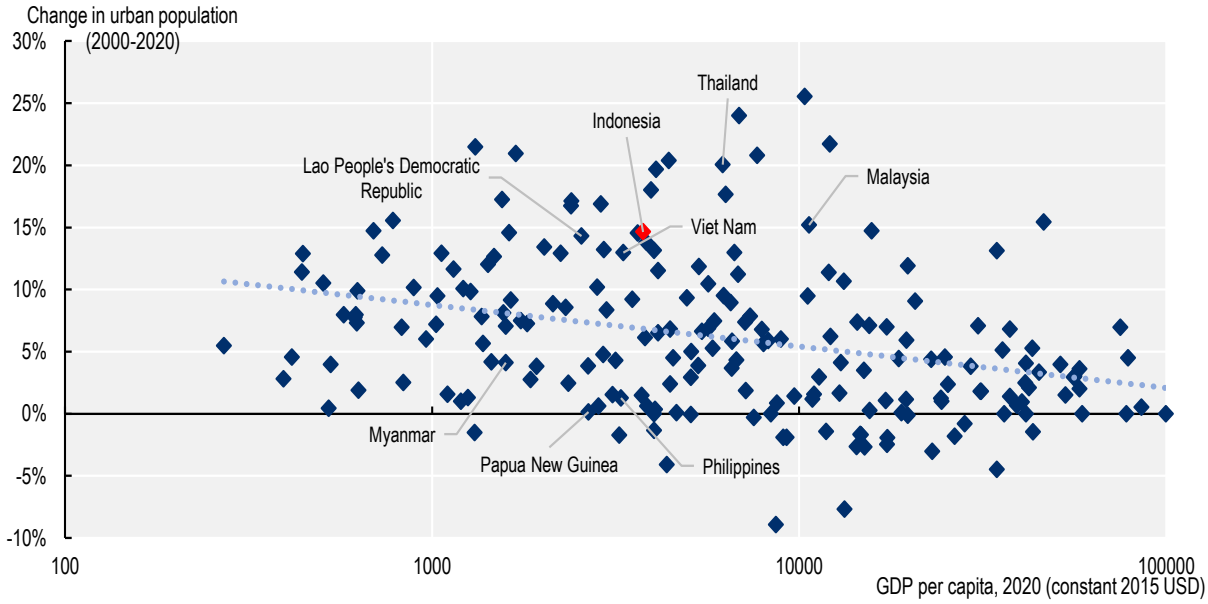
Effective LVC implementation is dependent on several underlying factors. Among others, public support is key, as LVC fundamentally entails a compromise between private property rights and the public good, resulting in an increase in taxes and fees on land. Second, administrative capacity is required to carry out underlying tasks including land valuation, maintenance of cadastres, and the regulation of land and its use. Opposition by landowners and lacking administrative capacity are the most important barriers countries face to implement LVC (OECD/Lincoln Institute of Land Policy, PKU-Lincoln Institute Center, 2022[6]). The implementation of LVC is thus challenging as it depends on institutional, legislative, and spatial planning frameworks, along with the enforcement of land-use regulations. The following sections discuss key issues.

4.1.3. The case for Land Value Capture in Indonesia

The need for sustainable land use and management

Indonesia is urbanising rapidly. Figure 4.1 plots the 2000-2020 change in urban population against 2020 GDP per capita. During this period, Indonesia's urban population share increased by 15 percentage points, well above the estimated trendline. This suggests that Indonesia's urbanisation exceeds other countries with similar income. Indonesia's current urbanisation rate of 57% is also still significantly lower than in higher income countries. More people will move to cities as economic growth continues. The new population living in cities will need adequate infrastructure and services, as well as land to live in. Land-based tools such as LVC will thus be needed to not only finance public investments, but also to properly manage newly built-up land so that development occurs in a sustainable and equitable manner.

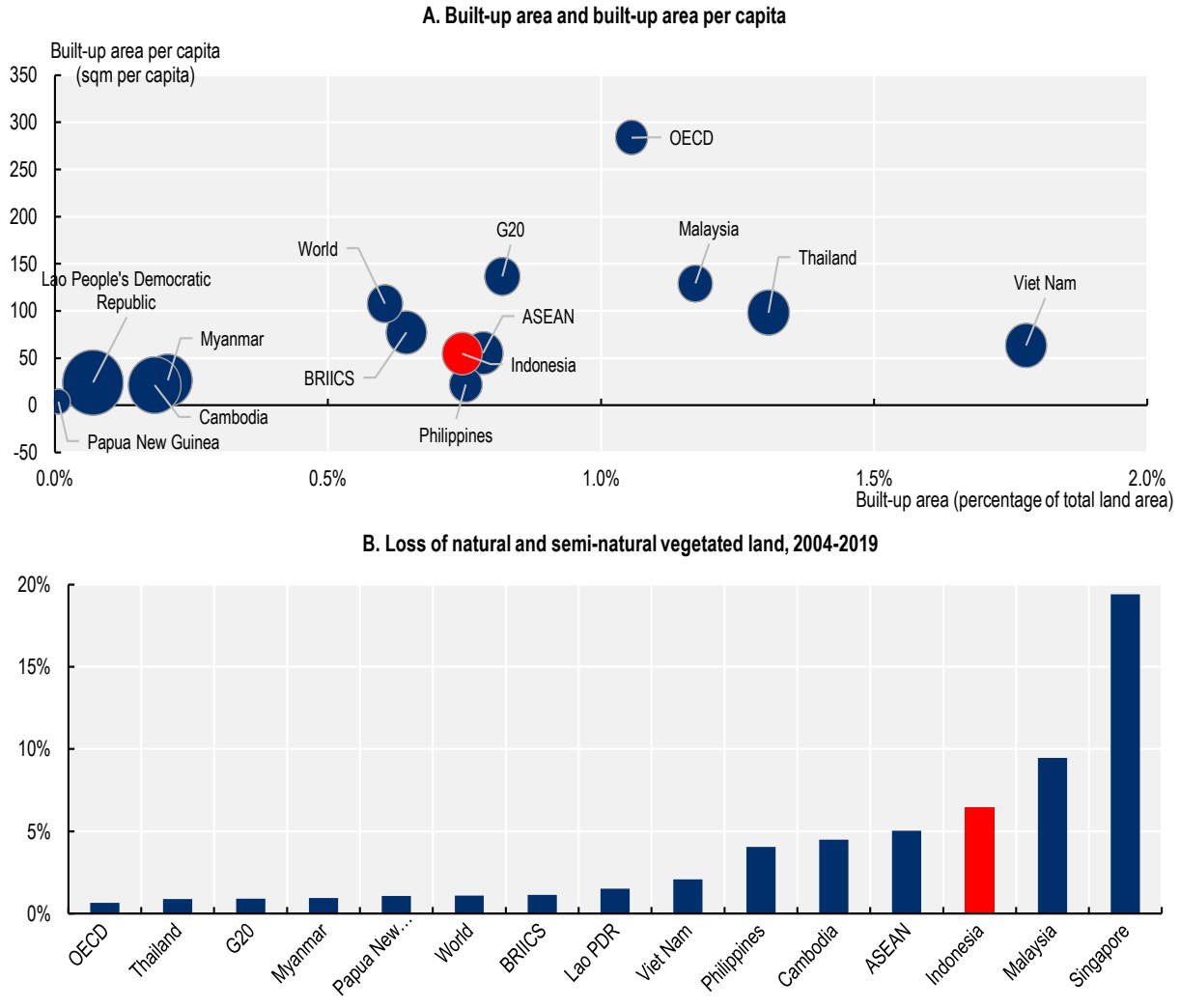
Figure 4.1. Urbanisation trends, 2000-2020



Notes: Change in urban population is measured as the percentage point change in urban population relative to the total population between 2000 and 2020. The dotted blue line indicates the estimated trendline for the datapoints.
Source: OECD national accounts; United Nations, Department of Economic and Social Affairs, Population Division (2019[7]), *World Urbanization Prospects: The 2018 Revision (ST/ESA/SER.A/420)*, New York: United Nations; World Bank national accounts

However, current trends in Indonesia's are inconsistent with sustainable land use practices. Built-up area in Indonesia is already greater than most of its peers with similar income levels, measured both as a percentage of total land area and in per capita terms (Figure 4.2 Panel A). In addition, built-up area continues to increase at a steady rate, suggesting that urbanisation is occurring mainly by 'building out' instead of 'building up'. This has many negative consequences including longer travel distances that lead to car dependency, greater greenhouse gas emissions and an increased carbon footprint. These patterns have also contributed to a significant loss of vegetated land (Figure 4.2 Panel B), which is key to maintaining biodiversity and preventing land degradation. As Indonesia further develops and continues to urbanise, LVC can play a key role in promoting sustainable development and environmentally friendly land use. However, the selection of investment and land use projects that are consistent with environmental sustainability remains critical, as environmentally unsustainable projects, which need to be avoided, can also raise land prices.

Figure 4.2. Sustainable land-use indicators



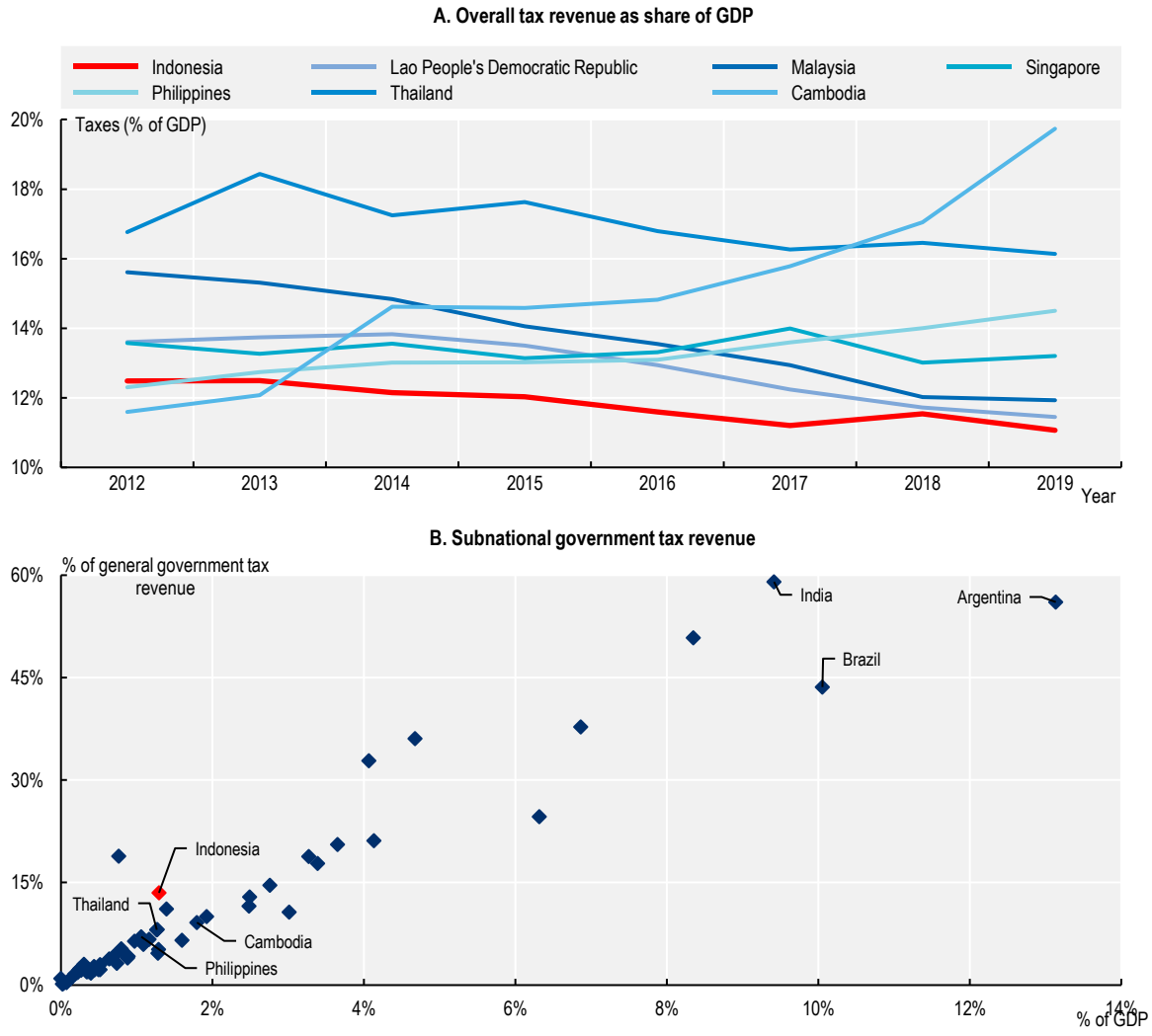
Notes: The bubble size in panel A indicates the magnitude of change in built-up area between 2000 and 2014. Loss of natural and semi-natural vegetated land is defined as the percentage of tree cover, grassland, wetland, shrubland and sparse vegetation converted to any other land cover type.

Source: Florczyk, A. et al. (2019[8]), *GHSL Data Package 2019, EUR 29788 EN*, Publications Office of the European Union, http://dx.doi.org/10.2760/290498.; OECD (2022[9]), *OECD. Stat* (database), https://stats.oecd.org/ (accessed 1 December 2022).

Weak tax revenues and subnational government fiscal autonomy

Indonesia's tax burden, at 11.1% of GDP in 2019, is among the lowest of Southeast Asian countries, and this share has been steadily declining since 2012 (Panel A of Figure 4.3). Subnational government revenues are also low when compared to other upper- and lower-middle income countries, both as a share of GDP and as a share of general government tax revenue (Panel B of Figure 4.3). LVC policy tools are therefore an attractive option to increase revenues for much needed public investment. LVC could be a viable tool to increase subnational fiscal autonomy and diversify revenue streams, as LVC revenues are primarily the jurisdiction of local governments.

Figure 4.3. Government tax revenue

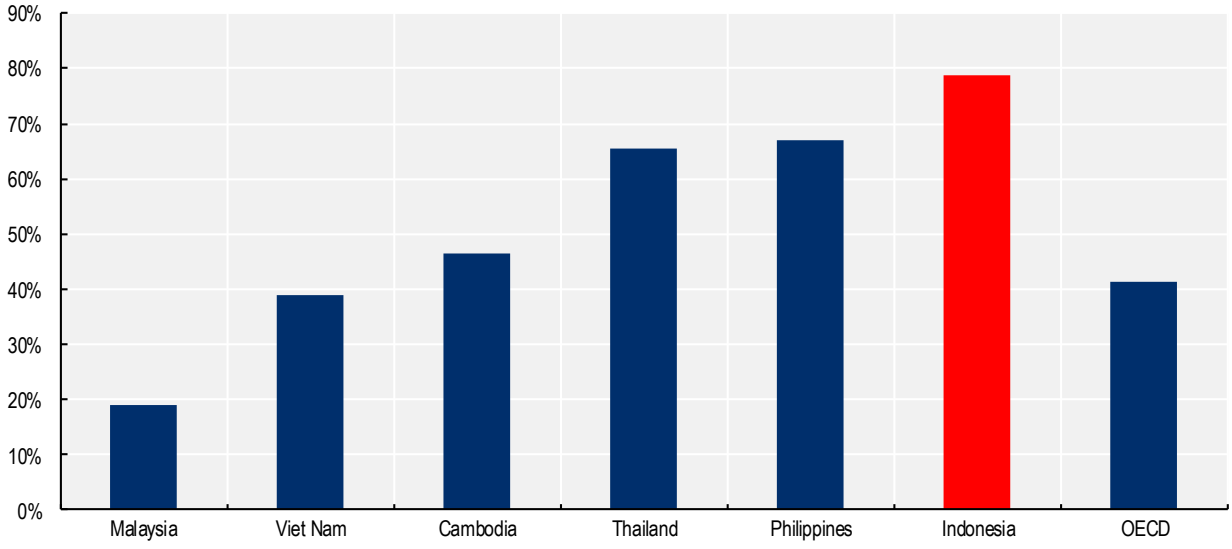


Notes: Only upper-middle income and lower-middle income countries are shown in panel B.
Source: Asian Development Bank (2018[10]), "Key Indicators for Asia and the Pacific 2019", *Key Indicators for Asia and the Pacific*, Asian Development Bank, Manila, Philippines, https://doi.org/10.22617/fls190428-3; OECD/UCLG (2022[11]), *OECD/UCLG World Observatory on Subnational Government Finance and Investment database (SNG-WOFI)*, https://www.sng-wofi.org/ (accessed on 1 December 2022).

The lack of subnational government tax revenues leads to an over-reliance on central government grants and subsidies (Figure 4.4). Central government transfers make up close to 80% of total subnational government revenues, which is close to twice the OECD average and significantly higher than other Southeast Asian economies.

From an economic view, the efficiency and accountability of local provision of services and infrastructure is best secured when subnational governments finance most of their own expenditures (Bahl and Bird, 2018[12]), given that these investments primarily benefit the local population. Together with user charges, local taxes are the most efficient local financing instruments, as they match the beneficiaries with those that bear the burden of the taxes and fees (Oates, 2008[13]). The utilisation of LVC could thus not only increase subnational revenues but also improve the efficiency of local government spending.

Figure 4.4. Central government grants and subsidies as share of subnational government revenues



Source: OECD/UCLG (2022[11]), *OECD/UCLG World Observatory on Subnational Government Finance and Investment database (SNG-WOFI)*, https://www.sng-wofi.org/ (accessed on 1 December 2022).

4.2. The enabling framework for Land Value Capture in Indonesia

4.2.1. Legislative framework

Chapter VI of the Indonesian constitution specifies that provinces, regencies and municipalities shall have 'wide-ranging autonomy' over all matters except those that are specified by law to reside with the central government (foreign policy, defence, security, judicial policy, national monetary and fiscal policy, and religious affairs). The 'big bang decentralisation' reform of 1998 paved the way towards regional autonomy and decentralisation (Asian Development Bank, 2022[14]). Amendments to the constitution in 2000 further anchored regional governance in Indonesia, Today, legislation continues to favour increased devolution of central powers (Table 4.1). In addition, proposed amendments provides a summary of relevant legislation and proposed amendments.

The Indonesian constitution also stipulates the social function of land and property, which lays the basis for implementing LVC. Within this framework, the proper implementation of LVC can be considered to uphold constitutional values while also providing a way for local governments to meet their duties set by law. Overall, Indonesia's legal framework provides a solid basis for LVC implementation, contrary to other countries across the world (OECD/Lincoln Institute of Land Policy, PKU-Lincoln Institute Center, 2022[6]).

Table 4.1. Recent trends in key local government legislation

Legislation	Amendments	Principal effect
Law No. 22 of 1999 on regional government	Original legislation	Deconcentrated central powers and increased devolution to districts and cities
	Law No. 32 of 2004 on local governance	Stipulated areas under the control of the central government and those under the control of subnational governments; sets out obligatory and optional tasks for local governments
	Law No. 23 of 2014 on local government	Repealed Law 32/2004 Strengthened central authority over local governments; mining, forestry, maritime affairs, and fisheries transferred to provinces
Law No. 25 of 1999 on revenue sharing between central and regional government	Original legislation	Set allocations of oil and gas revenues
	Law No. 33 of 2004 on fiscal balance between central and regional government	Set the framework for sources of local government funding based on the allocation of responsibilities among the various levels of government
	Proposed replacement for Law 33/2004	Rectifies inequalities in central funding allocations; incentivizes local governments to pursue more local-source revenue generation
Law 34/2000	Original legislation	Districts and cities given authority to impose new taxes, subject to specified criteria
Law No. 28 of 2009 on local taxes and charges	Original legislation	Transferred certain taxes from provinces to districts and cities Prohibited taxes (but not charges and fees) other than those specified in Law 28/2009
	Proposed replacement for Law 28/2009	Expands local government tax base, increases certain maximum tax rates, and improves the implementation of local taxes and charges

Source: Adapted from Asian Development Bank (2022[14]), *Modernizing Local Government Taxation in Indonesia*, Asian Development Bank, Manila, Philippines, https://doi.org/10.22617/tcs220138-2.

Despite constitutional provisions and efforts to reinforce legislative frameworks for LVC, local government adoption of LVC practices has been limited to specific use cases in select areas. Jakarta in particular has implemented a provision for impact fees and developer obligations on a case-by-case basis through the Governor of Jakarta Regulation No. 210 of 2016. It has also experimented with charging for rights to develop buildings above the standard development density allowed by local ordinances. Land readjustment has been used in the urban expansion of Yogyakarta and the regularisation of agricultural land in Cirebon, West Java. Strategic land management has been carried out in limited fashion by the National State Asset Management (LMAN) under the Ministry of Finance.

Greater LVC uptake has been hampered in part due to a lack of specific guidelines from higher level governments, as well as a lack of local ordinances outlining specific rules and regulations outside major urban centres such as Jakarta or Yogyakarta. Local governments have also obtained relative autonomy only recently, which results in a lack of expertise.

Since 2020, the government of Indonesia has been crafting a Presidential Decree for LVC implementation, with a draft being brought to public consultation in the end of 2022 (Box 4.1). The presidential decree proposes to allow earmarking land value capture revenues to infrastructure projects that generate the land value gains. There can be advantages and disadvantages to such earmarking. A public finance principle is to avoid earmarking as it encourages inefficient public spending. For example, the revenues may be larger than the efficient amount of spending in the project concerned, resulting in overspending. LVC revenue potential may exceed the cost of projects giving rise to the land value gains. It may be in the public interest to recover the full LVC potential.

Earmarking also gives rise to the risk that infrastructure projects are more likely to be developed where LVC potential is large. These areas may be economically dynamic and relatively wealthy, leaving poor neighbourhoods underserved. While earmarking may in some cases make it politically easier to introduce LVC instruments, over- and underspending may also give rise to political problems with earmarking. As the OECD Compendium on LVC policies reveals, many countries allocate at least some of the revenues

to the general budget, such as in Finland, or to a specific fund that serves to fund infrastructure projects more generally, such as in Hong Kong. This can help make sure that revenues are used equitably, giving priority to infrastructure poorer areas often need more badly. Another possibility for making sure LVC policy tools are deployed equitably is to use the revenues, or in-kind contribution requirements, for example in Developer Obligations, for social housing. This practice is also widespread and is for example done in Germany.

Box 4.1. Draft presidential decree for LVC

The government of Indonesia has been preparing a Presidential Decree to regulate the use of LVC. A draft has been recently issued for public discussion. This new legislation will address several important issues, including:

- Strengthening the authority of local governments at the municipal and regency level to implement LVC . The local government will be mandated to form a special agency or to appoint an existing agency to govern LVC implementation.
- Regulating the implementation of several LVC instruments. Several types of LVC Instruments that could be utilised in Indonesia are mentioned in the legislation, including the Infrastructure Levy (Pembayaran Sukarela Pengganti Pajak), FAR Compensation (Kompensasi Pelampauan KLB) with either in cash or in-kind contribution, Transfer of Development Rights (Pengalihan Hak Membangun), Developer Obligation, and Land Consolidation (Konsolidasi Lahan).
- Creating the option to earmark revenue obtained from LVC instruments for financing infrastructure development.

Source: Republik Indonesia (2022[15]), *Peraturan Presiden Republik Indonesia (draf): Pendanaan Penyediaan Infrastruktur Melalui Pengelolaan Perolehan Peningkatan Nilai Kawasan*.

4.2.2. Land registration and valuation

Land registration and valuation are central to LVC. Land registration is central to identifying land owners who may be asked to pay LVC contributions. Valuation allows governments to identify LVC potential and set charges in an economically efficient and equitable way.

Indonesia has slowly been transitioning from the dualistic land legislation regime originating from the Dutch colonial era to the land regulation enacted through National Law 5/1960. The Dutch colonial had different laws regarding land ownership for native and non-native citizens. The Dutch colonial government limited efforts to formally register land to urban areas predominantly occupied by Dutch citizens (Monkkonen, 2013[16]). It concentrated infrastructure developments in these limited areas.

After the enactment of the National Law number 5/1960, the government of Indonesia began acknowledging property rights from the customary use of land. The law stipulated that every individual may register their land ownership and obtain a legal title up to 20 years after the enactment of the law. However, the registration of land parcels in Indonesia has yet to be completed[OBJ]. Approximately 60% of land in Indonesia has not been registered by the government. This has led to issues concerning informal settlements and dual claims on land (Box 4.2). The Ministry of Agrarian Affairs and Spatial Planning launched a programme to accelerate the land registration process in 2017 (Percepatan Pendaftaran Tanah Sistematis Lengkap, PTSL), which aims to complete all land registration by 2025.

Land valuation in Indonesia is conducted mainly to either update the tax base for land and property taxes, or to calculate compensation for government land acquisition. The responsibility for updating land values

for tax bases is the responsibility of municipalities and regencies. Due to issues concerning land registration and a general lack of administrative capacity, local governments still often struggle with proper land valuation based on fair market values.

Land valuation for calculating compensation for acquisition is the responsibility of central government ministries and public agencies that propose land acquisition for public infrastructure development. Valuations are usually conducted by a certified land valuator appointed by the government through a public procurement mechanism. This land valuator is usually a private valuator who must own a professional valuator certificate issued by the Ministry of Finance.

Land valuation for compensation is likely the better instrument to use in the context of LVC. Up-to-date land valuation for tax purposes is difficult and costly to achieve in many countries, in part because all real estate subject to tax must be evaluated. These difficulties are reinforced in Indonesia. By contrast valuation for compensation can be applied in a targeted fashion to real estate benefitting from land value gains as a result of public action. To identify land value gains due to public action (infrastructure provision; land use regulation change), such assessments can be combined with hedonic price estimation methods, which assess the share of land value gain that can be attributed to these public actions.

Box 4.2. Informal settlements in Indonesia

Indonesia has many informal settlements, in particular in urban areas. These settlements, called “urban kampung”, are mostly in precarious areas, such as along flood-prone riversides or disaster-prone coastal areas.

Informal urbanisation is often attributed to the dualistic land registration system originating from the Dutch colonial era (Monkkonen, 2013[16]). Informal settlements are predominantly located in unregistered land plots. Within these plots, land is subdivided and developed without any legal permit from the government. In addition, procedures to register land and obtain development permits are long and costly, which further encourages informal settlement growth in Indonesian cities.

Informal settlements mostly lack even the most basic infrastructure and services, and struggle to provide water and sanitation. The Government of Indonesia and the Ministry of Public Works and Housing have attempted to address these issues, including through programs such as Program Pengentasan Kemiskinan Perkotaan (P2KP) in 1996-2006, Program Nasional Pemberdayaan Masyarakat (PNPM) Mandiri Perkotaan in 2007-2014, Program Peningkatan Kualitas Kawasan Permukiman (P2KKP) in 2015, and the recent Kota Tanpa Kumuh (Kotaku) Program.

4.2.3. Land acquisition

Governments may want to use land acquisition directly for LVC (“strategic land management”). To do so it is important they can acquire land at prices that does not incorporate the valuation gains from rezoning or building infrastructure the government undertakes. Moreover simple land acquisition rules are an important fall-back mechanism that can improve the willingness of private landowners to collaborate in LVC, for example, in the context of land readjustment (see below).

National Law number 5/1960 stipulates that the state can acquire individual property rights for public use if fair compensation is paid. The public agency or ministry planning to acquire land must make a proposal to the Ministry of Finance, which outlines the location, size, function, and land value estimation. Only recently through Law number 2/2012 on Land Procurement in the Public Interest has Indonesia introduced formal rules for land acquisition. The law allows land acquisition for water projects such as embankments, reservoirs, irrigation systems, drinking water channels, water disposal channels, and sanitation, among others. While the law allows legal recourse for landowners when the compensation is perceived to be

unfair, there is no clear procedure outlined for how land values should be determined to compensate owners, other than it be determined in a “fair and reasonable” manner. Likewise, there is also no stipulation for the government to be allowed to fix land values at a specific point in time, unlike many other countries.

Land acquisition for public infrastructure development is typically a long process in Indonesia. Government Regulation number 19/2021 outlines this process, which consists of: (1) preparation of the land acquisition proposal, (2) public announcement of development plan, (3) identification of the affected area, (4) public consultation of the development plan, (5) authorisation of the land acquisition and development proposal, (6) identification of the affected land plots, (7) appointment of land valuator, (8) general meeting for agreeing the form of compensation, (9) payment of compensation, and (10) execution of land acquisition.

Landowners can appeal both the development plan and the amount of compensation to be paid. If a landowner disagrees with the development plan, the committee appointed to manage land acquisition processes must report to the provincial government, which establishes a team to review the development plan and decide whether the development should continue. Landowners are allowed to sue governments in local courts when they do not agree with compensation terms, and cases can also be escalated to the Supreme Court in certain instances. In such cases, local governments make compensation payments according to the terms decided upon by the Supreme Court.

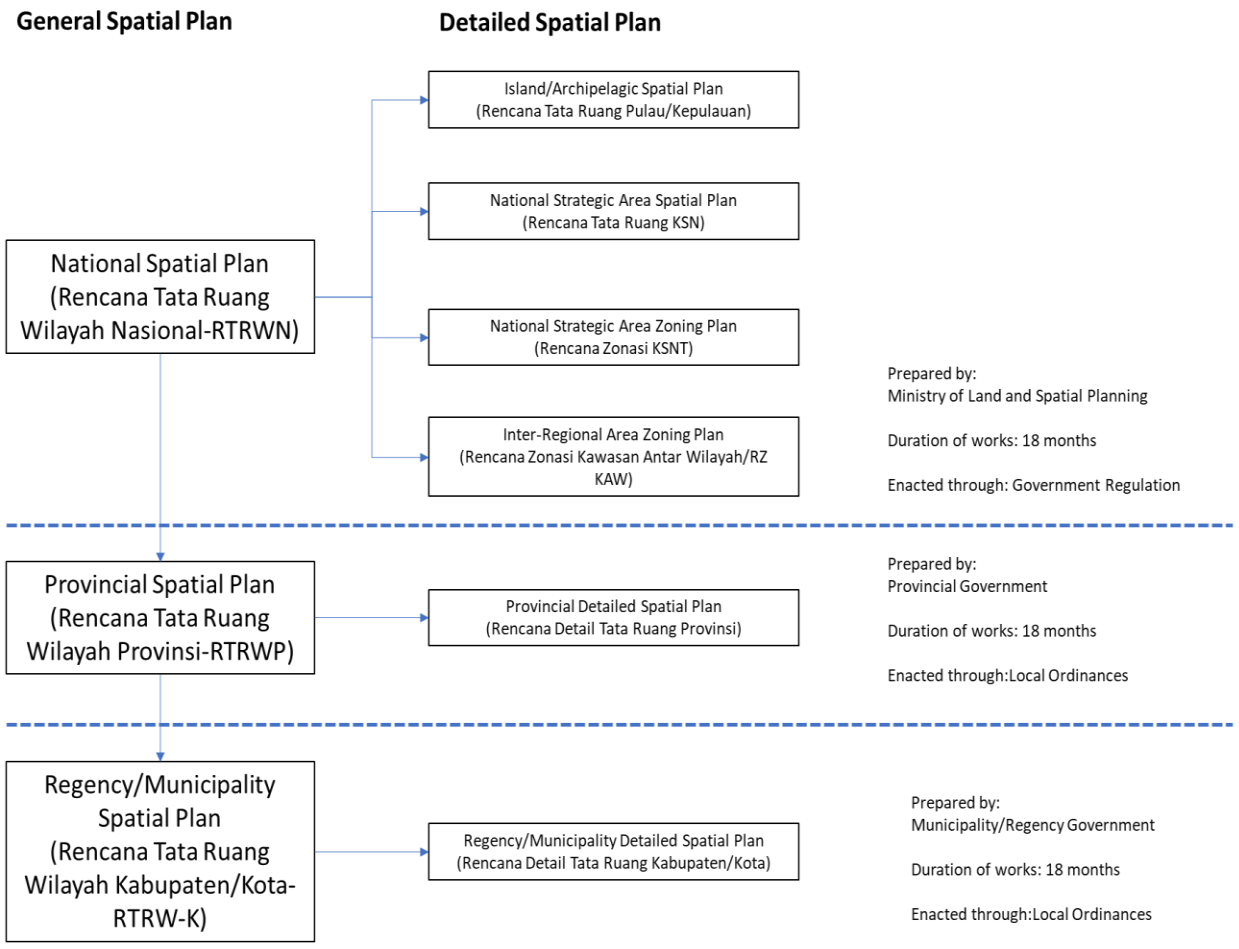
4.2.4. Land use and spatial planning

Land use and spatial planning are fundamental to LVC. They allow to identify and anticipate the public actions that generate value gains in private property and which can be the basis of land value capture, as changes in allowed land use and infrastructure provision are key public actions driving land value increases.

The spatial planning system of Indonesia is hierarchical and rigid, with lower-level spatial plans always mandated to follow guidelines set by upper-level spatial plans (Figure 4.5). The legal basis for the spatial planning system is established by National Law number 26/2007, with some parts having been amended by National Law number 11/2020.

Figure 4.5. Hierarchy of the spatial planning system in Indonesia

Derived from Government Regulation number 26/2007



Traditionally, the process of preparing spatial plans at the municipal level is long and arduous. Upper-level spatial plans are often absent, which precludes the preparation of local-level detailed spatial plans under the hierarchical spatial planning system. Moreover, local-level plans must be approved by the Ministry of Agrarian Affairs and Spatial Planning before being brought to the local parliament, which ultimately passes the plan as a local ordinance. The enactment of National Law number 11/2020 required development permits to be issued based on detailed spatial plans. Consequently, the Ministry of Agrarian Affairs and Spatial Planning introduced a program to accelerate the preparation of detailed spatial plans in all Indonesian municipalities. However, detailed spatial plans at the municipal and regency level are still rare in Indonesia, with only 243 out of 2119 detailed spatial plan regulations having been enacted by municipalities across Indonesia.

Lack of land-use and spatial planning regulation enforcement is also a challenge. This is because local governments generally lack the capacity to enforce regulations, and because of the difficulty in regulating informal settlements that are prevalent across Indonesia. Dubbed the “blueprint syndrome”, detailed spatial plans, if they exist, are often idealistic visions rather than acting planning documentation. As a result, there is often a lack of synchronisation between local agencies responsible for tasks including issuing development permits and regulating land use, increasing hidden costs related to development permits and infrastructure development (Monkkonen, 2013[16]).

The predominance of the informal land and property market is another issue that hampers LVC adoption. Stemming from land ownership rules under customary law, land is not registered with governments in many areas and is subdivided into smaller plots and developed without obtaining development permits. Moreover, the unclear and arduous process for obtaining permits has further encouraged informal development (Zhu and Simarmata, 2015[17]). Even today, informal settlements continue to grow rapidly in many areas across Indonesia.

4.3. Recommendations for implementing LVC for water infrastructure provision

Many different LVC instruments can be used to finance water infrastructure. Which one suits best depends on the characteristics of the infrastructure and the local development context. Policy makers should deploy a broad range of instruments depending on the circumstances. The following sections draw on the 'OECD-Lincoln taxonomy' of instruments (OECD/Lincoln Institute of Land Policy, PKU-Lincoln Institute Center, 2022[6]). It provides consistent definitions for the most used LVC instruments around the world (Box 4.3).

Box 4.3. The 'OECD-Lincoln taxonomy' of LVC instruments

Infrastructure levy

> *An infrastructure levy is a tax or fee levied on landowners possessing land that has gained in value due to infrastructure investment initiated by the government.*

Landowners pay a fee for public infrastructure from which they benefit. The decision to build infrastructure is generally initiated by the government, and the government identifies the catchment area in which landowners are to pay the levy. The amount of the levy should be based on the amount of land value benefit obtained and can be either a one-time payment or payable over a longer period.

Developer obligations

> *A developer obligation is a cash or in-kind payment designed to defray the costs of new or additional public infrastructure and services private development requires.*

Developer obligations apply when developers seek development approval or special permissions. The obligations can consist of cash or in-kind contributions. Unlike the infrastructure levy, developer obligations are triggered by the initiative of private developers and landowners. The obligations can be either negotiated between the government and developers or calculated using a fixed formula.

Charges for development rights

> *Charges for development rights are cash or in-kind contributions payable in exchange for development rights or additional development potential above a set baseline.*

Charges for development rights are levied to build at a higher density beyond a baseline defined by an ordinance or regulation. Developers may also be charged for development rights when governments alter zoning or density regulations. Limited development rights, for example in protected environmental areas, can also be transferred to a different plot better suited to higher density development.

Land readjustment

> *Land readjustment is the practice of pooling fragmented land parcels for joint development, with owners transferring a portion of their land for public use to capture value increments and cover development costs.*

Land readjustment is where contiguous plots of land are pooled and developed jointly. It is often accompanied by zoning changes so that newly developed land is more valuable. Landowners provide a share of their plots for public infrastructure and services. Landowners are returned a smaller plot of land that is nonetheless more valuable due to the upzoning and improvements made.

Strategic land management

> *Strategic land management is the practice of governments actively taking part in buying, developing, selling and leasing land to advance public needs and recoup value increments borne through public action.*

With strategic land management, governments buy land or use existing land holdings to extract values from them. If land is acquired at predevelopment prices, increases in land value that are due to public interventions are captured. Governments can recover land value gains with the sale or lease of rezoned and developed plots, or by leasing usage rights which capture value increments through rents.

Source: Adapted from OECD/Lincoln Institute of Land Policy, PKU-Lincoln Institute Center (2022[6]), *Global Compendium of Land Value Capture Policies*, OECD Regional Development Studies, OECD Publishing, Paris, https://doi.org/10.1787/4f9559ee-en.

4.3.1. Developer obligations and charges for development rights

With developer obligations, public authorities, in most cases local governments, require developers to contribute to public infrastructure and service provision in exchange for development approval. They therefore typically involve in-kind contributions, whereby developers provide public infrastructure in development areas themselves but can also involve cash contributions. They are often used to pay for the costs of increased public service demand resulting from the development. Limiting the charges to such costs may make it easier get political support for the charges, including from the developers themselves, as the provision of these public services increases land value. However, the charges can exploit the full valuation gains resulting from the development approval. Developer obligations can cover capital and operating costs. Developer obligations are also one of the least contentious LVC instruments, as the provided amenities tend to raise the value of properties. Relatedly, charges for development rights work in a similar manner to developer obligations and can be employed in similar ways to finance infrastructure in areas where development potential is high.

Developer obligations, often termed impact fees, negotiated exactions, and developer charges, are the most commonly used LVC instrument (OECD/Lincoln Institute of Land Policy, PKU-Lincoln Institute Center, 2022[6]). Many countries use them to fund urban water infrastructure, including Canada, Costa Rica, the Czech Republic, Germany, Korea, South Africa, and Sweden. They often cover costs for public infrastructure within the development area, such as water pipe and sewerage connections, but can also go beyond, depending on the value gains from the permission to develop. In Korea and Japan for example, the authorities agree the provision of water infrastructure of greater scale with developers, such as bulk water supply and treatment infrastructure. In Portugal, the ‘urbanisation tax’ is charged to offset the impact on infrastructure external to the project. Similarly, charges for development rights, sometimes referred to as air rights sale or transfer of development rights, have been used extensively in countries such as Brazil to fund urban infrastructure, including for water (Box 4.4).

There is much untapped potential to provide for water infrastructure through developer obligations and charges for development rights in Indonesia, especially as Indonesia’s population and economy continues to grow and demand for new developments remains strong. They require, a legal framework for implementation. There is no official national legal provision to charge developers for certain infrastructure obligations in Indonesia (Asian Development Bank, 2021[18]). At the subnational level the Governor Jakarta Regulation No. 210 of 2016 implements impact fees and developer contributions through ordinances. However, they are not mandatory and are only applied to a limited number of developments. In many other

countries developer obligations are mandatory to obtain development approval. Other regions of Indonesia lack similar ordinances. An assessment of the land value gains generated by development permits as well as of the cost of in-kind developer obligations would allow policy makers to make full use of the potential to exploit land value uplifts.

Developer obligations and charges for development rights also require strong planning and analytical capacity at the local level for setting fees and negotiating with developers. Another prerequisite is the proper enforcement of land-use regulations. Transparency on development permits and associated developer obligations could help prevent corruption and encourage peer learning across local governments. Central government support in developing the local administrative capacity to carry out related tasks is critical in ensuring the proper application of developer obligations, especially for regions outside of Jakarta. For example, the Development Bank of Ecuador provides a subsidised line of credit and technical support for municipalities in Ecuador to use in implementing LVC.

Box 4.4. Certificates of Additional Building Potential (CEPACs) in São Paulo, Brazil

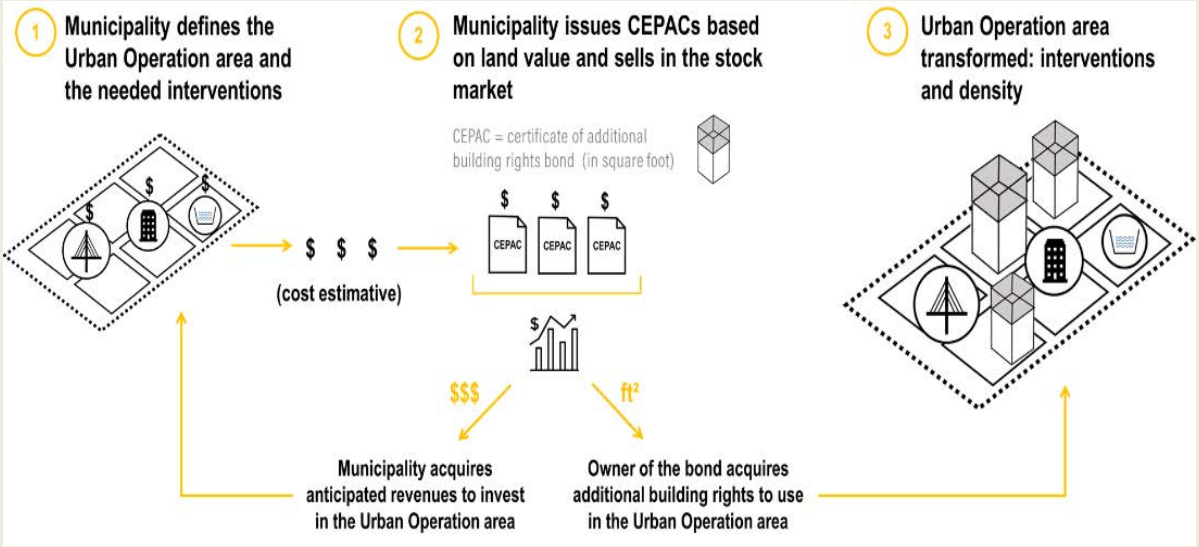
CEPACs (*Certificados de Potencial Adicional de Construção*, or Certificates for Potential Additional Construction) are a financial instrument created by the city of São Paulo, Brazil, to finance urban infrastructure projects and promote sustainable urban development. CEPACs are essentially certificates that represent the right to build additional floor area in a particular area of the city, beyond what is currently allowed by existing zoning regulations. These certificates are sold at public auctions to real estate developers, who can then use them to build taller and denser buildings in the designated areas. The idea behind CEPACs is that by allowing developers to build taller and denser buildings in designated areas, the city can raise funds for infrastructure projects, while also promoting more compact and sustainable urban development patterns.

OODCs (*Outorga Onerosa do Direito de Construir,* or Charges for Additional Building Rights) regulate charges for additional building rights in Brazil and provide the basis for CEPACs. It is based on the notion that the landowners' property rights are limited to a basic floor area ratio (FAR) that differs from the maximum FAR the area could support. The right to build at a density up to the basic FAR is free, but developers wanting to build at a higher density than the FAR established by zoning law for a particular area must pay compensation to the city. The OODC is defined by the City Statute (Brazilian Land Development Act), the national law approved in 2001, that sets the guidelines for urban policy.

In addition to the City Statute, the use of CEPACs in São Paulo is supported by a range of local regulations and guidelines. These include the Municipal Urban Development Plan, which sets out the overall strategy for urban development in the city, and the Municipal Public Transport Plan, which identifies the infrastructure projects that are eligible for funding from CEPAC proceeds. The city also has a set of guidelines for the sale and use of CEPACs, which govern the process by which they are sold at auction and the conditions under which they can be used by developers.

CEPACs are used in urban operations (UO), which are delimited urban areas subjected to zoning redefinition for land use and density and supported by improved urban infrastructure. UOs involve large-scale areas (typically over 500 hectares) and have building rights over and above the restrictions imposed by the master plan or zoning ordinances. These areas are chosen by the municipal government, and thus reflect both public and private interests. The owner of a CEPAC can either convert the charge into additional building rights in the UO or can resell it in the stock market as a security.

Figure 4.6. Workflow for CEPACs



Source: Mahendra, A. et al. (2020[19]), "Urban Land Value Capture in São Paulo, Addis Ababa, and Hyderabad: Differing Interpretations, Equity Impacts, and Enabling Conditions", *Lincoln Institute Working Paper WP20AM1*.

The use of these funds is governed by specific guidelines established by the city, which set out the conditions under which they can be used and the types of projects that are eligible for funding. In many cases, a fixed share (typically 10 to 30 percent) of these funds are used to develop affordable housing and finance slum urbanisation efforts, with a portion of land plots inside the UO being dedicated to affordable housing, known as Special Zones of Social Interest (ZEIS). More broadly, funds collected through OODCs are deposited in the Urban Development Fund (Fundo de Desenvolvimento Urbano), which finances public urban investments within the city boundary.

Since their introduction in 2004, CEPACs have become an important source of funding for urban infrastructure projects in São Paulo. As of 2016, it had been estimated that a total of BRL 2.7 billion (approximately USD 820 million) had been raised through the sale of CEPACS since their introduction in 2004. This funding has been used to support a range of projects, including the expansion of the city's metro system, the creation of new public parks and green spaces, and the provision of affordable housing.

Source: Ingram, G. and Y. Hong (eds.) (2010[20]), *Municipal Revenues and Land Policies, Lincoln Institute of Land Policy*; Mahendra, A. et al. (2020[19]), "Urban Land Value Capture in São Paulo, Addis Ababa, and Hyderabad: Differing Interpretations, Equity Impacts, and Enabling Conditions", *Lincoln Institute Working Paper WP20AM1;* Smolka, M. (2013[2]), *Implementing Value Capture in Latin America*, Lincoln Institute of Land Policy, Cambridge, MA, https://www.lincolninst.edu/publications/policy-focus-reports/implementing-value-capture-latin-america (accessed on 2 September 2020); Smolka, M. and C. Maleronka (2018[21]), "Assessing the monetary relevance of land value capture: the case for charges for additional building rights in Sao Paulo, Brazil", *International Journal of Real Estate and Land Planning;* Suzuki, H. et al. (2015[22]), *Financing Transit-Oriented Development with Land Values: Adapting Land Value Capture in Developing Countries*, The World Bank, https://doi.org/10.1596/978-1-4648-0149-5.

4.3.2. Land readjustment

Land readjustment is a process in which land is pooled for development and landowners contribute a portion of their plots for infrastructure and services. Even with the smaller land plots, land readjustment

tends to be beneficial for landowners because development makes land much more valuable. As a result, land readjustment is often less costly in terms of judicial procedures compared to expropriation.

The amount of land value increment that is captured through land readjustment is directly proportional to the amount of land that landowners contribute for public use. The contributed land in turn can be used to not only provide for infrastructure, but also to generate revenues through sale or lease. Land readjustment is typically used within the context of urbanisation and urban expansion, which is important in countries catching up with high income countries, such as Indonesia. The conversion of rural land for urban uses results in significant land value uplifts. 60% of urban expansion in the Seoul metropolitan area of Korea, for example, was accomplished through land readjustment in the 1980s, while land readjustment was carried out in 30% of all urban areas in Japan since the early 20th century (Asian Development Bank, 2021[18]; OECD, 2022[23]). Both countries have been remarkable for quickly catching up with high income countries in the 20th century (Box 4.5).

Indonesia's continued urbanisation, coupled with economic growth, has resulted in high demand for developed urban land. As a result, the demand for water infrastructure and other services has steadily increased, yet without the accompanying tax revenues needed to fund such public works (Figure 4.3). Therefore, there is strong potential to implement land readjustment in Indonesia, which would not only provide much needed funding for water infrastructure but also diversify local government revenue streams and reduce their dependence on central government transfers. Without such value capture mechanisms, urban developments risk not being provided basic water infrastructure such as piped water and sewerage systems, and can result in slumification.

Land readjustment is a versatile instrument that can be suitable for developing any water infrastructure that requires the reallocation of land plots. As land readjustment is typically implemented for large-scale projects, this includes larger water infrastructure facilities including water intake facilities, wastewater treatment plants, and raw water infrastructure such as dams and irrigation infrastructure. Furthermore, governments can retain a portion of land for sale or lease, which can provide funding for the operation and maintenance of water infrastructure in the area.

A challenge to the successful application of land readjustment is in obtaining landowner consensus. Many countries require a supermajority of up to two-thirds of landowners by law, which can sometimes be difficult to obtain. However, these issues can be overcome when land readjustment is utilised together with expropriation in a hybrid fashion, as is the case in Korea where landowners are given the choice between retaining a portion of their land after development or selling their land outright to the government (OECD, 2022[23]). Solid expropriation mechanisms can also be a valuable fall-back option which can encourage landowners to reach a consensus and go through with land readjustment projects.

Box 4.5. Land readjustment in Japan and Korea

Japan and Korea have a long history of land readjustment, dating back to the early- and mid-twentieth century when the countries were beginning to urbanise. In Japan, land readjustment is by far the most popular LVC instrument, and its scope has been expanded since the 1990s to also include disaster prevention and urban regeneration. In Korea, land readjustment has been used extensively since the 1970s following rapid urbanisation and economic growth, and its use has increased in recent years due to its perceived advantages over expropriation. In both countries, there are national frameworks and legislation that provide the general guidelines for implementing land readjustment projects, while the local governments oversee actual implementation.

In Japan, two-thirds of involved landowners and leaseholders must consent to land readjustment projects, while in Korea, the consent of landowners representing half of the total number of owners and two-thirds of the total land area is required. In Korea in particular, land readjustment can also be conducted without landowner consent for certain projects, such as when private efforts are unsuccessful, when projects concern the provision of key public facilities, or for rebuilding after natural disasters. In both countries, the participation of resisting landowners may be enforced through expropriations.

In both countries, typically a share of 30-40% of the area of readjusted plots is reserved for public improvements. This includes public utilities, public spaces, and transportation projects. Land readjustment projects can require the provision of basic water infrastructure including piped water and sewerage facilities, and for large-scale projects, more substantial water infrastructure may also be provided, such as treatment facilities and the revitalisation of riverbeds and their surrounding areas. Moreover, land readjustment projects also typically reserve a certain portion of the land for public sale and lease. This is an important feature of the system since these revenues may cover a significant portion of the development costs and the operating costs for infrastructure. In Japan, they are also used to compensate non-landowning stakeholders with various claims, such as informal residents and leaseholders.

The implementation of land readjustment faces resistance from landowners in some cases, especially when the share of land given up for public use is perceived to be too large. There are legal measures to enforce participation through expropriation, but in both countries, this rarely occurs as the remaining land is still much more valuable even after a portion of the original plot has been ceded for public use. Tenants and informal residents without ownership rights also resist in some cases, fearing that they may not receive adequate compensation. However, both Japan and Korea have fiscal and legal mechanisms to facilitate compensation for these stakeholders and provide temporary housing and relocation assistance.

Source: OECD (2022[23]), *"Financing transportation infrastructure through Land Value Capture: Concepts, tools, and case studies"*, OECD Regional Development Papers, No. 27, OECD Publishing, Paris, https://doi.org/10.1787/8015065d-en; OECD/Lincoln Institute of Land Policy, PKU-Lincoln Institute Center (2022[6]), *Global Compendium of Land Value Capture Policies*, OECD Regional Development Studies, OECD Publishing, Paris, https://doi.org/10.1787/4f9559ee-en.

4.3.3. Infrastructure levies

An infrastructure levy can pay for the costs of public infrastructure investment and upkeep by charging the landowners that have benefited from increases in land prices due to the public investment. Infrastructure levies are typically applied to already developed land, especially in urban areas, which benefit from new infrastructure. Infrastructure levies are therefore typically cash contributions. However, they may also be

applied to rural water infrastructure projects, such as irrigation infrastructure raising the value of agricultural land. They are charged based on the catchment area of real estate benefiting from the infrastructure. Infrastructure levies require government initiative and are less subject to negotiation. Due to these characteristics, infrastructure levies are typically applied to larger-scale public infrastructure projects that generate wide-ranging value uplifts in well-defined geographic areas, such as public transit systems and big-ticket public utilities.

Argentina, Austria, Ecuador, Hungary, Poland, and Turkey, among other countries, charge infrastructure levies when they provide water infrastructure, including wastewater management facilities and water treatment systems (OECD/Lincoln Institute of Land Policy, PKU-Lincoln Institute Center, 2022[6]). Typically, infrastructure levies are charged at around 30% to 60% of the gain in land value (Peterson, 2008[24]).

Infrastructure levies may be particularly attractive for flood protection infrastructure because it does not generate revenues from user charges. Using LVC for flood protection can therefore also help make sure development in flood-prone areas is avoided, unless a contribution towards flood protection is made. It can include flood management systems, river diversions, embankments, and green infrastructure, such as natural flood retention areas. Infrastructure levies are also particularly attractive when valuable assets benefit from the infrastructure service. Value uplifts and revenue potential may then be highest and can serve to finance expensive infrastructure to protect such assets. For example, Jakarta is currently implementing a large-scale river diversion project, funded fully through tax revenue. It aims to reduce flood risk, mostly in the wealthy Jakarta business district. Applying LVC policy tools are particularly useful in this context because the principal beneficiaries - wealthy landowners - can afford to pay LVC charges. The cost of the intervention, reported at USD 50 million, could be financed with an infrastructure levy on major real estate owners in the business district, with the cost of the project distributed to them based on a recent certified assessment of their property values. Setting up such an infrastructure charge early in the project development process could also mobilise resources and partnerships with the beneficiaries that support the cost-effective design, planning and implementation of the project. In this case, financing the project through LVC instruments could have promoted a progressive use of public funds, where tax revenues are used for other purposes than to the benefit of a defined group of wealthy beneficiaries.

Box 4.6. Nature-based solutions for water infrastructure

Nature-based solutions (NBS) are policy approaches to leverage nature and ecosystems to protect people and optimize infrastructure to do so, for example to protect against flood risk, while safeguarding the natural environment. NBS can be innovative solutions to manage water-related disaster risks (Gómez Martín et al., 2020[25]).

NBS have strong potential to make urban development sustainable in the face of global environmental challenges, including climate change, while providing local wellbeing benefits and disaster prevention, keeping highly urbanised areas liveable. They can contribute to CO2 emission reduction and biodiversity protection. They can reduce the impacts of climate change, limiting the impact of heatwaves, as well as the exposure and vulnerability to floods. They provide green recreational space, particularly in low-income neighbourhoods, where disaster risk exposure and vulnerability may be particularly strong and recreational space scarce. The large-scale delivery of urban NBS is therefore urgent for high-level government commitments such as the Sustainable Development Goals (Croeser et al., 2022[26]; Gómez Martín et al., 2020[25]; Schmidt, Guerrero and Albert, 2022[27]).

Green corridors for flood management, restoration of natural floodplains, and multifunctional public space for recreation and stormwater management, in particular, combine risk reduction with many of these sustainability and wellbeing benefits. NBS thus provides benefits beyond those of “grey” flood protection infrastructure. These also include the replenishment of aquifers, reduced energy

consumption, pollutants filtration with improved water and air quality, improved aesthetics, promotion of communal activities and crime reduction (Grafakos et al., 2019[28]). NBS' costs may also be substantially lower, as the example of Buenos Aires, Argentina suggests (Kozak et al., 2020[29]). They can therefore be considerably more cost-effective. Adding NBS to grey infrastructure in a hybrid approach can add benefits and land value gains without generating higher cost.

Policy makers face two major barriers to harness NBS:

- Governments must scale up the delivery of public space, which is contested, especially in cities.
- NBS do not generate revenues, unlike other infrastructure, such as irrigation or urban water supply, and prevents some land to be used for economic activity which generates revenue.

LVC can help overcome both barriers. LVC instruments can make land available, for example, through developer obligations or land readjustment, or deliver revenues, for example through infrastructure charges. Owing to the wide range of local wellbeing benefits, NBS can raise real estate prices considerably more than flood protection alone (Grafakos et al., 2019[28]), making the combined use of LVC for NBS potentially attractive to developers and real estate owners.

As the following examples illustrate, applying a broad range of LVC instruments may make the most of cost effective NBS. Political economy arguments may also play a role for instrument selection.

- In the Indian city of Kalkota, recent research proposes the use of LVC instruments to improve water retention; to restore or create rainwater catchments; and to expand large surface green corridors serving as parks as well as flood retention areas. These measures can be undertaken with charges for development rights, whereby real estate owners give up parcels of land in exchange for the permit to raise building heights; the infrastructure charges, whereby real estate owners benefiting from the green corridor make monetary payments; and developer obligations where developers are required to provide NBS in exchange for building permits. The amount of LVC charges and obligations can be assessed on the basis of a hedonic pricing model estimating the impact of past NBS investment on real estate values (Nath, Chakraborty and Banerjee, forthcoming[30]).
- In the Colombian city of Cali, dams, dikes, canals, and pumping plants have exacerbated flood hazards, shifting them to lower-income populations, due to lack of maintenance and degradation of natural ecosystems, while climate change is aggravating flood risk. The Cañaveralejo river project aims to build urban resilience by strengthening natural river flows, minimizing flood risk and improving public space. Consulted stakeholders argued that LVC instruments relating to investment, notably charges for development rights, are likely to be the best accepted. Infrastructure charges based on an assessment of real-time land value impacts of the project were seen as a promising revenue source, but complex, while simpler infrastructure charges without such assessment met with mistrust, owing incomplete municipal projects in the past and corruption. However, administrative and institutional barriers need to be overcome in any case, including for the consultation of all stakeholders (Grafakos et al., 2019[28]).

There is no legal mechanism to charge infrastructure levies in Indonesia. Infrastructure levies can be challenging to implement as they may be considered as charges for infrastructure imposed by the government for a service some landowners may not demand. Indeed, among the LVC instruments, infrastructure levies are the most susceptible to legal appeals (OECD/Lincoln Institute of Land Policy, PKU-Lincoln Institute Center, 2022[6]). Nonetheless, examples in countries such as the United Kingdom and Japan highlight how infrastructure levies can be successfully implemented by i) opening and maintaining robust channels for dialogue with the public that effectively communicate the benefits of the proposed infrastructure, and ii) clearly defining and communicating the rules for assessing how much landowners

are to pay so that they perceive the charges to be fair (OECD, 2022[23]). Like developer obligations, infrastructure levies also require strong central government support in developing local government capacity to estimate land value increments that arise due to the new infrastructure.

Infrastructure levies are best charged based on actual or estimated real estate value gains. In Ecuador for example, for urban water infrastructure such as sewerage, landowners whose plots directly gain access are charged, while for larger projects such as tram lines, all landowners in a neighbourhood are charged. How much benefiting landowners are charged is based on a formula that accounts for size, value and distance to the infrastructure, with the idea being those properties closer to the infrastructure benefit more and thus pay more in LVC fees. In this way, the real estate owners' contribution is clearly linked to the value benefit they receive from the public infrastructure project, reducing risks of resistance, while also increasing revenue potential and making levies fairer.

Infrastructure levies require established procedures to assess valuation gains, such as from professional assessments. Moreover, levies need to be credibly announced when the project starts, so that they accrue to owners that realise the value gain. Landowners below a certain income or wealth threshold are often excluded from paying charges altogether to avoid hardship (OECD, 2022[23]).

4.3.4. LVC through expropriations and the strategic management of public land

In many countries, governments actively participate in the development and management of land assets. This can be done by expropriating land for public use, generating value uplifts in government landholdings and through public private partnerships. The acquired land can be used to directly provide for water infrastructure. It can also be sold or leased to generate revenues. Countries such as Australia, Finland, Israel, and the Netherlands have adopted public land leasehold systems. For example, the Netherlands is well-known for its 'Active Municipal Land Policy', where municipalities acquire vacant, abandoned or unproductive land through debt financing, develop and service this land, and sell or lease this land to the private market. The profits generated during this process are used to finance the development of the land and infrastructure as well as provide for future operation and maintenance costs. In France, land for public infrastructure is often provided for by expropriation. As in many countries, the French government can purchase land at a price which prevailed before the announcement of the public improvements or development projects (OECD, 2022[23]).

The State Asset Management Agency (LMAN) manages the government's property in Indonesia. While expropriation and the strategic management of land is occasionally used as an LVC instrument, there are barriers to implementation that limit their more effective use. There is no legal basis for the government to purchase land at prices which prevailed before the announcement of the government intervention, which makes land acquisition costly. Administrative capacity and coordination among public entities to implement strategic land management practices are also lacking (OECD/Lincoln Institute of Land Policy, PKU-Lincoln Institute Center, 2022[6]). The effective utilisation of these instruments for LVC purposes will depend on reforming the legal basis for the government's role in the land market, and in balancing public interests with private property rights.

4.4. Recommendations to strengthen the enabling framework for LVC

The provision of water in Indonesia is predominantly funded either by tariffs or direct government transfers. However, the high cost of building water infrastructures and operating and maintaining them cannot be provided for by charges and transfers alone. This has resulted in inadequate and insufficient water infrastructure and a lack of access to basic water services such as piped water, as well as insufficient flood protection capacity. LVC instruments can provide tools to government at all levels (national, regional, local)

to bridge this financing gap. Indonesia is implementing legislative reforms for LVC to this purpose. Nonetheless some key actions still need to be addressed.

4.4.1. Developing local government capacity to implement LVC

Implementation of LVC involves the responsibility of all government levels, but in particular local governments. Their responsibilities include ensuring fundamental framework conditions are met. LVC requires the development and monitoring of spatial planning outcomes and land-use regulations, as LVC relies on governments having unique power to determine and alter land uses. It also requires defining landowners affected by LVC instruments, as well as setting the rates for fees and contributions, negotiating with landowners and developers, and managing land assets. Where the central government is in charge of such a project, it will need powers to set such charges in local areas benefitting from such infrastructure. This is the case, for example, for an ongoing river-diversion project providing flood protection to the business district of Jakarta. Nonetheless, even in such cases, local governments play a key role in the actual implementation of LVC.

Local governments need to improve administrative capacity to carry out these tasks. However, the history of decentralisation and regional autonomy is still relatively short in Indonesia, resulting in municipalities in Indonesia generally lacking the capacity to set LVC fees or negotiate with developers, among other tasks. Municipalities also lack the capacity to effectively collect taxes and fees, making them reliant on central government transfers. Most localities also lack formally enacted land-use regulations. This has hampered the issuance of development permits, which makes implementing LVC instruments such as developer obligations, charges for development rights, and land readjustment costly and time-consuming. This has contributed in part to the prominence of the informal land and property market, which further makes regulating land-use and public land acquisition difficult. The example of Ecuador in providing credit and technical support through the national development bank suggests a possible solution to aid local government capacity building efforts.

Developing local government capacity to implement LVC will require targeted central government financial and administrative support for municipal governments. A viable approach could be to maintain a pool of planning and administrative experts certified by the central government that are called upon as needed to aid local government planning efforts (OECD, 2022[31]). Equally important is simplifying the rigid spatial planning legislation which requires Detailed Spatial Plans to be approved by both the Ministry of Agrarian Affairs and Spatial Planning and the local parliament. Continued legislative reforms to expand local government autonomy in implementing and collecting taxes and fees should be carried out, and these reforms should be well integrated with the newly proposed presidential decree on LVC implementation.

4.4.2. Maintaining accurate land registries

Maintaining accurate and detailed land registries is essential for the effective implementation of LVC. A robust system of land administration and management allows clarity and certainty regarding land ownership. Land registries are also essential in developing and enforcing land use plans and land-based regulations, and are the basis for calculating land values and land value increases due to government interventions. More generally, accurate and detailed land registries allow the land market to function effectively and efficiently while discouraging informal and possibly illegal land uses and settlements.

Outside of Jakarta, land registries across Indonesia are largely incomplete and not sufficiently updated. This often results in complex landownership issues, for example double claims of ownership, and lengthy legal disputes hampering LVC implementation and public land acquisition. There are still many landowners that have not converted their old certificates issued by the colonial government to those issued by the National Land Agency.

In addition, land registries do not have accurate information on the values of land plots, and even if this information exists, the values are not updated regularly. Currently, land valuations are only updated for specific plots when the land needs to be acquired to develop infrastructure. This prevents calculating land value increments and holds back applying LVC. It also results in forgone land and property tax revenues. Legal provisions and administrative support should be provided to assess land values for projects of interest for LVC.

The maintenance of accurate land registries requires both sufficient financial resources and administrative capacity of local governments. Sufficient support provided by central government ministries and agencies in charge of maintaining land registries is needed for local governments to carry out on-the-ground assessments. Importantly, an adequate workforce of certified appraisers needs to be available at the municipal level. This could be achieved in part by allowing private professionals certified by the government to carry out land valuation and appraisal.

4.4.3. Reforming land acquisition legislation

Conducted in a fair and transparent manner, land acquisition can facilitate the provision of land for water infrastructure, especially in cases where the infrastructure requires a significant amount of land and landownership rights are complex. Furthermore, land acquisition can act to speed up LVC implementation in some cases by giving landowners a choice between sale and making LVC contributions. In Korea for example, projects often utilise a hybrid approach in which expropriations are carried out in cheaper areas and land readjustment is used for more expensive plots, which speeds up implementation and reduces overall project costs (OECD, 2022[23]). Land acquisition rules on terms that will allow the government to retain land value gains from its infrastructure development also serves as a fall-back mechanism when landowners fail to reach a supermajority for LVC projects to commence. It will provide stronger incentives for landowners to cooperate in with the government LVC, for example in the case of land readjustment, and avoid costly legal expropriation procedures. In many countries such as France and Singapore, governments have the right to acquire land for infrastructure development at prices that prevailed before the announcement of the infrastructure project, which effectively returns all or most of the windfall land value gains back to the public (Box 4.7).

To facilitate land acquisition for LVC purposes, legislation must be clear on how landowner compensation is determined. This can include stipulating whether estimated or market values are used, explicitly listing the specific criteria and land characteristics used to calculate fair values, as well as outlining when these valuations take place and who oversees them. A clearer land acquisition framework can help in expediting water infrastructure developments by reducing legal disputes. In order to prevent land acquisition from becoming prohibitively costly and to utilise acquisition as an LVC instrument, legislation could include clauses for freezing land prices at specific points in time predating government interventions, which can vary depending on the type of project and infrastructure.

Box 4.7. Land acquisition in Singapore

Singapore's rapid transformation from a colonial port city into a global financial centre was due at least in part to a sound land administration and management system. Many of Singapore's urban development efforts relied on a land acquisition framework that allowed government to acquire privately owned land to facilitate development of public infrastructure and services.

Landownership in the 1960s was concentrated among a small group of private enterprises and individuals, which initially made land acquisition difficult. Various pieces of legislation since then allowed the government to expropriate private land for any public purpose, and for residential, commercial, and industrial developments without excessive financial cost.

Singapore's legislation does not allow dispute over expropriation, but allows landowners to contest the amount of compensation paid. Singapore's legislation also allows the government to disregard land value increases for up to 2 years prior to the acquisition for improvements made by the owner to their own property, and for up to 7 years for increases due to infrastructure works in the surrounding area. Such legislation has paved the way for the construction of large-scale public housing and infrastructure and has facilitated large-scale development projects such as the reclamation of Marina Bay.

Singapore's system of land acquisition acts as an effective LVC instrument by allowing the government to expropriate land at a cost that does not include any windfall gains. Even with such legislation, landowner appeals are limited. This is because the acquired land was used for projects that had clear public benefits, such as the large-scale public housing programme that provided vast amounts of low-cost housing to citizens.

Source: Asian Development Bank (2021[18]), *Innovative Infrastructure Financing through Value Capture in Indonesia*, Asian Development Bank, https://doi.org/10.22617/spr200093-2.

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5 Disaster risk reduction through non-structural measures

As a large archipelago country consisting of thousands of islands, Indonesia faces various types of water-related disasters. This Chapter illustrates how strong institutional arrangements between a central disaster control tower and line ministries can lead to efficient disaster prevention. It also recommends land use system adjustments as a disaster prevention measure. Lastly, the Chapter covers several non-structural measures that can further reduce flood disaster risk, including flood forecasting combined with an early warning system and an integrated water information system.

Indonesia is vulnerable to water-related disasters that cannot all be mitigated through infrastructure such as dams, embankments, retention basins or channels. This chapter presents options for reducing disaster risks through non-structural measures. Non-structural measures are measures not involving physical construction using knowledge, practice or agreement to reduce disaster risks and impacts, in particular through policies and laws, public awareness raising, training and education. Common non-structural measures include building codes, land-use planning laws and their enforcement, research and assessment, information resources and public awareness programmes (UNDRR, 2022[1]).

This chapter analyses policy and institutional frameworks, illustrates water resource information systems including monitoring stations, and identifies areas for improvement in early warning systems in Indonesia. It reviews the meteorological and hydrological data for early warning and techniques related to flood forecasting. It also discusses the potential of satellite data in land use planning to reduce the risk of water-related disasters such as floods, and the establishment of an integrated information system that makes knowledge of the impact of land use change on exposure and vulnerability.

This policy analysis focuses on Indonesia's inherent problems and presents realistically feasible alternatives using modern Information and Communication Technology (ICT). As has already been proven in many cases, it is important to recognise that policies to prevent natural disasters are always insufficient with the efforts of the government alone: successful policies require engagement at all levels of government and civil society, including the private sector.

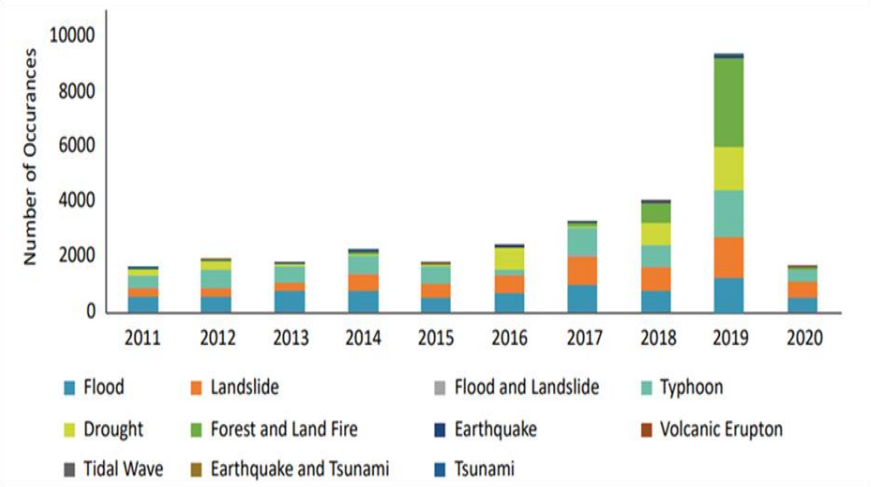
5.1. State of play: water disaster risk management in Indonesia

5.1.1. Natural disaster profile of Indonesia

A report by IBRD and WB (World Bank, 2021[2]) confirms that Indonesia is one of the most disaster-prone countries in the world. More than 75% of disasters are classified as meteorological or hydrological disasters. Indonesia loses more than 1% of its forests every year and ranks low behind India and China on the global environmental score. Thus, if action is not taken by 2045, the decrease of rice and palm oil production is expected to reduce GDP by 3.4%. If land degradation continues, inland flood disasters can cause a GDP reduction of 0.11%. It is also expected that GDP will decrease by up to 1.65% in the case of floods with a frequency of 50-year return period, and by 2.4% of land subsidence if excessive groundwater intake and SLR (Sea Level Rise) continue.

In Indonesia, various water-related natural disasters are hampering development benefits and affecting the population and landscape. Indonesia is vulnerable to 'slow onset disasters' such as coastal erosion, inundation, and delta subsidence, along with floods, droughts, landslides, tsunamis, tidal waves, and earthquakes (Republic of Indonesia, 2020; IBRD and WB, 2021). These risks have been greatly increasing due to anthropogenic factors such as deforestation, environmental degradation, and unsustainable water use, along with rapid urbanisation, agricultural activity and industrial development. Other disasters such as earthquakes, volcanic eruptions and tsunamis are also affecting water resources and water infrastructure (Figure 5.1).

Figure 5.1. Trends in disaster occurrence in the last 10 years



Source: International Bank for Reconstruction and Development and World Bank, Indonesia Vision 2045: Toward Water Security, 2021 (World Bank, 2021[3]).

In Indonesia, water-related disasters cause economic losses of 2-3 billion US dollars annually. More than 100 million people, or about 38% of the population, are exposed to flood risk, and 325 cities and regions are classified as high-risk areas. The number of flood events almost tripled, from 50 events in 2006 to 146 events in 2017 (World Bank, 2019[4]). The increasing flood risk, along with the lack of disaster-related information, in the downstream areas of rivers with growing urbanisation exposes urban areas to fatal actual risks such as dam collapses in the upper reaches. Flooding in Jakarta in 2020 affected 173,000 people. The flood risk burden is unevenly allocated to large cities and the poor and vulnerable (Government of Indonesia, 2020[5]).

Climate change is expected to increase the risk of natural disasters. Overall, the impact of climate change on water resources is expected to be significant, and it is projected to have a strong negative impact on society. Artificial disasters caused by unplanned developments in urban areas is prevalent and rampant. Additionally, climate change will affect water quality. But the biggest climate threat is SLR (sea level rise), which is expected to inundate extensive coastal areas and reduce GDP by up to 2.4% by 2045 (World Bank, 2021[3]).

5.1.2. Policies and practices of water and disaster risk management in Indonesia

The Indonesian government has developed policies to strengthen preventive measures and increase disaster resilience to protect people's lives and property from natural disasters. In particular, it focuses on strategies that maximise the effects of non-structural measures to compensate for the limitations of structural measures. Resilience-enhancing measures proposed by 'Vision 2045: Toward Water Security' (World Bank, 2021[3]) include: (a) optimising water usage and related development by aligning spatial planning with available resources; (b) reducing groundwater over-abstraction and consequent land subsidence, especially in urban and lowland areas; (c) reducing water pollution that is worsening with rapid urbanisation, industrialisation, and agricultural runoff; (d) protecting ecosystems, including watersheds and peatlands; (e) improving resilience to water-related disaster risks.

Indonesia's water authorities are responsible for surface water (Ministry of Public Works and Housing, MoPWH) and groundwater management (Ministry of Energy and Mineral Resources, MoEMR); water quality and catchment management (Ministry of Environment and Forestry, MoEF); spatial planning (Ministry of Agrarian Affairs and Spatial Planning, MoASP); provision of agricultural, residential and

industrial water services (MoPWH); economic activities affecting water resources (MoEMR, Ministry of Finance, MoEF, MoMAF); water-related disaster prevention and management (National Disaster Management Agency, BNPB); drinking water quality standards (Ministry of Health, MoH). It is underlined that disaster-related policies must be integrated or coordinated to efficiently implement the national plan, and information dissemination and early warning systems must be strengthened, and community participation must be encouraged (World Bank, 2021[3]).

Due to its geographical characteristics, combined with high exposure to natural disasters along with the effects of climate change, Indonesia may suffer greater losses and damages in the future if proper management and response measures are not taken. In relation to this awareness of the situation, the Indonesian government has prioritised improving resilience to natural disasters and climate change in the Medium-Term Development Plan 2020-2024 (Government of Indonesia, 2020[5]). The country's national policy priorities are (1) improving environmental quality; (2) increasing resilience to natural disasters and climate change; (3) the application of low-carbon development approaches.

Structural and long-term strategies for protecting and managing watersheds and extensive collaborative efforts are being emphasised by the Indonesian Government. Currently, there is a lack of coordination and cooperation between upstream and downstream. Therefore, water resource management tasks and disaster management measures should be further integrated. A priority should be the integration of land and water planning and management, integrating planning and management across the water sectors, and integrating agricultural development, water planning and wildfire management in natural land planning. It is necessary to strengthen information exchange among relevant ministries, central, provincial, and local governments. Policy coherence should be maintained across climate change adaptation, water and land management, spatial planning, ecosystem and biodiversity protection, and disaster risk reduction.

Asia Water Council (AWC) identified key factors hindering the implementation of disaster risk reduction and disaster management in Indonesia. These are: capacity enhancement, inter-agency disaster management cooperation, disaster-resilient land use planning, and impact-based early warning system. Considering the various issues pointed out in Indonesia's disaster management system, practical non-structural measures such as reducing disaster risk and improving disaster and climate resilience will be recommended. Specifically, related technologies and interpretation methods for meteorological and hydrological forecasting and disseminating disaster risk information will be also suggested in Chapter 5.2, 5.3 and 5.4. The National Dialogue on Water pointed to the following barriers in the implementation of disaster risk reduction measures:

1. There is a lack of momentum to promote a series of institutional efficiencies leading to disaster prevention, management, response, and recovery. As highlighted in various documents such as the responses to the questionnaire (Government of Indonesia, 2022[6]) and the above-mentioned national plans, severe restrictions on information sharing exist. Cooperation between the central and local governments and NGOs that play a key role in the value chain of disaster risk management, such as coordinating work in disaster prevention and management and sharing information or data, is also limited.
2. Effective service provision for disaster prevention and reduction are not systematic in terms of scope, content, scale and method. Moreover, hardware infrastructure, such as measurement and monitoring, and software infrastructure, such as data and information analysis and communication, are insufficient.
3. In Indonesia, the technical complexity of hydromet services, remains a significant challenge. Robust hydromet services are the most basic and essential requirement for the prevention and management of natural disasters.
4. Since the information integration of disaster-related inter-agency depends on inter-agency coordination, a lesson must be learned from the lack of a centralised medium to facilitate data and information.

5. In the case of Indonesia, various negative impacts such as extreme weather events due to climate change are expected to occur in the future, so stable finances and investment towards an information-oriented society are essential to ensure improved quality of climate data and flood forecasting.
6. To increase the effectiveness of a timely and sustainable “last mile” in disaster warnings, it should be carefully considered that even if a national disaster early warning system exists, the “last mile” will not necessarily reach communities or translate into effective early action. This can be seen in the recommendations of international organisations related to overcoming disasters, such as WMO and UNDRR, and the four priority measures of the Sendai Framework. Since people-centred early warning systems are based on risk knowledge, it is necessary to develop ideas to strengthen and improve knowledge management.

Indonesia’s unique geographic location makes flood risk management even more complex. Indonesia is located in a tectonic zone characterised by intense seismic and volcanic activity on the south-eastern edge of the geologically Eurasia continent. A long period of tectonic, seismic, and volcanic activity has created the topography of Indonesia today. Its features include long and narrow islands, high mountain ranges formed by active volcanic and orogeny activity, and rivers and coastal zones formed by erosion and deposition. These topographical features have become a factor that determines the way of life of the Indonesian people in terms of meteorology and hydrology, and natural disasters are part of life. Moreover, the topographic characteristics are untraceable and difficult to manage in terms of disaster risk management.

5.1.3. Review of international lessons learnt on disaster risk management

A survey of the Disaster Risk Governance (DRG) initiative found that there is a global shift from top-down disaster response to a more inclusive form of DRG. This trend has been observed in policies and organisations (Srikandini, Hilhorst and Voorst, 2018[7]). Especially in Indonesia, the role of civil society is well recognised. UNDRR (UNDRR, 2022[1]) provides clues to the direction of disaster management policy in Indonesia through its extensive reflection on the limitations and opportunities of systematic risk governance. It points out the need to improve the existing approach by reflecting on various disaster events in Indonesia.

In particular, community responses and systemic inefficiencies during disaster hazards have been identified as “last mile”, which is why the end-to-end early warning system must be strengthened by bridging the gap between the upstream and downstream of the early warning chain to ensure timely action (UNDRR, 2022[1]; UNDRR, 2021[8]). There have been several definitions of “last mile”: one is “last mile” as a challenge for rural communities to access media, which can be overcome by supplementing traditional media channels for warning dissemination with additional technologies (LIRNE Asia, 2008[9]); another one is ‘last mile’ as the capacity of the community to take action in response to a received warning, which supports the development of the capacities of local institutions (Bedi, 2006). In this report, the definition of “last mile” can be applied in a comprehensive sense of both definitions from the perspective of advanced information sharing in consideration of hazard arrival time or lead time for response.

The policy reform for reducing natural disaster damage and improving climate resilience in Indonesia still needs to be initiated. Disaster response capabilities can be assessed in 5 major sectors. These are 1) governance, 2) information/data and analysis, 3) strategic planning, 4) resources, and 5) monitoring and evaluation. Institutional capabilities can expect greater effects when all these areas are properly developed, and experiences and know-how are collected. Especially, institutional capacity is important not only for comprehensive resources within the organisation but also for digital resources that support them.

One example of the disaster response capability is to improve the accuracy of forecasts and warnings through technological advancement in the field of hydrometeorology and improvement of flood prediction models by means of various information provision methods such as satellite images and rainfall radar.

Mobile devices, smartphones, and social network (SNS) have progressed from a one-way information delivery system (based on public media such as TV, radio, village speakers or direct delivery means) to a smart environment where information can be shared in two-way or even multiple-way communication. Smart communication methods fit very well with the four priorities for disaster risk reduction of the Sendai Framework for Disaster Risk Reduction.

As the World Meteorology Organisation (WMO) emphasises, flood forecasting and warning services should operate in conjunction with the National Weather and Hydrology Service (NMHS), which supports civil protection and emergency response services (WMO, 2010[10]); (Hodgkin, 2016[11]) (APFM, 2022[12]). Prediction and warning services are in most cases based on information systems developed to provide reliable and timely information to the public as well as to private protection services. It should consist of institutional and technical functions that ensure sufficient lead time for stakeholders to take measures to protect themselves from floods or to take appropriate measures and enable disaster management agencies to intervene and take appropriate measures.

5.2. Recommendations to integrate disaster management and land use planning

The integration of disaster management functions is intended to be reviewed with emphasis on coordinating and managing overlapping or conflicting functions in the control tower, while responding to disaster management by individual departments, rather than managing all disasters in one control tower. Disaster prevention through land use planning suggests disaster-resistant land use planning based on foreign cases and Korea's experience.

5.2.1. Coordination of disaster management functions

More than ten percent of Indonesia’s surface area is subject to a relatively high mortality risk from multiple hazards. However, the percentage of Indonesian people living in these areas is close to sixty percent (Dilley, 2005[13]). this is mostly due to the concentration of risks on the island of Java, which has by far the highest population density and bears a high natural disaster risk (Rossum and René, 2010[14]).

Under these difficult circumstances, the Indonesian government has made various efforts to improve disaster management. The Indonesian government plans to move the capital to East Kalimantan on the island of Borneo by 2045 as part of a comprehensive strategy of balanced national development and reduction of the impact of disasters on Java Island.

According to the special law on Disaster Prevention (Undang-Undang Penanggulangan Bencana No. 24: UUPB) in 2007, Indonesia is a region prone to various natural disasters such as earthquakes, tsunamis, volcanic eruptions, floods, droughts, typhoons, and landslides.

After the 2004 Sumatra tsunami, the Indonesian government realised the need for a stronger and more integrated disaster management organisation. In 2008, President Susilo B. Yudhoyono established the National Agency for Disaster Countermeasure (BNPB), a Ministry dedicated to disaster prevention. It is implementing effective disaster prevention policies by linking to various ministries within the government. However, it is evaluated that many Indonesians are not protected from disasters due to the wide spread of Indonesian territory, the occurrence of various disasters, and the lack of capacity and financial resources of related organisations including, BNPB (Park and Lim, 2017). It can be concluded that Indonesia's related laws and systems have been established to some extent with the cooperation of international organisations and many foreign specialised organisations.

The tsunami shifted the disaster management paradigm towards prevention and mitigation and led to the establishment of a National Disaster Management Authority and Regional Disaster Management Authorities. The law is a significant improvement, but many problems remain, including the overlapping jurisdictions of the central and regional governments as well as difficulties in coordinating disaster

management activities. These must be overcome to prevent avoidable loss of life and property resulting from natural disasters.

Even though BNBP plays a role as control tower in the disaster management system, Indonesia is still vulnerable to disasters due to several reasons:

Although BNPB is in charge of all disaster operations, it still seems to lack the ability to coordinate and cooperate with the work of individual ministries directly responding to disasters. BNPB is directly responsible to the President of Indonesia and the chairman is directly appointed by the President. It provides guidance and direction on disaster management efforts that include disaster prevention, emergency response, rehabilitation, and reconstruction in a fair and equitable manner and assigns the standardisation and implementation of disaster management needs based on laws and regulations.

Promoting disaster preventive projects remains a challenge as the necessary financial resources have not been secured. Still, the priority of financial resources invested in disaster management is falling behind from the national financing priorities. Experience from Korea shows that significant investment can tremendously reduce disaster risks. Damage from typhoons and floods continued to occur in Korea until the end of the 1990s. To overcome flood disaster risk, the government dramatically increased the annual budget related river management from of 0.23 billion U.S. dollars, to 0.77-1.2 billion U.S. dollars since 2000(Internal data of Ministry of Land, Infrastructure and Transport of Korea). Owing to the increased fiscal budget the damage caused by river flooding has decreased, although the risk of disasters due to climate change has recently increased.

BNBP must make efforts to secure a stable budget for disasters. To this end, it should be known that disaster budget investment is an important factor in creating more national wealth in the long run. If there are difficulties in securing the government budget, it is necessary to seek ways to actively attract private capital. In general, there are limits to attracting private capital in disaster-related projects due to their strong nature as public goods. For example, in order to attract private capital to invest in river flood prevention, one way is to give development rights around rivers to private businesses. Land Value Capture as set out in Chapter 4 could be a relevant financing tool in this context.

Since Indonesia is a country composed of many islands, the central government has limitations in preventing and responding to all disasters. To overcome this issue, the BNPB's regional office’s function in each major region must be strengthened, and continuously establish a rolling plan for disasters through communication with the local government and community. Local office of BNPB also continuously promote the implementation and evaluation of the established plan.

Considering the overall situation, it is most important for BNPB to strengthen its role in coordinating and evaluating the work of various ministries related to disasters. At the same time, the local organisations of the BNPB - the BPBDs - should provide technical support for disaster-related tasks of local governments so that the local governments perform comprehensive functions for various projects, whether these come from central government and local government.

In particular, community-based disaster management, where disasters actually occur, can minimise human casualties through rapid evacuation and efficiently execute disaster recovery in coordination with the central government, local governments, and foreign aid. What is more, coping with disasters by relying on the ability of the central government alone is no longer effective because of resource limitations. Therefore, involvement of the entire community in disaster management is essential. Section 5.4 provides some suggestions on ICT applications for community-based disaster management.

5.2.2. Disaster-resistant land use planning

Land use planning is a major tool for reducing risks from natural hazards, and aiding sustainability and increasing resilience. Risk-based land use planning not only minimises damage in the event of a disaster, but also provides rapid resilience.

Conventionally, planning relies on the probability of occurrence of a disaster. However, this method tends to underestimate the ability to assess and quantify the consequences of various disasters, including the number of fatalities per year. If the probability of a disaster comes out low, it may encourage decisions that put society at risk, such as over-developing disaster-prone areas. This is because even if the probability of occurrence of a disaster is low, its impact may be very serious.

The key to risk-based planning is to be able to distinguish between different levels of risk (e.g., acceptable, tolerable, intolerable) and link them to appropriate land use policies. Acceptable risk levels should be based on measurable levels (see also Figure 5.3). Indicators to monitor risk levels ensure that acceptable levels of risk are not exceeded, and efforts are made to mitigate existing risks so that towns and cities can achieve sustainable development. The risk-based planning approach (RBPA) proposed by Saunders and Kilvington (Saunders and Kilvington, 2016[15]). has many implications for planned land use planning.

Risk-based land use planning has been evaluated as very encouraging by the United Nations Office for Disaster Risk Reduction (UNISDR) (Saunders and Kilvington, 2016[15]), and it is considered as an essential technique for mitigating risks in existing development and prohibiting or strengthening development in extreme risk areas.

Risk-based land use planning can also be used for risk-based planning assessments of the impact of a particular natural disaster that triggers another disaster (e.g., a tsunami or landslide caused by an earthquake). It can be quantified as part of future planning decisions about the economy, society, culture, infrastructure, and security resulting from a particular development.

5.2.3. International experiences with risk-based planning approaches

Risk-based planning is used all over the world, including Australia, Canada, European Union, Hong Kong, United Kingdom and the United States. During the development of the risk-based planning approach (RBPA) in New Zealand (between 2007 and 2013, see Box 5.1), other countries were developing similar risk-based frameworks. For example, Australia's Queensland Reconstruction Authority published a risk-based approach to flooding in 2012. The Geological Survey of Canada prepared a risk-based land use guide for risk assessment in 2015.

Box 5.1. Disaster-based land use planning in New Zealand: a matter of coordination

In New Zealand, multiple authorities are responsible for natural disasters. Ministry for the Environment (providing national regulatory and non-regulatory guidance), local councils (responsible for regional or watershed-scale policy frameworks), and land authorities (responsible for specific land-use designs and decisions are city and zoning committees), civil defence emergency management groups (disaster prevention and response), and national civil groups (social infrastructure management) share responsibilities complementary to each other.

Cooperation between these agencies is key to ensuring a streamlined and holistic national approach to planning for natural disasters and catastrophes. In New Zealand, which is surrounded by seas like Indonesia, there are four important laws that contribute to natural disaster management: the Resource Management Act (1991), Building Act (2004), Civil Defense Emergency Management Act (2002), and Local Government Act (2002). These laws are intended to operate in an integrated way to achieve the common goal of sustainability. The Resource Management Act is an important law for regulating land use planning.

Under the Resource Management Act, sustainable management enables people and communities to provide for their social, economic, and cultural well-being and for their health and safety while sustaining the potential of natural and physical resources to meet the reasonably foreseeable needs of future generations. The law deals with governance at three levels: national, regional and district. Risk-based planning helps regional and regional authorities mitigate the impact of natural disasters through land-use planning. The mitigation measures required by the district level under current resource management laws are those that can result in a reduction in disasters.

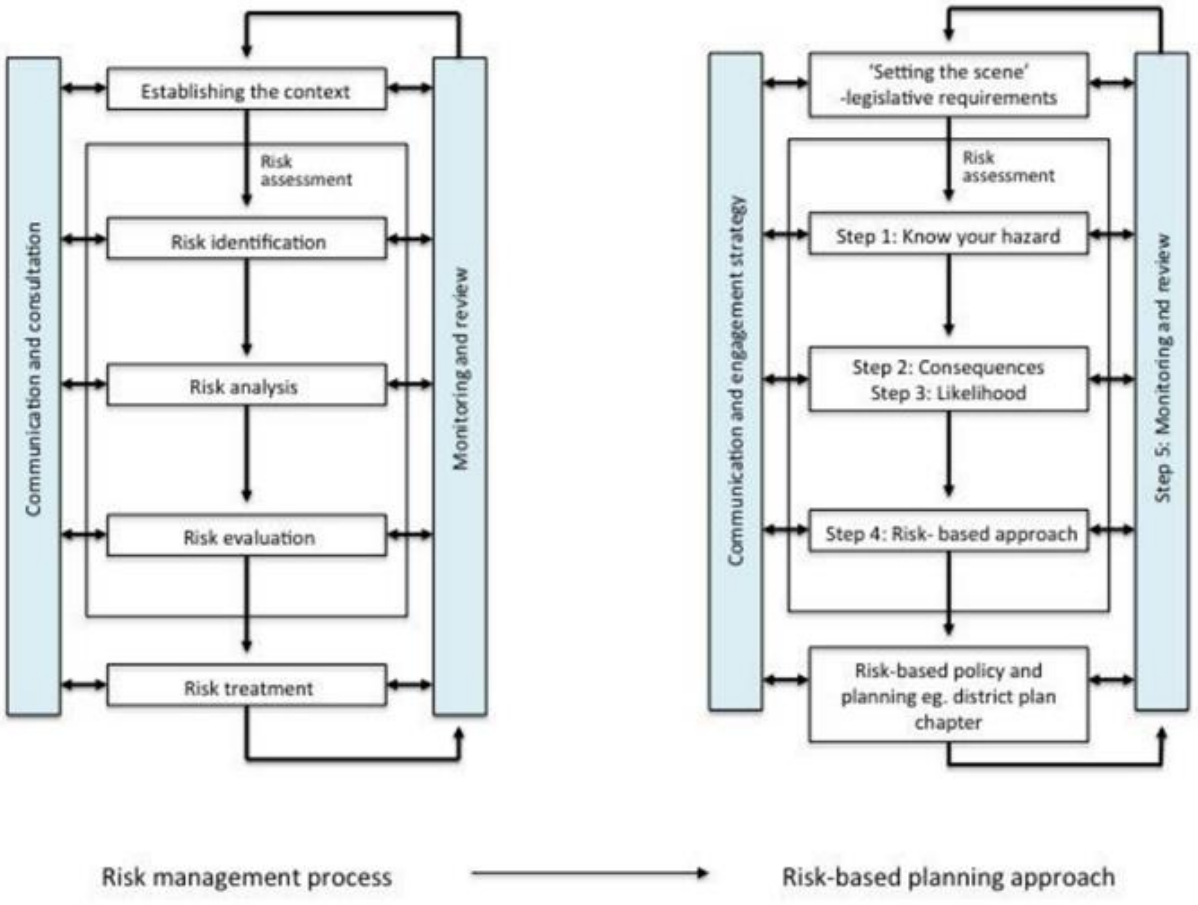
Source: (Saunders and Kilvington, 2016[15])

RBPA comprises five stages. The key is that stakeholders and affected communities must participate at each stage of the risk analysis, evaluation, and decision-making process. The five steps are to recognise the disaster risk in the area, determine the degree of disaster impact, evaluate the probability of occurrence of a disaster, select a risk-based approach, and finally go through the stages of monitoring and evaluation Figure 5.2. Communication and engagement about the disaster is essential to risk assessment and decision-making. In a broader sense, once the risk management process is established, it becomes a series of processes in which a risk-based planned approach is made. Figure 5.2 compares the standard risk management process with the risk-based planning approach, and shows that each step of the risk-based approach is consistent with the risk management standard (Saunders and Kilvington, 2016[15]).

A risk-based land use plan is finalised through the creation of a matrix on the likelihood and consequences of disaster occurrence Figure 5.3 shows how land use planning should be controlled by creating a matrix for the order of probability of occurrence (very high: 5) and the magnitude of the impact according to the severity level (largest: 5).

RBPA is a robust, transparent, and participatory framework for decision makers to determine risk levels. Policies are drafted on a risk basis, evaluated over time, and ultimately reduce the loss of people and property. RBPA is a method that considers the theoretical and practical challenges of adopting a risk-based approach to land use planning.

Figure 5.2. Comparison of risk-based planning and risk-based management process



Source: Saunders and Kilvington, 2016, Innovative land use planning for natural risk reduction: A consequence-driven approach from New Zealand, International Journal of Disaster Risk Reduction (Saunders and Kilvington, 2016[15])

Figure 5.3. An example of Levels of Risk and Associated Levels of Land Use Control

	Consequences				
Likelihood	**1**	**2**	**3**	**4**	**5**
5	5	10	15	20	25
4	4	8	12	16	20
3	3	6	9	12	15
2	2	4	6	8	10
1	1	2	3	4	5

Level of risk	Level of land use control
Acceptable	Permitted
Acceptable	Controlled
Tolerable	Restricted Discretionary
Tolerable	Discretionary
Intolerable	Non complying, prohibited

Source: Saunders and Kilvington, 2016, Innovative land use planning for natural risk reduction: A consequence-driven approach from New Zealand, International Journal of Disaster Risk Reduction (Saunders and Kilvington, 2016[15])

5.2.4. Nature-based solutions as low-impact development

Low Impact Development (LID) is a term used to describe a land planning and engineering design approach to manage storm-water runoff as part of green infrastructure. LID emphasises conservation and use of on-site natural features to protect water quality. This approach implements engineered small-scale hydrologic controls to replicate the pre-development hydrologic regime of watersheds through infiltrating, filtering, storing, evaporating, and detaining runoff close to its source.

In areas with high disaster risk, land is best used as a nature-based solution that can act as a low-impact development, wetland or floodplain to prevent flooding, improve water quality, and create walking trails and wetland trails for leisure activities of residents.

As a result of applying the LID technique to the housing development site of Korea's LH Corporation, it shows that the efficiency of urban water circulation increased by 41 per cent (Lee, 2016[16]). Bai et al. (Bai et al.[17]) also show a 32.5 per cent reduction in runoff at peak times during rainfall and a 31.8% reduction in overall flooding.

5.2.5. Some proposals related to institutional improvement

Reinforcing disaster response governance capabilities

Even if BNPB is the control tower, it is part of a cooperative governance system among various disaster management entities. Large-scale disasters lead to a wide variety of disasters. Since various disaster management entities have no choice but to participate, cooperative work among them is more important than anything else.

The UUPB is the highest law for overcoming disasters in Indonesia, and it is necessary to clearly specify the authority and responsibility of the central and local governments in each stage of disaster management, such as prevention, emergency response, and recovery. At the same time, it is necessary to explicitly stipulate in the law how to urgently secure financial resources for disaster recovery in the event of a disaster.

It is necessary to establish regular (5-year) plans for various sectors to prevent disasters and strengthen the system for evaluating the implementation results. Guidelines that local governments can refer to should be presented, and based on these, specific comprehensive measures should be established by the local government.

Strengthening the capacity of local governments

Local governments must establish disaster prevention measures at the local level and establish consistent measures with central government’s plan. The Japanese model could be relevant for Indonesia. In Japan, regional disaster prevention plans are established every year for the purpose of improving regional disaster prevention capabilities. When a disaster occurs, it is emphasised to support the vulnerable by utilising private resources (manpower, organisation, resources, logistics, etc.) within the region (Tokyo Disaster Management Council, 2014[18]).

Box 5.2. Participation of the private sector to improve Tokyo's disaster preparedness capacity

The Tokyo Metropolitan Government, the capital of Japan, aims to improve Tokyo's disaster preparedness capacity in order to protect the lives and properties of citizens and maintain urban functions. To this purpose, relevant measures have been prepared with the goal of creating a city that is resistant to earthquakes, creating a risk management system that protects the lives of citizens and urban functions, and creating a system that supports the lives of victims and regenerates Tokyo in a short period of time. The foundation is based on self-help, mutual assistance, and public assistance based on the participation of the private sector.

Measures for prevention emergency and recovery are: 1) improvement of disaster resilience of residents and regions, 2) realisation of safe city development, 3) securing of safe transportation networks and lifelines, 4) countermeasures against tsunami, etc., 5) enhancement of emergency response capabilities from a wider perspective 6) securing information and communication, 7) measures such as medical aid, 8) measures for those who are unable to return home, 9) measures for victims of the disaster, 10) promotion of logistics and transportation measures, 11) measures against radioactive substances, and 12) short-term reconstruction of residents' lives. In particular, as Tokyo, with a population of more than 13 million, is a large city with a very high population density, human casualties can greatly increase if a large-scale earthquake occurs. In order to minimise casualties, major activities that must be carried out within 72 hours after an earthquake are listed hourly in detail.

Source: (Tokyo Disaster Management Council, 2014[18])

Pre-planning and post-development for urban land uses

In order to prevent reckless and disorganised development and to achieve environment-friendly disaster-safe development, it is necessary to first establish a specific plan for development before proceeding with development. To this end, vulnerability assessment according to changes in land use such as urban reorganisation, new town construction, redevelopment, etc., should be made mandatory.

In addition, in case of any land use changes due to infrastructure construction activities such as industrial bases, airports, and ports of all central and local governments, it is necessary to specify in individual laws to carry out disaster impact assessment in advance so that the principle of pre-planning and post-development can be settled down.

In Korea, the disaster prevention basic plan manages disaster risks based on districts. The plan is led by the National Emergency Management Agency and the Ministry of Environment. The main components of the plan Natural Disaster Countermeasures Act in Korea (2022) are:

- Implementation of Disaster Impact Assessment for the land development over a certain scale
- Designation of natural disaster risk improvement district and establishment of maintenance plan
- Establishment and operation of disaster prevention performance targets by region considering regional characteristics
- Disaster prevention training for the civil servants and technicians
- Establishment of disaster information system & emergency support system

According to the National Territory Plan and Use Act in Korea (the top law for the use, development and preservation of national land), disaster vulnerability analysis should be included in urban management plans, which is established every 5 years. For example, Indonesia's UUPB could specify that the disaster risk in disaster risk areas should be assessed every five years and the mitigation methods should be established.

Risk-based land use planning in river basins

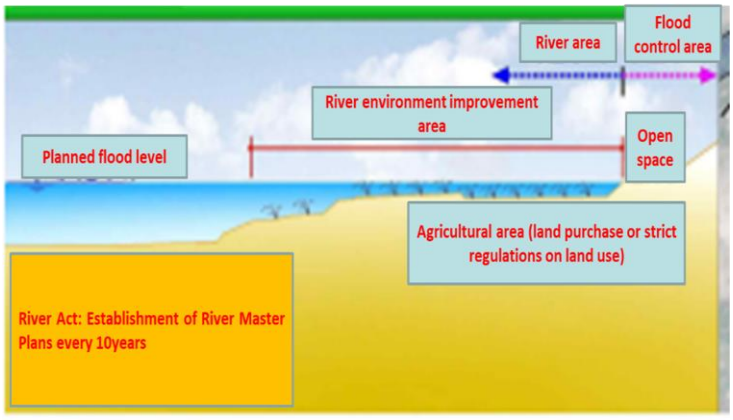
Legal support is needed to conduct disaster impact assessment on existing land use, focusing on areas vulnerable to disasters. In order to induce innovation in land use (Saunders and Kilvington, 2016[15]), the probability of disaster and the size of the impact of disaster should be matrixed. Land development must be banned in areas with high frequency of disasters and severe consequences.

It is essential to promote the relocation support of residents in areas with high disaster risk through the support of the central government and re-designate the area as a floodplain or disaster mitigation area.

In Korea, under its River Act, a basic river plan is established every 10 years to reduce damage caused by flooding of rivers. River plans are established in consideration of changes in rainfall caused by climate change and urban development.

The following figure shows the designation of river areas through the river basic plan. In the past, it was agricultural land, but if the planned flood level of the river increases due to climate change, these areas are designated as rivers.

Figure 5.4. Adjustment of river areas by river basic plan



Source: Author(Asia Water Council internal paper)

As mentioned above, land use planning that reflects the probability of occurrence of disasters and the impact of disasters is very important in disaster management. Based on past disaster experiences, it is necessary to manage risk areas through this approach to disaster risk areas. In order to push forward more strongly, it is necessary to specify disasters in this direction in the relevant laws.

If various disasters such as floods, landslides, and earthquakes are expected in a specific area, first, each disaster impact matrix is created, second all matrices are summed with the same or different weights. It is desirable to weigh each disaster type through the AHP (Analytic Hierarchy Process) technique.

Planning based on zones or districts

At the same time, it is necessary to implement strict land use regulations by actively introducing the zoning system for the sustainable urban development and growth. A good example is New Zealand's planning system is grounded in effects-based Performance Zoning under the Resource Management Act (Memon and B. Gleeson, 1995[19])

In Korea, the National Territorial Planning and Use Law stipulates that the protection of people's lives and property in response to climate change and natural disaster is regarded as one of the important principles. In addition, the designation or change of land use districts is determined by urban and county management

plans. This is because local governments are well aware of the disaster-prone areas in their area. In addition, disaster prevention districts are also designated for the prevention of storm and flood damage, landslides, and ground collapse.

In order to mitigate natural disasters caused by typhoons and floods, the Natural Disaster Countermeasures Act requires the head of a local government to conduct a disaster impact assessment before permitting development projects such as urban development, river use and development, and mountain development. At the same time, natural disaster risk improvement districts are designated and managed for habitually flooded areas and landslide risk areas.

Finally, it is necessary to increase the integrity of the water cycle by inducing development through the LID technique. The Seoul Metropolitan Government has been enforcing the Basic Ordinance on Water Circulation Recovery and Low Impact Development since 2020. The main purpose of this ordinance is to preserve the natural infiltration ability of rainwater based on related laws. Its purpose is to provide basic directions for LID development for the restoration of the natural water cycle deteriorated by urbanisation and the preservation of the water environment. It is necessary to enact laws or ordinances for efforts to restore the soundness of urban water circulation in Indonesia.

5.3. Recommendations to strengthen the flood forecasting system

This chapter recommends flood forecasting systems as one the most useful non-structural measures for flood disaster mitigation. Three shifts in the flood forecasting paradigm are discussed: 1) a shift from conventional technology to information and communications technology, 2) a shift from forecasting along the river to spatial forecasting, and 3) a shift from simulation models to the adoption of artificial intelligence.

5.3.1. Hydrological and meteorological data collection and management

For accurate flood forecasting, hydrological and meteorological data collection is essential. This includes data on rainfall, evapotranspiration, soil moisture, river stage, and discharge. Data monitored during a flood event are not only used for real time flood forecasting, but also for establishing or refining forecasting models. For this, the collected data must be properly managed. As much as the data quality, adequate frequency of data collection needs to be assured. Hourly data could be acceptable for flood forecasting for large rivers. However, data of every ten-minutes are required for small rivers and local urban floods.

With the advances in image processing and related measurement technology, stream discharge measurement is opening a new era. For example, Indonesia uses CCTV as a surveillance tool in several reservoirs. CCTV based automatic wireless discharge measurement technology enables unmanned, non-contact, automatic real-time monitoring of water level and discharge (see Figure 5.4). CCTV is a safe, non-contact method because no manpower is needed, and there is no flow disruption during the measurement. Since it allows continuous real time measurement, peak discharge measurement is always possible, and this is very useful if the measurement purpose is, e.g., to develop a stage-discharge relationship.

Indonesia could consider expanding the use of CCTV technologies for additional purposes, such as in an urban context. CCTV measurement technology is useful especially for small mountainous streams and urban streams. In view of flood forecasting standpoint, all the on-site information including video images can be transmitted through cell phone to the people downstream so that they can take necessary actions. Having suffered severe urban flooding in several cities including Seoul, Korean government is planning to install this kind of surveillance/measurement system in urban areas, and this could be also useful for flash flood forecasting/warning for Indonesian urban streams.

Table 5.1 shows data collection frequencies for hydrological and meteorological variables mostly related to flood forecasting. In Korea, the four Flood Control Offices (FCO) are mostly responsible for the collection of hydrological data, and Korea Meteorological Administration (KMA) collects and manages the

meteorological data. Rainfall and stage data for rivers and dams are open to public real time through FCO and KMA websites and cell phone apps. Most of the discharge data are converted from the stage data using stage-discharge rating relations. However, FCO also collects so-called automatic discharge data for some locations, which is measured by electric wave surface current meters. All the collected hydrological and meteorological data are disseminated every year in the form of a yearbook. The yearbook from 1960 to the present can be downloaded from the website of the Han River Flood Control Office.

Table 5.1. Data collection frequencies for hydrological and meteorological variables

Data	Institution	Data Collection Frequency
Rainfall	FCO	real time observation -> stored every 10 minutes -> open to public real time (web, CP app.)
	KMA	real time observation -> stored every minute -> open to public real time (web, CP app.)
Stage	FCO	real time observation -> stored every 10 minutes -> open to public real time (web, CP app.)
Discharge	FCO	stored every 10 minutes (measurements for validation more than twice a month)
	K-water	stored every 10 minutes (measurements for validation more than twice a month)
Discharge (Automatic)	FCO	stored every 10 minutes (measurements for validation more than twice a month)
Sediment discharge	FCO	measured more than 15 times a year, and stored
	K-water	measured more than 15 times a year, and stored
Soil moisture	FCO	measured every 2 hours, and stored
	K-water	measured every 2 hours, and stored
Evapo-transpiration	FCO	measured every 30 minutes, and stored

Source: Hydrologic Survey Works Handbook, internal document of Han River Flood Control Office (written in Korean)

Figure 5.5. Example of CCTV based Automatic Discharge Measurement Technology

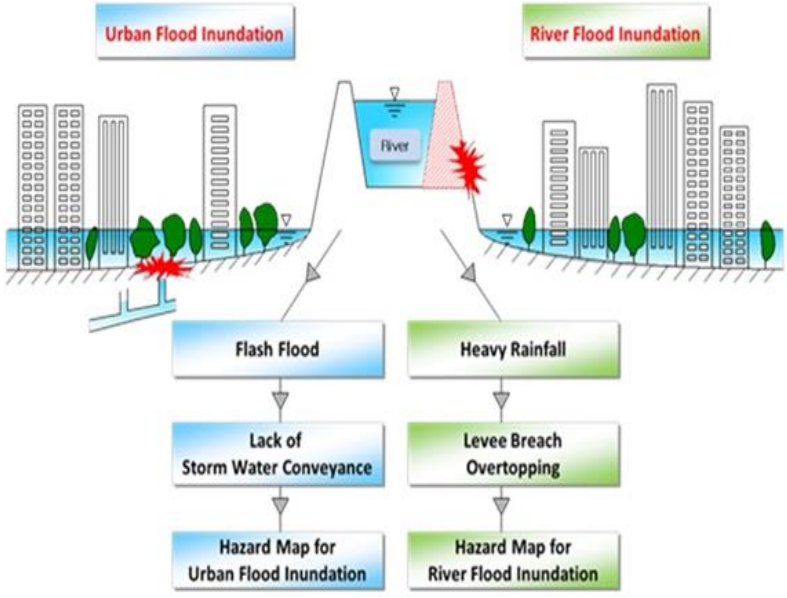
Source: (Yoon. B, 2022[20])

5.3.2. Spatial flood forecasting based on flood hazard maps

Flood forecasting has been largely made for major locations (points) of interest along a river. However, the need for spatial flood forecasting, i.e., forecasting for regions (areas), is growing. Flood hazard maps can contribute to improving the flood forecasting system by presenting the flood forecast for an entire area based on real time data.

Flood hazard maps provide information of expected flood depth and extent of river flooding (over-flowing) or urban inundation in the form of paper or electrical maps. Flood hazard maps can be categorized into river flood hazard maps (caused by river flooding) and urban flood hazard maps (caused by rainfall events exceeding drainage capacity) as shown in Figure 5.5. The spatial range of river flood hazard maps includes main river reaches, tributaries and expected flooding areas depending on flood scenarios. The spatial range of urban flood hazard maps include total drainage zones and flooding areas due to exceeding rainfall events, water level rise in receiving water bodies, and pump failures. Flood hazard maps are an example of non-structural flood mitigation measures. They provide information on potential flooding areas to regional governments and relevant authorities which can support in effective disaster prevention such as evacuation, flood insurance, land use regulation, and so forth.

Figure 5.6. Conceptualisation of river flood and urban flood inundation



Source: Lee et al., Catalogue of Hydrologic Analysis for Asia and the Pacific (2019[21])

Box 5.3. Flood hazard mapping in Korea

In Korea, the process of flood hazard mapping includes the following activities:

- Site surveys that include collecting basic hydraulic and hydrologic information, relevant plans, flood damage history and existing survey data for the target river or drainage areas.
- Topological data construction is a process to obtain topological information such as ground elevation for inundation analysis and, hence, it should guarantee the required accuracy and precision for inundation analysis.
- Flood scenario development, consisting of catchment conditions, flood scale, and inundation scenarios.
- Flood and inundation analyses are performed based on flood scenarios with a methodology determined by land use and land cover. Flood inundation results are obtained from one- and/or two-dimensional hydraulic modelling. In Korea, the HEC-RAS model is widely used for one-dimensional analysis, and the FLUMEN model is used for two-dimensional unsteady flooding simulation.
- Data base system: these results are mapped as a flood hazard map and kept in a database system.

Flood hazard maps are distributed to central and regional governments for the purpose of flood prevention and mitigation policies and activities. They can be used for establishing emergency action plan, natural disaster insurance management, and integrated planning of natural disaster mitigation and management. The Ministry of the Interior and Safety (MoIS) utilises flood hazard maps as a basis for the hazard map, flood insurance map, life safety map, and so forth. Regional governments utilise flood hazard maps as a basis for flood insurance maps and for flood-prone area management. Flood hazard maps can provide basic information for natural disaster management policies and reduce the budget and effort at the same time.

Source: Lee et al., Catalogue of Hydrologic Analysis for Asia and the Pacific (2019[21])

Spatial flood forecasts can be based on scenarios and dynamic spatial flood forecasting or on real time flood forecast. Both methods are compared in Table 5.2. Flood hazard maps can contribute to improving the scenario-based spatial flood forecasts, because the development of flood hazard maps is based on a scenario-based procedure. The database built for flood hazard maps can be directly used to improve the spatial flood forecasting.

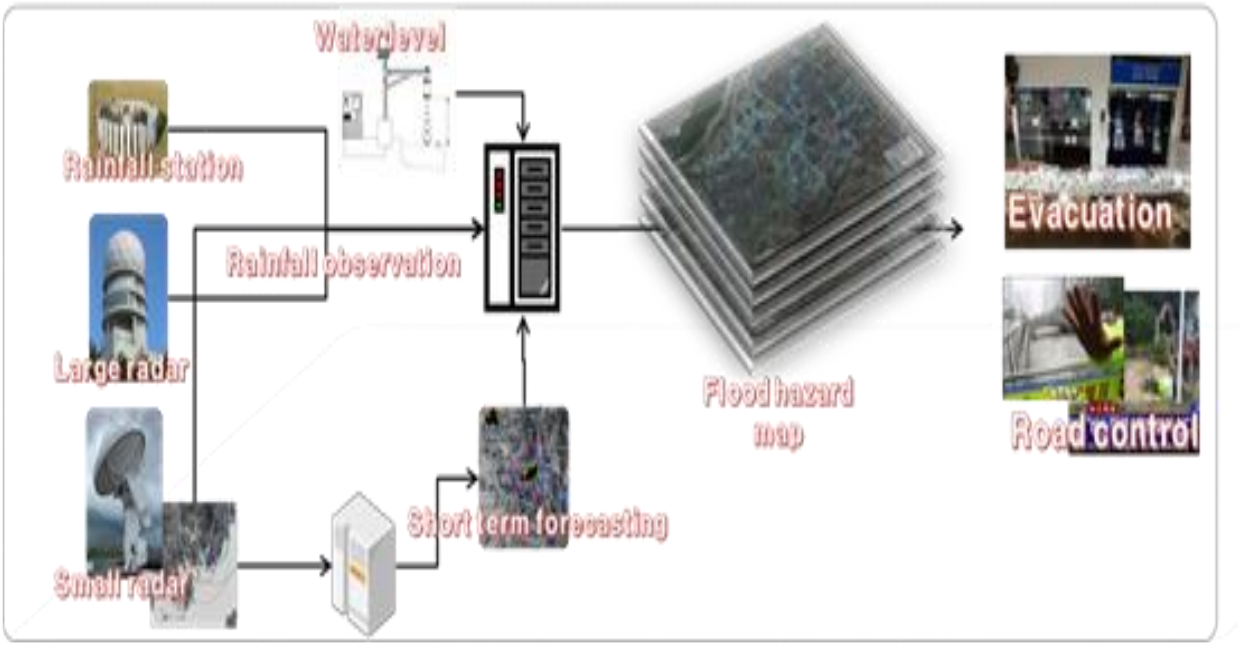
In addition, real time spatial flood forecasting can be obtained by real time flood simulation and long-term analysis. However, current computing power limits the application of real time flood simulation due to lengthy simulation time, which deteriorates the accuracy, proper timing and reliability of flood forecasting. It is expected that substantial amounts of technical advances and infrastructure are necessary to accomplish this. Currently, the scenario-based spatial forecasting system, combined with river flood hazard maps and urban flood risk maps, is regarded as the best alternative for improving flood forecasting systems. It is expected that real time dynamic spatial flood forecasting system would be possible in the near future with technical advances. Figure 5.6 shows an advanced example of a forecast system based on the flood risk map.

Table 5.2. Type of flood forecasts and their features

	Scenario-based spatial flood forecast	Real time simulation-based spatial flood forecast
Methodology	Utilising existing information from flood hazard maps	Dynamic spatial flood forecasting based on real time simulation
Buildup	• Integrating existing flood hazard map information • River flooding: WSE-flood extent • Urban flooding: Rainfall-flood extent	• Combined rainfall-runoff and flood inundation modeling • Improved technical background
Pros and cons	• Quick evaluation utilising existing information • Limitation of scenario-based modeling	• Computing power limitation • Uncertainties for forecast
Evaluation	Short term improvement of spatial flood forecasting based on flood hazard map information	Long term improvement of spatial flood forecasting based on real time simulation

Source: Lee et al., Catalogue of Hydrologic Analysis for Asia and the Pacific (2019[21])

Figure 5.7. Korea's flood forecasting system



Source: Lee J. Seo Y, Park S et al, 2019 Catalogue of Hydrologic Analysis for Asia and the Pacific | Volume 1 Flood Hazard Mapping Flood Hazard Map of Korea (Lee et al., 2019[21])

5.3.3. Artificial intelligence-based flood forecasting

Physically-based flood simulation models have been widely used for flood forecasting purposes. Physically-based hydraulic or hydrologic models are based on an understanding of the physical process that occurs within a natural system. The model reproduces the dominant processes through governing equations that are derived under a few simplifying assumptions. Typically, it is not possible to include each process within a simulation model owing to various simplifications and assumptions, and thus, the resulting model can only approximate a real-world system. Errors between the computed and observed values are inevitable due to various uncertainties including those of the model itself, hydrological initial and boundary conditions, and model parameters. All these uncertainties simultaneously affect errors in the model output that produce poor model performance despite a thorough understanding of the governing laws.

In contrast to physically-based models, data-driven (artificial intelligence, machine learning) models are not based on either a preconceived conceptualisation of the behaviour of the system or an explicit representation of discrete physical processes. Conversely, in data-driven models, system response is characterised by exploiting statistical information in a set of time-series data. Furthermore, data-driven models can use the advantages of whatever relevant data are available, and this allows such models to represent particular processes. With the accumulation of enormous amount of data due to the progress of sensor and Internet of Things technology, together with the computing power, deep learning models represented by artificial neural network (ANN) are widely used. The artificial intelligence (AI) based model is a powerful tool to address various practical problems, and it is extensively used for simulation and forecasting in diverse areas such as water resources, power generation, finance, and environmental science (Maier and Dandy, 2000[22])

Box 5.4. International experiences with AI flood forecasting

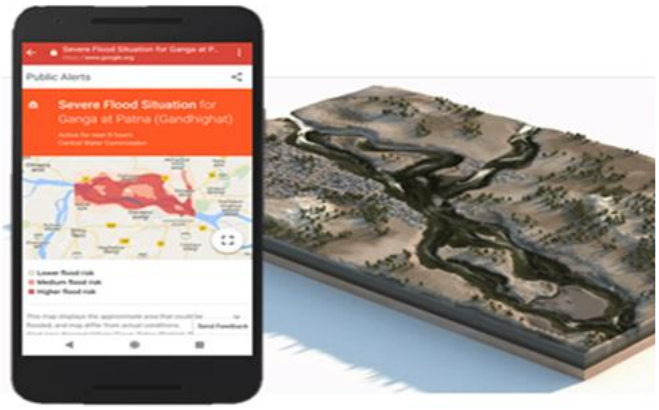
About 200 million Indian people and more than 40 million in Bangladesh are believed to receive flood information from flood forecasting system of Google AI for Social Good. Google also developed Nowcast, a deep learning weather forecasting model, which shortened the computation time to 5-10 minutes, and can forecast with lead time of up to 6 hours.

Japan also developed an AI based flood forecasting system, called WinmuSe, to provide forecasted stage and discharge information.

In Korea the top priority regarding the improvement of flood forecasting systems is to utilise big data collected from all sectoral sources. An AI based flood forecasting platform is expected to be developed in the very near future.

Source: Han River Flood Control Office (2022[23])

Figure 5.8. AI based Data-driven Model and Flood Forecasting



Prevailing methods of flood forecasting

- Flood forecasting based on rainfall-runoff simulation
- Flood forecasting focused on large rivers (75 locations)
- Flood forecasting relying on professionals
- Flood forecasting focused on gauged rivers
- Information focused on rivers (stage, discharge)

New methods for flood forecasting (near future)

- Flood forecasting based on big data and artificial intelligence
- Flood forecasting also for small and medium rivers (218 locations)
- Automated and swift flood forecasting
- Flood forecasting for ungauged rivers and basins based on rainfall radar
- Various contents directly related to people's life

Source: Han River Flood Control Office (2022[23])

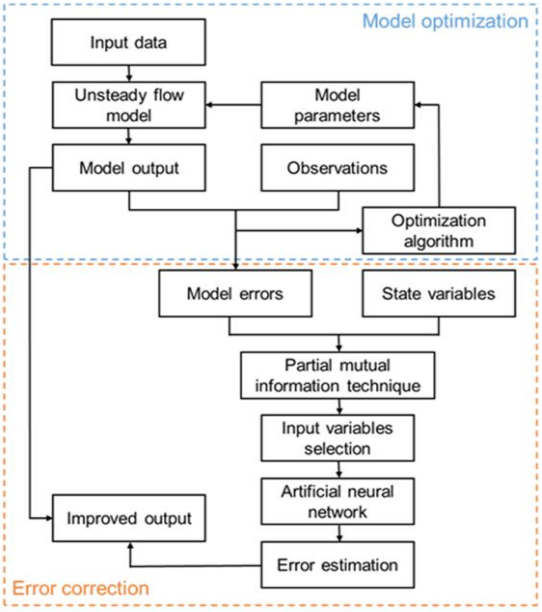
The AI based data-driven model shows excellent performance if the output variable(s) has certain correlations with input variable(s). If an artificial neural network is applied to forecast flood water level with 1 hour lead time, it shows much better performance than physically-based simulation models. However, as the forecast lead time increases, it shows poor performance because the output variable (stage after e.g., 3 hours) has less correlation with the input variables (current stages and discharges).

In order to improve the accuracy of flood forecasting, it is necessary to hybridise a physically-based model and a data driven model to extract complementary strengths and eliminate weaknesses in the respective methodologies rather than choosing between the individual modelling techniques. The fact that data-driven models exploit the relationship between data, whereas hydrodynamic flow models are based on physical principles, gives them a complementary nature. In order to provide more accurate information about flood flow, errors produced by the simulation model can be corrected by using postprocessor methods based on a data driven model. The selected error correction model should extract useful information about the physical process that was not considered during the construction of a physically based simulation model such that additionally obtained information can remove systematic biases of the calibrated simulation model.

Figure 5.8 illustrates the framework of a hybrid approach for river flow forecasting. The procedure shows that the hydrodynamic flow model is initially executed, and this is followed by the error correction model. The forecasts are improved by combining the results of the two models. An ANN model is used to estimate residual errors of the hydrodynamic model by considering time series that are closely related to the model

errors. It is assumed that the structural problems in the hydrodynamic model and data can be reflected in the detected patterns. The results of previous studies indicate that aggregating a physically based simulation model and a data-driven model rather than only applying a simulation model or a data-driven model can fully exploit different aspects of the physical system to minimise the prediction errors between estimated and observed flood water levels.

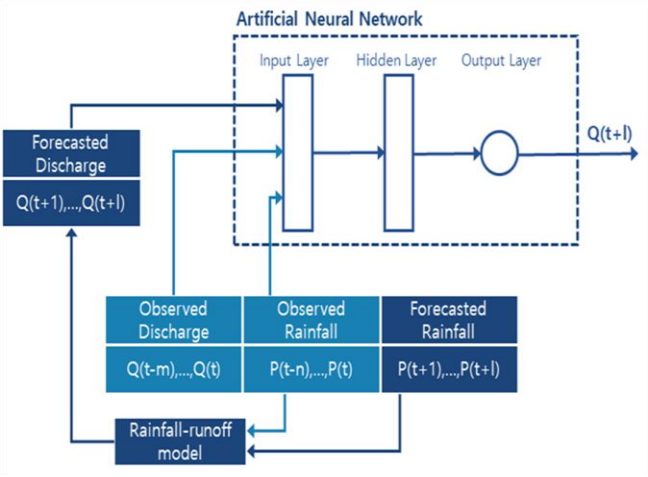
Figure 5.9. Methodology for a hybrid approach for river flow forecasting



Source: Li, L. and Jun, K.S. (2022). A hybrid approach to improve flood forecasting by combining a hydrodynamic flow model and artificial neural network (Li and Jun, 2022[24])

Figure 5.9 illustrates another kind of hybrid approach where the ANN model is combined with a rainfall-runoff model such as HEC-HMS. The runoff forecasted by the rainfall-runoff model feeds into the ANN model as an input variable to enhance the prediction accuracy.

Figure 5.10. Illustration of a Hybrid Approach for Runoff Forecasting



Source: Professor Jun, Korea

Figure 5.9 illustrates another kind of hybrid approach where the ANN model is combined with a rainfall-runoff model such as HEC-HMS. Since the forecasted runoff becomes less accurate as the forecast lead time increases if the discharge and rainfall data observed only up to the current point in time are used as inputs of the ANN mode, the future runoff forecasted by a simulation model is adopted in addition to the observed data. In short, the runoff forecasted by the rainfall-runoff model feeds into the ANN model as an input variable to enhance the prediction accuracy.

5.4. Recommendations to integrate flood information systems and early warning

Among the ways to respond to climate change, adaptation is to minimize the burden imposed on both humans and nature by activating non-structural measures rather than structural measures. The early warning system is one of the core frameworks recommended by many international organisations. In this regard, the ICT-based smart early warning system in order to realize “last mile or must have” more effectively is commented. The other is a strategy to increase the efficiency of water resource and disaster management by integrating water-related information systems that are dispersed among various ministries and agencies in Indonesia.

5.4.1. Latest trends of early warning systems

International framework for early warning systems based on the Sendai Framework

International frameworks for action to reduce risks from natural disasters are nothing new. The Sendai Framework is a voluntary and binding framework, recognizing that countries play a primary role in reducing disaster risk by 2030, but that responsibility must be shared with all stakeholders, including local governments, the private sector and other stakeholders. It aims to understand disaster risk at national, regional, local and global levels, and strengthen disaster risk governance for disaster risk management, and invest in disaster risk reduction for resilience, and more in effective response and recovery, rehabilitation and reconstruction. It sets priorities for action to be taken to "Build Back Better".

The gist of the Sendai Framework's action code emphasises that disaster prevention is the best strategy to reduce disaster risk. Disaster risk management is based on an understanding of disaster risk at all levels, disaster risk vulnerability, exposure of life and property, disaster risk characteristics and situations, and response capability. To this end, the framework recognises the shared responsibility between the central government, relevant sectors and stakeholders, and share disaster-related resources and data/information. Certainly, the national framework related to the natural disaster risk management has been presented in great detail from a theoretical point of view. However, as can be seen from the case of Indonesia, it is true that there is still much work to be done before implementing the policy and seeing the result.

One of the most representative elements is the multi-hazard early warning system (MHEWS) which addresses several hazards and/or impacts of similar or different type in contexts where hazardous events may occur alone, simultaneously, cascading or cumulatively over time (J Luther et al., 2017[25]). Another is the impact-based forecast and early warnings services (IBF-EWS) which is based on ensemble predictions to capture and exploit the uncertainty in the forecast to improve decision-making. The other is the end-to-end early warning service for flood forecasting (E2E-EWS-FF) which is the WMO framework to promote the enhancement of flood forecasting and early warning capabilities of NMHSs (National Meteorological and Hydrological Services), which is interoperable at all levels from data collection to informing users and decision support system (APFM, 2022[12]).

Even though those approaches slightly differ from one another, flood forecasting and warning as a focused activity are a subset of non-structural measures for flood management under the overall framework of Integrated Flood Management (IFM).

Table 5.3. Comparison of Three Flood Forecasting and Early Warning Services

Type of EWS	Definition of Concept
Multi-hazard Impact-based Forecast and Warning Services (WMO, 2021)	An integrated system that addresses several hazards of similar or different type in contexts where hazardous events may occur alone, simultaneously, cascading or cumulatively over time, and taking into account the potential interrelated effects
impact-based forecast and warning Services (ESCAP and WMO, 2021)	A structured approach for combining hazard, exposure, and vulnerability data to identify risk and support decision-making, with the ultimate objective of encouraging early action that reduces damages and loss of life from natural hazards.
End-to-End Flood Forecasting and Early Warning System (WMO, 2022)	Value chain from observations, to data collection, modelling and forecasting, dissemination of warnings and response to these warnings by the end users

Sources: WMO (2021[26]) ESCAP and WMO, 2021 (2021[27]) ; WMO, 2022 (2022[28])

Current situation and challenges with Indonesia's Early Warning System

In Indonesia, the multi-hazard early warning system started off well, but stakeholders commented that the low accuracy of warnings and the need for cooperation between multiple agencies hinder the functioning of the early warning system. It is worth noting this point because the development process of the system needs a lot of information, cooperation with related agencies and the capability to develop it as described in the WMO's guideline (WMO, 2010[10]).

Creating a common understanding of the disaster risks and building a culture of sharing risk knowledge is a key condition for any early warning system. In particular, it is important to change the perception of the people who directly or indirectly perform the relevant tasks in the field, because most of the actual damage is experienced by ordinary citizens and private business facilities rather than the national institutions that specialise in disaster risk management. Although this is being addressed through education or media, the quantity or quality of the information does not directly influence people living in disaster-prone areas. It has been proven by many examples that disaster warnings can significantly reduce losses when definitive risk warnings are available at the "last mile", actually starting five days before the flood event occurs (UNDRR, 2019[29]).

A series of processes related to the floods early warning system can be divided into three categories: (1) weather forecasting; (2) flood forecasting; (3) and flood warning (MetMatters, 2022[30]). After all, if these three axes are the key factors that determine the ability of early warning, all sectors need to be improved in Indonesia. Weather forecasting usually involves the National Weather Service collecting atmospheric and hydrological data from satellites, radar, and rainfall observation facilities to commit rainfall forecasts using numerical weather forecasting (NWP) models. Flood forecasting is the estimation of future water levels or flows at a single or multiple sites of a river system for different lead times. Flood warnings use the forecasting results of the rainfall-runoff model to predict flooding or flood-affected areas due to river level rise and specify flood warning areas. Early warning for a specific spot must be carried out quickly and accurately and must be made in real time in consideration of ever-changing discharge conditions. The series of processes should be expanded into the concept of "Service Chain", which actively conveys information by enabling two-way communication between information providers and users.

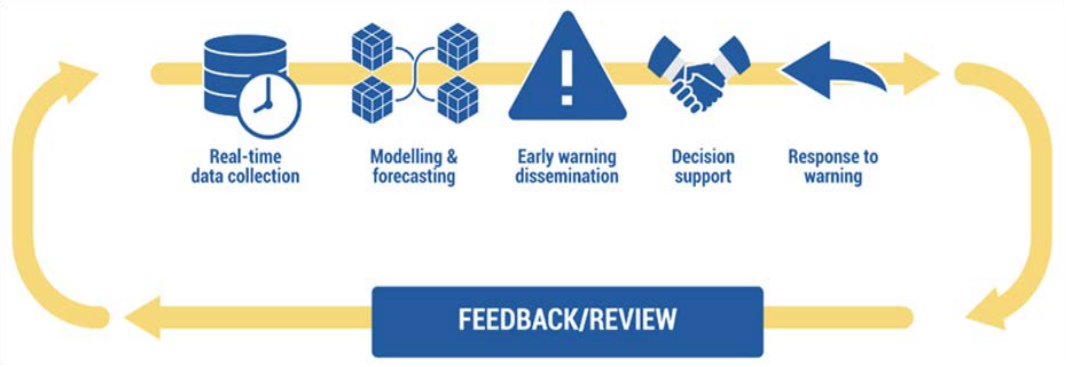
As pointed by Srikandini et al. (2018), a striking feature of disaster risk governance (DRG) is its heavy organisational set-up. The implementation of 'decentralized DRR' in Indonesia remains problematic because of the complexity of power sharing between the central and local governments and because of bureaucratic heaviness. The BNPB and BPBD are connected by a 'coordination line' rather than a 'command line'. Local government acts as the frontline in formulating local policy, arranging resources and

building community capacity. However, lack of budget, human resources and capacity as factors hampering its work in the region is still pervasive. In addition, intra-government coordination remains a major issue for DRG in Indonesia, where approximately 22 ministries and government agencies work on DRR related issues. Considering these points, it is necessary to further simplify the decision-making and cooperation system for disaster risk management through a barrier-free information sharing system.

5.4.2. ICT-based integrated Flood Information Systema and Smart-Early Warning Services

Under the Sendai Framework, an End-to-End Early Warning Systems for Flood Forecasting (E2E-EWS-FF) is a complete set of components that connects those who need to hear messages to others who compile and track the hazard information (Figure 5.11) (APFM, 2022[12]). It should be interoperable at all levels, such as information sharing and feedback, with a decision support system to provide an environment where residents can make their own decisions and take action through risk level warnings (APFM, 2022[12]).

Figure 5.11. End-to-end early warning systems for flood forecasting



Source: APFM, End-to-End Early Warning Systems for Flood Forecasting (2022[12])

In Indonesia, such an attempt has already been carried out or is underway. The structural EWS flourished after the 2004 tsunami in Aceh, and led to assorted laws and policies related to responsibilities of assorted government agencies at all levels, including information dissemination (Juwitasari, 2022). However, the evaluation these laws evoked several challenges (Government of Indonesia, 2020[5]) (Reni Juwitasari, 2022[31]). There are many factors that make this goal difficult, but technically implementing E2E-EWS-FF itself is not an easy task. In Indonesia, the information or analysis technology required to implement E2E-EWS-FF and the system supporting it are not sufficiently equipped. Particularly, building E2E-EWS-FF for 325 high-risk areas is not an easy job in terms of cost, manpower and equipment. As an alternative to cope with this task, adopting ICT-based and smart communication systems is recommendable.

The service chain of early warning systems has several challenges related to disaster risk knowledge, real-time monitoring and detection, data analysis and forecasting, early warning dissemination and communication, decision making, and preparedness and response to warning (Government of Indonesia, 2020[5]). Nationally developed contingency plans are common in many countries. Most of these are the responsibility of government agencies, but it is also the responsibility of ordinary citizens to respond to real situations. However, contingency plans are not customised to the target communities and integrated into emergency response plans due to a lack of participatory approaches in the planning and development of warning response measures. In the case of the Palu tsunami, BMKG successfully issued a tsunami early warning five minutes after the earthquake. This is in accordance with their SOP. However, the tsunami arrived sooner than that (UNDRR, 2019[29]).

ICT technologies can facilitate a human-centred early warning system, particularly in countries with high smart phone coverage like Indonesia. A concept to consider is the smart-early warning service concept, if ICT technology is applicable to the local context. A complete and effective smart-early warning system consists of four elements, namely risk knowledge, monitoring and warning service, dissemination and communication and response capability as decisively demonstrated in the Sendai Framework. An exemplary early warning system should have strong interconnections and effective communication channels between all elements (UNISDR, 2015[32]).

The four elements above-mentioned must solve the information sharing problem in each field in order to organise an effective people-centred early warning system. The Indonesian government also emphasises that data and information should be easily shared between government agencies and implements the 'one data policy'. Currently, government agencies do not have easy access to water-related data collected by other government agencies. The water-related information system managed by Han River Flood Control Office (HRFCO, 2022[23]) provides water-related data/information collected from 2 central ministries, 15 government-affiliated organisations, and 2 local governments. Table 5.4 lists the information systems used in the hydrologic and flood forecasting related data sectors currently in operation in Korea. These systems are based on ICT technologies and operated individually, but its accessibility and use are open systems for public and private users. An important condition is that anyone can access all data released by the government through the Open API.

Indonesia is modernising water monitoring, improving analysis tools, investing in water knowledge, and building open access and real-time centralized information systems (World Bank, 2021[3]). The Ministry of Health's “Smart for Public”, which currently monitors the progress of sanitation programs at the community level, is a good example. To promote public participation through clear roles, incentives and regulation in the city area, the private sector needs to bear its fair share of responsibilities for urban resilience. Incentives and clear regulations for development projects need to encourage developers to design risk-informed investments. Innovative programs for retrofitting of critical infrastructure, or land value capture opportunities in the floodplain management could be considered prosperity and liability (The World Bank, 2019).

Table 5.4. ICT-based Information Systems for Hydrological Data and Flood Prediction in Korea

Name	Feature	Technology
Korea Water Management Information Networking System (www.wamis.go.kr)	Providing information on various water resources	Network and Internet
Flood Forecasting System (not for public)	Flood Information for Early Warning Service	Intranet and Networking
National Hydrological Data Quality Management Information System (not for public)	Verification and Calibration of Hydrological Raw Data	Intranet and Networking
Development of Provision System for Map-based Probabilistic Rainfall and Flood Estimates (under development)	Providing User-centered Probabilistic Rainfall and Flood Discharge on the Map	Platform as a Service over Internet
River Management Geographic Information System (www.river.go.kr)	Providing River Geographic and Embankment information	Internet
National Groundwater Information System (www.gims.go.kr)	Management of Underground Water Use Permits and Providing Data for Policy Decision-making	ICT and Internet
Rural Area Water Resources Information System (www.rawris.go.kr)	Provision of Irrigation Water and Rural Water Information	Internet
Flood Hazard Map Information System (www.floodmap.go.kr)	Providing Flood Inundation Area and Evacuation Information	Internet and App
River Water Use Management Information System (https//ras.hrfco.go.kr)	Providing Information on the actual status of River Flow and Water Intake	ICT and Internet

Note: These systems are used in Korean and are categorized from the author's point of view.
Source: Authors

The application of ICT basically consists of a platform that provides hydrometeorological and flood analysis systems, as in the example of Korea above (Box 5.5). ICT is to provide a system that collects and analyses information from the central government's disaster management agency that is advantageous to manpower, technology and finance. For successful implementation of E2E-EWS-FF for 325 high-risk regions in Indonesia, the central government provides necessary expertise, resources, and information (e.g., demographic data, cloud sourcing/computing technology, GIS system, etc.) in order to realise ensure interoperability and data integration.

Box 5.5. Korea's Smart Water City information system

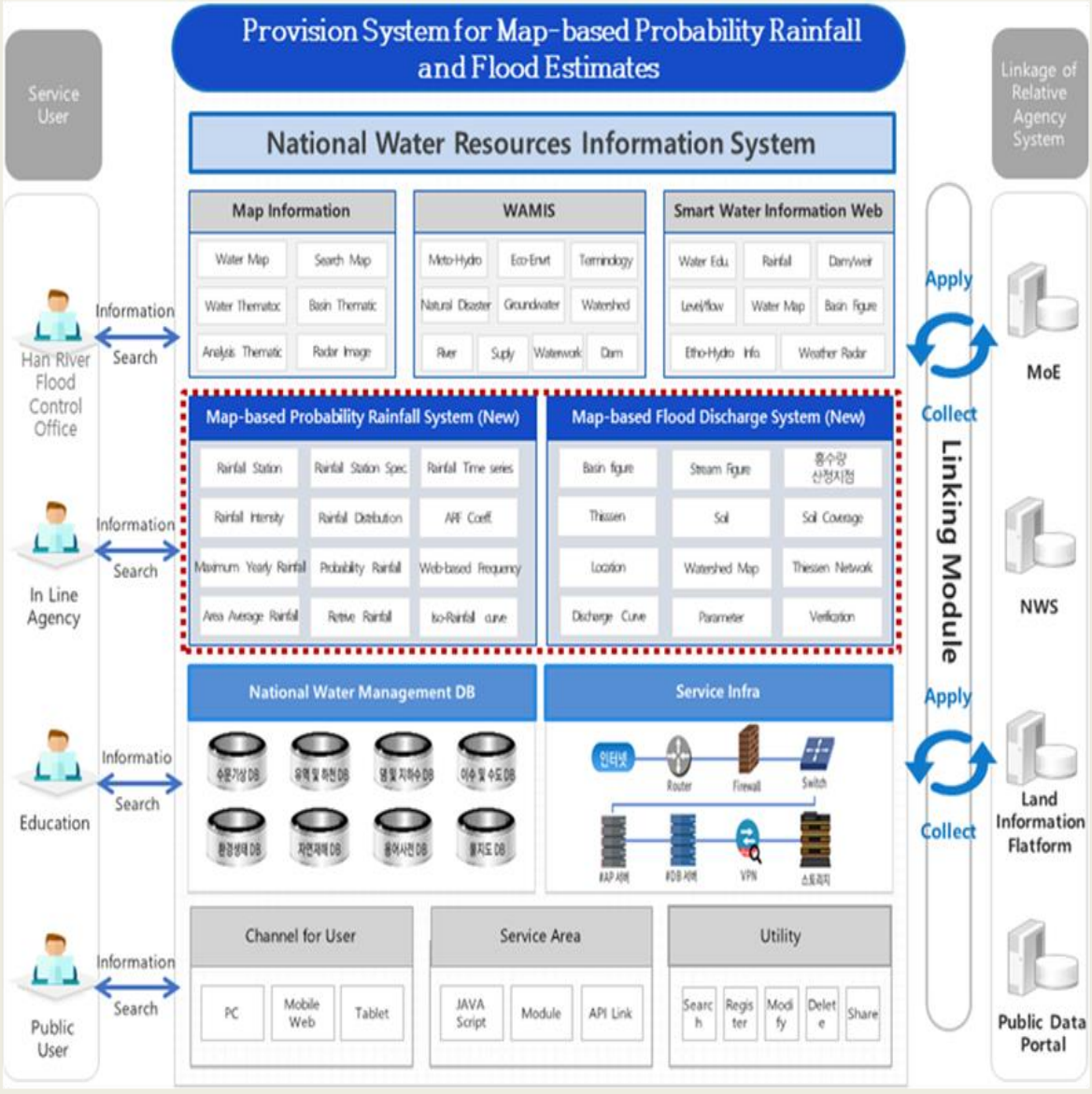
Recent advances in ICT are contributing to the qualitative growth of the business environment as well as the scalability of information use. In Korea, local governments are implementing the concept of 'Smart Water City', which is centered around the drinking water system. Currently, the Han River Flood Control Office of the Ministry of Environment is promoting the improvement of the service that provides probabilistic rainfall and flood discharge at specific points in major watersheds as depicted below in terms of providing hydrological information (Development of Provision System for Map-based Probabilistic Rainfall and Flood Estimates) (see Figure 5.12 below). This system will be able to provide the information needed to determine urban flood drainage. For the Smart Water management projects in Korea, Songsan Green City and Busan Eco-Delta City, which are currently under construction, were designed as Smart Water Cities from the beginning, and in 2017, the first national Smart Water City project was launched in Sejong City. K-water has also been given approval to introduce the system in Dongducheon City, Yangju City, Jeongeup City, Goryeong County and Naju City in 2017 (K-water, 2022[33]).

This system enables impact-based flood forecasting of most river points nationwide and allows early warning of specific hydrologic events. Indonesia has great potential for smart-early warning system as it has high rates of smartphone possession (238 million), social network services (217 million) and internet accessibility (Statista, 2022[34]). Strong policy enforcement of ICT-based disaster risk management system support Indonesia's agenda to become a flood-resistant country.

As shown in the figure, the map-based system for providing probabilistic rainfall and flooding forecasting is a structure in which the provision of probabilistic rainfall and flooding information is added by utilising already-built hydrologic data, river information, and GIS. In Korea, most of the basic data set for simulating flood event in major rivers have been well established. The information generated by the new system will be opened to the public, and the flooding at a certain site can be calculated according to the user's request.

Source: (K-water, 2022[33])

Figure 5.12. Development of Provision System for Map-based Probabilistic Rainfall and Flood Estimates



Source: Han River Flood Control Office (2022) (not officially published)

Local governments that should provide information to the public and interested parties can use the platform provided by central government agencies. Especially, local governments are strengthening cooperation during the “last mile” in predicting or forecasting, helping people understand the impact of risks on them and guiding them to take appropriate actions. Here, there are subjective measures in which stakeholders rely on their own judgement, or otherwise objective methods, that rely on risk knowledge information through impact prediction models using vulnerability data, exposure data, and weather information.

Meanwhile, the smart-based early warning system is an adaptive measure that uses an integrated communications system to help communities prepare for hazardous climate-related events (Climate ADAPT, 2022[35]). Indonesia's service chain of natural disaster management has multiple organisations (multi-institution), produces and distributes various information (multi-source), and has multiple information users (multi-user). The success factor of smart technology lies in the realisation of two-way communication.

The system in place at the sub-regional and regional level should enable two-way communication to components for risk knowledge, monitoring and forecasting, information dissemination and warning. In addition, preparation for hazards, rapid response, monitoring results and immediate response should be possible when it works.

After all, it must be considered that the penetration rate of smartphones is much faster than the speed of building infrastructure for water supply or disaster management in lower-middle income countries, including Southeast Asia. Recognizing those implications can help shape how the early warning system in Indonesia needs to be transformed.

5.4.3. Establishment of a smart-early warning system based on ICT

Transforming a conventional approach into a smart approach for non-structural disaster risk management

Today, non-structural measures to deal with natural disaster puzzles can be a reasonable way to consider the natural and ecological environments. Nevertheless, if structural measures are the most reasonable alternative and their execution has sufficient meaning, it should be pursued to achieve obvious public goals. However, non-structural measures must be addressed from a longer-term perspective, such as sustainability or climate change mitigation and adaptation. What non-structural measures mean today is not simply the opposite of structural measures, but rather a smart approach. Information and communication-based solutions such as Smart Water, Digital River, and ICT-based solutions can be used for water resources, water disasters, aquatic ecology, and water conservation facilities.

Building an integrated information system based on the cloud computing platform concept

The platform concept is a solution through so-called next-generation ICT technology. It builds an integrated water resource management platform that secures the necessary resources and decision-making space by real-time monitoring of water sources, hydrological conditions, disaster situation management and related facility maintenance, equipment operation, and abnormal activities. It also aims to provide monitoring, analysis and early warning of water disasters based on integrated data and GIS maps to support flood and drought control, accurate early warning and efficient emergency response. In particular, comprehensive monitoring of major water resource conservation targets such as rivers, reservoirs, and dams are possible based on the IoT, video, satellite remote sensing, and 5G technologies in modern society (inspur, 2022[36]). In the case of Indonesia, in order to carry out disaster management tasks targeting 325 high-risk areas, it is reasonable to build a cloud computing system that can support all of these from the central agency, considering the geographical conditions, professional manpower, and budget.

Rethinking a smart water management system for enhancing efficiency of water related works

Smart water management systems can provide a more resilient and efficient water supply system while reducing costs and improving sustainability. Technically, smart water management systems can detect any abnormal factors of water resources and water facilities and provide an integrated platform that can monitor in real time, integrated hydrological monitoring based on abundant observation data, flood forecasting analysis and early warning. The concept of smart water management is to monitor water resources and facility maintenance to ensure water resource safety and normal operation and reduce abnormal and illegal activities. It is to support scientific decision-making on water resource management, regulation and allocation, ultimately ensuring the quality and safety of water resources, improving water resource utilisation (inspur, 2022[36]) (K-water, 2022[33]).

Linking information providers and users using two-way communication for smart early warning services and securing "last mile"

Early warning to hazards, such as flooding, provides lead time to take action to reduce the risk impact and ensure safety for people, industries and communities. Prediction of upcoming floods is an important part of this warning service. In Indonesia, smart early warning systems deal with riverine, coastal and surface floodplains, especially inundation caused by landslides in volcanic regions and tsunamis in coastal lowlands. It is to use flood forecast information to evaluate the area and scale of floods and to predict the degree of possibility of disaster occurrence. The way of delivering the most recent information corresponding to the "last mile" directly to the residents of the 325 disaster-prone areas in Indonesia should be reviewed in a consistent and sustainable way.

Unlocking the potential of ICT to improve water related disaster risk management and smart early warning service

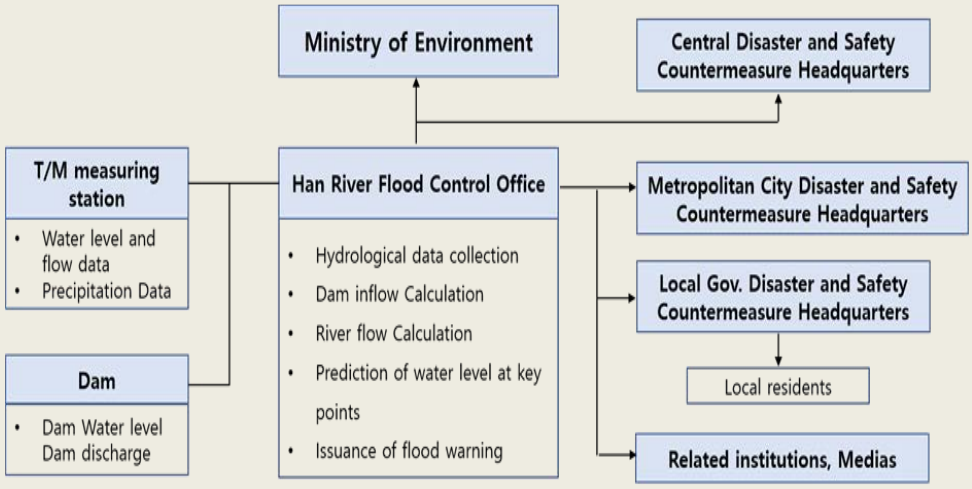
As of October 2022, Indonesia's social media landscape has over 260 million active social media users, ranking it 4th among countries with the highest number of social media users worldwide. Currently, Facebook has 70% market share, and WhatsApp is rapidly taking up the market (Statista, 2022[34])Other social media platforms such as Instagram are also gaining popularity. Ultimately, a policy that actively utilises mobile phones and social media environments is needed for disaster forecasting and warning. ICT-based flood analysis information and smart-early warning services are based on these diverse information-communication environments. In addition, the effectiveness of the dual warning system that utilizes simultaneously both the structural early warning and the traditional method highlighted by Juwitasari (Reni Juwitasari, 2022[31]) can be more synergistic when both systems are combined with ICT.

Box 5.6. Water Disaster Response System in the Han River in Korea

The Han River is a representative river of South Korea and serves as a drinking water source for approximately 30 million people. It has a total length of about 480 kilometers and a watershed area of 35,000 square kilometers. Geographically, the Han River includes administrative areas such as Seoul, Gyeonggi Province, Gangwon Province, and Chungcheongbuk Province. The river flows as two separate rivers, the North Han River and the South Han River, in its upper watershed before merging at the Paldang Dam and flowing into the West Sea. In the past, frequent heavy rainfall and rainstorms have caused flood damage along the Han River, but relatively little drought damage has occurred due to the river's abundant water supply and dam structures. However, managing multiple water resource facilities requires a high level of operational management skills, and failure to do so could result in dam collapses in upstream areas and significant flood damage in downstream areas.

The flood response system for the Han River is centered around the Han River Flood Control Center operated by the Ministry of Environment, and it includes local governments, water agencies such as K-water, etc. The management system of water related disaster in Han River is shown in the following (Figure 5.13).

Figure 5.13. Water related Disaster Management System



Real-time weather and hydrological data collected from the Han River and its watershed are gathered through the National Water Resources Information Management System (www.wamis.go.kr). The Han River Flood Control Center calculates dam inflow and river flow rates and predicts water levels at major river sites based on this data. The center analyzes this data and prediction results comprehensively to predict the possibility of flood occurrence and disseminates the information to relevant agencies and citizens. In preparation for water disasters such as floods, local governments, and related agencies collaborate to plan and perform joint response operations from the beginning of each year. To support this effort, they strengthen management organisations, secure and provide budgets, and do not neglect administrative management.

Flood facilities around the Han River such as embankments are continuously maintained. In case of a disaster, the local government forms a task force for a rapid response, and the central government provides support when needed. Related agencies such as the Ministry of Environment educate local residents on flood response and preparation methods and continuously conduct safety campaigns to minimize flood damage. The Han River Flood Control Center has created and distributed flood risk maps indicating flood risk levels and flood depth around riverbanks to minimize citizens' flood damage, and the information is currently available on the Flood Risk Map Information System (www.floodmap.go.kr).

Source: Ministry of Environment of Republic of Korea (2022) (not officially published)

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6 Tentative action plan resulting from the National Dialogue on Water

Based on the main findings of the National Dialogue on Water, this Chapter presents a tentative action plan for the implementation of the Dialogue's recommendations. The tentative action plan can support the preparations towards the new National Medium-Term Development Plan and the National Long-Term Development Plan of Indonesia. It also suggests actions that support the implementation of ongoing policy reforms, notably the tariff reforms and the forthcoming Presidential Decree on Land Value Capture.

The previous chapters present the main findings of the National Dialogue on Water and the policy recommendations that emerged from the Dialogue. Indonesia is in the middle of preparing the National Medium-Term Development Plan and the National Long-Term Development Plan. Water sector reforms have been ongoing, and new elements of that reform are expected to be introduced in the short-term, including a nation-wide uniform water tariff and the forthcoming Presidential Decree on Land Value Capture. In light of these developments, the table below provides a tentative action plan that presents the main policy actions resulting from the Dialogue. The action plan brings the threads together by highlighting the main elements of potential reforms in Indonesia's water sector (ranging from short to long-term action), and the partners and champions that ideally are part of this reform.

Table 6.1. Tentative action plan resulting from the National Dialogue on Water in Indonesia

Main finding	Recommended action	Objectives of the action	Champions / partners	Timeline
Making the water sector attractive to private finance: operational efficiency and tariffs				
Water utilities are underperforming and are faced with insufficient revenue streams. This poses a barrier to attracting investments in Indonesia's water sector.	Establish a national economic regulator that oversees tariff-setting and the performance of service providers. Jakarta Water Supply Service Regulatory Body can serve as an example.	Reliable water services for consumers Stable revenue stream for utilities Attract investments Operational efficiency of water utilities	PUPR Jakarta Water Supply Service Regulatory Body	Medium term
The introduction of a nationwide, uniform water tariff could lead to the weakening of revenue streams and operational efficiency of water utilities, but could also be an opportunity if designed well.	Couple the new tariff design to the introduction of an economic regulator Engage in a national consultation with relevant stakeholders to align different interpretations of the tariff reform Consider a uniform tariff for bulk water and pluriform tariffs for retail based on performance and cost recovery.	Ensure that the new tariff design improves financial stability, operational efficiency of water utilities, equity and affordability of water.	Home Affairs PUPR	Short term
Tariffs for water supply (bulk and retail) are not systematically collected, putting additional stress on the financial situation of PDAMs.	Implement a strategy for revenue generation, such as outsourcing collection, reducing free substitutes (groundwater), and increasing trust in tap water. Establish national targets revenue collection in the next Medium-Term Development Plan.	Reliable water services for consumers Stable revenue stream for utilities Attract investments	PUPR BAPPENAS PDAMs	Short to medium term
Policy instruments that regulate demand and pollution are in place, but do not have the desired impact.	Target central government support to local governments in building administrative and financial capacity to enforce environmental policies and collect environmental taxes/charges. Establish national targets for enforcement and charge/tax collection in the next Medium-Term Development Plan, including targets for local environmental tax administration. Explore additional instruments for water demand management, such as water allocation regimes that	Promote sustainable water use that reflect operational costs, environmental costs and opportunity costs of water Incentivise clean effluent discharge in water bodies / reduce pollution	Ministry of Environment and Forestry Provinces and districts PUPR BAPPENAS	Medium term

Main finding	Recommended action	Objectives of the action	Champions / partners	Timeline
	regulate demand.			
Introducing Land Value Capture as new financing instrument for water				
LVC is underutilised given the revenue potential in the Indonesian context	Implement LVC instruments including developer obligations, charges for development rights, land readjustment, and infrastructure levies as a revenue source for water infrastructure	Increase revenues to fund water infrastructure Promote balanced and sustainable development through land use planning Redistribute property wealth accumulated through public actions	BAPPENAS PUPR Ministry of Agrarian Affairs and Spatial Planning Local governments	Medium to long term
Local governments lack the sufficient capacity to implement LVC and proper spatial planning	Target central government support to local governments in building administrative and financial capacity to develop the enabling frameworks for LVC adoption Simplify the rigid spatial planning system to be flexible and conducive to rapid changes in land needs Expand local government autonomy through continued legislative reforms	Improve local government capacity to implement LVC Enhance local government autonomy Enable better land-use regulation and spatial planning in general	Ministry of Agrarian Affairs and Spatial Planning Other national government ministries Local governments	Short to medium term
Land registries are incomplete and inaccurate, precluding effective LVC implementation	Provide central government financial and administrative support to develop and maintain accurate land registries Maintain an adequate workforce of certified appraisers at the municipal level	Reduce the prominence of the informal land and property market Provide the enabling framework for LVC adoption	BAPPENAS Ministry of Agrarian Affairs and Spatial Planning Local governments	Short term
Land acquisition processes are lengthy and tedious, impeding LVC implementation	Clarify land acquisition legislation to lay out guidelines for landowner compensation procedures Allow for the fixing of land prices at specific points in time predating government interventions	Facilitate streamlined land acquisition to speed up infrastructure development and LVC processes Effectively capture windfall gains in land values that are due to public intervention	Ministry of Agrarian Affairs and Spatial Planning BAPPENAS Local governments	Medium to long term
Non-structural measures that reduce flood disaster risk				
Pre-planning and post-development for all land uses	Establish a specific plan for development before proceeding with development Vulnerability assessment according to changes in land use such as urban reorganisation, new town construction, redevelopment, etc., should be made mandatory.	Establish disaster resistant land use planning	PUPR Home Affairs	Short & medium term
Evaluate the risk of disasters and prepare policy alternatives for each risk level	Create a matrix on the likelihood and consequences of disaster occurrence for the disaster hazard zone Establish countermeasures according to the degree of risk of disaster (Relocation of residents of existing areas to safer areas, Establishment of structural and non-structural	Minimise human casualties and property damage to lay the foundation for sustainable development	PUPR Home Affairs Local governments	Short & medium term

Main finding	Recommended action	Objectives of the action	Champions / partners	Timeline
	measures etc.)			
CCTV based Automatic Discharge Measurement	Expand the use of CCTV technologies to flood surveillance for small mountainous streams and urban streams.	Enable continuous real time measurement of flood stage and discharge Develop a stage-discharge relationship	PUPR Provinces and districts BAPPENAS	Medium term
Spatial flood forecasting based on flood hazard maps	Improve the flood forecasting system by presenting the flood forecast for an entire area based on flood hazard maps	Provide information on potential flooding areas to regional governments and relevant authorities which can support in effective disaster prevention such as evacuation, flood insurance, land use regulation, and so forth.	PUPR Provinces and districts BAPPENAS	Medium term
Strategic plan for utilising ICT technology to substantially realise the "last mile or must have" in early warning services	ICT-based Disaster Information System Considering Community Participation Development of "Last Mile" Improvement Plan Using ICT Technology Pursuing the simultaneity of sending and receiving message in early warning service delivery	Facilitate of modern communication technology Two-way communication system for “must have” Strengthen “last mile” in End-to-End Flood Forecasting and Early Warning Systems	PUPR BAPPENAS Other agencies related to disaster risk management	Short term
Development of technical solutions for the building and utilisation of integrated water and disaster management information systems considering various localities and varieties of disasters	System integration by sector primarily (ex, weather, hydrologic and flood forecasting, water and sanitation, map and GIS, etc.) Platform or Clouding System for Participation and Utilisation of Local or Basin Units Improving accessibility to Database and Application System and integrating systems	Build small-scale integrated systems by sector Integrate data base server and flood farecasting system into platform as a service Delivery of computing service for 325 high risk areas	PUPR BAPPENAS Other agencies related to disaster risk management	Medium term

OECD Studies on Water

Water Financing and Disaster Risk Reduction in Indonesia

HIGHLIGHTS OF A NATIONAL DIALOGUE ON WATER

This report presents the policy recommendations resulting from the National Dialogue on Water in Indonesia, which took place between June 2022 and March 2023. Getting water resources management right, underpinned with appropriate financing mechanisms, is a prerequisite for realising Indonesia's ambitious national economic growth agenda to become one of the top five global economies by 2045. The Dialogue, therefore, centred around two priority areas: 1) financing water infrastructure and 2) non-structural measures for flood disaster risk reduction.

The report explores several instruments to enhance the financing of water services in Indonesia, such as the advantages and disadvantages of uniform water tariffs, independent economic regulation, pollution charges and demand management instruments. The report recommends the utilisation of land value capture as an additional source of financing. It also explores how water information systems for disaster response, flood forecasting and early warning can reduce flood disaster risk.

The National Dialogue on Water in Indonesia is part of a regional initiative with the Ministry of Environment of the Republic of Korea, the Asia Water Council and the OECD.

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