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INDONESIA

VISION 2045

TOWARD WATER SECURITY

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1818 H Street NW, Washington, DC 20433
Telephone: 202-473-1000; Internet: www.worldbank.org

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Table of Contents

List of Figures

List of Tables

List of Boxes

List of Maps

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Stakeholders consulted across 35 government departments

Ministry of National Development Planning (BAPPENAS) • Directorate of Water Resources and Irrigation, Deputy for Infrastructure • Directorate of Forestry and Conservation for Water Resources, Deputy for Maritime Affairs and Natural Resources • Directorate of Urban, Housing and Settlement Areas, Deputy of Infrastructure	**Coordinating Ministry of Maritime and Investment Affairs (CMMAI)** • Deputy Assistant of Basic Infrastructures, Urban, and Water Resources. Deputy for Infrastructure and Transportation Coordination
Coordinating Ministry for the Economic Affairs (CMEA)	**Ministry of Public Works and Housing (MPWH)** • Secretariat of National Water Council, Directorate General of Water Resources • Directorate of Irrigation and Lowlands, Directorate General of Water Resources • Directorate of River and Coastal, Directorate General of Water Resources • Directorate of Dams and Lakes, Directorate General of Water Resources • Directorate System & Strategy of Water Resources, Directorate General of Water Resources • Directorate of Technical Development for Water Resource Management, Directorate General of Water Resources • Sub-Directorate Planning, Directorate O&M Management, Directorate General of Water Resources • Directorate of Drinking Water Supply, Directorate General of Human Settlements • Directorate of Sanitation, Directorate General of Human Settlements
Ministry of Agriculture (MoA) • Directorate of Agricultural Irrigation, Directorate General of Agricultural Infrastructure and Facilities • Directorate of Fertilizers and Pesticides, Directorate General of Agricultural Infrastructure and Facilities • Secretary of the Directorate General of Food Crops, Directorate General of Food Crops	**Ministry of Environment and Forestry (MoEF)** • Directorate of Water Pollution Control, Directorate General of Pollution and Environmental Damage Control • Research Centre and Development for Quality and Environmental Laboratory (P3KLL); Reserach , Development and Innovation Agency
Ministry of Energy and Mineral Resources (MoEMR) • Center for Groundwater and Environmental Geology, Geological Agency • Directorate of Technical and Environmental Affairs of Mineral and Coal, Directorate General of Mineral and Coal • Directorate of Electricity Program Development, Directorate General of Electricity • Directorate of Various New Energy and Renewable Energy, Directorate General of New Renewable Energy and Energy Conservation	**Ministry of Agrarian and Spatial Planning Affairs (MoASP)** • Directorate of National Spatial Planning, Directorate General of Spatial Planning • Directorate of Survey and Thematic Mapping, Directorate General of Spatial Planning
National Disaster Management Agency (BNPB) • Deputy for System and Strategy • Centre for Data, Information, and Disaster Communication (PUSDATINKOM)	**Ministry of Health (MoH)** • Directorate of Environmental Health, Directorate General of Public Health
Ministry of Home Affairs (MoHA) • Directorate of Regional Affairs Synchronization II, Directorate General of Regional Development	**Ministry of Village, Development of Disadvantage Regions and Transmigration (MoVDDRT)** • Directorate of Utilization of Natural Resources and Appropriate Technology, Directorate General of Village Development and Community Empowerment, Directorate General of Rural Area Development
Operation and Maintenance Division • Perum Jasa Tirta I (PJT I) • Perum Jasa Tirta II (PJT II)	**Planning and Cooperation Division - the Peatland Restoration Agency (BRG)**
Indonesian State Electricity Corporation (PT. PLN) • Vice President of Environment - Health, Safety, Security, Environment Division	**Research Center for Limnology, Deputy for Earth Sciences, Indonesian Institute of Sciences (LIPI)**

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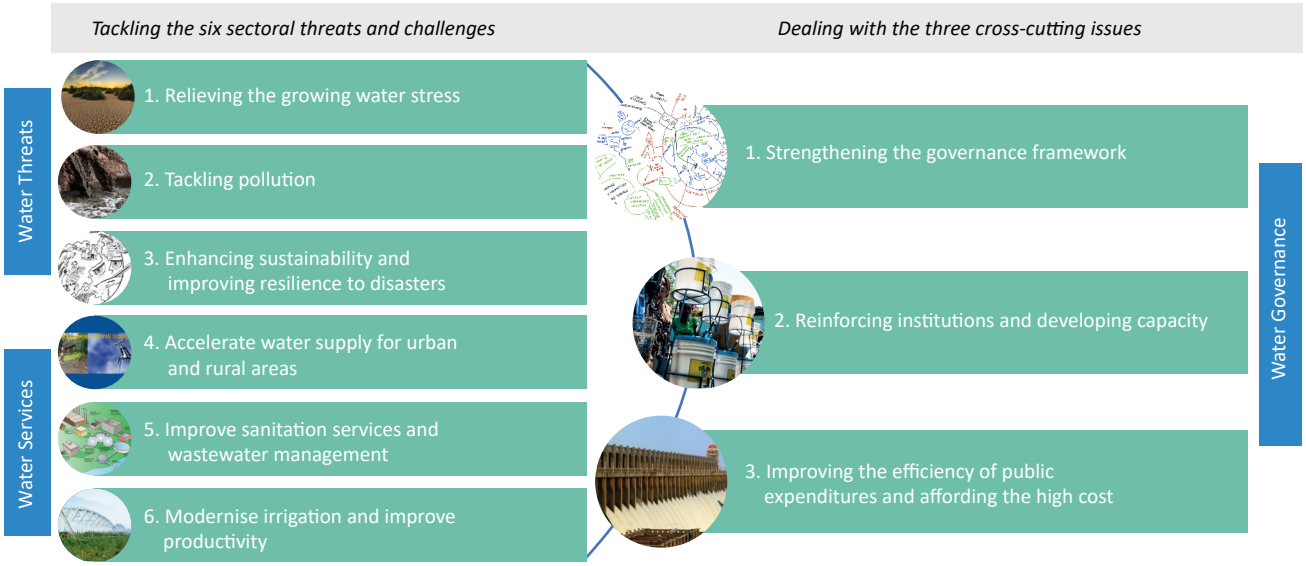
Extended Summary

Vision 2045 aims to significantly transform Indonesia with the target of becoming one of the world's top five economies by the time it reaches its centenary in 2045. But is this achievable without considering Indonesia's Water Security? This study reflects on this question in detail, highlights potential challenges and quantifies the impact of water related threats – if left unaddressed – on GDP and overall socio-economic development. It further suggests targeted actions to move toward water security and shows windows of opportunities for sector reform underpinned by the ongoing revisions of the legal and regulatory framework following the promulgation of the 2019 Water Law and 2020 Omnibus Law.

Water security and actions required to turn the negative impact on socio-economic development into opportunities is a complex topic and requires in-depth analyses and broad stakeholder consultation. This study is the result of a partnership between the World Bank and the Government of Indonesia, driven by senior decision-makers within Directorate of Water Resources and Irrigation, BAPPENAS. The analytical base is provided by a detailed Diagnostic Report and two complementary reports: (a) Water-Related Threats to Indonesia's Economy, using a Computable General Equilibrium (CGE) modelling framework and (b) Indonesia's Future Water Stress, which forecasts Indonesia's water demand by 2030 and 2045.

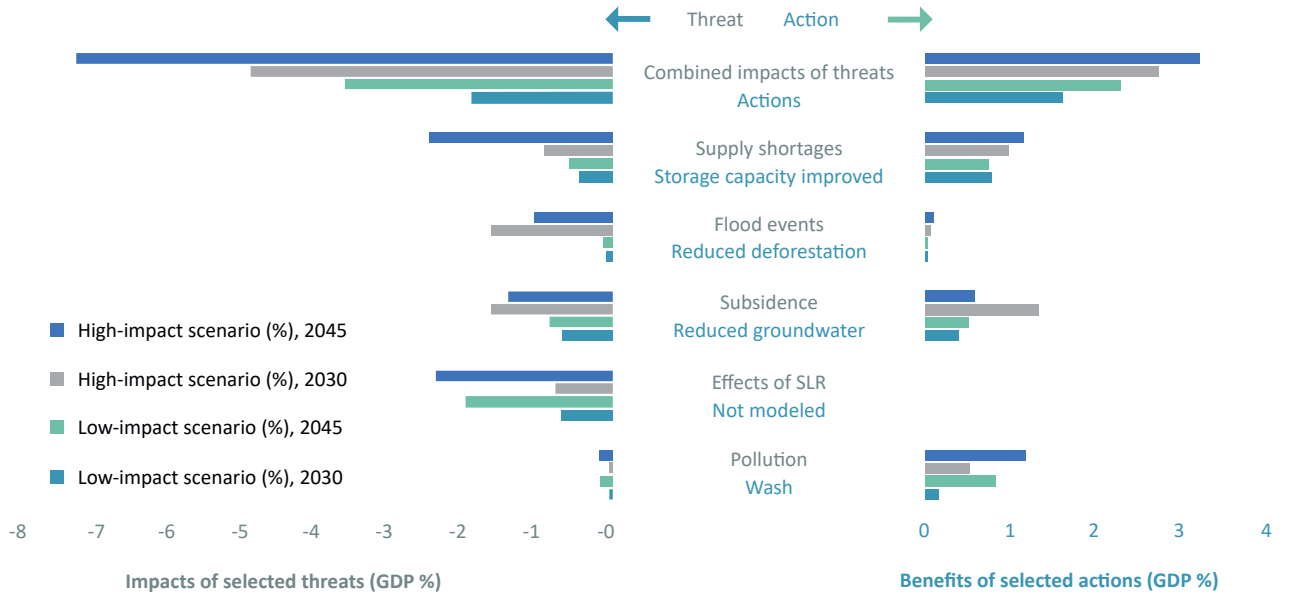
To inform and verify the study, 35 government departments across relevant Ministries were consulted. Further, six focus group discussions with more than 150 participants were held amongst the government, civil society and academia. In addition, the final draft of the Policy Note was reviewed by six leading CSOs and by the 35 consulted government departments. Concurrent series of in depth studies are also conducted on urban water management in Indonesia that aim to elaborate how suggested water security concepts can be further customized to the Greater Jakarta region. Following these analyses and stakeholder interactions, the study prioritizes nine actions structured in three main pillars covering: (i) water threats; (ii) water services; and (iii) cross-cutting issues under "water governance" (Figure ES.1).

Figure ES.1: Structure of the policy note



To achieve Vision 2045 an average annual GDP growth rate of 5.7 percent is required – yet if water-related threats remain unaddressed, GDP is likely to be 7.3 percent lower by 2045 putting the GOI's targets into jeopardy. The impact on GDP for five selected water-related threats is assessed (Figure ES.2), including (a) water pollution from inadequate water, sanitation, and hygiene (WASH) coverage; (b) effects from Sealevel rise (SLR) and land subsidence on coastal flooding; (c) impacts of subsidence caused by groundwater overabstraction; (d) impact of land degradation and climate change on inland flooding; and (e) impact of water shortages. The largest negative effects would be from shocks to water availability (a 2.5 percent reduction in GDP by 2045) as well as from coastal flooding and due to SLR and land subsidence (a 2.4 percent reduction).[1]

Figure ES.2: Impact on GDP from action versus inacton on water-related threats by 2030 and 2045

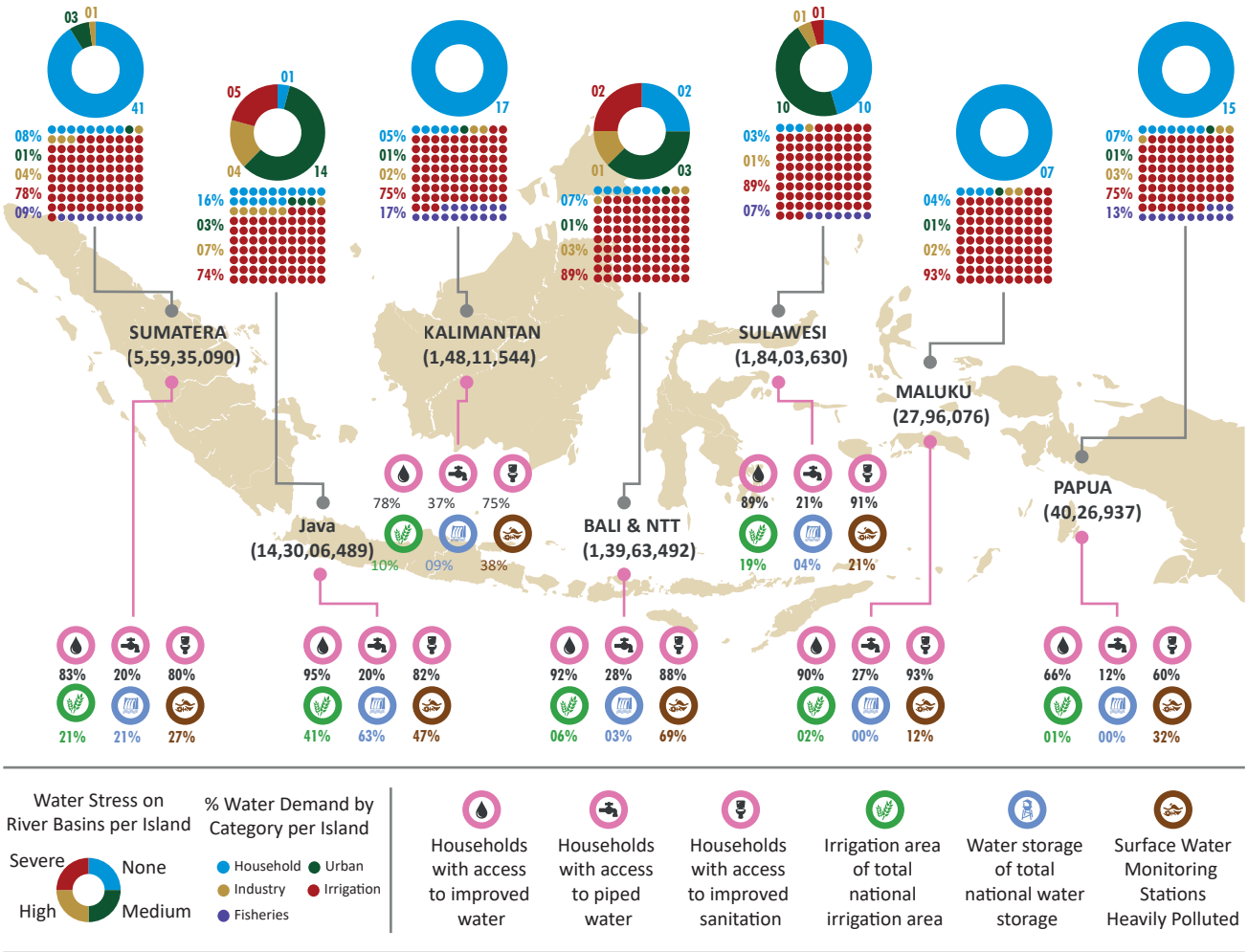


1 To provide a more differentiated analysis, a low-impact scenario and a high-impact scenario were assessed. The low-impact scenario has a greater likelihood of occurring, while the high-impact scenario requires attention to allow policy makers to arbitrate chosen measures with potential future impacts. To assess the sensitivity regarding future climate change projections, a 'wet' and a 'dry' future scenario were chosen.

However, threats to water security are avoidable if decisive actions are taken and can support the achievement of Vision 2045. With the analyzed actions alone, the negative impact of reducing 7.3 percent of GDP by 2045 can be buffered and an up to 3.2 percent increase in 2045 GDP can be achieved. Analyzed actions include (a) full WASH coverage, (b) groundwater abstractions limited to safe yields, (c) reduced deforestation rates, and (d) construction of 50 BCM water storage nationwide. The greatest benefits would come from providing full water and sanitation coverage (1.2 percent increase to 2045 GDP) and from increased water storage (1.1 percent increase to 2045 GDP).

Indonesia comprises a vast archipelago with five main islands, two major groups, and 60 smaller island groups—with water challenges – and thus required actions - varying across regions. Figure ES.3 illustrates how Indonesia's island groups face different water challenges. Water stress is only a challenge for the island groups of Java, Bali and East Nusa Tenggara *(Nusa Tenggara Timur or NTT)*, and Sulawesi. Papua, Kalimantan, and Sumatra on the other hand struggle more with access to WASH services. While all island groups face heavily polluted surface water, Java, Bali and NTT, and Kalimantan are most affected. The majority of national rice production comes from the two island groups which have the largest storage available—Java and Sumatra. Java, as mentioned above, is also the most water stressed island group.

Figure ES.3: Overview of water challenges across Indonesia



While the GDP impact was only estimated across five selected threats, the risks and opportunities are even broader. Table ES.1 provides the overview which will be elaborated further below.

Table ES.1: Three actions proposed for each of the three pillars.

	Action 1	Action 2	Action 3
Pillar I. Managing water resources sustainably and strengthening resilience to water threats	Take action to reduce localized water stress and optimize scarce resources in future development planning.	Significantly reduce water pollution by increasing wastewater treatment (municipal, industrial, and mining), reduce nonpoint water pollution from agriculture and aquaculture, and strengthen water pollution control.	Enhance sustainability and improve resilience to disasters.
Pillar II. Improving the inclusivity, sustainability and efficiency of water services	Accelerate inclusive, sustainable, and efficient water supply for all Indonesians.	Expand and finance inclusive, sustainable, and efficient sanitation services and wastewater treatment.	Modernize irrigation and improve its productivity.
Pillar III. Strengthening governance and institutions for sustainable and efficient water management	Strengthen the governance framework.	Strengthen institutions through better coordination and capacity building.	Improve the efficiency of public expenditures for water and mobilize finance.

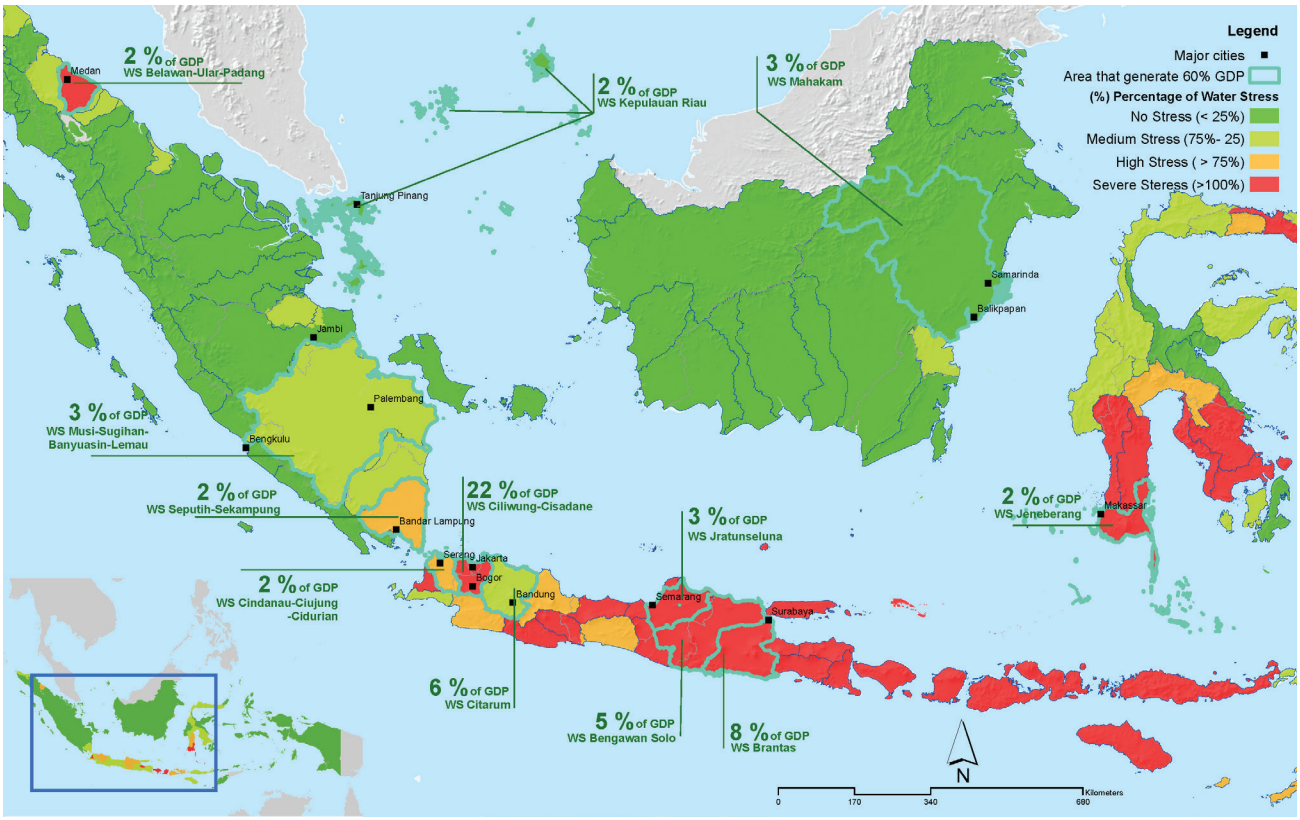
Action 1: Relieving the growing water stresses

Predicted impact on GDP in case of inaction by 2045

- Insufficient and inadequate water supply could **reduce GDP by as much as 2.5 percent by 2045.**
- Inaction on curbing groundwater overabstraction is predicted to increase the impact of floods due to land subsidence and to **reduce GDP by up to 1.42 percent by 2045.**

Although *water resources* are generally abundant in Indonesia, they are unevenly distributed. Already, half of the country's GDP is produced in river basins that suffer 'high' or 'severe' water stress in the dry season. If nothing changes, by 2045 two-thirds (67 percent) of GDP is predicted to be generated in highly or severely stressed basins (Map ES.1).

Map ES.1: Indonesia's dry season water stress in relation to river basins generating 60% of GDP (2045)



Water demand is continuing to rise fast under demographic and economic forces and is expected to increase by 31 percent between 2015 and 2045. By 2045, 31 river basins, out of 128, are expected to face a water supply-demand deficit (Figure ES.4)

Figure ES.4: High' and 'severe' water stress across Indonesia's 128 river basins in 2019, 2030, and 2045 (annual and dry season)

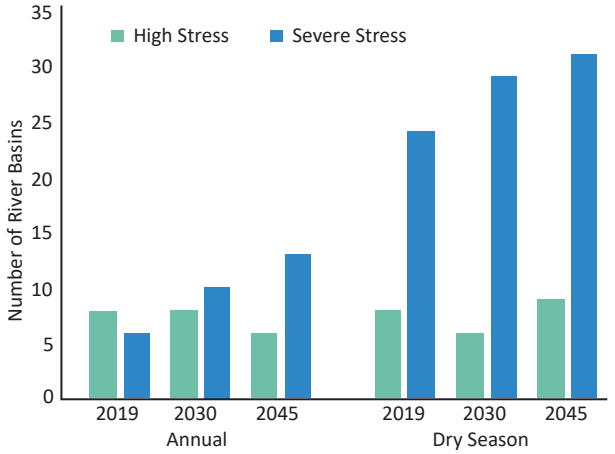
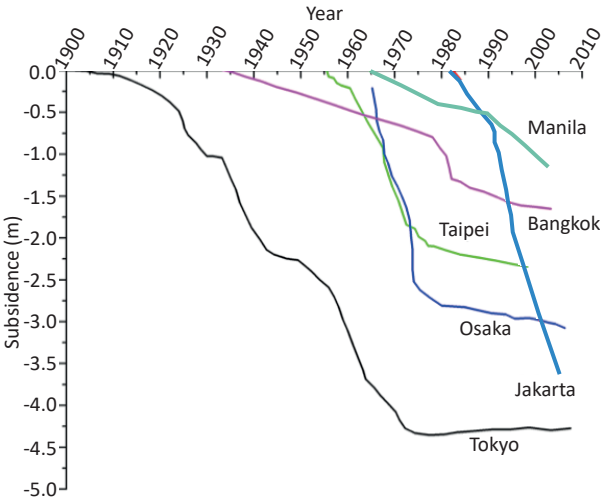


Figure ES.5: Comparative land subsidence rates across Indonesia (cm/year) and Asian megacities



Overpumping of *groundwater* has depleted aquifers around key cities and led to widespread subsidence and consequent increased vulnerability to flooding. The capital Jakarta has subsided on average over 3.5 m since the 1980s and continues to sink at rates of up to 20 cm a year (Figure ES.5)

Indonesia's *water storage* capacity (71 m³ per capita) is far below that of countries with similar seasonal variability, such as its neighbour Malaysia (710 m³ per capita) and Japan (228 m³ per capita). Only 8 percent of the country's hydropower potential has been developed and the GoI has set a visionary target of 31 percent of renewable energy in the national energy mix by 2050. Lack of integrated catchment management leads to sedimentation of dams, reducing their capacity significantly (Figure ES.6)

Figure ES.6: Storage capacity per capita in m3

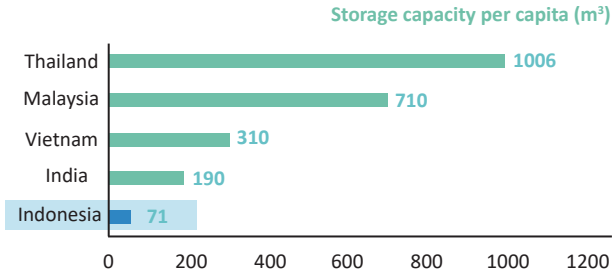
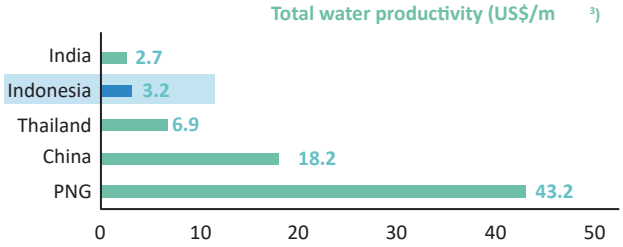


Figure ES.7: Total water productivity (US$/m3) across Asian countries



Water productivity (US$/m3) **in Indonesia is one of the lowest in Asia.** Generating only around US$3.2 for each cubic meter of water withdrawn Indonesia falls behind comparable countries in terms of GDP and agricultural water usage, such as Cambodia (US$8.3 per m³) or Thailand (US$6.9 per m³) (Figure ES.7)

Priority Actions

- Incorporate water resource carrying capacity into spatial and development planning.
- Adopt an integrated approach to water supply management for (urban) areas facing (future) water stress, encompassing demand management, efficiency improvements, rainwater harvesting and managed aquifer recharge, increase in bulk water supply, and non-traditional water source development.
- Establish a national water information system and enhance knowledge management.
- Enhance integrated management of water resources, including rivers, lakes, and groundwater.
- Implement a groundwater management strategy integrated into overall basin and water resource planning and curb groundwater abstraction in water-stressed areas.
- Improve coordination between Ministry of Energy and Mineral Resources (MoEMR), Ministry of Public Works and Housing (MoPWH), and Ministry of Environment and Forestry (MoEF) on hydropower dams, groundwater and integrated water management.

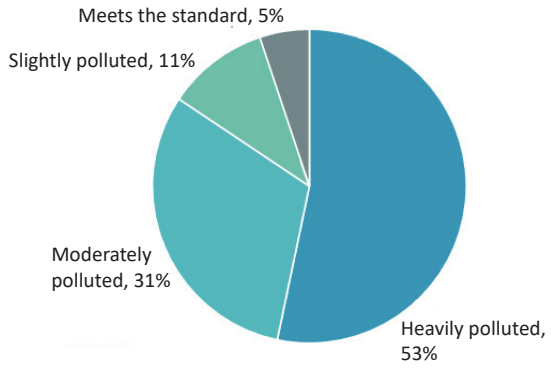
Quick Wins - Consider priority actions during:

- The Drafting of Government Regulation (RPP) on water resources management (Responsibility: DGWRM, MoPWH)
- Drafting of Implementing Regulation of Government Regulation 21 Year 2021 on Spatial Planning (Responsibility: MoASP)

Action 2: Managing water quality sustainably by tackling pollution

More than half of Indonesia's rivers are heavily polluted, and two of the country's major river systems are among the most polluted in the world (Figure ES.8).

Figure ES.8: River water quality status across Indonesia (2019)



The extent of the harm caused by water pollution is unknown as up to three-quarters of the population live in areas where water quality is not monitored.

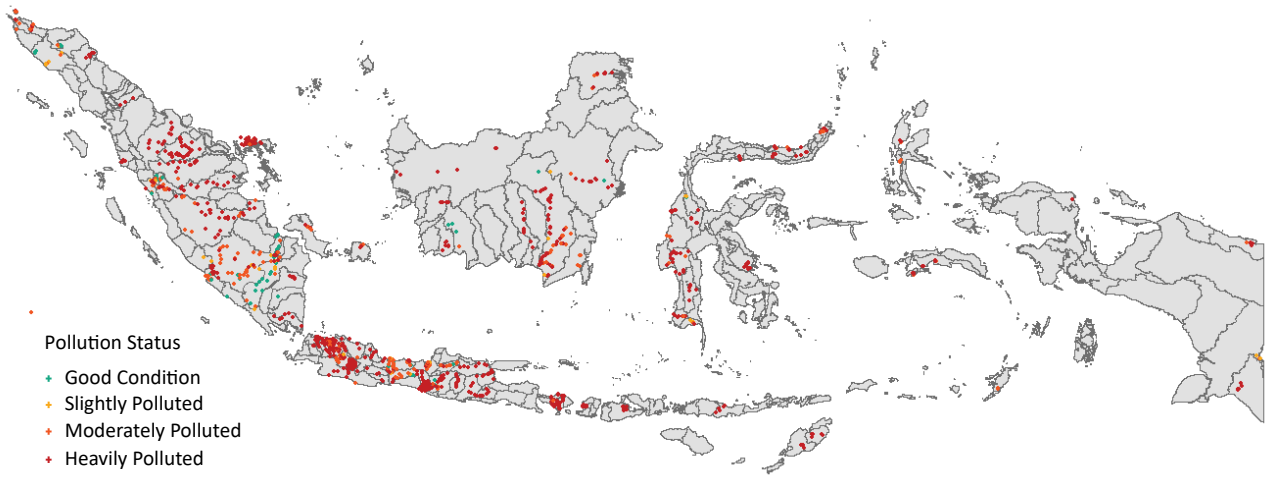
Where water is being tested, around 85 percent of the population are exposed to fecal coliform pollution in water sources (Figure ES.9). More than 70 percent of GDP is generated in river basins where most water samplings are categorized as 'heavily polluted'.

Groundwater quality is deteriorating, with more than four-fifths (93 percent) of groundwater samples exceeding pollutant threshold levels. About 70 percent of Indonesia's groundwater pollution comes from leaking septic tanks and septage disposed into waterways.

Deforestation and palm oil expansion are further deteriorating water quality. Rivers account for more than 80 percent of the plastic leaking to the marine environment from land-based sources in Indonesia.

With Indonesia's economic development, emergent pollutants, such as chemicals and heavy metals, are on the rise in addition to sanitation and agriculture-related pollution – already significantly impacting health. Pollution contributes to Indonesia's high stunting levels (35 percent).

Figure ES.9: Surface water pollution status across Indonesia



Source: Calculations based on data provided by MoEF.

Priority Actions

- Place major focus on the prevention of pollution and of damage to natural resources and the environment, together with institutional strengthening and enforcement.
- Enforce pollution control regulations by expanding the water quality monitoring network (see Action 8), determining the assimilation capacity of all water bodies and limiting the issuance of discharge licenses in line with the assimilation capacity.
- Increase incentives for local governments to enforce and monitor treatment of domestic and industrial, incl. mine, wastewater and evaluate their performance.
- Create regulatory clarity on water quality, especially between MoEF Regulation No. 28/2009 (on trophic states) and Government Regulation No. 22/2021 (on water quality classes).
- Strengthen pollution standards by including emerging pollutants as well as pollution from mines.
- Reduce agricultural runoff by optimizing usage of fertilizers and pesticides and adopting a "Smart Fertiliser Subsidy Program"
- Assess the potential for the application of PPP models for river quality improvement.
- Clarify responsibilities, such as on managing strategic rivers and monitoring antibiotics, enhance coordination on water quality across institutions and increase capacity.

Quick Wins - Consider priority actions during the revision of:

- Government Regulation 22 Year 2021 on The Protection and Management of the Environment (Responsibility MoEF)

Action 3: Enhance sustainability and improve resilience to disasters

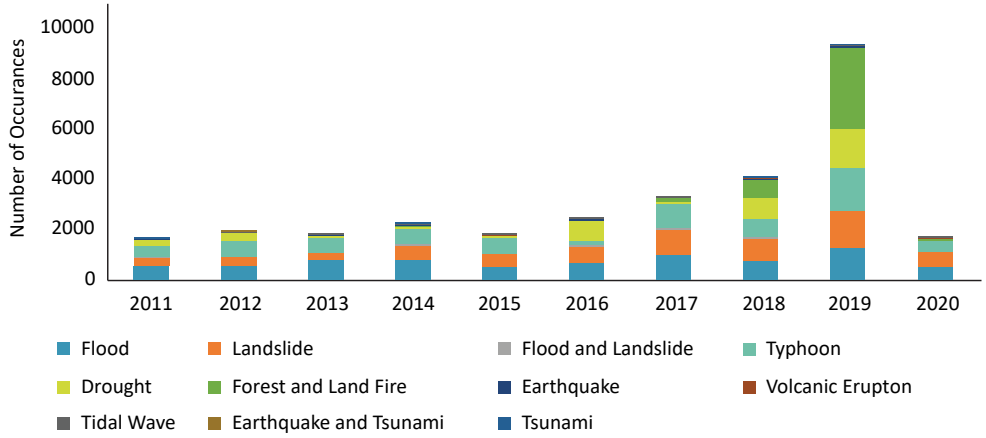
Predicted impact on GDP in case of inaction by 2045

- 3.4 percent if rice and palm oil continue to be produced on peatland instead of on non-peatland
- 0.11 percent for projected mean inland flood events and by up to 1.65 percent for projected future '1-in-50-year' inland flood events if there is ongoing land degradation and climate change
- 2.4 percent if land subsidence continues due to groundwater overabstraction and SLR.

Indonesia is one of the most disaster-prone countries in the world. More than three-quarters of Indonesia's disasters are meteorological or hydrological, such as floods, landslides, droughts, extreme weather, tidal waves, and forest fires. Water-related disasters have caused considerable loss of life and average economic losses of US$2–3 billion each year between 2007 and 2018. Over the past 10 years, the number of disasters in Indonesia has increased and anthropogenic impacts—along with climate change—significantly aggravate the risk and impact of disasters.

More than 1 percent of Indonesia's forest cover is lost *every year,* with significant impacts on the water balance, water storage functions and water quality. Indonesia ranks poorly on global environmental scoring (116 out of 180 countries), far behind comparators such as China and India.

Figure ES.10: Trend of disaster occurrence in the last 10 years



Source: BNPB 2020c.

Priority Actions

- Adopt a structural and long-term strategy and start a massive coordinated effort across at least MoPWH, MoEF, National Disaster Management Agency (Badan Nasional Penanggulangan Bencana, BNPB), MoEMR, Ministry of Agrarian Affairs and Spatial Planning (MoASP), RBOs, and local governments to protect watersheds and prevent disasters.
- Adopt an integrated land-water-environment management approach in peatland areas.
- Increase effectiveness of law enforcement on deforestation and land use changes based on regional spatial planning.
- Apply technological solutions, such as remote sensing, to enhance enforcement of regulations, licensing, and monitoring of mining activities and to thus reduce the environmental impact.
- Establish a risk-based integrated disaster management system, emphasizing prevention and preparedness; combining structural and non-structural measures, leveraging grey infrastructure and nature-based solutions, coordinating disaster response across different sectors and levels of government, and ensuring adequate financing and managing fiscal risk at central and local levels.
- Expand the national dam safety program to cover all dams and ensure sufficient O&M
- Mainstream climate change adaptation in infrastructure development and planning

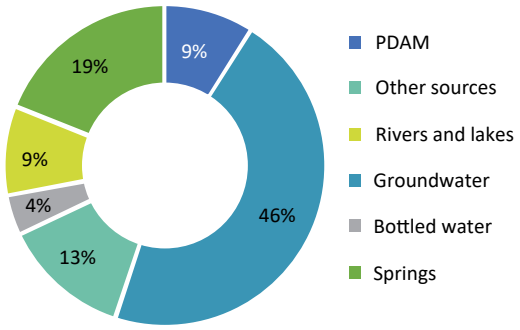
Quick Wins - Consider priority actions during the revision of:

- MoPWH Regulation 10/2014 on Guidance on Disaster Mitigation on Housing and Settlement (Responsible: MoPWH)
- Draft President Regulation (PERPRES) concerning the acceleration of lake rehabilitation (Responsible: MoPWH)

Action 4: Accelerate inclusive, sustainable, and efficient water supply for all Indonesians

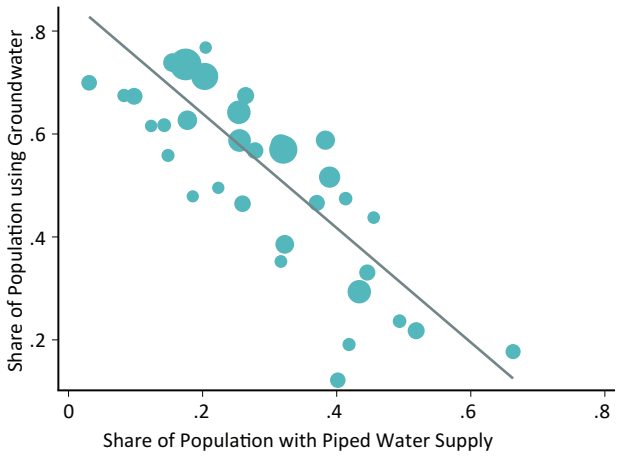
Water supply services fall well short of usual standards at Indonesia's level of development and far below the aspirations of Vision 2045. Only 23 percent of Indonesians have access to piped water (Target RPJMN 2014-19: 60 percent; Figure ES.11).

Figure ES.11: Water sources for domestic demand (2019)



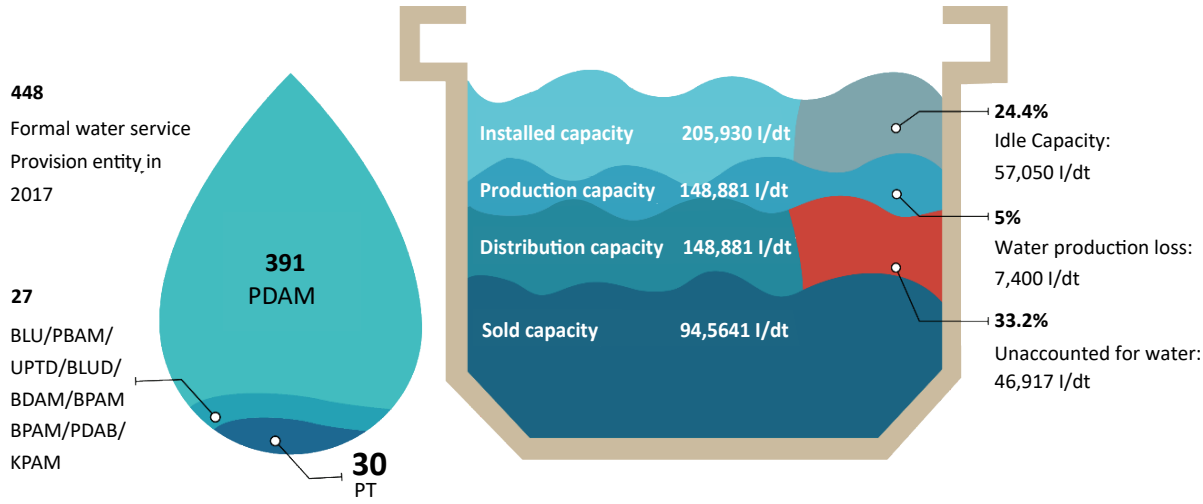
Only 9 percent of total domestic water demand is provided by PDAMs (Figure ES.11). Thus, almost half of all households and most commercial and industrial premises rely on supplies from onsite groundwater, contributing to a significant depletion of aquifers and ultimately land subsidence (Figure ES.12).

Figure ES.12: Groundwater usage and access to piped water supply by province



Water supply systems are often highly inefficient, with service interruptions which may last several days, low utilization of treatment capacity, and officially 33 percent of "non-revenue" water. Current bulk infrastructure capacity of PDAMs can only provide 30 percent of the total national raw water demand, yet as much as 24 percent of bulk water available for water supply is not utilized (Figure ES.13)

Figure ES.13: Water service providers (left) and water supply in Indonesia (right)



Piped water quality is below standard and monitoring capacity by accredited water quality testing laboratories and MoH is low. Groundwater quality – the key water source - is deteriorating in urban and industrial areas, with little capacity for treatment at the household level.

Priority Actions

- Increase the effectiveness of public investment in water supply by adopting an Integrated Urban Water Management approach.
- Improve efficiency and sustainability of water supply by strengthening the governance, financial viability, and performance of the water utilities (PDAMs) including moving toward full cost recovery tariffs, amalgamating nonviable PDAMs, restructuring balance sheets, and reducing non-revenue water.
- Consider amending the regulatory framework to manage water utilities as natural monopolies.
- Increase access to water by refining and expanding effective programs such as PAMSIMAS and Water

Hibah and create targeted programs for areas with unreliable water sources.
- Provide detailed MSS for district levels and track progress publicly while improving water quality monitoring and provision, as well as "safe" access.
- Increase piped water supply access and use, by expanding PDAM services, incentivising PDAM connections and provide financial support for low-income households in areas where pipe network is available, particularly in areas with groundwater overabstraction or polluted water supplies.
- Promote household level solutions, such as low-cost water filters and enhanced quality control at water refill stations.
- Open the door to private finance by enhancing regulatory certainty, finalizing and implementing the PPP framework for the water supply sector, and revising the PPP contractual structure to leverage private investment.

Quick Wins - Consider priority actions during the revision of:
- Amendment to Government Regulation (PP) 122/2015 on Drinking Water Supply System
- Revised Government Regulations 46/ 2010 on Public Company (perum) Jasa Tirta I and 7/2010 on Public Company (perum) Jasa Tirta II (Responsible MoPWH, MoSOE)

Action 5: Expand and finance inclusive, sustainable, and efficient sanitation services and wastewater treatment

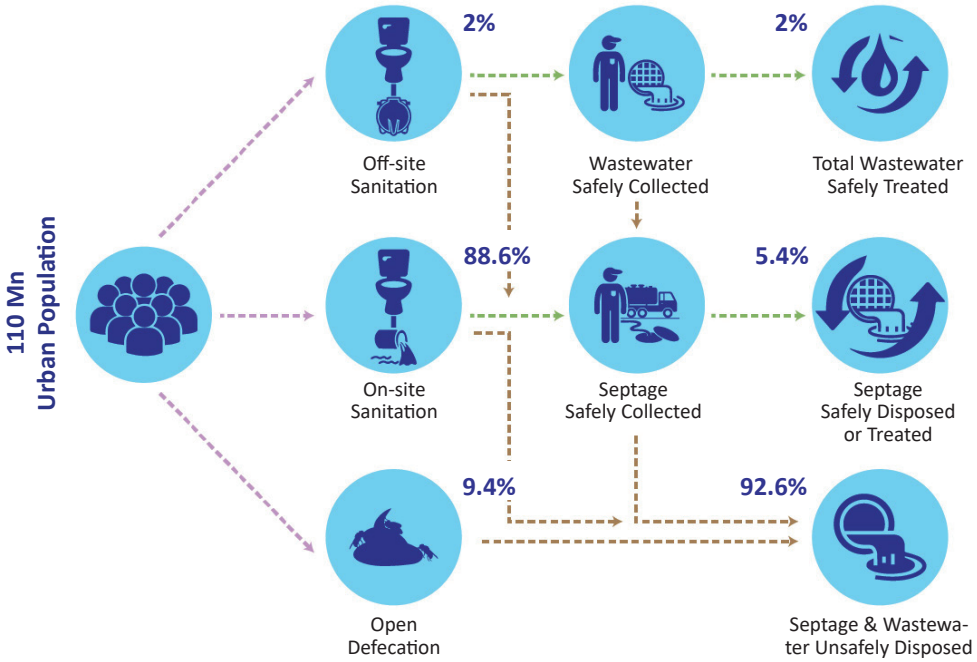
Predicted impact on GDP in case of inaction by 2045
- Increase by up to 1.17 percent if 100 percent coverage of improved WASH is achieved.

Indonesia has lower levels of access to basic sanitation than would be predicted based on its GDP levels and has not achieved its ambitious targets for universal access to sanitation by 2019.

A sewerage connection is available to less than 2 percent of the population–and 17 percent of rural people still practice open defecation.

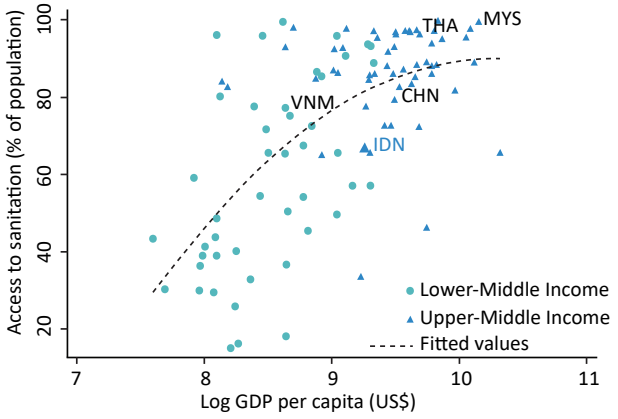
Nationwide only 7.4 percent of municipal wastewater is safely collected and treated; the remaining 92.6 percent is discharged untreated to water bodies. Yet existing systems have unutilized capacity due to low rates of household connections.

Figure ES.14: Wastewater and septage flow in urban Indonesia



Source: BAPPENAS 2019.

Figure ES.15: The impact of lack of access to sanitation on stunting rates



Note: IDN=Indoneisa; VNM=Vietnam; CHN=China; THA=Thailand; MYS=Malaysia

About 70 percent of Indonesia's groundwater pollution comes from leaking septic tanks and septage disposed into waterways.

Indonesia's severe child stunting problem (35 percent of under 5 children) is in part linked to water pollution and poor sanitation (Figure ES.15).

Besides untreated domestic wastewater, there are thousands of industries as well as mining, agriculture, and aquaculture businesses that have major polluting activities.

Priority Actions

- Adopt a risk-based and adaptive national sanitation policy and develop a public investment program based on priorities and outcome targets to significantly increase access to safely managed sanitation.
- Expand the community-led 'Total WASH Program' for rural sanitation and link it to sanitation marketing and financing schemes
- Design institutional and business models for sanitation and wastewater.
- Create an incentive for urban households to connect to the 'better' or 'more modern' services, such as a sewerage network, where available. When unavailable, develop and improve off-network approaches, such as fecal sludge management.
- Create incentives for local governments to invest in sanitation and wastewater and to enforce regulations, such as benchmarking sanitation performance and linking it with financing.
- Ensure SANIMAS systems meet water quality parameters under the revised regulation.
- Enforce and monitor pollution control from industries and mines and increase their incentives to comply with pollution control, by making cost of pollution higher than cost of compliance, and by promoting corporate water stewardship. Make monitoring tamperproof.
- Reduce water pollution from acid mine drainage and develop an integrated strategy to tackle pollution especially from coal, gold and ore (nickel) mining.
- Improve solid waste management practices in larger urban areas as well as in rural areas and also aim to reduce plastic use and increase community-based recycling.

Quick Wins - Consider priority actions during the revision of:

- Government Regulation (PP) 122/2015 on Drinking Water Supply System (Responsible: DGHS, MoPWH)
- Ministerial Regulation on Development and Provision of Infrastructure and Facilities for Management of Solid Waste in Housing and Settlements (DGHS, MoPWH)

Action 6: Modernize irrigation and improve its productivity

Indonesia has the third highest paddy yields among the top global rice producers and great differences across river basins allow for further improvement. More than one-third (35 percent) of rice production is in river basins experiencing severe or high water stress.

Agriculture uses 80 percent of Indonesia's water, yet nearly half (46 percent) of irrigation systems are classed as 'in poor condition'. Systems managed by the central government seem to perform best overall, with only 7 percent categorized as 'ruined', while systems managed by districts overall perform worst, with 21 percent categorized as 'ruined'.

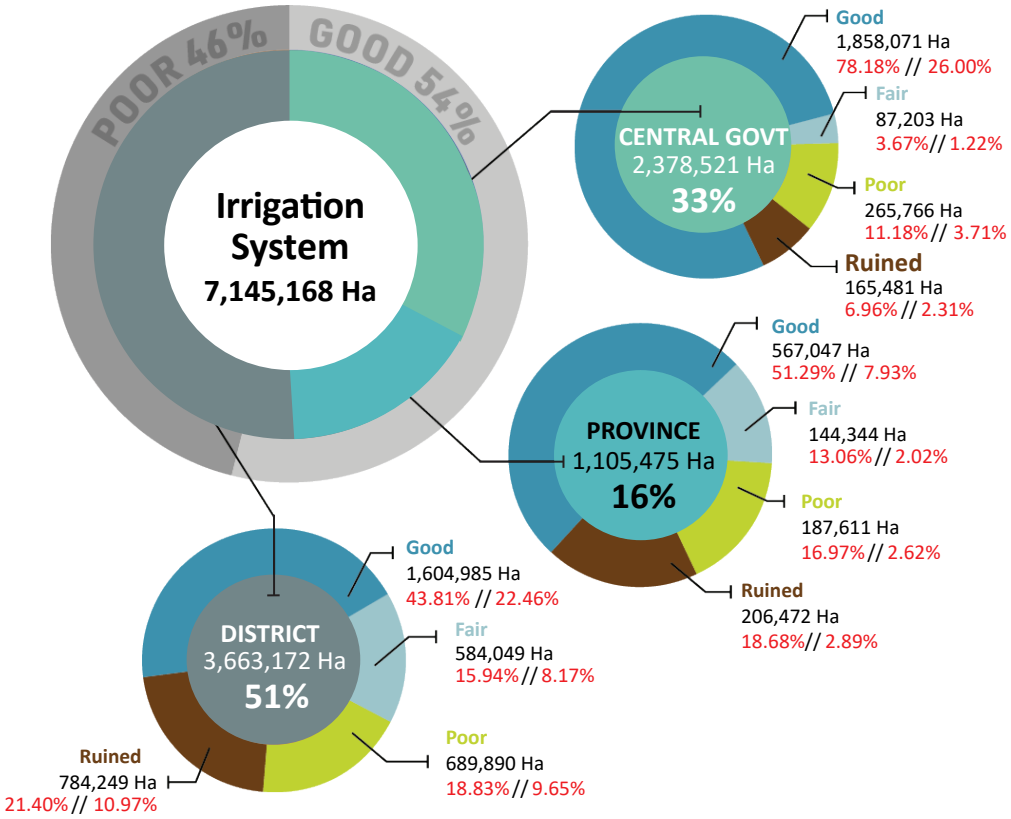
Only 12 percent of irrigation is supplied from reservoirs (premium irrigation), seasonal water shortages can severely affect crops.

Development of lowland areas for food crops and plantation has driven deforestation and drainage of peatland area - large agricultural areas in the lowlands are already unsuitable for productive agriculture.

Priority Actions

- Irrigation strategy should focus on a least-cost, maximum-value model, prioritizing modernization, high-value crops, and efficient water use.
- Improve functioning and management of existing irrigation systems through enhanced cooperation between MoA, MoPWH and Water User Farmer Associations. Clarify the institutional responsibility of Water User Farmer Associations.

Figure ES.16: Overview of irrigation system functioning across national, provincial, and district management (2014)



- Increase the efficiency and effectiveness of infrastructure investment and planning. Base sector investment on outcomes such as increases in '$ per drop' and 'nutrition per drop' rather than on outputs. New investment should be subject to economic analysis and should be optimized within a basin framework.
- O&M for irrigation systems needs to be fully financed on a sustainable basis, with a sharing of the financial burden. Accountability needs to be enhanced through irrigation service agreements.
- Protect highly productive agricultural land in spatial plans.
- Develop location-specific strategies to optimize water and food security, and address the entire value chain for a sustainable shift.
- Improve the sustainability of agriculture by reducing or optimizing production in lowland areas, reviewing land recovery programs in swamp areas against economic and environmental criteria.
- Tackling agricultural pollution by developing a "Smart Fertilizer Subsidy Program", train farmers on the correct usage of fertiliser and pesticide inputs and enforce restrictions on harmful and banned inputs.
- Intensify climate-smart approaches, good agriculture and organic farming practices.

Quick Wins - Consider priority actions during the drafting of:

- Government Regulation (RPP) on irrigation (responsibility DGWR, MoPWH)

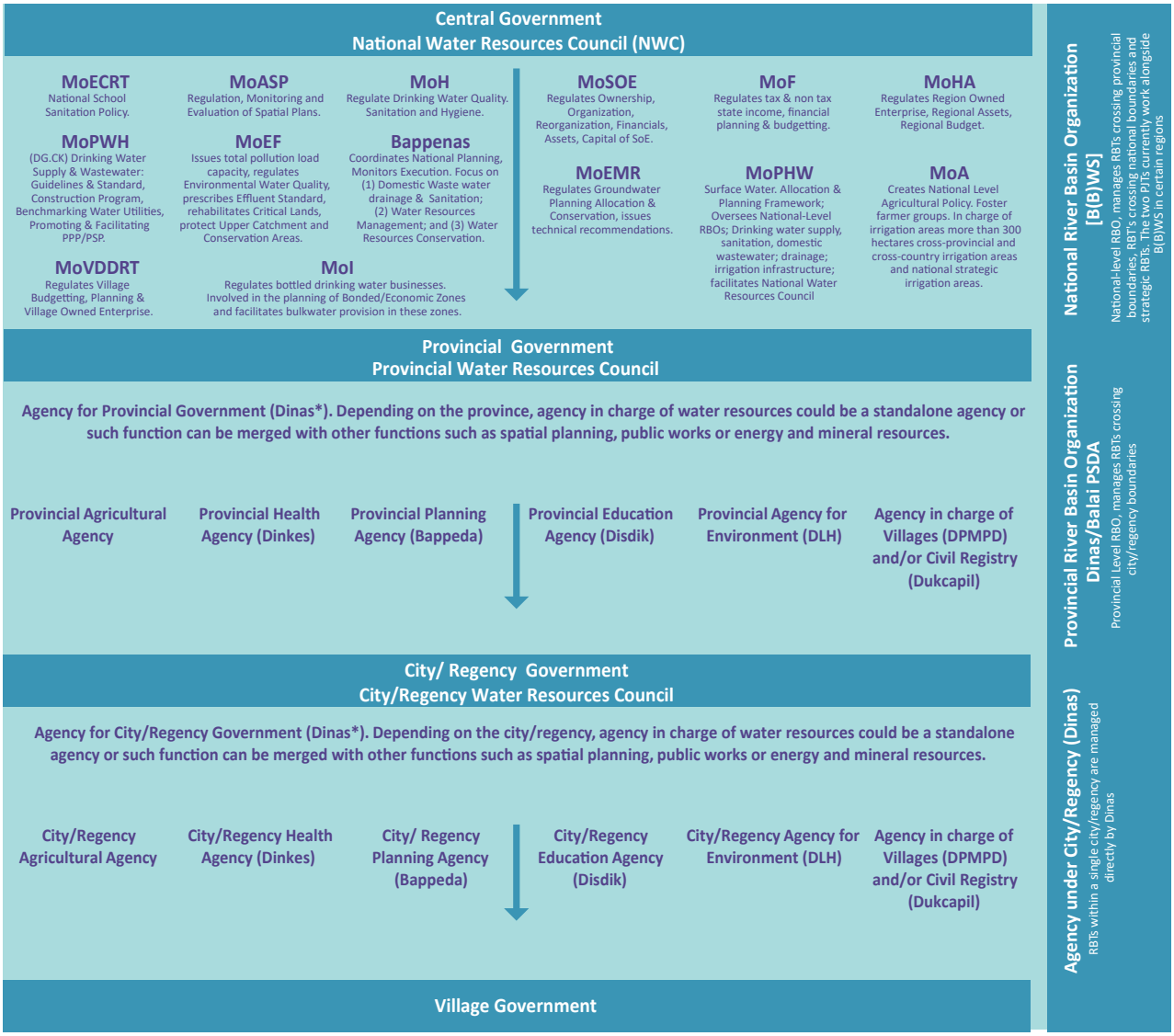
Action 7: Strengthen the governance framework

There is some regulatory uncertainty on responsibilities, with some tasks overlapping (Figure ES.17).

Following the promulgation of the 2019 Water Law and 2020 Omnibus Law the National Policy on Water Resources Management (Jaknas) as well as implementing regulations need to be either revised or additional ones passed.

There is a legal void on regulating water and wastewater services, as the 2019 Water Law does not regulate sanitation nor defines it as a basic service. As a consequence, there is no adequate legal basis to issue implementing regulations. The groundwater planning mechanism has no clear legal basis, as while the Government Regulation 121/2015 (under revision) contains provisions on groundwater commercialization, it does not contain provisions on groundwater planning.

Figure ES.17: Organizational and institutional structure of Indonesia's water sector



Ministerial regulations are mostly coordinated within the implementing ministry only – causing potential disharmony with other regulations. Current regulations do no incentivize efficiency and effectiveness of utilities due to a lack of competition and regulation.

Priority Actions

- The passing of the 2019 Water Law and the 2020 Omnibus Law provides an opportunity to address coordination and implementation challenges and to move toward more integrated water resources management.
- Harmonize the 2019 Water Law and 2020 Omnibus Law with the existing legal framework.
- Issue regulations on key outstanding points requiring clarification from the 2019 Water Law, incl. groundwater, water allocation and environmental flows.
- Consider the issuance of a water and wastewater service law.
- Consider amending current regulations to consider water utilities as natural monopolies.
- Develop a coordination mechanism for developing and revising all ministerial regulations concerning water across all relevant ministries.
- Harmonize the National Policy on Water Resources Management (Jaknas) with Vision 2045.

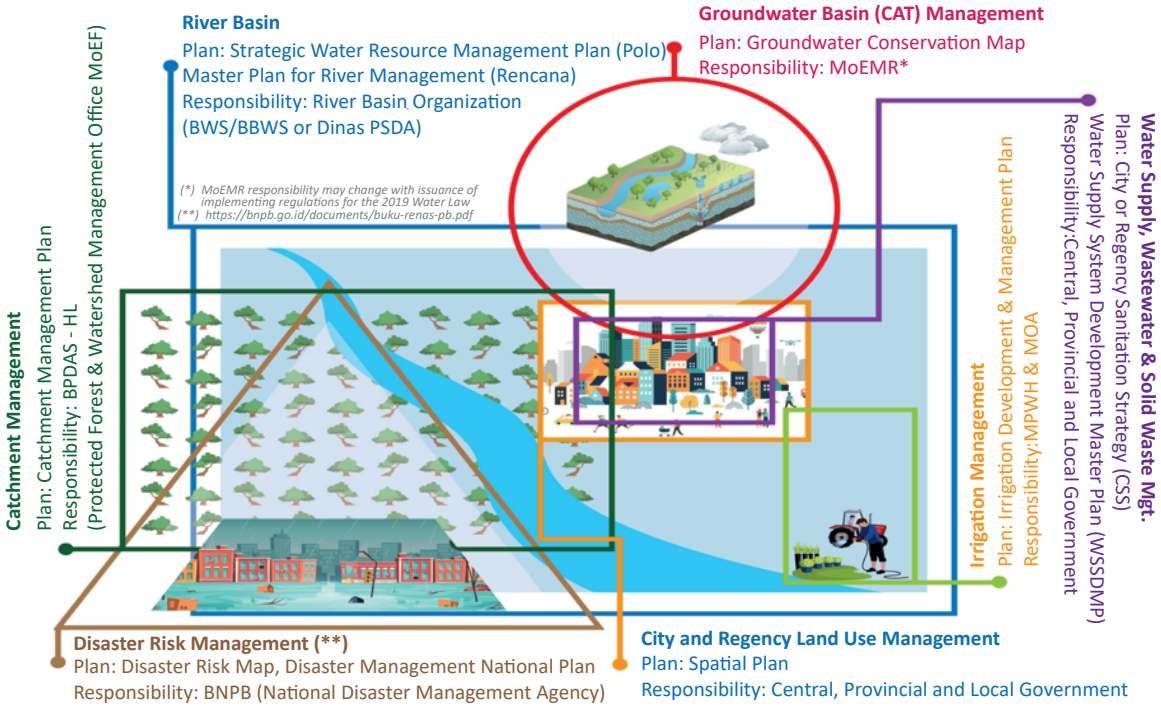
Quick Wins - Consider priority actions during the drafting of:

- Government Regulation on Water Resources Management (Responsibility: MoPWH)

Action 8: Strengthening Institutions: Coordination and capacity building

Responsibility for managing and protecting water resources is fragmented among agencies. Jurisdictions and planning documents overlap spatially and without integration targets may not be achieved and may even impede each other (Figure ES.18). Limited capacity to respond to increasingly complex water challenges.

Figure ES.18: Overlapping responsibilities and planning documents in a river basin



Priority Actions

- Improve water governance and accountability by clarifying responsibilities across ministries and departments as well as strengthening coordination mechanisms such as Water Resources National Council (Dewan Sumber Daya Air Nasional, Dewan SDAN) and coordination teams for water resources management (Tim Koordinasi Pengelolaan Sumber Daya Air, TKPSDA), including by involving governors in decision-making and follow-up.
- Strengthen integrated planning at the basin level by implementing the 'one basin, one plan, one management' approach required in the 2019 Water Law and harmonizing the Strategic Water Resources Management Plans (Pola Atau Rencana Strategis, pola) and Master Plans for River Management (rencana) with other sector plans as well as with land use zoning and spatial plans.
- Improve basin management and performance of RBOs by enhancing technical and financial capability, as well as re-aligning incentives and increasing accountability.
- Consider if PJT model can be replicated across further river basins.
- Enhance capacity across government to manage increasingly complex water challenges by developing the technical, financial, and managerial skills of water professionals, practitioners, and key workers, especially in the RBOs.
- Strengthen coordination between subnational governments on water issues, and clearly define authority across government levels.
- Enhance the cooperation between the government and the private sector and civil society and create incentives for a culture of sustainable water management behaviour.
- Establish a real time national water information and knowledge management system, which integrates and verifies all relevant databases.

Quick Wins - Consider priority actions during the revision of:

- Ministerial Regulation 09/2018 regarding the Review of Medium-Term Regional Development Plan (RPJMD) (Responsibility: MoHA)
- Ministerial Regulation 06/2006 on Organization and Working Arrangement of the Secretariat of Development Cooperation Agency Jakarta, Bogor, Depok, Tangerang, Bekasi and Cianjur[4] (Responsibility: MoHA)

Action 9: Improving the efficiency of public expenditures for water and mobilizing finance

Resources allocated to the water sector are insufficient to meet sector targets—and are below international averages. While public expenditure on the water supply sector has increased threefold in real terms over 2001–2016 and now accounts for 1.7 percent of total national spending for the entire water sector, Indonesia is among the countries with the lowest spending on water and sanitation. At only 0.2 percent of the national GDP (2016), it is far lower than the levels recommended for East Asian countries (0.5 percent) or by the United Nations (1 percent). Around 55.5 trillion IDR would be needed annually to achieve

universal WASH access, while only 12.1 trillion IDR are annually spent – leaving a gap of 43.5 trillion IDR.

To make matters worse, due to low execution rates (ratio of spending to budget allocated), the allocated resources are not even fully utilised. Currently, the execution rates of Directorate General Human Settlement and Directorate General Water Resources, for example, are below 90 percent.

To date there is insufficient private sector investment, further slowing down the achievement of sector targets. Insufficient O&M spending is not only reducing the asset life but also affecting the ongoing functioning of investments.

Subsidies, particularly fertiliser subsidies as second highest subsidies in Indonesia, are contributing to water pollution.

Priority Actions

- Allocate sufficient resources to meet RPJMN targets, link expenditure to clear, realistic policy targets, improve execution capacity by government and balance resources between central and decentral levels.
- Appraise investments across their entire life cycle using economic cost-benefit analysis, integrate these into broader spatial planning and agree on sustainable arrangements for post-completion management up front.
- Focus investment on provinces with low fiscal capacity and encourage provinces with high fiscal capacity to use their own resources and to increasingly leverage financing from the private sector.
- Increase spending effectiveness and efficiency by adequate financing of O&M, thereby improving infrastructure performance and lifespan.
- Revisit subsidy schemes to understand their full economic impact; introduce for example, a 'Smart Fertilizer Subsidy Program'
- Address financial challenges to connect to services by poor households by enabling microfinance schemes and allowing for payment plans.
- Enhance attractiveness of water supply and wastewater sector investments to the private sector by reducing legal uncertainty, creating viable business and institutional models, creating a project pipeline and developing a dedicated PPP one-stop shop.

Quick Wins - Consider priority actions during the revision of:

- Ministerial Regulation 09/2018 regarding the Review of Medium-Term Regional Development Plan (RPJMD) (Responsibility: MoHA)

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The agenda on water is vast—nine key areas for action—but experience from other countries shows it is doable. Carrying out this agenda for Indonesia will require political commitment at both central and decentralized levels together with the collaboration of many institutions. Urgent action should be taken to avoid downside risks and costs. Concerted and sustained action on the nine challenges can put Indonesia on the pathway to realize the ambitious and noble goals for Indonesia@100.

Anchoring the proposed actions in what is already a subject of revision within the government makes the recommendations both pertinent and practical. All nine areas for action need to be addressed together, while an implementation road map for the short-, medium-, and long term can be developed around the time frame of the regulatory reform.

Developing benchmarks to tailor solutions to specific localized needs across the vast archipelago. Given Indonesia's vast diversity of water security challenges—spanning from water stress in Java to lack of access to safe water in Papua—a system needs to be established to accurately and quickly determine the region's challenges to then tailor targeted solutions to address these. A benchmarking system can capture and rank different water security outcomes (water stress, water pollution, floods, lack of WASH access, and so on) for each locality, which can then be aggregated to river basin level

The passing of the 2019 Water Law and the 2020 Omnibus Law creates an opportunity to implement many of the recommendations in this Policy Note. Many of the recommendations can be implemented through the process of issuing and revising regulations that has been set in motion by the passing of the 2019 Water Law and the 2020 Omnibus Law. As the revision of key implementing regulations is scheduled to be completed between 2021 and 2024, action needs to be taken urgently to allow for key recommendations of this note to be discussed and—if found supportive—reflected in the revised implementing regulations.

Acronyms

ADB	Asian Development Bank
B2B	Business-to-Business
B-C	Benefit-Cost
BAPPEDA	*Badan Perencanaan Pembangunan Daerah* (Regional Development Planning Agency)
BAPPENAS	*Badan Perencanaan Pembangunan Nasional* (Ministry of National Development Planning/National Development Planning Agency)
BAU	Business As Usual
BBWS	Balai Besar Wilayah Sungai (River Basin Organization)
BJPSDA	*Biaya Pengelolaan Jasa Sumber Daya Air* (Water Resources Management Services Fee)
BKSP	*Jabodetabekjur Development Cooperation Agency*
BLUD SPAM	*Badan Layanan Umum Daerah - Sistem Penyediaan Air Minum* (Service Unit owned by sub-national governments. BLUD-SPAM at the province is usually dedicated to bulk water supply.)
BNPB	*Badan Nasional Penanggulangan Bencana* (National Disaster Management Agency)
BOD	Biochemical Oxygen Demand
BPPSPAM	*Badan Peningkatan Penyelenggaraan Sistem Penyediaan Air Minum* (Agency to Support Acceleration of Drinking Water Supply Services Development)
BPS	*Badan Pusat Statistik* (Indonesian Central Bureau of Statistics)
BPSDM	*Badan Pengelolaan Sumber Daya Manusia* (Agency for Human Resource Development)
BRG	*Badan Restorasi Gambut* (Peatland Restoration Agency)
BUMD	*Badan Usaha Milik Daerah* (Local Government-Owned Enterprise)
BUMN	*Badan Usaha Milik Negara* (State-Owned Enterprise)
CAT	*Cekungan Air Tanah* (Groundwater Basin)
CGE	Computable General Equilibrium
CMEA	Coordinating Ministry for Economic Affairs
CMIP5	Coupled Model Inter-Comparison Project Phase

COD	Chemical Oxygen Demand
DAS	*Daerah Aliran Sungai* (River Basin Catchment)
DAT	*Daerah Tangkapan Air* (Lake Catchments)
Dewan SDA	*Dewan Sumber Daya Air National* (National Water Resource Council)
DGHS	Directorate General of Human Settlements
DGWR	Directorate General of Water Resources
DIIF	District Irrigation Improvement Funds
DKI Jakarta	Daerah Khusus Ibukota Jakarta (Special Capital Region of Jakarta)
DTBP	*Daya Tampung Beban Pencemaran* (Assimiative Capacity)
EFR	Environmental Flow Rate
EMRP	Ex-Mega Rice Project
EPI	Environmental Performance Index
GAP	Good Agriculture Practices
GCM	General Circulation Model
GDP	Gross Domestic Product
GHG	Greenhouse Gas
GoI	Government of Indonesia
IPCC	Intergovernmental Panel on Climate Change
IPLC	*Ijin Pembuangan Limbah Cair* (Wastewater Discharge Permit)
IPLT	*Instalasi Pengolahan Lumpur Tinja* (Fecal Sludge Treatment Plant)
ISF	Irrigation Service Fees
IUWM	Integrated Urban Water Management
JAKNAS	*Kebijakan Nasional Dewan Sumber Daya Air, or JAKNAS SDA* (National Policy for Water Resources)
JIWMP	Java Irrigation and Water Resources Management Project
MoA	Ministry of Agriculture
MoASP	Ministry of Agrarian Affairs and Spatial Planning
MoEF	Ministry of Environment and Forestry
MoEMR	Ministry of Energy and Mineral Resources
MoF	Ministry of Finance
MoH	Ministry of Health
MoHA	Ministry of Home Affairs
MoI	Ministry of Industry
MoMAF	Ministry of Maritime Affairs and Fisheries
MoPWH	Ministry of Public Works and Housing
MoT	Ministry of Trade
MoTC	Ministry of Tourism and Creative Economy
MoVDDRT	Ministry of Villages, Development of Disadvantaged Regions, and Transmigration
MSS	Minimum Service Standards
NDC	Nationally Determined Contribution

NGO	Non-Governmental Organization
NTT	*Nusa Tenggara Timur (E*ast Nusa Tenggara)
NUWAS	National Urban Water Supply Framework
O&M	Operation and Maintenance
P3-TGAI	*Program Percepatan Peningkatan Tata Guna Air* Irigasi (Improvement of Tertiary Irrigation Canal Construction Work)
PAMSIMAS	*Penyediaan Air Minum dan Sanitasi Berbasis Masyarakat* (Community-Based Water Supply and Sanitation Systems)
PDAM	*Perusahaan Daerah Air Minum* (Local Government Owned Water Utility)
PFAS	Per- and Polyfluoroalkyl Substances
PFOS	Perfluorooctane Sulfonate
PHU	Peat Hydrology Unit
PJT I/II	*Perusahaan Umum Jasa Tirta I*/II (Jasa Tirta I/II Public Corporation)
PLN	*Perusahaan Listrik Negara* (Indonesia's National Power Company)
Pola	*Pola Atau Rencana Strategis* (Strategic Water Resources Management Plan)
POP(s)	Persistent Organic Pollutant(s)
PPLH	*Pejabat Pengawas Lingkungan Hidup* (Environmental Supervisory Officials)
PPNS	*Penyidik Pegawai Negeri Sipil* (Official Civil Servant Investigator)
PPP	Public-Private Partnership
PROPER	Program Penilaian Peringkat Kinerja Perusahaan Dalam Pengelolaan Lingkungan (Program for Pollution Control, Evaluation, and Rating)
PROSIDA	*Proyek Irigasi IDA* (Irrigation Project International Development Association)
Puskesmas	*Pusat Kesehatan Masyarakat* (Community Health Center)
PVMBG	*Pusat Vulkanologi dan Mitigasi Bencana Geologi* (Centre for Volcanology and Geological Hazard Mitigation)
RAAR	*Rencana Alokasi Air Rinci* (Detail Water Allocation Plan)
RAAT	*Rencana Alokasi Air Tahunan* (Annual Water Allocation Plan)
RBO	River Basin Organization
RBT	River Basin Territory
RCP	Representative Concentration Pathways
Regional SPAM	*Regional Sistem Penyediaan Air Minum* (Regional Bulk Water Supply Schemes)
Rencana	*Rencana Induk Pengelolaan Sungai* (Master Plan for River Management)
RENSTRA	*Rencana Strategis* (Strategic Plan)
RPJMD	*Rencana Pembangunan Jangka Menengah Daerah* (Regional Medium-Term Development Plan)
RPJMN	*Rencana Pembangunan Jangka Menengah Nasional* (National Mid-Term Development Plan)
RPJPN	*Rencana Pembangunan Jangka Panjang Nasional* (Long-Term National Development Plan)
RPP	*Rancangan Peraturan Pemerintah* (Draft Government Regulation)
RTRW	*Rencana Tata Ruang Wilayah* (Spatial Plans)
SANIMAS	*Program Sanitasi Berbasis Masyarakat* (Community Based Sanitation Program)
SDA	*Sumber Daya Air* (Water Resources)
SDGs	Sustainable Development Goals
SIMURP	Strategic Irrigation Modernization and Urgent Rehabilitation Project

SLR	Sea Level Rise
SOEs	State-Owned Enterprises
STBM	*Sanitasi Total Berbasis Masyarakat* (community-led total WASH)
TFWW	Total Freshwater Withdrawn
TKPSDA	*Tim Koordinasi Pengelolaan Sumber Daya Air* (Coordination Team for Water Resources Management/CT-WRM)
TRWR	Total Renewable Freshwater Resources
WASH	Water, Sanitation, and Hygiene
WAVES	Wealth Accounting and Valuation of Ecosystem Services
WHO	World Health Organization
WISMP	Water Resources and Irrigation Sector Management Project
WUA	Water User Association
WUAF	Water User Association Federation

1

Setting the Scene

About This Policy Note

The World Bank was requested by the Government of Indonesia (GoI) to undertake the study *"Indonesia: Vision 2045. Towards Water Security".* The study has been conducted under the joint leadership and guidance of the Directorate of Water Resources and Irrigation at the Ministry of National Development Planning/ National Development Planning Agency, (*Badan Perencanaan Pembangunan Nasional*, BAPPENAS) and the Directorate General of Water Resources (DGWR), Ministry of Public Works and Housing (MoPWH).

The overall objective of the study is to support the GoI in identifying policy actions to accelerate the implementation of the National Mid-Term Development Plan *(Rencana Pembangunan Jangka Menengah Nasional,* RPJMN) 2020–2024. Specifically, the study aims to undertake an analytical assessment supporting decision-makers at the national level to (a) understand the economic impacts of water-related threats if left unaddressed; (b) outline strategies for sustainable, resilient, and productive water systems; (c) identify areas to strengthen institutional and regulatory frameworks for water resources management; and (d) explore ways to address competing demands on resources in the context of limited public financing.

This Policy Note summarizes the findings of a comprehensive Diagnostic Report. This Policy Note contains an overview of key threats and challenges along with recommended actions. The Diagnostic Report provides the full background and analysis.

The study has been carried out in partnership with the government and in full consultation with other stakeholders. Starting with a desk study, initial findings were verified and further expanded upon through a broad consultative process. Besides a series of consultations to receive specific information, a series of focus group discussions were held on the following topics: (a) water quality and pollution control; (b) river basin management and water resource allocation; and (c) groundwater management. The draft Diagnostic Report that resulted from this process has been shared to date with more than 30 government departments. Inputs from these consultations and from further bilateral meetings with civil society organisations have been invaluable in refining the findings and recommendations of the study.

The Diagnostic Report and this Policy Note are based on the analysis provided by two complementary reports. First, the World Bank commissioned an economic study of the costs of inaction regarding selected water threats titled '*Water-Related Threats to Indonesia's Economy*'. The study was conducted by consultants using a computable general equilibrium (CGE) modelling framework. Second, forecasts developed for water demand and water stress in Indonesia's river basins in 2030 and 2045 were estimated. The detailed methodology, data sources, and assumptions are presented in the report *Indonesia's Future Water Stress*.

The report links to two further documents focusing on urban water management in Indonesia, which are being prepared concurrently, the National Framework for Integrated Urban Water Management and the Water Security in Greater Jakarta analytical report.

Structure of the Policy Note

This Policy Note is structured to provide key insights into the threats and challenges faced by Indonesia's water sector now and in the future, along with recommended actions.

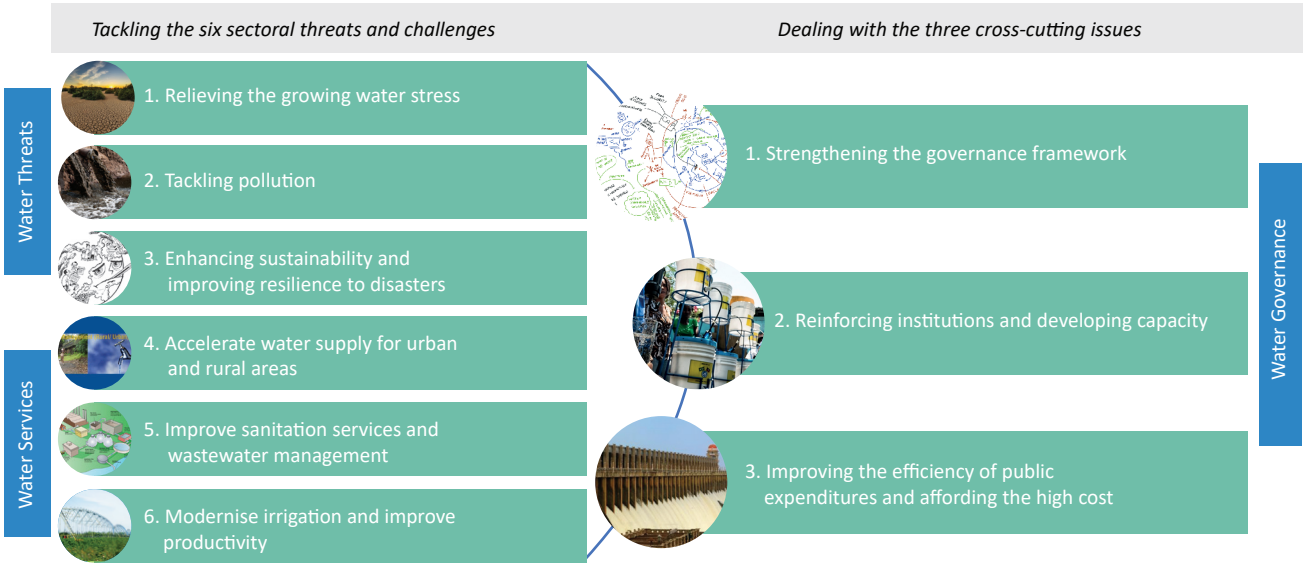
While the water sector challenges are vast and plentiful, nine recommended actions were prioritized based on the analysis further detailed in the Diagnostic Report and on the consultation with 34 government departments. These recommended actions were categorized into three pillars to understand *why* action is required (Pillar 1), *what* can be done to amend water service delivery to address these threats (Pillar 2), and *how* the enabling environment needs to be revised to allow for sustainable water management (Pillar 3). It needs to be noted that the discussed threats and challenges take place concurrently, with the potential of exacerbating each other. Thus, while actions to address these threats and challenges are presented within pillars, a system-wide view is required to take action rather than addressing each challenge in isolation.

This note first highlights the importance of water security in achieving the GoI's immediate and long-term targets as captured in RPJMN 2020–2024 and Vision 2045. The emphasis is not only on the imperative for action but also on the high economic cost of inaction.

The note then focuses on nine actions, structured around three pillars:

- **Pillar I. Managing water resources sustainably and strengthening resilience to water threats provides an overview of why action is required to ensure water security.** The discussion illustrates the growing water stress, the high pollution levels, degrading ecosystems, and mounting water-related risks and discusses the actions needed to tackle these challenges.
- **Pillar II. Improving the inclusivity, sustainability and efficiency of water services provides an overview of recommended actions to improve delivery of water services.** The discussion covers water supply services for urban and rural areas, sanitation, drainage and wastewater management, and agricultural water usage.
- **Pillar III. Strengthening governance and institutions for sustainable and efficient water management provides an overview of how water governance can be improved to support reduction of water threats and improvement in water services provision.** It discusses the cross-cutting issues of strengthening the governance framework, reinforcing institutions and developing capacity, and improving the efficiency of public expenditure.

Figure 1: Structure of the report



Finally, the legal and regulatory opportunities to implement recommended actions are presented, as—at the time of writing—there are a number of implementing regulations that are being revised or are planned to be revised in the near future as a result of the promulgation of the 2019 Water Law and the 2020 Omnibus Law.

This Policy Note highlights priority areas for investment and ways to improve investment effectiveness but does not look at specific investment programs.

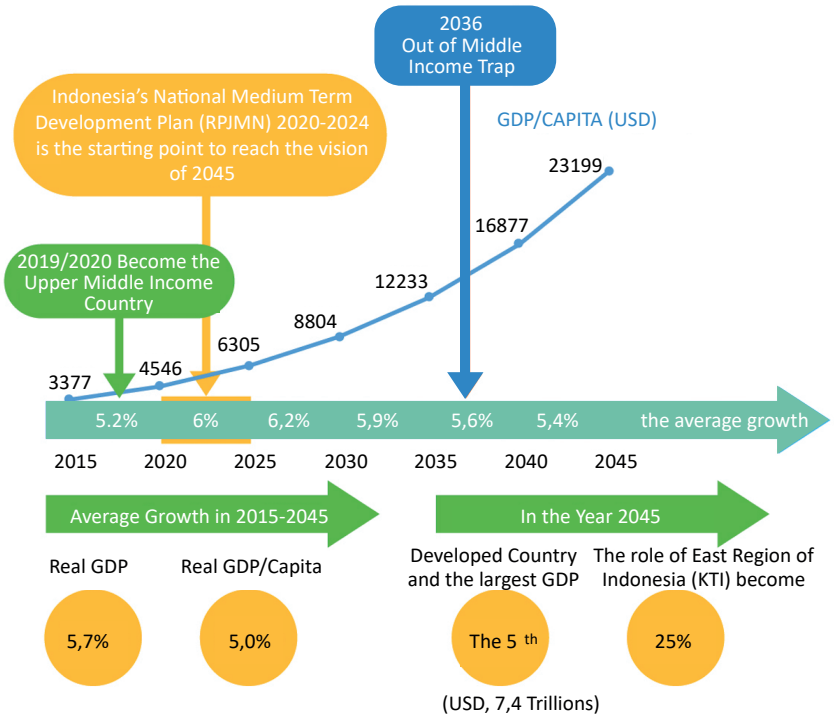
Acting on water security is key to realizing Indonesia's Vision 2045

The development of water resources and services has been a principal driver of the sustained growth in gross domestic product (GDP) and per capita incomes in Indonesia. Indonesia has drastically reduced the

proportion of people living below the international poverty line (US$1.90 per day) from 57 percent in 1990 to 6.5 percent in 2016.[2] Challenges remain in rural areas: the percentage of people below the national poverty line in rural areas—around 13 percent—is nearly double the percentage of those in urban areas—around 7 percent—in 2020.[3] Today 9 out of 10 Indonesians have access to improved water and two-thirds have access to improved sanitation. A productive agricultural sector meets food security needs and sustains livelihoods for one-third of the population. Water drives industry, and clean hydropower contributes 7 percent of the nation's electricity.

Indonesia's economic goal is to be ranked among the world's top five economies by 2045. Between 2015 and 2045, Indonesia's 'Vision 2045' assumes an average real GDP growth rate of 5.7 percent each year, with a 5 percent average growth rate in GDP per capita (Figure 2). Vision 2045 aims to enhance water security to ensure access to safe water and sanitation for all; to drive the economy; and to reach targets for sustainability, biodiversity, and food and energy security. The vision is ambitious, calling for agricultural productivity to increase more than fourfold over 2015 levels and renewable energy capacity to increase sixfold, among other targets.

Figure 2: Targets of Vision 2045



Source: Narrative RPJMN 2020–2024.

Water sector challenges and risks have to be addressed for Indonesia to achieve the targets of Vision 2045. Piped water supply reaches only one-third of the urban population and less than one-tenth of rural households. Citywide sewerage systems exist in only 13 cities and just 7.4 percent of urban wastewater is treated and disposed of properly. Incomes in smallholder agriculture are falling far behind urban incomes and the development of plantations in lowland areas has caused huge environmental problems and its sustainability is doubtful. Despite apparent abundance, water resources are becoming scarce in key urban locations, particularly in the dry season. Wastage, pollution, and uncoordinated development are exacerbating water stress in river and groundwater basins of high economic importance. The overuse of groundwater is causing rapid depletion of aquifers and shortages in water supply, and the consequent land subsidence is rendering large areas vulnerable to flooding. The capital of Jakarta epitomizes the challenges Indonesia is facing (**Box 1**).

2 https://www.bps.go.id/dynamictable/2018/08/07/1549/proporsi-penduduk-yang-hidup-di-bawah-garis-kemiskinan-internasional-1-90-usd-per-hari-1990-2016.html

The proportion of people living below the international poverty line was 39 percent in 2000 and 15.7 percent in 2010.

3 Measured as 'Percentage of Poor People', which is defined as people's average monthly expenditure per capita below the national poverty line. The Indonesian poverty line differs across provinces; the national average is around US$1 per capita per day. https://www.bps.go.id/indicator/23/192/1/percentage-of-poor-people-by-province.html

BOX 1: Indonesia's water challenges agglomerated in the microcosm of metropolitan Jakarta (Jabodetabek)

The case of metropolitan Jakarta (Jabodetabek) is a microcosm of the interconnected water security issues explored in this report. The population of Jabodetabek, estimated to be 33.5 million in 2018, has doubled in the last 20 years. Since 1992, its land cover has expanded by 28 percent and today spans across multiple districts and river basins. Due to institutional capacity constraints, however, rising demand for water resources has not been met by adequate expansion of water supply and sanitation infrastructure networks (current deficit of 22 m^3/sec for Jabodetabek) (BAPPENAS 2020). This lack of water service delivery has brought with it a set of direct and indirect costs that threaten the resilience, inclusivity, sustainability, and efficiency of metropolitan Jakarta.

In the face of low coverage and lack of reliable water supply, for instance, many domestic and private users increasingly rely on groundwater to meet their needs. But excessive reliance on groundwater is hard to monitor and regulate and land subsidence due to groundwater overabstraction has led to increased risks of flooding. Some parts of the city lie below sea level, and up to 10 million residents are at risk of urban flooding, coastal erosion, and sealevel rise (SLR) (World Bank 2019c). Flooding in 2007 affected up to 2.6 million people and led to losses of US$900 million. Land subsidence also compromises the structural integrity of existing buildings. The risks posed by land subsidence can be capitalized into lower property values and thus affect income streams of property developers and tax revenues of local governments (Yoo and Perrings 2017). But in the absence of well-functioning markets and institutions, these externalities are not internalized.

Groundwater quality is threatened by inadequate wastewater treatment infrastructure. Around 85 percent of households use onsite wastewater disposal systems, such as septic tanks (BAPPENAS 2020). These are often substandard, giving rise to high levels of groundwater pollution among their immediate surroundings. A single wastewater treatment plant serves the city and the sewerage system reaches only 2.5 percent of households, posing a threat to the health of residents. Inequality in service delivery within the metro area means that the poorest are most vulnerable to these detrimental effects of inadequate service delivery on human capital. About 96 percent of surface water is heavily polluted by agricultural, industrial, and household waste. Contaminants have made their way into marine water bodies, threatening food supplies. (BAPPENAS 2020). These hazards to the environment and human capital threaten the productivity of affected residents and the firms that hire them.

Acting on these threats is complicated by the fact that the risks are often cross-cutting. Addressing them will require significant financing. The investment costs for planned sewerage systems are expected to be US$6.5 billion. Efficient coordination and planning is constrained by jurisdictional boundaries: sectoral, functional, or spatial (BAPPENAS 2020). Coordination between the public and private sectors will be needed to fill demand-supply gaps while ensuring that uncoordinated and decentralized use of the resource does not give rise to large negative externalities and indirect costs.

The need to act upon cross-cutting threats through an integrated water management approach is required not only in Jakarta but in Indonesia as a whole if Vision 2045 is to be achieved. These areas are highlighted across the Policy Note.

If there is no action on water-related threats, GDP is likely to be 7.3 percent lower by 2045 in the high-impact scenario and it will prove more challenging for Indonesia to meet the targets of Vision 2045. The CGE analysis carried out as a complement to this report (see above) assesses the impact on GDP for five selected water-related threats. These include (a) water pollution from inadequate water, sanitation, and hygiene (WASH) coverage; (b) effects from sealevel rise (SLR) and land subsidence on coastal flooding; (c) impacts of subsidence caused by groundwater overabstraction; (d) impact of land degradation and climate change on inland flooding; and (e) impact of water shortages (Figure 3). To provide a more differentiated analysis, a low-impact scenario and a high-impact scenario were assessed. The low-impact scenario contains more conservative estimates for each specific threat, while the high-impact scenario offers more aggressive estimates. While the low-impact scenario has a greater likelihood of occurring, the high-impact scenario requires attention to allow policy makers to arbitrate chosen measures with potential future impacts. Climate change is captured in the modelling through several different scenarios that focus on the degree of SLR, the magnitude of floods, the extent of seasonal water shortages, and the extent to which insufficient reservoir storage exists. Two different future climate change projections were used to assess the sensitivity of water sector outcomes in Indonesia: a 'wet' and a 'dry' future scenario. These were selected from a set of 43 emissions-climate model combination in the Coupled Model Inter-comparison Project Phase 5 (CMIP5) ensemble of general circulation models (GCMs) employed in the Intergovernmental Panel on Climate Change *(IPCC)* Fifth Assessment Report. The largest negative effects would be from shocks to water availability *(a 2.5 percent reduction in GDP by 2045)* as well as from coastal flooding and due to SLR and land subsidence *(a 2.4 percent reduction)*. More detail on the economic impact of water threats

and of potential benefits from inaction is presented in the INSIGHT boxes in the respective sections of this note, while more information on the methodology, data sources, and assumptions can be found in the underlying report titled "*Indonesia Toward Water Security – Diagnostic Report*".

Threats to water security are avoidable if decisive actions are taken and can support the achievement of Vision 2045. If Indonesia can avoid these negative effects and act to improve water sector outcomes, the negative impact of reducing 7.3 percent of GDP by 2045 can be buffered. By taking the assessed actions alone, a up to 3.2 percent increase in 2045 GDP can be achieved, a significant buffer to soften the negative impacts from water threats and a boost toward Vision 2045 targets. Analyzed actions include (a) full WASH coverage, (b) groundwater abstractions limited to safe yields, (c) reduced deforestation rates, and (d) construction of 50 BCM water storage nationwide. The greatest benefits would come from providing full water and sanitation coverage *(1.2 percent increase to 2045 GDP)* and from increased water storage *(1.1 percent increase to 2045 GDP)*. Note that the scope of the CGE analysis only included considering actions for four out of the five threats due to modelling and time constraints.

Figure 3: Impact on GDP from action versus inacton on water-related threats by 2030 and 2045

Source: World Bank 2020b.

Note: The combined impact of threats considers all threats jointly and thus differs from the addition of all individual threats, due to interactions of threats on the overall impact. Threats from inadequate WASH are likely to be much higher. The threat of pollution from inadequate WASH only considers a loss in fishing productivity in case of inaction as business as usual (BAU) is assumed for the percentage of the population with WASH access to remain the same until 2045. Benefits to WASH consider health care costs, labor productivity, energy savings, and fishing productivity (see Box 14).

The Strategic Direction for Water Resources Management (*Kebijakan Nasional Dewan Sumber Daya Air*, JAKNAS SDA) 2011–2030[4] guides national policies on water resources. It was developed and is reviewed by the National Water Council every five years. The JAKNAS serves as a (a) reference to ministers and heads of non-ministerial government agencies in sectoral policies related to the water resources, (b) reference to the provincial government to formulate water resources management policies, and (c) guidance to draft Strategic Water Resource Management Plans (*Pola Atau Rencana Strategis*, *pola*) for national strategic river basins and transboundary rivers. The JAKNAS SDA 2011–2030 also includes indicators and targets. The water security index, forming part of these targets, is currently being developed by the National Water Council.

Early action is needed, beginning with National Mid-Term Development Plan (Rencana Pembangunan Jangka Menengah Nasional or RPJMN) 2020–2024. Vision 2045 is supported by the Long-Term National Development Plan 2005–2025 (*Rencana Pembangunan Jangka Panjang Nasional or* RPJPN), which is to be implemented through four five-year RPJMN. In line with these plans, the President shared his vision for "a developed sovereign, independent and characteristic Indonesia following the principle of 'gotong royong'"[5] to be achieved through nine missions for 2020–2024, which also target the sustainable, efficient, and equitable development of water resources and services and managing the emerging risks. This Policy Note aims to support the implementation of RPJMN 2020–2024 to accelerate the realization of Vision 2045.

Box 2: Water security, fragility, and conflict

Water insecurity can cause severe disruptions and compound fragilities in social, economic, and environmental systems. Fragility and conflict can increase in areas in which there is a (perceived) failure of (a) providing citizens with basic water services, (b) protecting citizens against water-related disasters, and (c) preserving surface, ground, and transboundary water resources. It was found that in Indonesia greater investments in disaster risk reduction have taken place in the wealthier and more politically represented regions of Western Sumatra and Central Java (Williams 2011). This may be perceived as regions getting preferential treatment (World Bank 2017). On the other hand, evidence suggests that carefully designed investments in water security can contribute to increasing stability and preventing fragility (World Bank 2017).

Considering this vicious circle is of particular importance in regions that have experienced fragility and conflict in the past, such as some areas of Maluku Islands, Sumatra (Aceh), Papua (West Papua), North Kalimantan (City of Tarakan), Central Kalimantan (Sampit district), and Central Sulawesi (Poso district). Further, given the economic impact of the COVID-19 pandemic and an expected increase in poverty, some regions may now be more prone to fragility and conflict—making water security concerns ever more important.

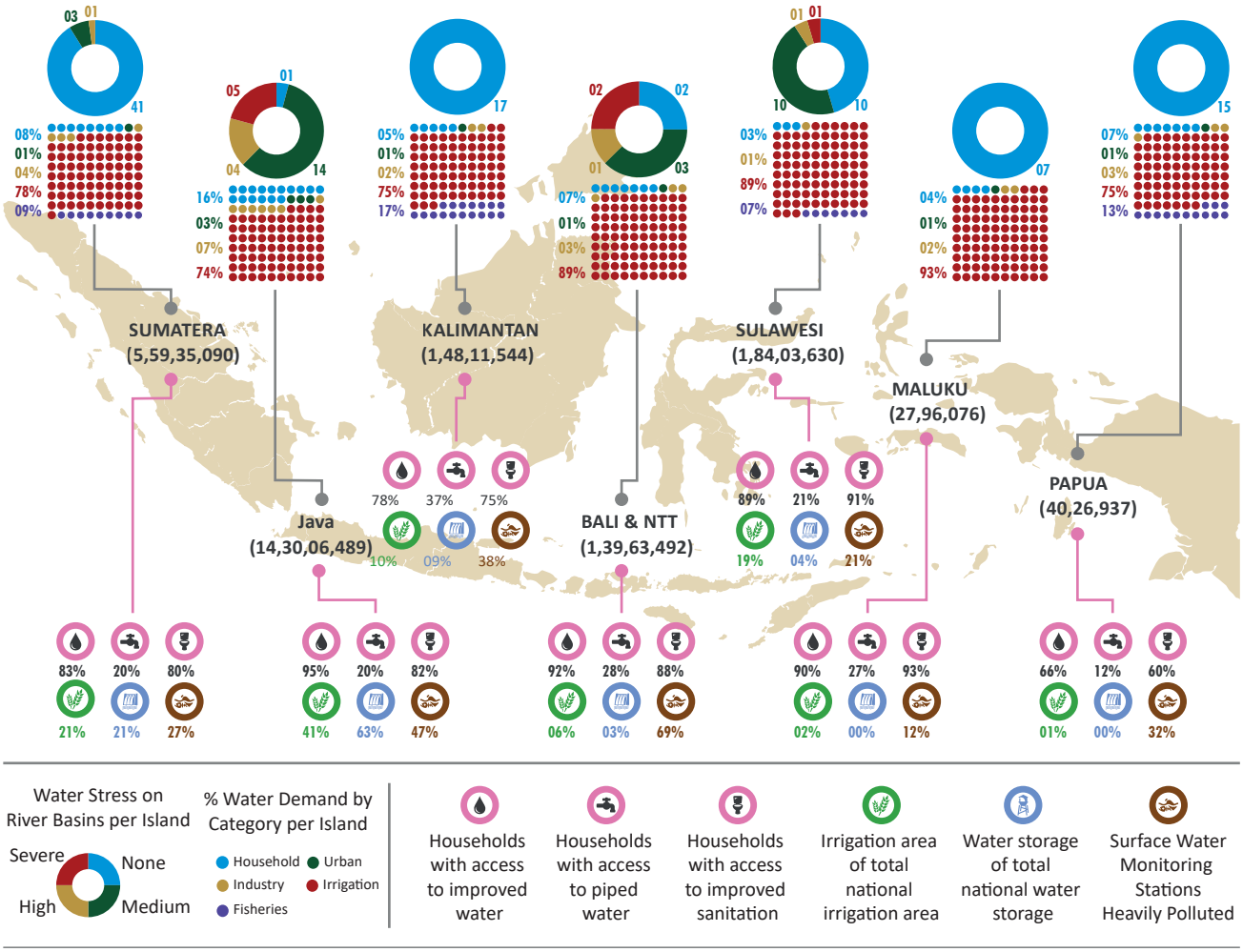
Indonesia comprises a vast archipelago with five main islands, two major groups, and 60 smaller island groups—with water challenges varying across regions.[6] It has 8,000 watersheds and over 5,700 rivers grouped into 128 main river basins and 421 groundwater basins—an extraordinary water management challenge that requires a complicated set of considerations to find the right response. Figure 4 illustrates how Indonesia's island groups face different water challenges. Water stress is only a challenge for the island groups of Java, Bali and East Nusa Tenggara *(Nusa Tenggara Timur or NTT)*, and Sulawesi. Papua, Kalimantan, and Sumatra on the other hand struggle more with access to WASH services. While all island groups face heavily polluted surface water, Java, Bali and NTT, and Kalimantan are most affected. The majority of national rice production comes from the two island groups which have the largest water storage available—Java and Sumatra. Java, as mentioned above, is also the most water stressed island group.

4 Enforced with Government Regulation No. 33/2011.

5 'Gotong royong' is a core Indonesian tenet and can be best translated as 'cooperation among many people to attain a shared goal'.

6 The five main islands include Sumatra, Java, Kalimantan, Sulawesi, and New Guinea (Papua). The two major island groups are Nusa Tenggara and the Maluku Islands.

Figure 4: Overview of water challenges across Indonesia



Source: Findings of this study

The challenges have been sharpened by the COVID-19 pandemic. The repercussions of the pandemic are putting pressure on the economy, increasing concerns about food security, and underlining the central importance of clean water and a well-conserved ecology for both a healthy population and a thriving and sustainable economy. As a result, the achievements of infrastructure development targets are delayed.[7]

Box 3: Water-related government response to COVID-19

The GoI has taken numerous measures in response to COVID-19, with an estimated budget of IDR 36.19 trillion for MoPWH alone. Three categories of measures are of particular importance to the water sector and are implemented through the *Acceleration of Labour Intensive Programs*, (a) Improvement of Tertiary Irrigation Canal Construction Work (Program Percepatan Peningkatan Tata Guna Air Irigasi or P3TGAI); and (b) Provision of community-based water supply and sanitation systems (*Penyediaan Air Minum dan Sanitasi Berbasis Masyarakat*, PAMSIMAS); and (c) community-based sanitation (decentralized wastewater treatment systems, *Program Sanitasi Berbasis Masyarakat*, SANIMAS).

The original budget for *Labour Intensive Programs* in 2020 has been increased from IDR 3.8 trillion (614,480 beneficiaries) by an additional IDR 791 billion to provide more 'cash for work (Padat Karya Tunai/PKT)' to around 80,888 people in need.

7 Stakeholder consultation with Directorate System & Strategy of Water Resources Management (MoPWH) on 26 November 2020.

Around 1 percent (IDR 372 billion) of the total MoPWH COVID-19 response budget is allocated to P3TGAI. Farmers and local residents receive a wage to support the improvement of the tertiary irrigation infrastructure. A total of 4,023 irrigation areas across 34 provinces are part of this program and will support around 6,000 beneficiaries.

Only around 0.06 percent (IDR 23.2 billion) of the total MoPWH COVID-19 response budget is allocated to the provision of PAMSIMAS. The funds will be used by around 4,806 villages (around 48,060 beneficiaries) to purchase masks and to construct additional handwashing facilities in construction sites and public places.

Around 1.1 percent (IDR 396 billion) of the total MoPWH COVID-19 response budget is allocated to accelerate SANIMAS. Measures to improve infrastructure for bathing, washing, and latrines and communal wastewater treatment plants shall benefit around 15,705 people.

Brief overview of Indonesia's water governance

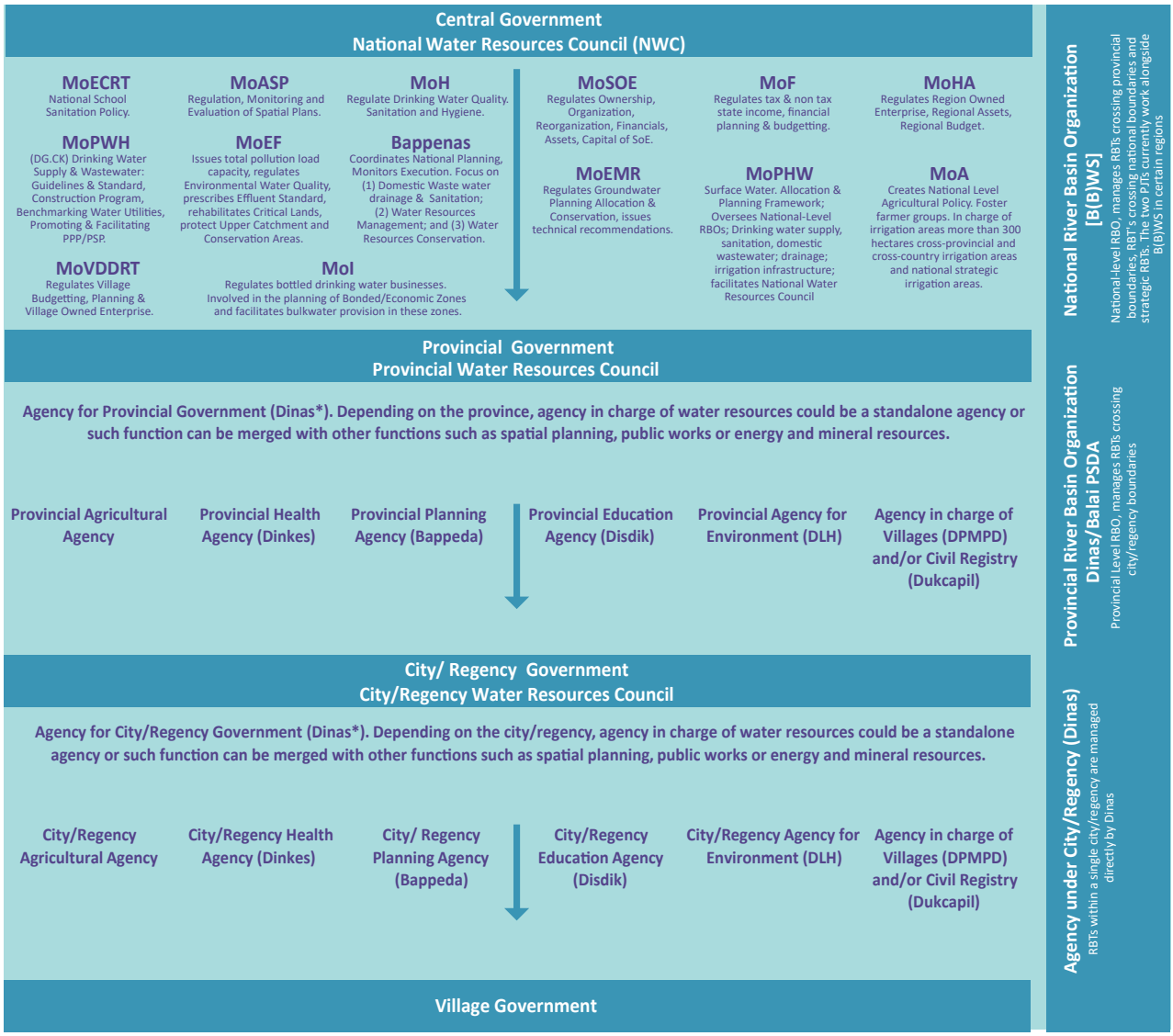
Indonesia is a decentralized, unitary republic divided into five layers of government: central, provinces, regency (kabupaten) and city (kota), districts (kecamatan), and subdistrict/villages (kelurahan/desa). In 2000, wide-ranging decentralization programs and reforms were adopted and replaced the previous system of centralized government. Before the reform, subnational governments mainly functioned as implementing agencies of national policies and programs. Now, responsibilities in the areas of public works, health, environment, agriculture, manufacturing, and other sectors are transferred to provinces, regencies, and cities, and the central government provides monitoring, evaluation, and guidance on national priorities. District-level mandates and minimum targets for basic services, including drinking and wastewater, are stipulated in the national Local Government Law (23/2014).

In Indonesia, responsibility for water is divided horizontally among multiple sectoral ministries and their local branches (Figure 5). The key ministries responsible for water are the following:

- **State Ministry of National Development (BAPPENAS).** It is responsible for national development planning through five-year plans (RPJMN) in cooperation with line ministries. It is further responsible for ensuring the integration between RPJMN and other planning documents such as the Strategic Plans (*Rencana Strategis or RENSTRA*s) and Regional Medium-Term Development Plan (*Rencana Pembangunan Jangka Menengah Daerah*, RPJMDs) and for the implementation of RPJMN.
- **Ministry of Public Works and Housing (MoPWH).** It is responsible for water resources and river basin management, water supply and sanitation, irrigation, dam safety and standard operating agreements with, for example, hydropower developers as well as for infrastructure financing
- **Ministry of Environment and Forestry (MoEF).** It is responsible for catchment management, preparation of zoning and spatial plans for forested areas, monitoring of water quality and wastewater discharges, the issuance of permits, and enforcement of discharge standards (mainly for industrial and estate discharges). MoEF is also responsible for environmental impact assessment of major projects.
- **Ministry of Energy and Mineral Resources (MoEMR).** It is currently responsible for groundwater management and for energy policy and programs. Future responsibilities for groundwater management—as per 2019 Water Law—are yet to be determined.
- **Ministry of Home Affairs (Interior Ministry) (MoHA).** It is responsible for the domestic governance, public order, and regional development at provincial and district levels. MoHA is responsible for ensuring synchronization of RPJMN and RPJMD and other local governments' budgeting and planning documents and for monitoring the implementation of RPJMD.
- **Coordinating Ministry for Economic Affairs (CMEA).** It is chairing the of National Water Resource Council (NWC), which coordinates and synchronizes the formulation and implementation of national water resources policies. Further, it is responsible for regional development and spatial planning.

The functions of these ministries are carried out by provincial and local governments. More details can be found in Annex 2.

Figure 5: **Organizational and institutional structure of Indonesia's water sector**



Water resources are managed in 'river basin territories' (*Wilayah Sungai* or RBT) which may consist of one or several river basins or small islands. Depending on their location within administrative boundaries, different government levels are responsible for their management. Core policy and regulatory functions of the government which oversees the RBT may include policy making, issuing of licenses, enactment of *pola* and their implementation programs (Master Plan for River Management, *Rencana Induk Pengelolaan Sungai*, *rencana*), formation of coordination bodies, and enactment of water user fees. All levels of government can delegate management on 'non-core' tasks to 'water managers', which in turn can be in charge of one or more RBTs (Table 1). (Major) River Basin Organisations (Balai Besar Wilayah Sungai or B(B)WS) or Government Agencies/ Municipalities (Dinas) are usually tasked with construction, operation, maintenance, flood risk control, and issuing of 'technical recommendations' which are a prerequisite to attain licenses. Licenses, however, can only be granted by regional or national governments. B(B)WS also supports TKP-SDA in formulating *pola* and *rencana*.

Table 1: Responsible government authorities for RBTs

Area of RBT	Responsible government level	Delegated 'water managers'
RBT within one city/regency	City/regency governments	Regional agencies (Dinas)
RBT crossing city/ regency boundaries	Provincial government	Regional provincial agencies (Dinas); at the provincial level Dinas usually create a dedicated technical unit called Balai PSDA. (Pengelolaan Sumber Daya Air)

RBT crossing provincial boundaries	Central government (MoPWH)	Balai Besar Wilayah Sungai (BBWS) for large RBT or Balai Wilayah Sungai (BWS) for smaller RBT, jointly referred to as B(B)WS
Nationally strategic RBT	Central government (MoPWH)	BBWS

Two basin corporations have been formed: state-owned enterprise of Jasa Tirta I and II (*Perum Jasa Tirta*, PJT I and PJT II) with area of management on Java and Sumatra. PJT I was formed in 1986 to manage Brantas river. PJT II was established in 1967, originally as an entity that manages the Jatiluhur dam, and now is also responsible for Citarum River Basin as well as for parts of (a) Ciliwung-Cisadane, (b) Cimanuk-Cisanggarung, (c) Cidanau-Ciujung-Cidurian, and (d) Seputih-Sekampung. Both PJTs are now constituted as state-owned enterprises (SOEs) taking the form of a general purpose company (*Perusahaan Umum*) established through government regulations. The duties and functions of both PJTs are similar and include (a) development and operation and maintenance (O&M) of water infrastructure; (b) use of water resources for non-business and business needs; and (c) collection, receipt, and use of water resources management services fee (*Biaya Pengelolaan Jasa Sumber Daya Air*, BJPSDA).[8]

Water management is coordinated at the river basin level through coordination team for water resources management/CT-WRM (*Tim Koordinasi Pengelolaan Sumber Daya Air*, TKPSDA) and at the administrative level through water councils. Both the TKPSDA and the National Water Resources Council are led by a government official. The water councils consist of an equal proportion of government representatives (permanent members) and nongovernment members (non-permanent members) which are determined by the president.[9] TKPSDA is usually chaired by one of the head of regional planning agencies in the RBT and governors chair regional water councils. Both TKPSDA and councils consist of stakeholders representing respective areas of work. However, there is not much coordination with the stakeholder platforms for other sectors such as the catchment area forum and irrigation commission (Table 2).[10]

Table 2: Overview of coordinating bodies

Responsible area	Coordinating body	Tasks
RBT	TKPSDA	Formulate *pola* (strategic WRM Plan) and *rencana* (implementing WRM Plan).
Provincial and municipal (regency/city) level	Water Resources Council at the provincial/regency/city level (Dewan Sumber Daya Air Provinsi/Kabupaten/Kota)	At the provincial/regency/city levels. If not yet formed, such functions are carried out by Dinas.
National level	National Water Resources Council (*Dewan Sumber Daya Air Nasional*)	Formulate national-level policy; draft designation and redesignation of RBT; formulate policy for hydrology, hydrometeorology, and hydrological information system.

Decisions on water allocation are based on a participatory process. Water allocation plans must refer to the *pola* and *rencana*. B(B)WS prepares a draft Annual Water Allocation Plan (*Rencana Alokasi Air Tahunan*, RAAT) in cooperation with TKPSDA and submits this to the government that is responsible for the RBT. The government is responsible for enacting the RAAT. The RAAT is further detailed into an allocation plan (Detail Water Allocation Plan, *Rencana Alokasi Air Rinci*, RAAR) covering a shorter time span of 7–15 days and is operationalized by B(B)WS.

However, groundwater and water quality are managed by different authorities (Table 3). Groundwater planning and conservation is considered a 'geological affair' by the Regional Government Law and thus falls under the auspices of the Geological Agency under MoEMR for aquifers crossing provincial boundaries or the Provincial Energy and Mineral Resources Agency for aquifers within provincial boundaries. However, the 2019 Water Law has omitted this division of responsibility from the Regional Government Law and implementing

8 Government Regulation (PP) no 7/2010 about Perum Jasa Tirta (PJT).

9 As determined by a Presidential Regulation.

10 Stakeholder consultation with Directorate of Operation and Maintenance Development (MoPWH) on 26 November 2020.

regulations need to determine who is responsible for groundwater now. Water quality is managed across different levels of government and technical approvals are issued by national/provincial or regency/city governments in charge of the Environmental Impact Assessment. Although water quality regulation covers groundwater/aquifer in addition to surface water, in practice, regions often perceive that the management of groundwater quality is the responsibility of MoERM. Thus, while B(B)WS is responsible for O&M at the river basin level, legally most of the water quality issues are beyond its control, which may affect its ability to meet the targets set out in memoranda of understanding or agreements.

Table 3: Responsibilities for groundwater and water quality management

Area	Responsible government level
Groundwater	
Within provincial boundaries	Provincial Energy and Mineral Resources Agency
Across provincial boundaries	Geological Agency (MoEMS)

Licensing and tariffs are issued depending on area and type. Table 4 provides an overview of the responsibilities.

Table 4: Overview of licenses, tariffs, and responsible authorities

License	Issued By
Surface water licenses	
The RBT is exclusively within city/regency.	City/Regency government
The RBT spans across city/regency.	Provincial government
The RBT is a national strategic river. The RBT crosses provincial boundaries or the RBT crosses national border.	Central government
Groundwater licenses	Provincial energy and mineral resources agency (subject to changes with 2019 Water Law)
Technical Approvals	City/Regency/Province/Minister
Drinking water tariff	Regional heads (regents/mayor)

Water supply and sanitation services are the responsibility of city/regency governments and can be delegated to region-owned companies. In cities and regency centers, water supply is delegated to local government-owned water enterprises (*Perusahaan Daerah Air Minum*, PDAM). However, the majority of water users rely on private wells. In villages, community-based organizations sometimes operate the water supply system notably through the PAMSIMAS program. The majority of PDAMs obtain permits from BBWS to abstract raw water from surface water, or a river intake is built by BBWS. For the remaining PDAMs, raw water is supplied by PJTs or regional general service entities dedicated to bulk water supply *(Badan Layanan Umum Daerah - Sistem Penyediaan Air Minum or BLUD SPAM)*. The service area across PDAMs often overlaps. Creation of new regency through the separation of existing regencies is often followed by creation of new PDAMs. The government has encouraged the merger and 'regionalization' of PDAMs to leverage economies of scale. Due to low coverage of sewerage system, most household utilizes septic tanks. Regional agencies sometimes create a dedicated sanitation technical units (Unit Pelaksana Teknis Daerah or UPTD) which operate desludging trucks and fecal sludge treatment plants (*Instalasi Pengolahan Lumpur Tinja*, IPLT). Few regions established their own sewerage companies (*Perusahaan Daerah - Pengelolaan Air Limbah or PD-PAL)*. Small-scale sanitation systems have been built in the cities by the government and are operated by community members. Some PDAMs also provide wastewater services. The 2019 Water Law limits the granting of abstraction licenses for drinking water to state/region/village-owned enterprises. Water distribution cannot be operated by the private sector, while management of water treatment plants by the private sector is allowed (Government Regulation 122/2015). Long-term concessions have been implemented in Jakarta (1997–2023) and in Batam (1995–2020)—and remain unaffected by new rules under 2019 Water Law as the rules do not apply retroactively to older contracts. Self-sustained cities (*Kota Mandiri*) and large gated communities sometimes have their own water supply and sewerage system, often served by housing developers that are in the private sector.

There is no economic regulator for water and wastewater services. The now disbanded Agency to Support Acceleration of Drinking Water Supply Services Development (*Badan Peningkatan Penyelenggaraan Sistem Penyediaan Air Minum*, BPPSPAM - an entity under MoPWH) conducted annual performance evaluations that ranked PDAMs according to their 'health' level, but they did not function as regulator. Drinking water quality, however, is regulated by the Ministry of Health (MoH).

2

Threats, Challenges, and Actions

Pillar I. Managing water resources sustainably and strengthening resilience to water threats

To achieve Vision 2045, measures under RPJMN 2020–2024 should aim at the following:

- Optimize water usage and related development by aligning spatial planning with available resources
- Reduce groundwater overabstraction and consequent land subsidence, especially in urban and lowland areas
- Reduce the water pollution that is worsening with rapid urbanization, industrialization, and agricultural runoff
- Protect ecosystems, including watersheds and peatlands
- Improve resilience to water-related disaster risks

Action 1: Relieving the growing water stresses

Action 1 - Key takeaways

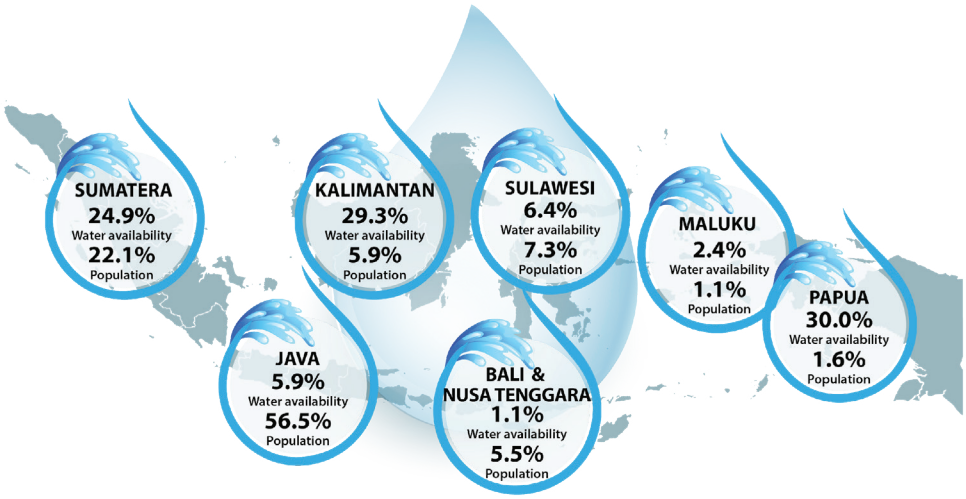
- Highly uneven distribution of water supply and demand across islands—Java has 5.9 percent of available water for 56.5 percent of the population.
- 50 percent of GDP is generated in high or severe water stress basins today (67 percent by 2045).
- Overabstraction of groundwater resulted in significant land subsidence (for Jakarta 3.5 m since 1980).
- Water productivity in Indonesia is one of the lowest in Asia (US$3.2 per m^3).
- Predicted impact on GDP in case of inaction:
  - Insufficient and inadequate water supply could **reduce GDP by as much as 2.5 percent by 2045.**
  - Inaction on curbing groundwater overabstraction is predicted to increase the impact of floods due to land subsidence and to **reduce GDP by up to 1.42 percent by 2045.**

Threats and Challenges

Water is generally abundant but demographic and economic pressures are contributing to growing stress in key economic river basins.

Overall, Indonesia appears water abundant but resources are unevenly distributed. Currently only 11 percent of available water is used to meet demand, but water is unevenly distributed across the islands and between seasons, and water shortages are beginning to threaten key economic activities concentrated in urban areas. Only around 6 percent of all available water resources are found on Java, while the island is home to 57 percent of Indonesia's population, resulting in localized water shortages (Figure 6). Also within islands, the availability of water resources varies spatially and temporally.

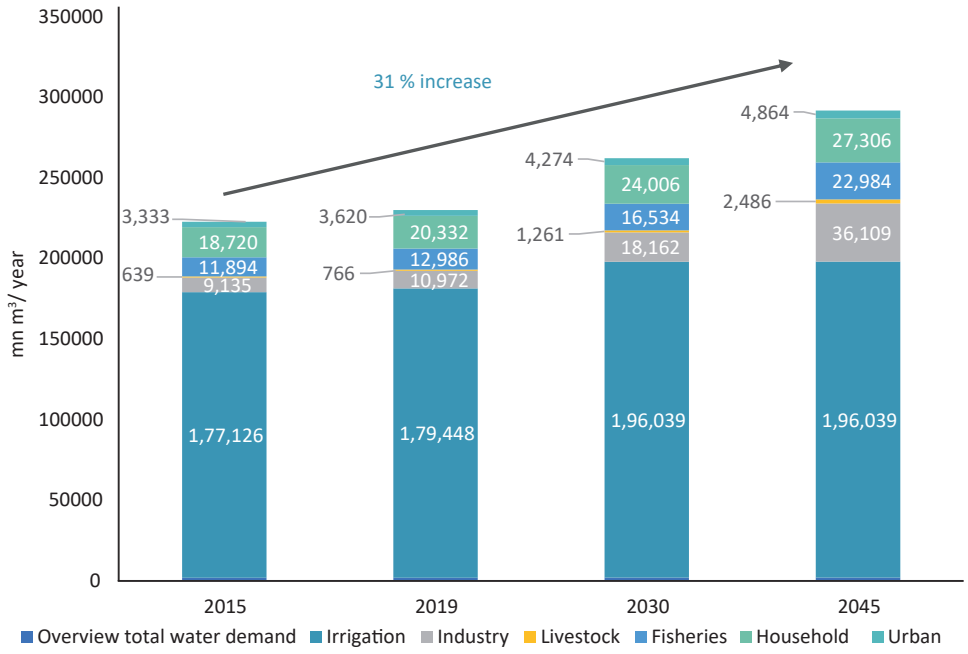
Figure 6: Spatial variability of available water and population



Source: Adjusted from PUS AIR 2016.

Water demand is continuing to rise fast under demographic and economic forces and is expected to increase by 31 percent between 2015 and 2045. Agriculture, which accounted for about 80 percent of water demand in 2019, is facing competition for water from other sectors. Between 2015 and 2045, agricultural water demand is expected to increase by only about 10 percent—from 177 billion cubic m^3 to 196 billion m^3—while industrial water demand is expected to increase fourfold, from about 9 billion m^3 in 2015 to 36 billion m^3 in 2045 (Figure 7).

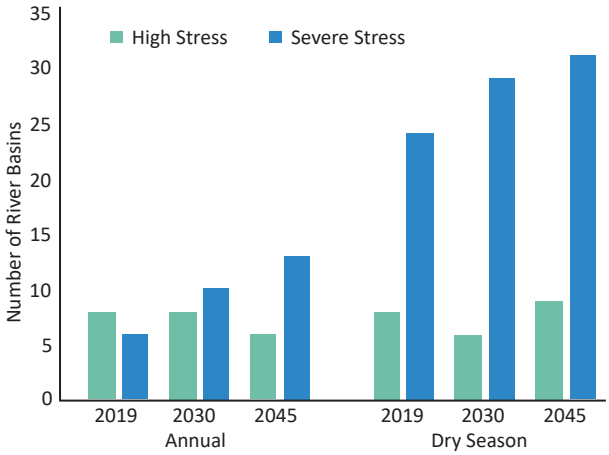
Figure 7: Annual water demand projections by sector, 2015–2045



Source: Calculations based on PUS AIR 2016, Indonesian Central Bureau of Statistics (*Badan Pusat Statistik*, BPS), and RPJMN 2020–2024.

Demand for water is concentrated in areas with relatively limited resources and many economically important river and groundwater basins are subject to water stress, particularly in the dry season (Figure 8). About 60 percent of Indonesia's GDP is generated in just 12 out of 128 river basins, 6 of which are located on Java. Of the five river basins facing an annual water supply deficit ('severe water stress'), three are located on Java, two on Bali, and one on Nusa Tenggara.[11] However, even if there is no water deficit in a river basin, it may suffer from 'water stress'. This can be captured with the Water Stress Index.

Figure 8: 'High' and 'severe' water stress across Indonesia's 128 river basins in 2019, 2030, and 2045 (annual and dry season)[12]



Source: Calculated based on PUS AIR 2016 and internal World Bank data.

Half of the country's GDP is produced in river basins that suffer 'high' and 'severe' stress in the dry season—and dry season stress is expected to increase. In the dry season, 24 out of 128 river basins are unable to meet demand, including 13 on Java (Map 1). One of these basins, Ciliwung-Cisadane, generates nearly one-quarter of national GDP (22 percent).[13] By 2045, 67 percent of GDP is predicted to be generated in 'highly' and 'severely' water stressed basins (Map 2). It is crucial to align development and spatial plans to optimally use the available water resources to avoid water stress. Investments in regions should be directed to areas that are relatively more water secure, following Singapore's example of locating industrial activity in Changi and Jurong.

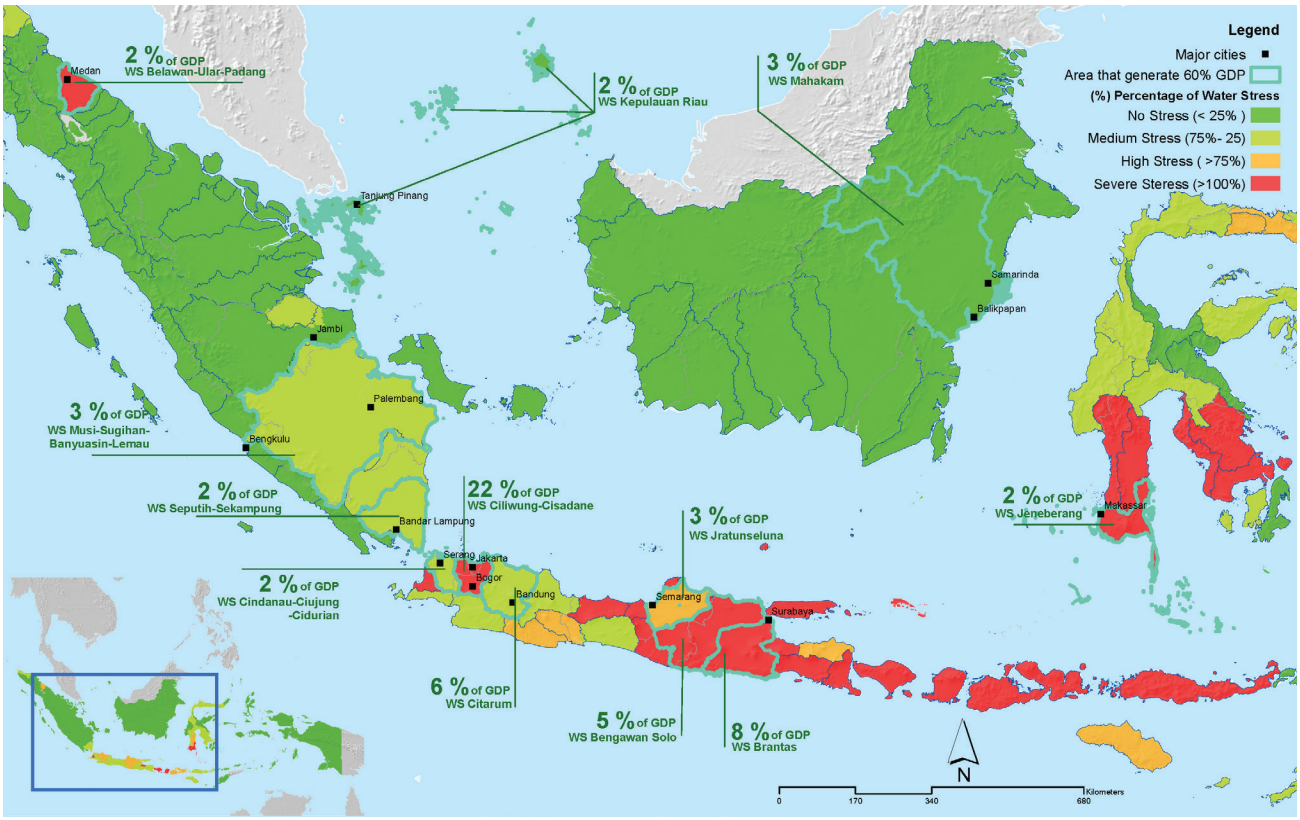
By 2045, water shortages are predicted to reduce GDP by up to 2.5 percent annually. The CGE analysis conducted complementary to this study found that if no action is taken to prevent water shortages, the cost of replacing this required water for agriculture, industry, households, and urban areas would amount to up to 2.5 percent of GDP in 2045 (Box 4).

11 *Note:* Water stress is measured following the methodology suggested for Sustainable Development Goal (SDG) Indicator 6.4.2 "By 2030, ensure sustainable withdrawals and supply of freshwater to address water scarcity." More specifically, it is the ratio between total freshwater withdrawn (TFWW) by all economic sectors divided by the difference between the total renewable freshwater resources (TRWR) and the environmental flow rate (EFR). TRWR is the long-term average annual flow of rivers and recharge of groundwater measured as a volumetric unit (km/year) and considering any overlap between them. Water stress (%) is estimated as TFWW divided by TRWR less than EFR. Threshold values are as follows: <25 percent - no water stress; 25–75 percent - medium stress; >75 percent - high stress; >100 percent - severe stress. Note that 'severe stress' is not part of the SDG thresholds but was added for this analysis. It occurs when the water balance turns negative, that is, all available freshwater resources are withdrawn/overabstracted and show an annual dry season 'water supply deficit' (FAO 2019). The analysis does not consider inter-basin water transfers.

12 Please see definition of water stress in previous footnote.

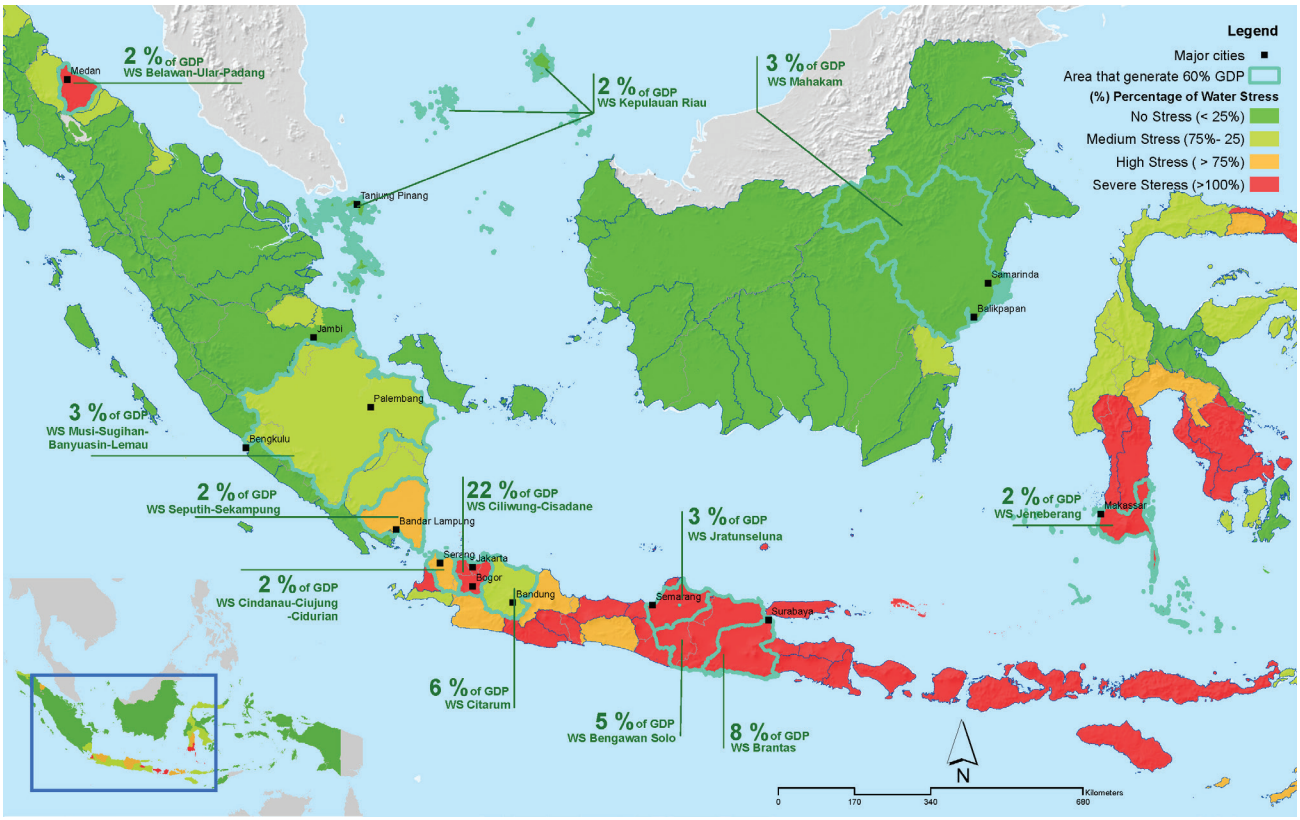
13 Note that while DKI Jakarta is located in *Wilayah Sungai* Ciliwung-Cisadane, Jakarta receives most of its water from *Wilayah Sungai* Citarum.

Map 1: Indonesia's dry season water stress in relation to river basins generating 60% of GDP (2019)



Source: Amended from PUS AIR 2016, BPS, RPJMN 2020–2024, and internal World Bank data.
Note: Water stress is estimated for 2019, while GDP is based on 2018 values.

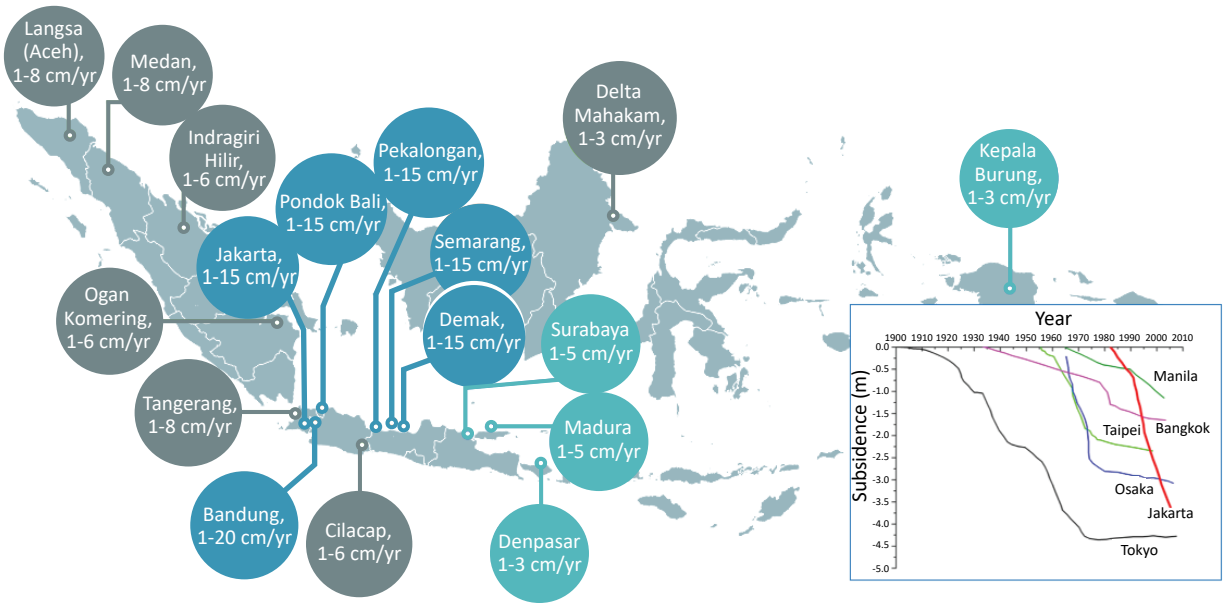
Map 2: Indonesia's dry season water stress in relation to river basins generating 60% of GDP (2045)



Source: Amended from PUS AIR 2016, BPS, RPJMN 2020–2024, and internal World Bank data.
Note: Water stress is estimated for 2045, while GDP is based on 2018 values.

If left unaddressed, the effects from groundwater overabstraction,[14] largely for domestic, commercial, and industrial water supply, are predicted to reduce GDP by up to 1.42 percent by 2045. On the other hand, action to reduce groundwater abstractions to sustainable yield is predicted to increase GDP by up to 1.32 percent by 2045. Overabstraction of groundwater is leading to aquifer depletion, land subsidence, and seawater intrusion and has increased the exposure of sunken lands to flooding particularly in urban centers across Indonesia. The main users are industries, commercial establishments, and households that have drilled their own wells. In 2019, 46 percent of all domestic water came from groundwater (RPJMN 2020–2024). The absence of access to reliable piped water supply is a major cause of overabstraction, as users without piped access resort to unregulated groundwater abstraction. The most rapid land subsidence rates, between 1 and 20 cm per year, are found on Java (Figure 9). Jakarta has high land subsidence rates and they are increasing year on year, putting the city among the major cities worldwide that have made headlines as 'sinking cities' (Figure 9, right). Jakarta already lies significantly below sea level and land subsidence is increasingly exposing it to high coastal and inland flood risks, even without considering SLR. Box 4 highlights the likely economic impacts for Indonesia of land subsidence driven by groundwater overextraction that may be expected by 2030 and 2045 if no action is taken—and the benefits if action is taken. In areas where surface water is also scarce, the reallocation of water resources to higher-value uses may be required.

Figure 9: Comparative land subsidence rates across Indonesia (cm/year) and Asian megacities



Sources

- Land subsidence rates in Asian megacities (bottom right): Kaneko and Toyota 2011 and Takagi et al. 2016.
- Land subsidence rates across Indonesia: Andreas et al. 2018.

Box 4: INSIGHT 1: The economic impact of land subsidence driven by groundwater overabstraction on GDP by 2030 and 2045

Inaction is predicted to reduce GDP by up to 1.42 percent by 2045.

Limiting groundwater abstraction to sustainable yields can increase GDP by up to 1.32 percent by 2045.

With nearly 50 percent of domestic water demand met with groundwater in addition to industrial and commercial water demand, overabstraction is a predominant challenge for urban areas. The overabstraction results in increasing pumping costs and declining quantity and quality and in land subsidence, which in turn aggravates floods. Furthermore, falling groundwater levels also result in unmet water demands if groundwater becomes either physically or economically infeasible to pump.

The analysis considered two scenarios for 2030 and 2045, under three climate change scenarios:

a. **Business as usual (BAU)**, in which water demands on threatened aquifers continue to rise due to population growth and urbanization

14 Groundwater also includes springs.

and surface water supply coverage continues to decline. As a result, the recent trend in land subsidence continues. This scenario is analyzed for both **moderate** and **high** land subsidence sub-scenarios as well as for **no climate change** and **wet** and **dry** climate change sub-scenarios.

b. **Reduced groundwater pumping to safe yields** such that subsidence no longer occurs. Under this scenario, surface water supply coverage increases considerably. This scenario is also analyzed for both **moderate** and **high** land subsidence and **no climate change** and **wet** and **dry** climate change sub-scenarios.

The analysis considers the costs of flooding and inundation in case of inaction and the costs of alternative water supplies—in this case desalination—in case of action.

Table 5 presents the impacts of subsidence on GDP by year and for various subsidence and climate change scenarios, which represent both the costs of inaction and the benefits of action. The table also presents the costs of action, which are the impacts of desalination investments on GDP, broken down by subsidence and climate change scenarios, sector, and year. The total costs of subsidence reach 1.42 percent of GDP by 2045 under a dry future, whereas the costs of moving to desalination in this scenario reach a maximum of 0.85 percent of GDP. All benefit-cost (B-C) ratios except the dry 2045 scenario are greater than 2, suggesting these investments to substitute groundwater with desalinated water are worthwhile from a macroeconomic perspective.

On the flipside, the benefits of limiting groundwater abstraction to sustainable yields can result in an increase of GDP by up to 1.32 percent by 2045 (calculated as subsidence impacts minus the water supply costs).

This provides a conservative estimate as cheaper water supply options, such as storage or water demand reduction measures, are likely to be available and thus making investments in alternative water supply options to groundwater even more economically beneficial.

Table 5: Scenario analysis on the economic impact (% of GDP) of land subsidence driven by groundwater overabstraction—and actions—by 2045

Subsidence scenario	Climate scenario	Subsidence impacts (%)	Water supply costs (%)	B-C ratio
		2045	2045	2045
Low	Dry	–1.42	–0.85	1.67
	Wet	–0.85	–0.35	2.43
High	Dry	–1.42	–0.85	1.67
	Wet	–1.11	–0.35	3.17

Source: World Bank 2020b.

Note: As this is a high-level analysis, the number of people affected by inundation due to SLR is based on the census and not on physical observation data, such as remote sensing. Thus, it assumes an equal distribution of people within a district. Further, it is assumed that land subsidence occurs uniformly across an administrative region, while in practice localized subsidence is observed. Further, environmental impacts from desalination need to be considered. Additional analysis would be required to estimate localized impacts.

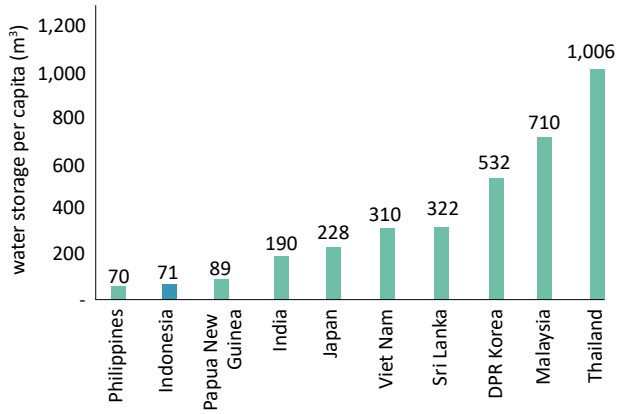
More information and additional scenarios are presented in the underlying report *"Indonesia Toward Water Security – Diagnostic Report"*

Indonesia mostly depends on surface water resources for formal water supply delivery, yet water storage capacity is low and insufficiently managed. Surface water contributes 92 percent of total raw water for treatment but seasonal and spatial variability in surface water flows together with basin characteristics (steep terrain and short run to the sea) contribute to supply-demand gaps. If water demand reduction measures fail to close the gap, it may indicate the need for water supply augmentation solutions, such as storage. However, storage is currently limited—just 1 percent of total available water resources, equivalent to 71 m^3 per capita, compared to 310 m^3 in Vietnam and more than 1,000 m^3 in Thailand (Figure 10).[15] In comparison with countries with similar seasonal variability, Japan and Malaysia have higher storage rates per mean annual flow (Figure 11).[16] However, even the limited storage is not managed to reach its full potential. Inadequate O&M for dams and inadequate upstream catchment management result in the sedimentation of dams, reducing their water storage potential.

15 PUS AIR 2016. Assuming 2020 population of 270 million people.

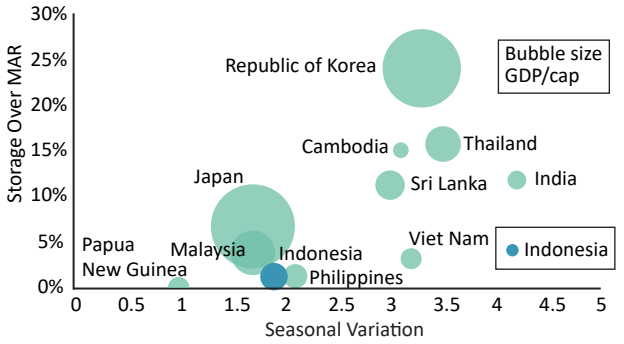
16 This would bring Indonesia to a similar per capita storage of Japan (228 m^3 per capita), which faces similar seasonal water variability, but is still quite far behind its neighbor Malaysia (710 m^3 per capita). Assuming 2020 population of 270 million people in Indonesia and 71m^3 per capita.

Figure 10: Storage capacity per capita in m3



Source: FAO Aquastat, latest available data; Indonesia: own calculations based on Directorate of Dams and Lakes and Directorate of O&M, MoPWH.

Figure 11: Relationship between seasonal inflow coefficient of variation and storage over mean annual runoff



Source: World Bank 2020b.

Indonesia's long-term development plan targets a large increase in per capita storage from targeted levels of 86 m³ per capita by 2024 to nearly 2,000 m³, more than 20 times the 2024 levels. Although such a large increase must be for the long term, an increase in storage capacity of just 25 billion m³—nearly 30 percent more than current capacity and around 155 m³ per capita—would be enough to eliminate the negative impact of water shortages on GDP in 2045 without climate change or in the wet climate change scenario. An increase of 50 BCM from the current 19 BCM—a near 160 percent and around 250 m³ per capita—could eliminate negative impacts of water storage even in the dry climate change scenario (Box 5).[17] In RPJMN 2020–2024, the GoI has planned to build 52 new reservoirs[18] to hold a further 5.2 BCM. While this would add more than one-quarter to current capacity (27 percent), it would only increase storage capacity per capita to around 86 m³—still far below the international comparators and the target of 1,975 m³ per capita outlined in the 2005–2025 long-term development plan.[19] The potential construction of storage—considering socioeconomic and environmental factors—would need to be assessed on a case-by-case basis and by considering an integrated framework that also addresses water demand management. Currently, there is no agreement on whether ponds, lakes, and aquifers are included in the definition of 'water storage'.[20] However, managed groundwater recharge is an option that can be explored particularly for over-abstracted aquifers in areas with high groundwater demand.

Some of Indonesia's key lakes—critical for water storage and usage, inland fisheries, and tourism—are severely degraded and polluted. There are over 500 major freshwater lakes in Indonesia. Poor lake management, such as with Indonesia's largest lake, Lake Toba, has a significant impact on the people and the wider economy. Key threats include aquaculture production beyond the carrying capacity of the lakes and discharge of untreated domestic and industrial wastewater, and loss of the catchment area due to land use changes. Currently, there is still quite a low awareness around lake ecosystem functioning—which is required to tailor lake restoration and management plans. While lakes are included in River Basin Management Plans, their scale is insufficient to manage lakes sustainably. Lake Management Plans, and specific studies on zoning around lakes, are not yet completed. The standard methodology for calculating the assimilative capacity for lakes and dams have been determined[21],

17 Current water storage is concentrated on the two main islands—Java (66 percent of total storage nationwide) and Sumatra (23 percent). There are low levels of storage on Kalimantan (7 percent), Sulawesi (3 percent), Bali and Nusa Tenggara (2 percent), and Maluku (0.03 percent). Papua Island has no storage. Source: Directorate of Dams and Lakes and Directorate of O&M, MoPWH.

18 Originally RPJMN 2020–2024 had planned for 65 new dams, holding an additional 8.2 billion m3. However, as four dams were 'socially rejected' only 61 will be constructed. Stakeholder consultation with Directorate of Dams and Lakes (MoPWH) on 16 Sept 2020.

19 PUS AIR 2016. Assuming 2019 population of 270 million people. World Bank data.

20 Stakeholder consultation with Directorate of Forestry and Conservation of Water Resources (BAPPENAS) on October 12, 2020.

21 Peraturan Menteri Negara Lingkungan Hidup Nomor 28 Tahun 2009 Tentang Daya Tampung Beban Pencemaran Air Danau Dan/Atau Waduk

however, the regulation does not require historical assessment of water quality in lakes nor encourages the understanding on the functioning of each lake systems. While Government Regulation 22/2021 prescribes the quality parameters for lakes, however, it is considered too detailed to be implemented.[22] It is suggested that several basic index parameter for lakes should be introduced instead.[23] Further, since the utilization of lakes preceded the plans, it may be challenging to change water and land uses to move toward sustainable lake management.[24]

Hydropower contributes only 6 percent of Indonesia's electricity generation while only 8 percent of the country's hydropower potential has been developed.[25] Indonesia primarily uses coal (63 percent) and natural gas (21 percent) for electricity generation.[26] The GoI has set a visionary target of 23 percent of renewable energy in the national energy mix by 2025, rising to 31 percent by 2050 (Hydropower Sustainability 2018, World Bank 2019q). This target is to be partly met by increased hydropower development. The 2011 Hydropower Master Plan programmed 89 new sites for 13 GW. Between 2019 and 2025, it is estimated that hydropower capacity will increase from 5.9 GW in 2019 to 7.9 GW in 2025.[27] This amounts to nearly doubling hydropower capacity between 2000 and 2025 (IEA 2020b). Until 2021, the focus will be on completing outstanding dams from the 61 dam target of the previous RPJMN 2015–2019. The current RPJMN 2020–2024 programs the construction of 18 additional multipurpose dams (including hydropower) and The National Electricity Development Plan 2019–2038 (Rencana Umum Ketenagalistrikan Nasional, RUKN) includes policy directives to develop attractive investment schemes, with competitive pricing for renewable energy to reach the targets set by the National Energy Policy (GR 79/2014). However, the 2019-2028 Electricity Provision Plan (RUPTL) requires the State Electricity Company to prioritize the development of renewable energy, alongside mine-mouth coal, gas, as well as wellhead power plants.[28] According to the RUPTL, mine mouth coal plants will still dominate the type of plant to be built (48 percent). Mine-mouth coal plants will increase water demand to the existing river basin and caution needs to be exercised with respect to water abstraction, possible thermal water pollution and the quality of wastewater discharge. Sufficient measures need to be in place so that coal ash ponds in those installations will not contaminate water sources.

Yet—before moving to water storage solutions to address water stress, there is significant potential to increase Indonesia's water productivity (US$/m^3), which is currently one of the lowest in Asia. At only around US$3.2 for each cubic meter of water withdrawn, Indonesia falls behind countries with comparable GDP and agricultural water usage, such as Cambodia (US$8.3 per m^3) or Thailand (US$6.9 per m^3) (Figure 12). As Vision 2045 targets to bring Indonesia among the top five economies, 'more dollars per drop' need to be generated. Japan and China, currently among the top five economies globally, generate US$50.6 per m^3 and US$18.2 per m^3, respectively. When compared to Indonesia, this presents an increase by around 1,500 percent for Japan and around 470 percent for China. As Indonesia uses 80 percent of its water withdrawals for agriculture, quick wins may be identified in improving irrigation efficiency and crop choices (see Action 6).

22 See Attachment VI of Government Regulation 22 Year 2021 on the Protection and Management of the Environment.

23 Some lakes with more phytoplankton can have pH more than 9, whereas the bottom of deep lakes can have no Oxygen. An simple index comprising of Clorophyl A, total Phosporus and total Nitrogen can be developed to lower monitoring burden and encourage benchmarking. Interview with Arianto Budi Santoso, Limnology, Indonesian Institute for Sciences, April 26, 2021

24 Stakeholder consultation with Directorate of Dams and Lakes (MoPWH) on September 16, 2020.

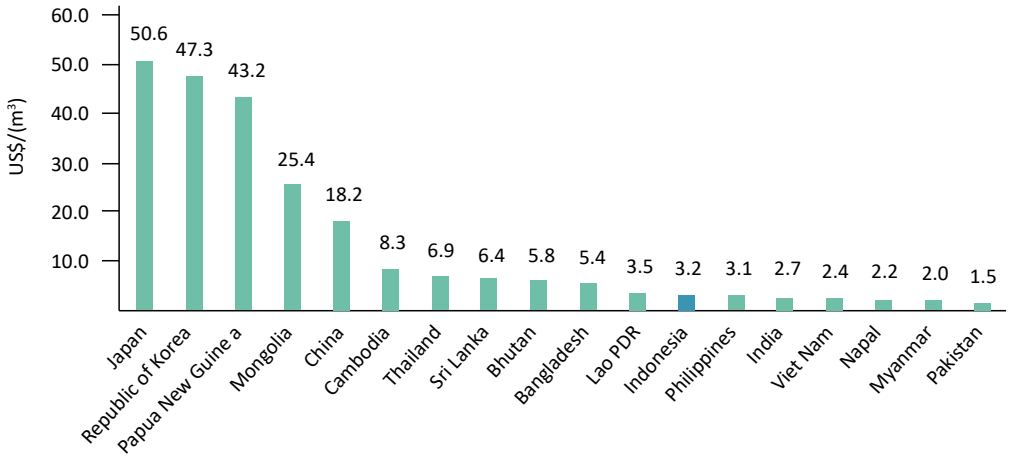
25 http://ebtke.esdm.go.id/post/2020/06/05/2547/laporan.kinerja.ditjen.ebtke.tahun.2019

26 Coal-fired power plants are mostly located at the coast and use seawater for cooling. Hence, the impact on freshwater availability is negligible. However, coal mining and mine mouth coal power plants pose challenges in terms of water quality and watershed degradation (see Action 2 and 3).

27 Assuming accelerated development, hydropower capacity may even increase by an additional 1.6 GW to 9.5 GW by 2025 (IEA 2020b).

28 Decree of Minister of Energy and Mineral Resources No. 39 K/20/MEM/2019 Regarding State Electricity Company's Electricity Provision Plan for the Year 2019-2028 (RUPTL 2019-2028), page V-35. See Table 5.44

Figure 12: Total water productivity (US$/m3) across Asian countries



Source: FAO Aquastat, latest available data; Indonesia: own calculations based on PUS AIR and World Bank. *Note:* Calculated as U.S. dollar divided by total water withdrawals. Malaysia was excluded as latest available data on water withdrawals from FAO were for 1996. Water withdrawals from all sectors were considered.

Water demand reduction measures alone could lead to eight river basins generating 16 percent of Indonesia's GDP, overcoming their water supply-demand deficit. Water demand reduction measures can include improvement in agricultural water use efficiency as well as alternative crop choices, reduction of non-revenue water, increase in water and wastewater reuse, increase in industrial water use efficiency, and so on. Figure 13 illustrates a stylized analysis on the impact of water demand reduction measures alone on the water balances of the 24 river basins that were identified to face severe water stress in the dry season in 2019. Assuming a conservative reduction of 20 percent for irrigation, 15 percent for households, and 10 percent for urban and industrial water demand, eight river basins could meet all their unmet water demand.[29] These eight basins jointly generate 16 percent of Indonesia's GDP. For the remaining river basins, the water demand-supply gap is reduced on average by 17 percent.

Environmental flows required to maintain good ecosystem services are unknown.[30] For water bodies to provide ecosystem services, such as water supply and fish production, a certain amount of river runoff—also referred to as environmental flow—needs to be maintained. The environmental flow requirement differs for each river system—and often even differs across sections of the river—and depends on the desired usage of the river. Rivers can be divided into different environmental management classes—ranging from 'natural', that is, rivers with minor modification of instream and riparian habitat to 'critically modified', that is, ecosystems in which the modifications have led to almost total loss of ecosystem services. Environmental flow requirements differ depending on how the water body shall be used, that is, which environmental management class it belongs to or shall belong to in future. Subject to environmental flow requirements, it can be determined how much surface water and groundwater can be abstracted sustainably. In Indonesia, environmental flows for individual rivers have not yet been determined to date. Currently, institutions apply national averages to estimate environmental flows. For the water stress analysis presented earlier, the data from PUS AIR were used which assumes around 10 percent of average monthly discharge to be preserved as environmental flow. For groundwater, it was assumed that 70 percent of the groundwater yield needs to be maintained as environmental flow. While these assessments are a first step, the localized needs for EFRs need to be determined to understand how much water can be abstracted sustainably.

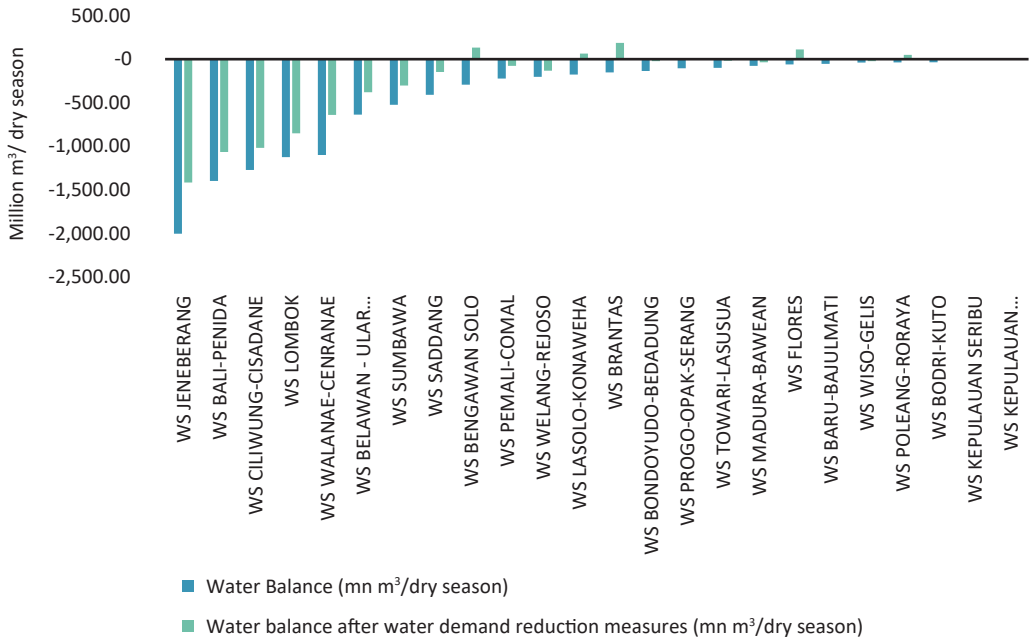
There is currently a legal and regulatory void regarding groundwater planning, conservation, utilization (except for licensing), and damage control—and there are challenges to manage surface water and groundwater in an integrated manner. The legal void is discussed more under Action 7. In Indonesia, the groundwater basin boundaries (*Cekungan Air Tanah*, CATs) in most cases do not match river basin boundaries (*Wilayah Sungai*, RBT). In some cases,

29 The Alternate Wetting and Drying approach to rice farming can reduce water use by up to 30 percent and methane emissions by 48 percent and has been field tested in Indonesia (CGIAR 2011).

30 Knowledge on environmental flows is also required to estimate the progress on SDG 6.4 (water stress) and SDG 6.6 (protect and restore water-related ecosystems).

CATs span across multiple *RBT*. Thus a system needs to be developed to allow for integrated surface water and groundwater management across *RBT* and CAT boundaries. While MoEF is responsible for monitoring groundwater quality,it focuses predominantly on surface water quality. MoEMR has undertaken some groundwater quality monitoring. To ensure that resources are used adequately and that information is accessible for relevant stakeholders, these functions should be clarified in practice and integrated.

Figure 13: Illustrative impact of water demand reduction measures on the water balance deficits of the 24 river basins facing severe dry season water stress in 2019



Source: Amended from PUS AIR 2016 and internal World Bank data.
Note: The underlying analysis is based on high-level estimates only. To gain a more detailed picture, further in-depth analysis is required.

Box 5: INSIGHT 2: The economic impact of water shortages on GDP by 2045.

Inaction is predicted to reduce GDP by up to 2.5 percent by 2045.

Regional and seasonal water stress is becoming an increasing threat to Indonesia's socioeconomic growth. When water demand reduction measures are exploited, water supply solutions, such as water storage, can increase the amount of available water resources when needed most.

When comparing current, planned, and potential water storage, there may be scope to expand storage if required. In Indonesia, water storage per capita amounts to 71 m^3, far below the target of 1,975 m^3 per capita (530 BCM) as outlined in the 2005–2025 long-term development plan.

The analysis evaluates several future scenarios that assume various storage volumes and future climate conditions for 2030 and 2045:

- **BAU**, where no additional storage is constructed, under a future with **no climate change**, as well as a **dry** and a **wet** future.
- **Investment in several levels of storage nationally**, including (a) **5 BCM**, (b) **10 BCM**, (c) **25 BCM**, (d) **50 BCM**, and (e) **100 BCM**, each evaluated under a future with **no climate change** and a **dry** and a **wet** future. These costs and supply reliability of these levels of storage are analyzed using a reservoir balancing approach.

Storage options are only considered in river basins that have unmet water demand and sufficient mean annual runoff to meet these demands. The analysis includes two categories of impacts when demands are not met: (a) impacts on agriculture and (b) impacts on industry, household, and urban sectors[31] due to the need to purchase water from another source.

Table 6 presents the impacts of insufficient water storage on GDP under different climate scenarios; the net benefit on GDP from increased storage (that is, the GDP gain from reducing unmet demand versus the GDP impact of paying for storage); and the B-C ratio of the storage investment. The table presents only the most cost-effective storage solution of 50 BCM and for 2045.

31 Urban water demand includes water demand from commercial and social uses, such as shops, warehouses, workshops, schools, hospitals, and hotels.

With current reservoir storage, impacts of water shortages on GDP range from 0.59 to 2.5 percent in 2045 in the wet and dry future, respectively. Storage greatly diminishes these impacts, with impacts turning positive in several scenarios above 25 BCM. Impacts turn positive as in addition to avoiding losses, there would be more rice land irrigated than in the base case. A 50 BCM increase in storage is predicted to result in a 1.15 or 0.72 percent increase in GDP relative to the base case by 2045. Storage B-C ratios are above 3 in all climate scenarios for 50 BCM, making it a worthwhile investment.

Table 6: Scenarios on the economic impact of water shortages—and actions—on GDP by 2030 and 2045

Added national storage	Climate scenario	Impacts vs base case (%)	Net storage benefits (%)	Storage B-C ratio
		2045	2045	2045
Current (BAU)	No climate change	–1.04	0.00	
	Dry	–2.50	0.00	
	Wet	–0.59	0.00	
+50 BCM	No climate change	–0.23	0.82	3.49
	Dry	–1.35	1.15	4.85
	Wet	0.13	0.72	3.23

Source: World Bank 2020b.*Note:* BAU refers to storage levels of 2015. B-C ratio refers to the GDP benefits of storage divided by the costs. The impact on energy security was not considered—thus the GDP impact may be expected to be even higher. The 100 BCM scenario is still below the targeted storage increase of 530 BCM outlined in the 2005–2025 long-term development plan.

More information and additional scenarios are presented in the underlying report *"Indonesia Toward Water Security – Diagnostic Report"*

Priority actions

Localized solutions need to be found for water stress and water resource usage needs to be optimized accordingly.

- **RPJMN 2020–2024 sets the target that the area of sufficient water availability must cover almost all the country (at least 175.5 million ha, 93 percent of Indonesia) and water availability per island must be maintained above 1,000 m^3 per capita per year.** Given the current status of water stress in key river basins, water demand and supply measures to reduce water stress need to be taken rapidly.
- **A more detailed assessment is required to understand localized impacts and solutions to the water-related challenges that are constraining economic growth and human well-being.** The present study offers only a high-level assessment of water stress and its impacts. Assessment and solutions need to be more localized. In areas of water stress, costs of water demand reduction measures and water supply augmentation measures need to be assessed comprehensively to inform investment plans. Hotspots for land subsidence due to groundwater overabstraction need to be identified and solutions to provide and enforce the usage of alternative water supplies need to be found (see Action 4). The operation of dams, including upstream catchment management, needs to be enhanced to use existing water storage optimally. Options for managed aquifer recharge and rainwater harvesting need to be assessed. The conjunctive use of surface water and groundwater needs to be enforced, particularly in high water demand areas with aquifers either at risk of being or already overexploited. This conjunctive use needs to be reflected in the *pola* and *rencana*.
- **There is great potential to increase water productivity ('dollar per drop').** Water productivity is relatively low in Indonesia compared to other Asian countries (Figure 12). As about 80 percent of water is used in irrigated agriculture, the greatest water savings can be sought in that sector, for example, by improving irrigation efficiency and crop choices (see Action 6). Options for water demand management, including water efficient technologies—for industrial, municipal, and agricultural use—need to be identified and their adoption incentivized, for example, through tax rebates. To ensure the incentives and usefulness of saving water a framework should be developed to identify how the freed up water resources can be used for the most beneficial and efficient water uses.

A publicly accessible national water information system, including real-time monitoring for both surface water and groundwater quality and quantity as well as better knowledge management, is needed for sustainable water resources management.

- **More information on the national water information system is presented in Action 8.**
- **More information on groundwater is required for effective management.** The groundwater potential needs to be updated—latest data are from 2005. Further, the safe yield of aquifers is based on a

fixed quota of 40 percent of groundwater potential across all aquifers. To safely manage groundwater reserves, the safe yield needs to be assessed—at least for priority aquifers. Groundwater conservation maps need to be completed for all CATs, prioritizing CATs that already suffer from groundwater overabstraction.[32]

- **More information on lakes is required to be collected to understand their storage capacity and their role in hydraulic systems; a bathymetry map that includes lake depth and morphology should be created at least for priority lakes.** Lake Management Plans need to be completed as well as studies on zoning around lakes—at least for priority lakes.[33] While lakes are included in River Basin Management Plans, more detailed analysis and planning is needed for lakes. Particularly for lakes, key characteristics need to be understood, as management approaches will differ, for example, between deep and floodplain lakes.[34]
- **More insights on environmental flows, such as the minimum and maximum flow ratios for priority rivers, are required to manage watersheds sustainably.**
- **More knowledge on climate change is required.** To allow for adaptation to climate change, assessments on the impact of climate change on extreme rainfall events—in addition to the existing Meteorology Climatology and Geophysics Agency (Badan Meteorologi, Klimatologi, dan Geofisika or BKMG) assessment on overall rainfall—are required for each island and need to be considered in spatial, storage, and overall infrastructure planning.[35]
- **The information needs to be publicly accessible to ensure ease of access across ministries, as well as by universities and the public in general.**

The water governance framework on water resources management and planning needs to be improved to allow for sustainable outcomes.[36]

- **Water-related actions mentioned in RPJMN 2020–2024 need to be reflected in the RENSTRAs of all relevant ministries.** To support the implementation of the national water security policy as stipulated in RPJMN 2020–2024, programs and strategies need to be determined and included in the ministries' RENSTRAs. Policies related to water demand management at national and subnational levels of government need to be updated to reflect current and future water stress situations.
- **The management of different water resources needs to be more integrated.** Currently, rivers, lakes, reservoirs, and groundwater are rather independently managed, while in practice they are intrinsically connected. For storage, for example, there is no agreement whether lakes and groundwater can also be considered storage. In practice, these two resources are key to store and balance water supplies. Incorporating these lakes and groundwater to reservoirs may lead to a more integrated system and increase resilience. Further, rainwater harvesting should be included for remote and/or water-stressed areas.
- **The boundaries for all groundwater basins need to be determined and groundwater conservation maps need to be developed with higher resolution.** To date, the boundaries have not yet been determined for all CATs—particularly outside of Java. This is a prerequisite to manage these basins sustainably. Further, for proper planning BAPPENAS and MoASP require groundwater conservation maps with greater resolution (1:25,000). While there is no standard on the scale of groundwater conservation maps (besides the requirement to fit on A0), maps for the One Map Policy are only required with a lower resolution (1:100,000). MoEMR and MoASP should cooperate to determine protection areas.[37]
- **Groundwater should be integrated into overall basin and water resources planning.** Currently, MoEMR is responsible for groundwater management, while MoPWH manages surface water. Under the 2019 Water Law, groundwater is to be an integral part of river basin planning. While this is a step in the right direction, groundwater basins (CATs) in most cases do not match river basins (*Wilayah Sungai*, RBT). While conservation

32 Stakeholder consultation with Centre for Ground Water and Environmental Geology, Department of Geology (MoEMR) on September 24, 2020.

33 As per 2019 Water Law.

34 Stakeholder consultation with Research Center for Limnology, Deputy for Earth Sciences, Indonesian Institute of Sciences (LIPI) on September 17, 2020.

35 Stakeholder consultation with Directorate of Technical Development for Water Resources Management (BINTEK SDA) (MoPWH) on November 11, 2020.

36 Pillar 3 discusses cross-cutting water governance issues, while this section focuses specifically on water governance issues relevant for water resources management.

37 Stakeholder consultation with Centre for Ground Water and Environmental Geology, Department of Geology (MoEMR) on September 24, 2020.

of groundwater should be continued at the CAT level, water licensing for groundwater and surface water should be coordinated closely. The planning process should articulate the priority accorded to the use of surface water over groundwater in the new Water Law, and also integrate Water Quality Protection and Management Plans undertaken at the river basin or aquifer levels.[38] Groundwater conservation and recharge can be incentivized by granting preferential water allocation to water users applying these practices, such as PDAMs. To strengthen integrated river basin management, steps need to be taken to strengthen the water council's coordination mechanisms across all stakeholder institutions.

- **Costs and revenues from groundwater management and usage need to be joined again/should be accrued at the same level of government.** While provinces are responsible for CAT management and groundwater licensing, districts collect the water use tariffs. Thus, provinces have no financial interest in conserving and managing groundwater. District governments do not receive information on groundwater licenses from the provincial governments and thus cannot control—and have no incentive to control—illegal groundwater abstractions. Quite the contrary even as they charge users also for illegal groundwater abstraction.[39]
- **Clarity on future responsibilities around groundwater management are required.** Roles and responsibilities across MoEMR, MoEF, and MoPWH need to be clarified. While the overall management of groundwater is expected to be clarified in the implementing regulations of the 2019 Water Law (see Action 7), Government Regulation 22 states that groundwater monitoring should be conducted based on the aquifer. Thus, it can be expected that legally the task will fall into central government (for inter provincial and international groundwater aquifer) and to provincial government (for aquifers within its territory).[40]
- **The management of lakes needs to be accorded more importance and be better integrated in water resource planning.** According to the 2019 Water Law, the National Water Resources Council is responsible for coordinating integrated lake management, but the council has not yet assumed this role. This coordination is important because responsibilities are split among agencies. For example, upstream management of both lake catchments (*Daerah Tangkapan Air*, DAT) and river basin catchments (*Daerah Aliran Sungai*, DAS) is the responsibility of MoEF and of the Ministry of Agriculture (MoA). However, the downstream management of lake borders and lake water bodies is the responsibility of several other agencies, including the local governments at provincial and district levels (Pemda), MoPWH, the Ministry of Maritime Affairs and Fisheries (MoMAF), the Ministry of Tourism and Creative Economy (MoTC), the Ministry of State-Owned Enterprises, and so on. Sound management action towards lakes requires: (i) the scientific understanding on the functioning of each lake system, (ii) historical assessment of each lake's water quality (iii) a consensus for restoration target and (iv) modelling exercise to understand measures required to achieve such restoration targets. The determination of the restoration target will require a consensus through consultation with stakeholders with competing interest (for example between tourism versus fisheries) and may require trade-off and cost-benefit analyses.[41] Existing regulation does not explicitly require these mechanisms to be implemented.
- **Relieving water stress requires spatial and development planning that optimizes the carrying capacity of water resources.** Proactive planning can contribute to sustainable allocation of water and optimal development of water infrastructure and land uses requiring and/or affecting water resources. By aligning development priorities with the availability of water in the municipal area, municipalities will be able to make provision for new infrastructure and redirect new developments to better suited locations.[42] Many areas that face overabstraction of groundwater also face stressed surface waters. Besides implementing solutions that reduce water demand from current uses and augmenting supplies, water resources may need to be reallocated to higher-value uses. Particularly around high water demand centers that face water stress, such as Greater Jakarta region, reallocating

38 See Government Regulation No. 22 Year 2021 on the Protection and Management of the Environment, Article 108

39 Stakeholder consultation with Centre for Ground Water and Environmental Geology, Department of Geology (MoEMR) on September 24, 2020.

40 See Government Regulation No. 22 Year 2021 on the Protection and Management of the Environment Arts 118-119.

41 Interview with Arianto Budi Santoso, Limnology, Indonesian Institute for Sciences, April 26, 2021

42 Stakeholder consultations with Directorate of Survey and Thematic Mapping - Ministry of Agrarian Affairs and Spatial Planning (MoASP) on November 2, 2020.

water resources from low-value agricultural uses to higher-value agricultural uses—or even domestic and industrial uses—may be considered. Especially in water-stressed areas, a water allocation analysis should be undertaken and incorporated into regional development plans. An assessment of the value of water or development of a hierarchy of trade-offs for specific water uses in stressed areas may support investment and policy decision-making.

– **River basin management and planning need to be strengthened.** Indonesia's river basin organizations (RBOs) are key to integrated water resources management—and they need strengthening. Further, river basin planning and the plethora of other planning processes and agencies need to be integrated and coordinated (see Action 8).

Improve cross-sectoral coordination on the water-energy nexus.

– **Coordination between MoEMR, MoPWH, and MoEF on hydropower policy needs to be improved.** BJPSDA for hydropower has increased, and this will increase the cost of energy production through hydropower. This may make the generation of hydropower less economical when compared to nonrenewable energy development and thus impede the GoI's renewable energy target of 23 percent by 2025.

– **Dam development and operations, including for hydropower, need to be better integrated into spatial plans and river basin management.** While dams are integrated in spatial plans, the operation of dams and river basin management are recorded in separate planning documents. Hydropower infrastructure makes permanent changes to the river regime but at present operations are not optimized within a water resources management framework. Maximizing power production and optimizing operational schedules of hydropower dams are not well linked to other river management objectives.[43]

– **Water pollution needs to be tackled, including solid waste, to ensure optimal functioning of hydropower generation.** Although hydropower plants are required to pay a water conservation fee to the RBOs to keep the water body clean, solid waste in waterways remains a challenge. Clear service agreements between hydropower plant operators, such as PLN, and RBOs, including PJT I and II, are required (see Action 2).[44]

– **The development of geothermal and coal fired power plants need to be sufficiently reflected in the River Basin and Catchment Management Plans.** Geothermals (depending on the type of cooling system) and mine-mouth coal plants may increase water demand in the river basin. Care needs to be taken in the construction of sumps and wells in geothermal plants, so that no contamination occurs to shallow groundwater (ADB, 2019). Water abstraction by these plants requires careful planning to avoid land subsidence or the decrease of groundwater table (Kristmannsdóttir et al. 2003). The permission of utilising water in nature reserves and nature conservation areas needs to be clarified – currently it is prohibited under Water Law 17/2019 but allowed under other regulations.[45]

Action 2: Managing water quality sustainably by tackling pollution

Action 2 - Key takeaways

- More than 50 percent of Indonesia's rivers are polluted; two rivers are among the most polluted in the world.
- About 85 percent of the population are exposed to fecal and total coliforms in water sources.[46]
- More than 70 percent of GDP generated in river basins is categorized as 'heavily polluted'.[46]
- About 93 percent of groundwater samples exceeded pollutant threshold levels.[46]
- About 70 percent of groundwater pollution comes from unsanitary septic tanks and septage.
- More than 80 percent of plastic leaking into the ocean is transported by rivers.
- About 75 percent of the population live in areas where water quality is not measured.

43 Stakeholder consultation with Directorate of National Spatial Planning - DGSP - Ministry of Agrarian Affairs and Spatial Planning on October 15, 2020.

44 Consultation with Indonesia's National Power Company (Perusahaan Listrik Negara, PLN) on September 29, 2020.

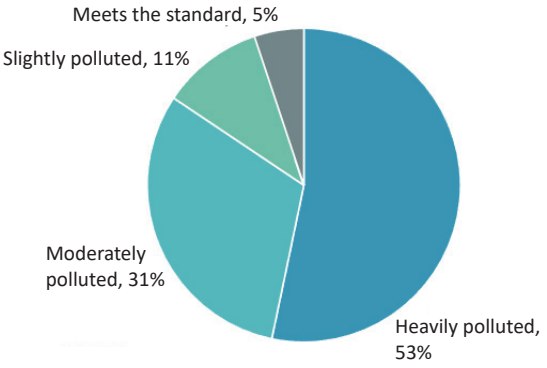
45 See Water Law 17/2019 Article 33, Government Regulation 108 Year 2015 on the Management of Natural Reserve Areas and Nature Conservation Areas. See also Dewan Energi Nasional. "Penggunaan Air Untuk Energi Panas Bumi Di Kawasan Hutan Lindung." https://den.go.id/index.php/dinamispage/index/943-penggunaan-air-untuk-energi-panas-bumi-di-kawasan-hutan-lindung.html

46 Where water quality is sampled.

Threats and Challenges

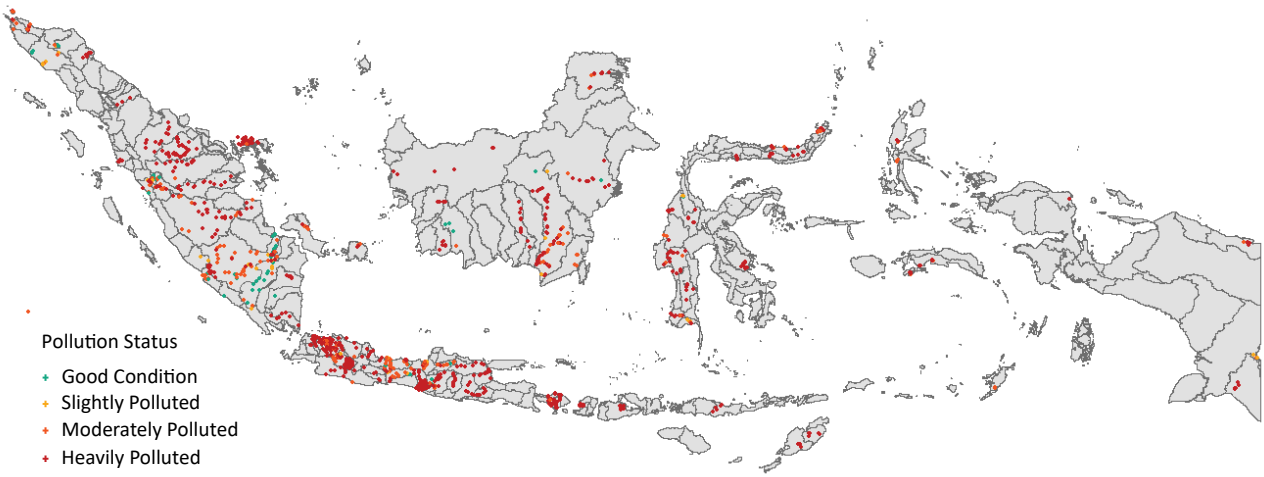
Indonesia's rapid economic development has come at a cost to the environment, with the country experiencing dramatic levels of pollution from both point and nonpoint sources. More than half of Indonesia's rivers are heavily polluted, and two of the country's major river systems are among the most polluted in the world (Figure 14). Surface water pollution is a particular challenge on Java and Sumatera (Figure 15). About 83 percent of all groundwater quality samples taken nationwide between 2010 and 2020 exceed the safe threshold for at least one pollutant category.[47] Some of Indonesia's key lakes—critical for inland fisheries; tourism; and municipal, industrial, and agricultural water use—are severely degraded and polluted. For example, poor lake management of Indonesia's largest lake, Lake Toba, has a significant impact on the ecosystem, population and on both the local and the wider economy. Deforestation and expansion of palm oil plantations is further contributing to deterioration of water quality (see Action 3).

Figure 14: River water quality status across Indonesia (2019)



Source: MoEF. 2020. Water quality classification based on MoEF Ministerial Decree (115/2003) on the Guidelines For Determining Water Quality Status.

Figure 15: Surface water pollution status across Indonesia



Source: Calculations based on data provided by MoEF.

The majority of Indonesia's population is exposed to water pollution.[48] About 85 percent of the population living within a 5 km radius of water quality monitoring stations are exposed to fecal and total coliform levels above thresholds. About three-quarters (73 percent) of this population are exposed to nitrogen and nitrogen derivatives beyond thresholds, while 5 percent are exposed to mercury beyond thresholds. High levels of coliform, biochemical oxygen demand (BOD), and chemical oxygen demand (COD) reflect a lack of adequate wastewater management in densely populated and industrial areas. Nitrogen-based pollutants originate largely from the agricultural sector and untreated wastewater, while mercury pollution originates from industries and from gold mining. As usage of mercury has been prohibited in gold mining[49], the key challenge comes from small-scale artisanal and illegal gold mining. Acid drainage from closed mines is also highly polluting.

More than 70 percent of national GDP is generated in river basins in which the majority of sampling locations are found to be 'heavily polluted'. Almost

47 About 30 percent of all samples exceed the thresholds in iron (36 percent), pH (33 percent), turbidity (31 percent), color (29 percent), total dissolved solids (26 percent), and lead (26 percent).

48 It needs to be noted that it can be assumed that monitoring stations are mostly located in areas of interest, that is, areas in which pollution may affect a significant proportion of the population.

49 See Minister of Energy and Mineral Resources Decree 1827/ 2018 about Guidelines for Implementing Good Mining Engineering Principles.

all (93 percent) of urban wastewater and septage is discharged untreated and finds its way into water systems. There are thousands of polluting industries, and mining, agriculture, and aquaculture are also major polluting activities. While some larger industries follow environmental regulations—many of which are part of Program for Pollution Control, Evaluation, and Rating (PROPER) initiative—small and medium-sized companies mostly do not have wastewater treatment facilities. This becomes a challenge especially for highly polluting 'cottage' industries, such as textile.[50] Heavy metals, excess nutrients, pesticides, persistent organic pollutants (POPs), and hazardous and toxic waste are polluting water resources. Key lakes are heavily polluted and fish die-off is frequent.

Once pollution thresholds are exceeded, it is difficult to reduce pollution loads. The assimilative capacity (*Daya Tampung Beban Pencemaran* DTBP) for Citarum River—for example—has been exceeded. There are currently challenges in enforcing the treatment of industrial wastewater. Further, the polluting industries are already established—and even if industrial wastewater was treated—the total number of industries would need to be reduced. Ideally spatial planning would consider DTBP and pollution potential of companies before issuing licenses. Untreated domestic wastewater—under the responsibility of MoPWH and local governments—was found to be the key contributor to very high pollution levels. MoEF and MoPWH need to cooperate to reduce these pollution hotspots, while MoASP should consider pollution control as part of its spatial planning. Industrial areas should be increasingly planned to group polluting industries into one area to enable investments in common wastewater treatment plants.[51]

Upstream water pollution reduces downstream GDP. A global World Bank study (2019p) found that when the BOD[52] level exceeds 8 mg per liter—a level at which rivers are considered heavily polluted—GDP growth in downstream regions falls significantly, by 0.82 percentage points. When the sample is restricted to only middle-income countries—which includes Indonesia—where BOD is a bigger problem, the impact increases to 1.16 percentage points. With an estimated 4.8 percent GDP growth forecast for 2021 (adjusted for COVID-19 impact), this implies that around a quarter of growth is lost. Further, water pollution can have direct detrimental effects on Indonesia's tourism sector and areas that rely on it. For instance, the water quality of Lake Toba has noticeably declined since the mid-1990s, threatening tourism potential and the lake's long-term sustainability. In response, the government is preparing an integrated, cross-ministerial, and cross-sector approach for the future development of tourism at Lake Toba (World Bank 2019m). Tourism has also contributed to increasing pollution issues.

Rivers account for more than 80 percent of the plastic leaking to the marine environment from land-based sources in Indonesia. Approximately 0.34–0.71 million tons per year of mismanaged plastic waste is estimated to end up in Indonesian rivers due to both

Box 6: Rivers and other waterways are key pathways of transport for mismanaged plastic waste in Indonesia

Mismanaged waste that is dumped on land, including plastic, can be washed by rainfall runoff processes into rivers and other water bodies and subsequently transported to the sea. Solid waste generation and management and the hydrological conditions that transport waste vary considerably throughout Indonesia. Across the country there are more than 4,000 main rivers that discharge into the marine environment. The largest are found on Kalimantan, Sumatra, and Papua; in Kalimantan and Sumatra large cities lie along some of the major rivers, while on Papua there are primarily small remote settlements. On Java, where most people live, large dams on some of the main rivers capture plastic waste from upstream although much of the population live downstream.

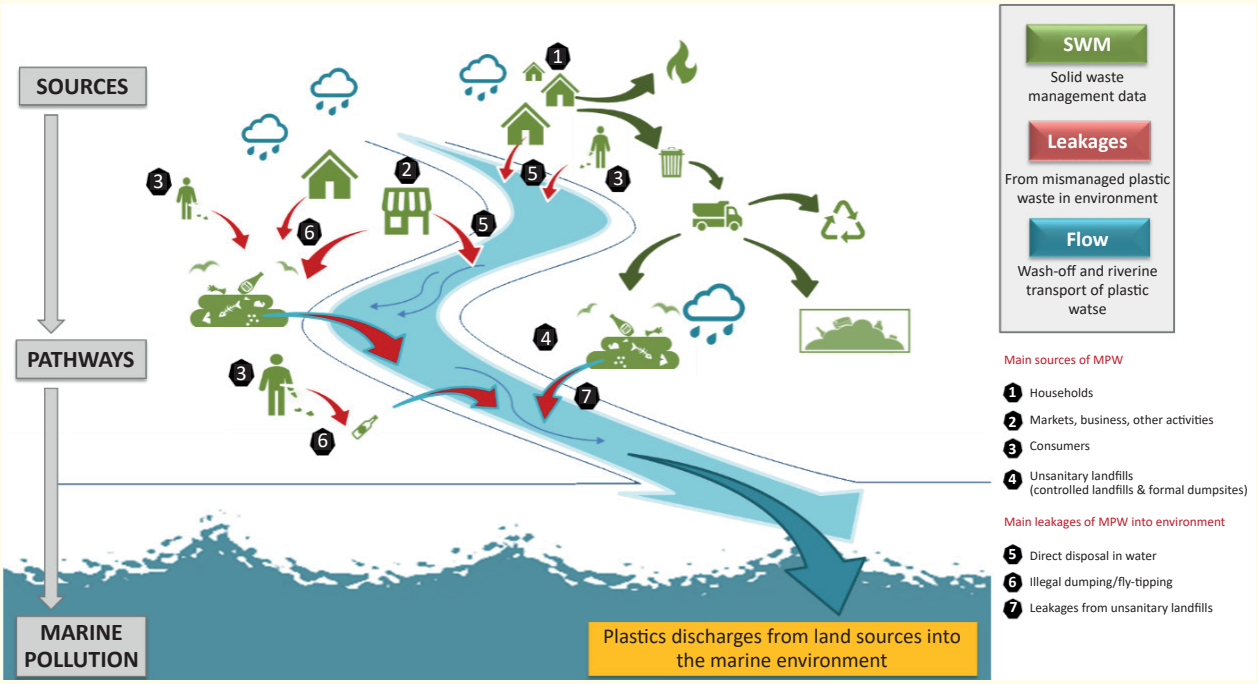
All these aspects affect how much plastic at any time is washed off to a stream, river, or lake and how much is transported to and discharged into the marine environment. A recent World Bank study integrated Indonesian data on plastic waste generation and waste management performance with actual hydrological conditions, using a modelling approach to produce a national estimation of mismanaged plastic waste carried in and discharged by freshwater systems. Figure 16 summarizes the conceptual framework used.

50 Stakeholder consultation with Directorate of Water Pollution Control (MoEF) on 2 November 2020.

51 Stakeholder consultation with Directorate of Water Pollution Control (MoEF) on 2 November 2020.

52 BOD is one of the most widely used water quality indicators. It is a measure of the amount of oxygen that bacteria will consume in decomposing organic matter (Barnes, Meyer, and Freeman 1998). Therefore, it is often used as an umbrella proxy for overall water quality. It is highly correlated with other water quality indicators, such as dissolved oxygen and chemical oxygen demand, and is a good indicator of the amount of organic material in water (World Bank 2019p - verbatim).

Figure 16: Conceptual framework depicting leakages and transport of plastic waste from land-based sources via rivers



Note: MPW = Mismanaged plastic waste; SWM = Solid waste management.

Based on the results of the study, in addition to improving solid waste management practices in larger urban areas, policies and investment should target rural areas, focusing on improving collection and should also aim to reduce plastic use and increase community-based recycling. The household practice of improperly disposing of waste (including plastic) directly into waterways suggests that behavioural change, regulations, and associated monitoring and enforcement can play an important role in reducing plastic waste pollution. National sanitation campaigns at the household level[53] already exist, but these will need to be strengthened in rural areas, with a particular focus on the solid waste management pillar. This would need to be supported by improved collection rates and solid waste management infrastructure in these areas.

Priority rural areas include those adjacent to the Musi River, the Serayu River on Java, and the Barito River on Kalimantan where significant proportions of uncollected plastic waste are deposited directly in water. Some urban areas also need improved collection rates, particularly in some parts of DKI Jakarta. There should also be an increased emphasis on existing programs such as the development of Tempat Pengolahan Sampah - Reduce-Reuse- Recycle (TPS3R)[54] and waste banks and measures to increase financial viability of recycling. Policies and investments aiming to reduce plastic in rivers and in the marine environment should be prioritized based on the influences of hydrology, population distribution, local waste management practices, and dumpsite locations to have the quickest results in addressing plastic pollution.

Source: World Bank 2020h.

Box 7: Exchanging plastic for rice in times of COVID-19 on Bali

As around 80 percent of GDP is generated from toursim in Bali, the travel bans related to COVID-19 hit Bali hard. The nongovernmental organization (NGO) 'The Plastic Exchange' acted quickly and started to exchnage plastic for rice—rather than just handing out food aid. Acknowledging that low-value plastic, such as single-use plastic bags, packaging, and straws, has the greatest impact on the environment and is the hardest to collect, plastic was divided into three categories with differing rice reward ratios. Figure 17 presents that 4 kg of low-value plastic can be exchanged for 1 kg of rice, while 7 kg of high-value plastic is required for 1 kg of rice. For just US$0.75 4 kg of plastic can be collected and the rice can feed four people for one day. Since the start of the crisis, 100 tons of plastic have been collected. The collected plastic is shipped to a plastic recycling facility on Java, which procures the plastic. Revenue from plastic sales suffices to pay for the shipment of the plastic to Java, while rice still needs to be procured from donations. The NGO cooperates with the village governmnet (the Banjar), which informs the people and organizes the exchange. This allows to clean up the environment and assures food security with dignity.

53 STBM - Sanitasi Total Berbasis Masyarakat (Community-based Total Sanitation).

54 Official recycling facilities in Indonesia.

Figure 17: Plastic for rice exchange ratios

wash off from land, including from dumpsites, and direct dumping into waterways. Just over 70 percent of this is estimated to be due to direct dumping into waterways, although the extent of this practice varies across the country, depending on both behavioral aspects and waste collection rates. Importantly, there is a notable discrepancy in average plastic waste collection rates between rural areas (15 percent) and urban areas (64 percent). After accounting for retention in rivers[55] and behind dams, the study estimated that around half of the mismanaged plastic waste in rivers is transported to the marine environment (0.17– 0.45 million tons per year). Aside from the rivers flowing through DKI Jakarta, the next key rivers in Indonesia transporting plastic to the marine environment are the Musi River on Sumatra, the Bengawan Solo River on Java, and the Brantas River on Java which are estimated to account for more than 8 percent of land-based plastic discharges to the marine environment (World Bank 2020h). Box 6 provides further information.

While the 'highly visible pollutants' receive more attention, the less visible pollutants may pose an even greater risk to ecosystems and human health. As countries develop, the priority is targeting highly visible and easily measurable pollutants with acute impacts, such as those related to fecal contamination. Less visible pollutants, such as chemicals and heavy metals, whose impacts may take years to show up in human health the form of cancer or other chronic illnesses, receive less attention, as it is harder to directly link health impacts to exposure to specific pollutants in the past or over time. However, given the long degradation time, failure to prevent these pollutants from entering the environment today can have long-lasting effects in the future. But also the ecosystem is significantly impacted by pollutants, including flora and fauna. The rise in emergent pollutants, including pharmaceuticals such as anti-inflammatory drugs, analgesics, antibiotics, and hormones, creates a dangerous mix with bacteriological contamination from inadequate sanitation that countries may not easily get rid of by themselves.

Limited availability of technology, financial resources, and capacity makes it hard to clean all pollutants from drinking water supplies making prevention of water pollution the paramount objective. Without prior treatment, pollutants remain in water supplies and endanger consumers. Treating even an increase in the nutrient loads of raw water greatly increases the cost of potable water. In the current situation in Indonesia, polluters rarely pay for these additional costs. Essentially, profits from avoiding pollution control are being privatized—that is, industries increase their profits from saving on wastewater treatment—while the costs of the pollution caused are socialized—that is, the government and

55 Due to plastic waste sinking or being trapped in sediment or vegetation.

private users need to cover the costs of treating water before usage. Furthermore, less than a tenth (9 percent) of domestic water is provided by public utilities[56] and receives treatment. It is likely that the remaining 91 percent is used without treatment, causing significant exposure.[57] Although ultra-filtration, reverse osmosis, and other forms of water treatment may offer solutions to poor water quality, they imply very high investment and operating costs.[58] At the limit, they may be economical for drinking water or water for industry but almost never for agricultural water. In any case, the most economical solutions are prevention and pollution control.

The impact from water pollution on health can be significant including acute illnesses such as diarrhea and chronic diseases such as cancer and other degenerative diseases, organ damage, embryo defects, and stunting. Pollution in water is becoming an increasing threat around and downstream of industrial, urban, and (illegal) mining sites and has entered the food supply chain. A study found harmful levels of mercury and other heavy metals to be present in commonly consumed fish in key water bodies including Jatiluhur, Indonesia's largest multipurpose dam and the major water supply source for Jakarta, as well as in the Cirata and Saguling Reservoirs (Riani 2015; Riani 2020a, 2020b, 2020c). Mercury is highly toxic to fish and also poses a risk to humans through direct consumption of the water or as it enters the food chain. This pollution is contributing to Indonesia's high stunting rate (35 percent) as well as to a rise in acute and chronic diseases.

The true extent of the harm caused by water pollution is unknown as up to three-quarters of the population live in areas where water quality is not monitored.[59] The coverage of water quality and quantity monitoring is limited. Although there are more than 1,600 monitoring stations,[60] less than 30 percent of the population live within a 5 km radius of a monitoring station. Monitoring stations are predominantly in urban areas, thus the exposure to pollution for rural areas—including those affected by industrial parks, mines, and agriculture—is less known. Mining leads to highly localized heavy metal pollution which can be very harmful. Similarly pollution from industrial and palm oil processing plants can also be harmful. However, as the impact is localized it is difficult to discern it from aggregated water quality data or if stations are not close to these hotspots – leaving key impacts unknown (World Bank 2021). BAPPENAS estimates that less than 10 percent of monitoring data are continuous and real time.[61]

And even where monitored, capacities to correctly analyze data are low and available data are incomplete and the selection of measured surface water quality parameters does not allow for an analysis on the impact of industrial and mining activities on water quality. The parameters measured include general descriptive parameters of the water body (discharge, river width and depth, water temperature, and pH) and parameters measuring nutrients, selected heavy metals, conductivity, oil and fat, detergents, and phenols. However, these parameters are not equally measured at all monitoring stations. Further, water quality sampling does not show a temporal consistency across stations—some stations only sample once a year, others up to four times—and the timing of the sample (pre or post monsoon) is mostly not recorded. While pollution is increasing and becoming more complex, the overall number of parameters sampled have been reduced from 66 in 2015 to just 29 in 2019—and relevant parameters such as mercury and various heavy metals have been taken out. This occurred as the responsibility to sample water quality was transferred from provincial governments to MoEF in 2018 and due to lack of capacity the total number of monitored parameters was reduced.[62] Other relevant water quality parameters, such as all banned B3 and per- and polyfluoroalkyl substances (PFAS), are not measured. Further, institutional capacity to sample is low—the analysis for the same sample in different institutions was found to differ from one another (Riani 2020a, 2020b, and 2020c). For example, when equipment

56 That is, by PDAMs.

57 Unless there are highly advanced household-level filters, such as reverse osmosis, which only a small segment of society can afford. For lesser polluted waters, household level filters with ceramic, activated carbon and colloidal silver, for example can be used, at very affordable prices (around 25 USD/ filter).

58 Once groundwater supplies become exposed, particularly in the case of nutrients and heavy metals, treatment is generally uneconomic, even in situations where the value of water is high (Maheshwari, Singh, and Thoradeniya 2016).

59 This high-level analysis captures the population living within a 5 km radius of the monitoring station. Further analysis is required to understand the full impact on the population considering downstream impacts.

60 There are about 1,638 monitoring stations listed in the MoEF river quality monitoring data between 2015 and 2018.

61 Comments received from BAPPENAS 'Review Final Report Water-Related Threats to Indonesia's Economy' in July 2020.

62 Stakeholder consultation with Research Centre for Quality and Environmental Laboratory (P3KLL) - Ministry of Forestry and Environment (MoEF) on 16 September 2020.

Box 8: Citarum Harum - Cleaning up one of the most polluted rivers in the world with multistakeholder engagement

Citarum River has critical strategic importance, providing raw water for 49.94 million residents of West Java Province and for residents of the capital DKI Jakarta, as well as for irrigation, fisheries, industries. It is also a source for hydroelectric power supply for Java and Bali. However, it was also declared to be one of the most polluted rivers in the world on 2013.

This was caused by watershed degradation leading to soil erosion and subsequent sedimentation but also by untreated discharge of wastewater from livestock as well as domestic and industrial wastewater and excessive aquaculture. Various toxic substances were found in the river which had a negative impact on 35 million people in the 13 riparian districts/cities.

In 2018 President Joko Widodo passed Presidential Decree (15/2018) on "Accelerating Pollution and Damage Control of Citarum River" in an effort to revitalize the whole river. The Taskforce (SATGAS) Citarum Harum was formed, headed by the Governor of West Java. The vice heads of the SATGAS are (a) West Java Military Regional Command, (b) Jayakarta Military Regional Command, (c) West Java Regional Police, and (d) Metropolitan Regional Police. Further members include local leaders, cultural experts, academics, and media. Further guidance is provided by the Advisory Panel of the SATGAS, consisting of members from 19 ministries, which are coordinated by the Ministry for Maritime and Investment Affairs.

The SATGAS developed an action plan consisting of 12 programs which shall be completed by 2025, that is, (a) handling of critical land, (b) handling of industrial waste, (c) handling of livestock pollutants, (d) handling of domestic waste water management, (e) waste management, (f) control of spatial use of the Citarum River Basin, (g) water resources management, (h) arrangement of floating net cages, (i) law enforcement, (j) education, (k) public relations, and (l) water quality monitoring.

After two years of operations, there are first signs of success: reduction of pollution load from 911 industries, construction of 305 communal sanitation units and 125 communal septic tanks with subsequent reduction of E. coli load, construction of 35 dump sites in priority villages and removal of 20,000 tons of garbage, acquisition of riverbank area for 1,100 building units to improve spatial planning, among others.

The Governor of West Java stated that the success of the Citarum Harum program is also due to the use of the **Penta Helix collaboration concept** or collaboration of five parties: Academic, Business, Community, Government, and Media (A-B-C-G-M) that must be included and support each other, to build a fragrant, clean, healthy, and sustainable Citarum.

Sources: BBWS Citarum 2020; BPS of West Java Province 2020; Gewati 2019; Secretary of Cabinet 2018; Tuasikal 2019; West Java Province 2020.

to assess persistent organic pollutants (POPs) was procured from Japan, POPs were not detected in water samples with the equipment operated in Indonesia, while the same samples showed high POP levels with the same equipment when operated in Japan.[63]

Priority actions

The GoI policy is to promote environmental quality improvement, integrating prevention, mitigation, and recovery measures.

- **RPJMN 2020–2024 has a major focus on the prevention of pollution and of damage to natural resources and the environment, together with institutional strengthening and enforcement.** Among the measures envisaged are (a) monitoring water quality; (b) strengthening regulation and enforcement, including licensing, supervision, and imposition of penalties; (c) regulating household waste disposal; (d) reducing pollution by plastics; and (e) improving hazardous waste management, including mining effluent, mercury, and so on. To allow for long-term planning, water quality targets should be added to \Vision 2045.[64]
- **To address the challenge of water pollution, four critical watersheds are prioritized for restoration by 2024.** These include three watersheds on Java—Ciliwung, Cisadane, and Citarum—together with the Asahan Toba watershed on Sumatra.[65] Key challenges in these watersheds include (a) severe water pollution, (b) high solid waste pollution, (c) floating net cages for aquaculture exceeding carrying capacity, (d) lack of access to sanitation, and (e) flooding of cities downstream.[66] Tackling the water challenges in these priority basins can allow for lessons learned before action is taken

63 Expert opinion Prof Etty Riani on 13 April 2021.

64 Stakeholder consultation with Directorate of Urban, Housing, and Settlements (BAPPENAS) on November 2, 2020.

65 Presentation by Pak Abdul, Directorate of Water Resources and Irrigation, BAPPENAS at Focus Group Discussion on Policy and Institutional Framework of Water Pollution Control in Indonesia, organized by this study team on July 2, 2020.

66 "Policy and Institutional Framework of Water Pollution Control in Indonesia," PowerPoint Presentation presented at World Bank Focus Group Discussion on July 2, 2020, by Direktorat Pengairan dan Irigasi Deputi Sarana dan Prasarana Kementerian PPN/BAPPENAS.

across all affected river basins in Indonesia.

– **To address critically degraded lakes, RPJMN 2020–2024 has prioritized 30 lakes for enhanced lake management.** Key challenges include (a) aquaculture beyond carrying capacity of lakes and resultant pollution, (b) discharge of untreated domestic and industrial wastewater as well as pollution from water-based transport, and (c) disconnect with upstream watershed management. These 30 lakes are further divided into 15 lakes of first priority and 15 lakes of second priority.

Responsibilities for water quality across institutions need to be taken more seriously and be better coordinated.

– **The role of the National Water Council and of the Provincial Water Councils needs to be strengthened to improve coordination across the Government.** Responsibilities for water quality are highly fragmented and programs to fight pollution require active coordination among all the agencies responsible for water resources management. Overall responsibility for water quality management lies with MoEF, while responsibilities for water quantity lie with MoPWH—complicating integrated water resources management for these closely interrelated management areas. Further, while MoPWH has designated various RBOs for managing rivers (that is, 'quantity'), MoEF has no specific organization for managing quality of water sources within its jurisdiction nor a cooperation mechanism with RBOs. Further, the responsibility for monitoring of wells as a part of drinking water quality surveillance lies with health agencies (*Dinas Kesehatan*) and community health centers (*Pusat Kesehatan Masyarakat*, *Puskesmas*) under the MoH. Spatial plans—including location of industrial areas—are developed by MoASP, without considering the assimilative capacity of water bodies (DTBP) and potential to develop common wastewater treatment plants for multiple industries. In addition Ministries overseeing activities that contribute to water pollution also need to be considered in the coordination. These include the MoA (use of fertilizers, pesticides and other inputs), MoMAF (use of medication, such as antibiotics, and feed in aquaculture), MoI (pollution from industries), MoT (permitting goods to be traded which negatively impact the environment), and MoEMR (pollution from mines). Monitoring data are often not shared between agencies at the regional level. In these circumstances, there is a need for stronger high-level coordination. The role of the National Water Council and of the Provincial Water Councils should be reinforced for this purpose, while MoEF should be added as member to all RBOs to enhance on-ground coordination.

– **Water pollution control compliance and performance of district and city governments should be monitored and evaluated.** Currently, environmental issues, including water pollution control, are not taken seriously by most district and city governments.[67] Central, provincial and local governments issue Technical Approvals for wastewater discharge which are based on the DTBP and the wastewater quality standard ('Baku Mutu'). They also have the responsibility to supervise the enforcement. If the assimilative capacity is exceeded, there will be a moratorium for new discharge approvals and officials are required to evaluate all technical approvals that have been previously issued.[68] To evaluate the performance of the district and city governments, MoEF has now revived the PROKASI program for clean rivers. A composite index measuring the (a) pressure on water quality, (b) management, and (c) actions will be developed for each district and city government and compared. It has been piloted in Citarum River and will now be trialed for 100 further districts and cities (around 25 percent of Indonesia's districts and cities).[69] This project should be expedited and extended to all of Indonesia. The PROKASI score could be linked to (financial) incentives for the district and city governments.

– **Responsibilities for water quality management of 'strategic rivers' located entirely within one jurisdiction need to be clarified.** Certain rivers are classified as 'strategic rivers' but are located within one province, such as the Brantas River and the Deli River.[70] In practice, it is not yet clear whether MoEF or the province is responsible for water quality management. This unclear responsibility has resulted in cases where water quality management is rendered ineffective, for instance, in determining the assimilative capacity of a water body (DTBP) or in planning for the recovery of polluted rivers. The new Government Regulation 22/2021 clarifies that water quality management will be based on

67 Stakeholder consultation with Directorate of Water Pollution Control (MoEF) on November 2, 2020.

68 Government Regulation 22 Year 2021 on the Protection and Management of the Environment, Article 134

69 Consultation with Directorate of Water Pollution Control, MoEF, on November 2, 2020.

70 This occurs in Brantas River, see Kompas.tv (2019). Regarding Deli River (Wilayah Sungai Belawan-Ular-Padang), see ICEL and Van Vollenhoven Institute 2016.

the river basin area.[71] This new requirement must be harmonized across all governmental levels.

- **Responsibilities to monitor antibiotics need to be clarified.** While MoEF mentioned that it did not monitor water quality for antibiotics, as this was the role of the MoH, MoH mentioned that this was part of the responsibilities of MoEF. Untreated discharge from pharmaceutical industries and from livestock and aquaculture farming can result in high levels of antibiotics with adverse effects on aquatic and human life.[72]
- **Water quality restoration needs to be enforced and funds allocated. Government Regulation 22/21 requires polluters to restore the water quality restoration.** In case these fail to do so, it is the mandate of the central or local governments to perform restorative actions themselves using the environmental fund. However, this may not apply to business or activities which are not officially registered or have not deposited such funds. In case of diffuse pollution or pollution without identifiable polluters, the responsible governmental level needs undertake restorative measures themselves.[73] As such, government levels which face serious water pollution challenges should integrate water quality restoration into their regional planning scheme.
- **The minimum ambient water quality standards for each class determined under Government Regulation 22/2021 should be maintained across all provinces**. Although national regulations should be applied in all provinces, in practice some provincial governments apply ambient water quality standards that are more relaxed to give local enterprises a competitive advantage (Riani and Cordova 2020b). Relaxing environmental regulations to attract industries at the cost of the environment and public health should be strictly prevented.
- **The 'assimilative capacity' needs to be determined for all water bodies and used systematically for licensing and monitoring.**[74] Although wastewater discharge licenses are supposed to be issued based on the 'assimilative capacity' of water bodies (DTBP), water quality monitoring is weak and the DTBP has only been determined for 15 priority river basins.[75] Further, mostly the water quality modeling software Qual2kw is applied to determine DTBP, which only considers biodegradable and organic materials, but not toxic and hazardous pollutants such as heavy metals.[76] Further, most lakes, including the national priority lakes, do not have historical records on water quality—which complicates setting the assimilative capacity correctly. An analysis of the historical conditions of rivers and lakes needs to be conducted to derive the correct benchmark for the assimilative capacity.[77]
- **Human resource capacity and incentives to monitor the compliance with technical approvals for wastewater need to be enhanced.** While supervisors (*Pejabat Pengawas Lingkungan Hidup*, PPLH) are granted considerable authority under the 2009 Environmental Protection and Management Law to control pollution, budget allocations may not allow for promoting personnel to this position. Further, given the high workload and higher risk faced by a supervisor, adequate incentives must be provided by the regional government to motivate state employees to apply for this position.
- **The model applied to the 'Citarum Harum Initiative' should be replicated to restore other river basins, and the GoI program to clean rivers 'PROKASI' should be expanded** (see Box 8). Community participation motivated by social media campaigns to promote the value of a clean river and law enforcement conducted by the military are said to be among the success factors for Citarum Harum. Through social media, violators of water pollution control measures were 'socially punished' by posting their violations with pictures. While the initiative needs to be adapted to local circumstances, replication of this model to other river basins can be explored.[78] Currently, the GoI is trialing the revitalized PROKASI program in 100 districts and cities, which assesses whether districts and municipalities are compliant with environmental regulation based on (a) state

71 Government Regulation 22 Year 2021 on the Protection and Management of the Environment. Article 117-120

72 Stakeholder consultation with Research Centre for Quality and Environmental Laboratory (P3KLL) - Ministry of Forestry and Environment (MoEF) on September 16, 2020 and with Directorate of Environmental Health, Directorate General of Public Health (DGPH), Ministry of Health (MoH) on October 13, 2020.

73 Government Regulation 22 Year 2021, Articles 424-427

74 As mandated by MoEF Regulation 28/2009.

75 Consultation with Directorate of Water Pollution Control, MoEF, on November 2, 2020.

76 Expert opinion from Prof Etty Riani on 13 April 2021.

77 Stakeholder consultation with Research Center for Limnology, Deputy for Earth Sciences, Indonesian Institute of Sciences (LIPI) on September 17, 2020.

78 Stakeholder consultation with Deputy for System and Strategy (BNPB) on November 4, 2020.

of the environment, (b) actions taken, and (c) management.[79] However, ensuring that districts and cities will take action will be key.

The legal framework around water quality can be strengthened.

- **Ambiguities between the two regulations on water quality, MoEF Regulation No. 28/2009 and Government Regulation No. 22/2021, need to be resolved.** Both regulations classify water quality differently. For MoEF Regulation 28/2009, the trophic state is used as the basis for classification and for determining the baseline for assimilative capacity in lakes and reservoirs. On the other hand, Government Regulation 22/2021 (Elucidation) uses the functionality of the water bodies to divide them into four classes (I–IV).[80] The parameters and values used in these two regulations are different and at times mutually exclusive. For Lake Toba, for example, both water quality regulations were implemented and the Government of North Sumatra instructed that its water quality should meet class I (raw water for drinking water) as well as reach the oligotrophic state. However, technically speaking, class I standard does not meet oligotrophic criteria, although it is the standard for drinking water. According to trophic state criteria, class I standard falls in the eutrophic-hypertrophic range.
- **The implementation of Government Regulation No. 46/2017 regarding economic instrument for the environment can be reviewed.** The regulation seeks to provide a reward for any party that preserves and protects the environment and on the other hand, punishment/liability for any party that causes pollution or damage to the environment. Instruments include Payment for Ecosystem Services, Pollution Emission Quota Trade, and Environmental Guarantee Funds, such as hazardous waste management insurance. However, the implementation has been challenging. A review to identify the causes and also expedite adoption of the regulation would be beneficial.

Capacity needs to be enhanced and sufficient budget needs to be allocated to allow for water pollution monitoring and control.

- **Develop capacities and provide adequate technologies for water pollution control at the regional and local levels.** This is required to allow for monitoring emerging pollutants, conducting baseline studies, and formulating integrated control and reduction strategies. Currently, there is insufficient equipment to detect pollutants such as persistent organic pollutants (POPs), including Per- and polyfluoroalkyl substances (PFAS). Liquid chromatography systems should be procured and staff trained in its usage. Further, training in forensic technologies will allow to undertake a source-pathway-receptor analysis to hold industries discharging untreated effluent accountable.[81] For example, many polluting inputs are specific to a certain industry, such as the use of Paraquat can be traced back to in palm-oil plantation (Asep et al 2019).
- **A model to assess—and manage—nonpoint source pollution needs to be developed.** Given the challenges of directly measuring nonpoint pollution, such as agricultural runoff, a model is required. The Directorate of Pollution Control (MoEF) is currently working on the development of a nonpoint pollution model but mentioned that given the complexities, it requires additional information on how to develop it—and once developed how to apply it. Opportunities for international cooperation and capacity development need to be explored.[82]
- **Current budget allocated to water pollution control is insufficient.** The budgets for district and city governments allocated to water pollution control do not suffice to complete the tasks required, such as supervision. The importance of water pollution control needs to gain greater visibility to ensure sufficient budget allocation and consideration in planning through each region's mid-term development plan (RPJMD).
- **Expand the real-time water quality monitoring to all potentially harmful industries.** MoEF Regulation 80/2019 ('SPARING') mandates businesses across 12 industrial activities[83] to install real-time water quality monitoring devices and to record and report the data to the minister, governors, regents,

79 Stakeholder consultation with Directorate of Water Pollution Control (MoEF) on November 2, 2020.

80 See specifically the classes determination for lakes in attachment VI part II.

81 Stakeholder consultation with Research Centre for Quality and Environmental Laboratory (P3KLL) - Ministry of Forestry and Environment (MoEF) on September 16, 2020.

82 Stakeholder consultation with Directorate of Water Pollution Control (MoEF) on November 2, 2020.

83 Industries are selected based on their relatively large pollutant loads (discharge/volume and high concentration) and on their relatively large environmental impact. These include (a) rayon, (b) pulp and/or paper, (c) upstream petrochemical, (d) basic oleochemical, (e) palm oil, (f) petroleum processing, (g) oil and gas exploration and production, (h) gold and copper mining, (i) coal mining, (j) textile, (k) nickel mining, and (l) industrial areas

and mayors through the MoEF data center. In the revision of the regulation, two polluting industries were taken out of the mandatory monitoring—the paper and the fertilizer industries. Depending on the nature of the industry, total suspended solids, pH, COD, ammonia, and discharge need to be monitored. However, this does not capture toxic and hazardous pollutants, including heavy metals etc., which industrial effluents are likely to contain. By now—two years after the enforcement of the regulation—all relevant businesses are required to have the SPARING system installed. However, to date, only 117 companies are in various stages of installing the technology. Of these only six are connected to the data center and eight are in operation (MoEF 2020b). It is paramount to connect and monitor all potentially harmful industries and all businesses falling within these industries.

– **More information on the national water information system is presented in Action 8.**

Action 3: Enhancing sustainability and improving resilience to disasters

Action 3 - Key takeaways

- Indonesia is one of the most disaster-prone countries in the world.
- More than 75 percent of Indonesia's disasters are meteorological or hydrological.
- More than 1 percent of Indonesia's forest cover is lost *every year,* affecting watersheds.
- Indonesia ranks poorly on the global environmental score and lags behind India and China.
- Impact on GDP in case of inaction by 2045:
  - If rice and palm oil continue to be produced on peatland instead of on non-peatland GDP can be reduced by 3.4 percent
  - If land degradation continues and climate change remains unaddressed, GDP can be reduced by 0.11 percent for projected mean inland flood events and by up to 1.65 percent for projected future '1-in-50-year' inland flood events
  - If land subsidence continues due to groundwater overabstraction and SLR, GDP can be reduced by 2.4 percent

Threats and challenges

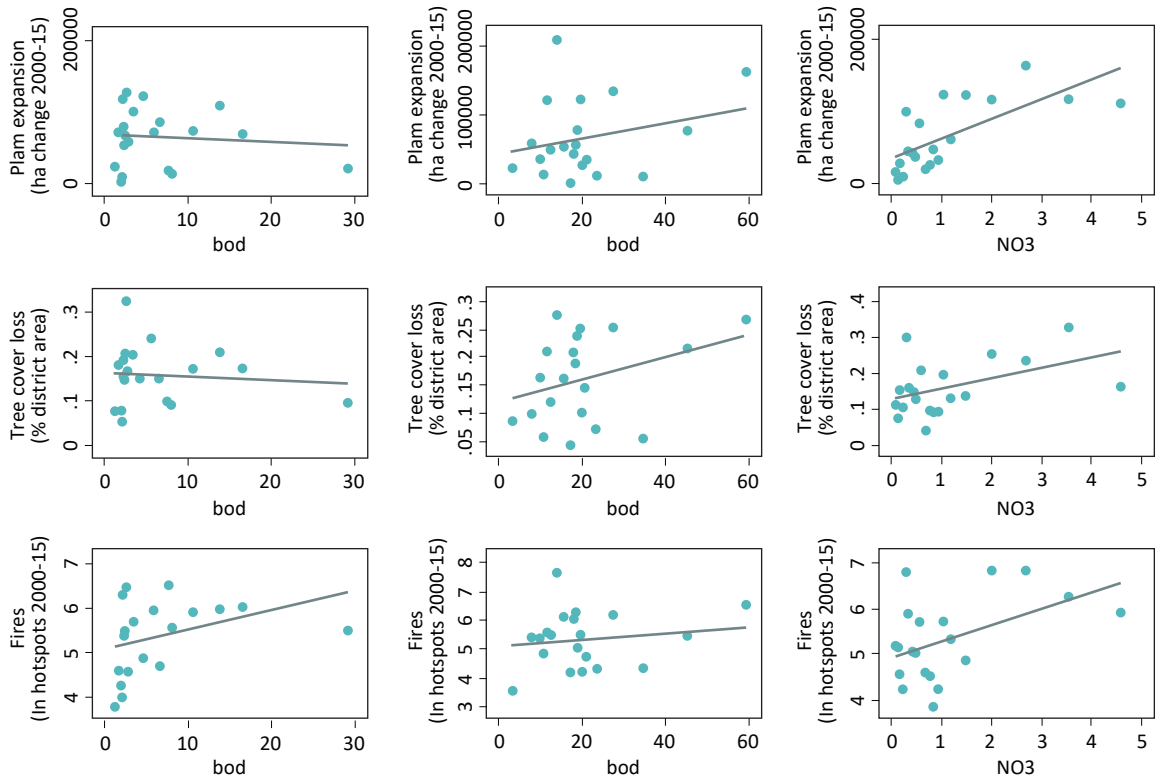
Watershed degradation

Deforestation and the degradation of watersheds have had significant impacts on the water balance, water storage functions and on water quality. Ecosystem health is directly proportional with the provision of ecosystem services – only healthy freshwater ecosystems can provide the services required for a thriving Indonesia. About 1 million ha (>1 percent) of Indonesia's 94 million ha of forest are lost every year. Forest cover has been reduced from 64 percent of the territory in 1990 to 50 percent in 2016—a 14 percent reduction (FAOSTAT 2020). The largest causes of deforestation are clearing for palm oil and for pulp and paper production, followed by coal mining, particularly on Kalimantan. Deforestation and conversion of slopes to agriculture have caused widespread catchment degradation, resulting in erosion and consequent high sediment loads and reservoir sedimentation, increased risk of landslides, and affecting the watershed's function as a water tower to provide water downstream. In higher elevations, conversion of forests to farmland has led to biodiversity loss. Environmental flows and the aquatic environment are under threat, and water quality is declining almost everywhere (see Action 2). As the 2020 Omnibus Law has taken away the obligation to preserve 30 percent of the forest cover in each watershed, it is uncertain how the required forests will be monitored and preserved in future.

Deforestation and conversion of land to palm oil plantations also impacts water quality. As deforested lands are often converted into agricultural lands, nitrogen, pesticides as other agricultural inputs are washed into waterways. The lack of plants in the forest, that consume nitrogen and other nutrients, leads to these being washed away. A data analysis shows a strong correlation between palm oil expansion and deforestation with increased water pollution, particularly nitrogen levels (Figure 18). Districts below the median palm acreage have nitrogen levels of just over 3mg/l while those above are at a staggering 245 mg/l—5 times the health guideline of 50 mg/L prescribed by the World Health Organization (WHO). However, that new and emerging research has shown that health effects also occur at levels well below prescribed limits, making this pattern a concerning one (Zaveri et al., 2019; Ward et al.,

2018).[84] This only considers diffuse pollution from palm oil plantations, and not point source pollution from the palm oil processing factories as monitoring stations are seldom close enough to these factories to capture this impact. (World Bank 2021).

Figure 18: Correlation of palm oil expansion, deforestation, and forest fires, with water quality



Source: World Bank 2021.

Together with unplanned downstream development, deforestation and degradation of watersheds are contributing to sedimentation, flooding, and environmental problems. Downstream, the widespread development of certain coastal swamps and peatlands has triggered massive oxidation and has contributed to land subsidence and consequent flooding. Urban development and encroachment into flood plains has not been sufficiently controlled by spatial planning. Reduced river capacity during periods of peak discharge is one of the causes of more frequent flooding and the incidence of flash floods is increasing. Fluctuations in natural river flows, caused for example by dams, changes in land use and major water abstractions upstream, can have a significant impact on aquatic life, especially on migratory fish. The impact on health and quality of life is particularly severe for those in informal settlements which tend to crowd along the rivers. Destruction of mangroves and seagrass beds are also increasing flood risks and impacts. Seawater is intruding into rivers and coastal aquifers. Increased salinization due to deeper intrusion of saline water as a consequence of SLR and reduced dry season flows is an increasing challenge for lowland areas (World Bank 2020c).

The environmental targets under RPJMN 2015–2019 have not been met, with the environment degrading further. Indonesia's environmental quality index[85] has mostly remained stagnant from 65.7 in 2016 to 65.1 in 2018 (RPJMN 2020–2024). The targets set out in RPJMN 2015–2019 on the rehabilitation of critical forests and land, including forest restoration and watershed management, were not achieved. The reasons are (a) constraints on land tenure and status and (b) suboptimal management of land use in the watershed. Further, there is no single indicator—or set of indicators—nor a single institution to determine the condition of a watershed, thus aggravating target setting and monitoring of improvements.

84 These patterns persist when removing the outlying high-leverage observations. The same patterns are also observed if we instead focus on palm expansion—the difference in area under palm oil cultivation between 2000 and 2015

85 The environmental quality index is a composite index consisting of three components with the following weights: Water Quality Index (30 percent), Air Quality Index (30 percent), and Land Cover Quality Index (40 percent). It is calculated separately for each province and aggregated for the country as a whole.

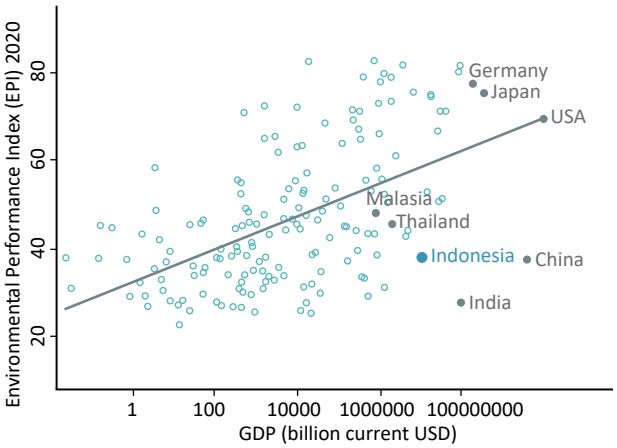
Lowlands development has brought short-term economic benefits but with accompanying ecological harm and increased disaster risk

Lowland areas, which account for approximately 15 percent of the total land area of Indonesia,[86] have been extensively developed and contribute 35 percent of GDP. However, much of this lowland development has been on peatland—one of the greatest carbon sinks on earth. This has triggered massive oxidation, subsidence, and vast peat fires. The annual cost of the fires alone is estimated at US$16.1 billion (2 percent of GDP). Development on peatlands is impairing their regulatory function for water services, reducing the quality and quantity of water downstream, and causing widespread subsidence and fire, in addition to contributing to high levels of carbon emissions, with impacts on a global scale. The benefits to be obtained from farming these peat soils are short-lived. In fact, medium-term benefits are higher for agricultural production on non-peat soils (Box 9).

Like water resources, peatland areas do not follow administrative boundaries and there are institutional uncertainties around responsibilities. Land use licenses for forest peat areas are provided by MoEF, while licenses for non-forest peat areas are provided by either the local or provincial government or by MoEF—as designated by the spatial plan. The spatial plan, however, does not consider the condition of the peatlands and there is currently no integration between licensing processes. The spatial plans should be based on strategic environmental assessments to better understand the condition of the peatlands and thus adapt allowed usage of the peatland to its condition.[87] A further challenge is adherence to the spatial plans, monitoring of land use, and reporting of any violations. At the moment—while there is a reporting mechanism—it is unclear who to report violations to and who should take actions.[88]

Improving its performance on environmental conservation would support Indonesia's goals under Vision 2045. Using the Environmental Performance Index (EPI)[89] to set Indonesia's performance on sustainability issues in an international context, there is clearly considerable scope for improvement. With an EPI score of 37.8 out of 100, Indonesia ranks 116 out of 180 countries (1 = best performer), thus showing a poorer performance than two-thirds (64 percent) of all other countries. Indonesia's performance on the categories relating to water is particularly poor.[90] While China and India are among the top five global economies with comparatively low EPI scores, Figure 19 shows that the more developed of the 'top five' global economies—Germany, Japan, and the United States—have both high EPI scores and high GDP. In fact, China and India are now rather belatedly realizing the impact of achieving economic growth at the cost of sustainability and are taking measures to reduce negative environmental impacts. For example, to address water stress and water pollution from unsustainable economic growth, China has introduced the approach of 'Three Red Lines'. At the core of this approach are targets that (a) limit total national water use, (b) specify minimum standards for water use efficiency, and (c) establish clear limits on pollutant loads.

Figure 19: Comparing countries' GDP with their EPI score



Sources: Wendling et al. 2020; World Bank GDP Indicators (latest available year).

Dam safety is becoming an increasing risk

Insufficient O&M, coupled with high sedimentation rates of reservoirs, has become a serious threat to the operation and asset life of reservoirs and hydroelectric power in Indonesia (Rohi,

86 There is no officially agreed definition of lowlands in Indonesia. These lowlands numbers are based on an updated version of mapping originally generated by the Water Management for Climate Change Mitigation and Adaptive Development in the Lowlands project (World Bank 2019f). An agreement on a lowland definition needs to be achieved.

87 For this, spatial plans need to have a scale of at least 1:250,000 (current scale is 1:50,000).

88 Stakeholder consultation with Badan Restorasi Gambut (BRG)/Peatland Restoration Agency on 18 September 2020.

89 The EPI, developed by Yale University, uses 32 performance indicators across 11 issue categories to rank 180 countries on environmental health and ecosystem vitality. These indicators gauge at a national scale how close countries are to establish environmental policy targets.

90 That is, 'water resources', 'sanitation and drinking water', 'ecosystem services', and (partially) 'fisheries'. 'Water resources' scores zero due to the lack of wastewater treatment in Indonesia.

Box 9: INSIGHT 3: The economic impact of peatland and lowland degradation on GDP by 2030 and 2045

Inaction is predicted to reduce GDP by up to 3.37 percent by 2045.

Indonesia's lowlands cover roughly 34 million ha of Sumatra, Kalimantan, and Papua and generate 37 percent of GDP through the country's agriculture, fisheries, and forestry sectors (World Bank 2020c). Shallow and deep peatland areas are being transitioned into agricultural and plantation areas. Peatland destruction causes increased flooding occurrence, land subsidence, saline intrusion into coastal aquifers, and large-scale CO_2 emissions, among other impacts. All these effects are intensified by SLR and storm surges.

To shed light on the trade-offs of developing agriculture on peatlands, the analysis compares the impacts of developing agriculture on peatland versus development on typical non-peat soils.

A single high-level scenario was analyzed for this threat, which assumes that (a) planned palm and rice plantations are developed on peat areas between 2020 and 2030 and are fully productive by 2030 and (b) impacts from peatland degradation, that is, subsidence, flooding, and salinization, occur by 2045.

The following impacts from peatland development are considered: (a) saltwater intrusion and inundation resulting from peatland drainage and subsequent subsidence, (b) flooding impacts on capital and labor productivity, and (c) greenhouse gas (GHG) emissions from degrading peatlands and the resulting additional cost incured by the GoI to meet its nationally determined contributions (NDCs).

Table 7 shows that while production benefits are equal on non-peat and peat soils in 2030, production on peat soils drops considerably from 2.29 percent of GDP increase to just 1.02 percent GDP increase by 2045 when compared to the base case, due to subsidence effects. Thus, production on non-peat soils is 3.08 percent of GDP more beneficial than on peat soils by 2045. Considering all factors besides GHG, by 2045 overall GDP benefits have fallen sixfold—to 0.59 percent—relative to what they would have been on non-peat soil. Considering the costs of required measures to offset the resultant GHG emissions to meet the NDCs, this would result in a further 0.4 percent reduction in GDP by 2030, a 1.12 percent reduction by 2045. Overall, with GHG emissions considered, the total effect of peatland development is negative by 2045 at a 0.53 percent reduction in GDP.

Table 7: The economic impact of agriculture on peatland and lowland compared to non-peatland on GDP by 2030 and 2045

Effect	Typical non-peatland (%)		Peatland (%)		Difference in 2045 (%)
	2030	2045	2030	2045	
Rice and palm production benefits	2.29	4.10	2.29	1.02	–3.08
Capital costs	–0.19	–0.15	–0.19	–0.15	0.00
Flooding capital impacts				–0.12	–0.12
Flooding labor impacts				–0.17	–0.17
Total effect without GHG	**2.10**	**3.95**	**2.10**	**0.59**	**–3.37**
Impact of GHG emissions on meeting NDCs	0	0	–0.40	–1.12	
Total effect	**2.10**	**3.95**	**1.70**	**–0.53**	

Source: World Bank 2020b.

Note: The World Bank program 'Wealth Accounting and Valuation of Ecosystem Services (WAVES)' is in the process of conducting a broad analysis of the extent of peatland degradation and estimating the macroeconomic consequences of emissions, selecting biophysical consequences of peat development. The above analysis provides a summary assessment until WAVES results are available.

Bisri, and Lomi 2013). Three-quarters (72 percent) of Indonesia's dams are more than 20 years old and only 7 percent have operating permits. Degradation of watersheds and deforestation are causing increased sedimentation and reducing the capacity of dams. Some of the large hydropower plants and reservoirs in Indonesia experience a much faster sedimentation rate than the design parameter. Tackling these challenges becomes even more important, given the GoI's plans to expand hydropower capacity by 34 percent from 5.9 GW in 2019 to 7.9 GW in 2025 (IEA 2020b).

Increasing flood risk coupled with downstream urbanization and paucity of real-time data impair dam performance and create real risks of dam failure and catastrophic downstream flooding. Dam failures in recent years resulted in considerable loss of life and widespread damage: the failure of the Situ Gintung dam in 2009, for example, cost around 100 lives.

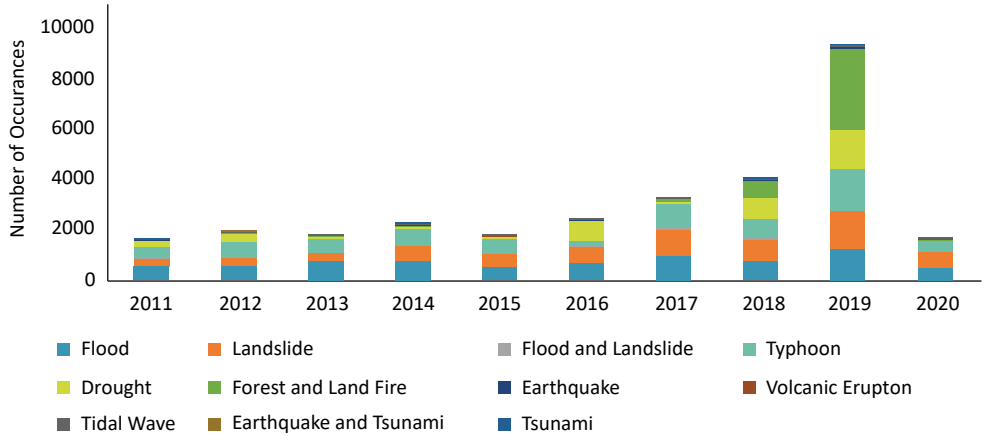
The level of water-related disaster risks has been growing

Indonesia is a disaster-prone country and is exposed to a range of natural hazards that can hinder development outcomes, affecting the population and the economy. Indonesia is vulnerable to floods, droughts, landslides, tsunamis, tidal waves, earthquakes plus 'slow onset disasters'—coastal erosion, inundation,

delta subsidence. Over the years, these risks have been greatly increased by anthropogenic factors, particularly deforestation, environmental degradation, and unsustainable water usage, together with rapid urbanization and agricultural and industrial development (Figure 20).

More than three-quarters of Indonesia's disasters are meteorological or hydrological. Floods, typhoons, droughts, landslides, and forest fires are principal among these disasters. In addition, water resources and water infrastructure are at risk from other disasters such as earthquakes, volcanic eruptions, and tsunamis. The incidence of water-related disasters has been increasing, with over 7,000 lives lost in 2007–2018 and annual economic losses of US$2–3 billion.[91] Most at risk are large cities and the poor and vulnerable.

Figure 20: Trend of disaster occurrence in the last 10 years



Source: BNPB 2020c.

Floods are the greatest and most costly water-related risk. More than 100 million Indonesians, about 38 percent of the population, are exposed to flood risks, and 325 cities and districts are classified as high risk. From 2002 to 2015, Indonesia suffered an average reported damage of US$367 million annually due to flooding,[92] with a total cost of an estimated US$5.2 billion over the period, discounting associated socioeconomic losses. An analysis of 92 cities across Indonesia indicates that the number of reported floods in these cities almost tripled from 50 in 2006 to 146 in 2017 (DIBI 2018). In 2020, flooding in Jakarta affected 173,000 people.

Box 10: INSIGHT 4: The economic impact of floods aggravated by land degradation and climate change on GDP by 2030 and 2045

Inaction is predicted to reduce GDP by up to 0.11 percent for projected mean flood events and by up to 1.65 percent for projected future '1-in-50-year' flood events by 2045.

Urbanization, changes in land use—including deforestation—and climate change impacts will expose the population to increasing flooding risk. The analysis assesses the biophysical and macroeconomic impacts of flooding across Indonesia for a scenario consistent with historical conditions as well as a future scenario where flooding worsens through climate change and land degradation (deforestation) impacts. Deforestation changes the infiltration capacity of the soil, and thus the curve number in the flooding analysis.

The analysis developed flood runoff models for each of Indonesia's 752 drainage basins and considers the impacts of 'mean flooding events' and of a '1-in-50-year flood event', that is, the year with maximum damage nationally, based on the following scenarios for 2030 and 2045:

- **No land use change,** under a *no climate change* and a *wet climate change* sub-scenario
- **Further land degradation**, under a *no climate change* and a *wet climate change* sub-scenario.
- The analysis attempts to capture the following:
- **Direct effects on the area flooded,** including disruption and destruction of public infrastructure, disruption and destruction of

91 National Disaster Management Authority, Head of Data and Information 2018, and World Bank/GFDRR 2012. Among the Association of Southeast Asian Nations (ASEAN) countries, Indonesia faces particularly high expected annual economic losses from floods and earthquakes.

Appraisal Document of the Indonesia Disaster Resilience Initiatives Project (P170874). http://documents1.worldbank.org/curated/en/160881575169231425/pdf/Indonesia-Disaster-Resilience-Initiatives-Project.pdf

92 International Disaster Database EM-DAT 2018.

private industrial capital, reduced production, destruction of residential housing
- **Indirect effects on the rest of the economy,** including reductions in labor productivity resulting from displacement.

Table 8 provides the impacts of both flood events for the two land use change scenarios for a wet climate change future. The combined impacts of the projected future mean flood under the changing precipitation and changing land degradation scenario amount to GDP losses of 0.09 percent in 2030 and 0.11 percent in 2045, with the driving impact being climate change. While the trend of impacts for each scenario is similar, the projected future 1-in-50-year flood has an absolute greater magnitude than the projected future mean flood. When compared to the mean historical flood, the combined capital and labor impacts of the projected future 1-in-50-year flood in the scenario with both land degradation and climate change amount to a loss of GDP of 1.65 percent in 2030 and 1.05 percent in 2045. Note that the effects in 2030 are higher than those in 2045 because the 1-in-50-year event in 2030 is larger than in 2045 for the particular wet scenario selected here. When the impacts of the 50-year projected flood are compared to the impacts of the 50-year historical flood (that is, to identify the marginal effects of land degradation and climate change on the 50-year event), the GDP impact of land degradation alone is 0.09 percent in 2045. The combined impact of both land degradation and precipitation generates impacts of 0.64 percent in 2030 and 0.44 percent in 2045 on GDP when compared to the base case.

Table 8: Scenario analysis on the economic impact of flooding aggravated by land use change and climate change by 2030 and 2045 (% GDP change from base case)

Climate	Land degradation scenario	Mean historical flood		Projected future 50-year flood compared to:			
				Mean historical flood		50-year historical flood	
		2030	2045	2030	2045	2030	2045
Wet	No change	–0.08	–0.10	–1.62	–1.03	–0.61	–0.42
	Further degradation	–0.09	–0.11	–1.65	–1.05	–0.64	–0.44

Source: World Bank 2020b.

Note: As this is a high-level, national analysis, the flooding analysis is conducted for each of the 752 drainage basins in Indonesia. The results, however, are aggregated and presented at the national level, which is the scale of the CGE model. The analysis does not attempt to evaluate inundation depths or map infrastructure impacts in specific locations. A more detailed, regional analysis is required to understand the full impact of floods.

More information and additional scenarios are presented in the underlying report "Indonesia Toward Water Security – Diagnostic Report"

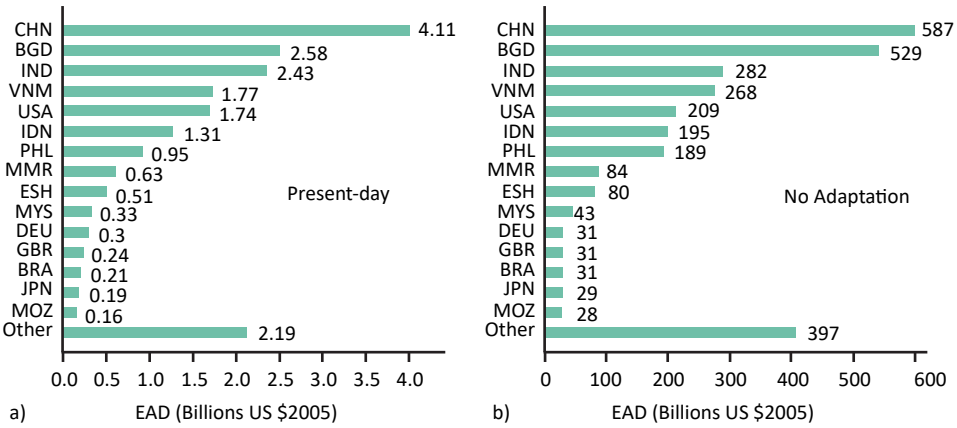
Flood risks are expected to worsen. About 20.5 million people are settled in areas of high flood risk. It is expected that by 2055, the number of Indonesians exposed to fluvial (river) flood risk will increase by 75 percent (World Bank 2019o). Flood risk is expected to increase due to continued urban population growth and the associated transformation of the built and natural environment, particularly where there is poor quality infrastructure and lack of or insufficient risk-informed planning. Without addressing land degradation and climate change, a 1-in-50-year flood is predicted to reduce GDP by 1.65 percent by 2030 (Box 10). The projected effects of climate change and more widespread land subsidence (see Action 1) are likely to further intensify risks (World Bank 2019e). The increased flood risk in Indonesia follows a region-wide pattern, with a 1-in-100-year flow predicted to become a 1-in-50-year or 1-in-25-year event in most of South, Southeast, and East Asia (Paltan et al. 2018).

SLR and associated coastal erosion have raised the risk of coastal flooding. There are 42 million Indonesians who are living at less than 10 m above sea level and are vulnerable to threats from SLR. A 50 cm SLR, combined with land subsidence in Jakarta Bay, could permanently inundate densely populated areas of Bekasi and Jakarta that house more than 270,000 residents.[93] Without adaptation, Indonesia's expected annual damage from coastal flood hazards is expected to increase from US$1.31 billion to US$209 billion by 2080—a 160-fold increase (Figure 21).[94] Coastal flooding caused by SLR is predicted to reduce GDP by up to 2.4 percent. If groundwater abstraction continues, the impact on GDP increases by 1.32 percent resulting in an overal reduction of 3.66 percent by 2045 (Box 11).

93 Appraisal Document of the Indonesia Disaster Resilience Initiatives Project (P170874).

94 Expected annual damage is estimated by taking the integral of the exceedance probability-impact (risk) curve, considering the risk per year, urban damage (impact), vulnerability, and the annual probability of non-exceedance of the protection standard.

Figure 21: Top 15 countries with coastal flood risk in (a) current conditions and (b) 2080 if no adaptation takes place for the scenario RCP 4.5/SSP2



Source: Tiggeloven et al. 2019.
Note: The countries and value on the x-axis change for each graph.

Box 11: INSIGHT 5: The economic impact of coastal flooding aggravated by seal level rise and groundwater induced subsidence on GDP by 2030 and 2045

Increased coastal flooding due to SLR is predicted to reduce GDP by up to 2.4 percent. Inaction to address groundwater overabstraction with resultant subsidence is predicted to aggravate this impact by an additional GDP reduction of up to 1.32 percent, resulting in an overall reduction of 3.66 percent by 2045.

Inaction to reduce GHG emissions (and resultant SLR) is predicted to reduce GDP by around 1 percent by 2090.

Rising sea levels and land subsidence (due to groundwater over-extraction) threaten coastal infrastructure and agricultural lands. SLR could affect the 42 million people who live within 10 m above sea level in Indonesia, and a 50 cm rise could permanently inundate sections of Jakarta and Bekasi (World Bank 2020b).

The analysis of SLR and subsidence impacts considers the following scenarios:

1. **Subsidence only,** which includes *moderate* and *high* land subsidence sub-scenarios. Climate change is not considered to estimate the marginal impact of subsidence compared to SLR.
2. **SLR only**, which includes *low SLR* and *high SLR* sub-scenarios drawn from the latest IPCC estimates.
3. **SLR and BAU land subsidence**, which includes *low SLR + moderate subsidence* and *high SLR + high subsidence* sub-scenarios.

In addition, one the scenario for SLR by 2090 was added, which includes *RCP4.5* and *RCP8.5* sub-scenarios for 2090, to demonstrate the potential effects of global GHG mitigation on Indonesia.

This analysis used a geographic information system to estimate the population and agricultural land area inundated under various SLR and land subsidence scenarios. It translated these inundated areas into lost capital and agricultural production and then extrapolated impacts to the national level for processing within the CGE. Note that this analysis does not model storm surge explicitly nor does it conduct a detailed geospatial analysis on coastal infrastructure, as it is a significant undertaking with large data and modelling requirements. These impacts, however, can be expected to be of even greater concern, as SLR and storm surges in Indonesia could lead to coastal flooding damages 150 times higher than are currently experienced (Tiggeloven et al. 2019).

Table 9 presents the results for the impacts on coastal flooding aggravated by (a) subsidence only, (b) SLR only, and (c) the two shocks combined, for both medium- and high-impact scenarios. GDP losses for subsidence only range from 1.01 for moderate subsidence to 1.32 percent for high subsidence levels by 2045. GDP losses from SLR only range from 1.98 percent for low SLR to 2.4 percent for high SLR by 2045. The combined effects range from 2.94 percent in the moderate scenario to 3.66 percent in the high scenario. While GHG mitigation to reduce SLR depends on many external factors, groundwater overabstraction can be tackled by the GoI, which could avoid up to 1.32 percent of GDP losses by 2045.

Mitigation of SLR can only be achieved by reducing GHG globally. Running the RCP4.5 versus RCP8.5 for 2090 shows impacts of 6.51 and 7.45 percent, respectively. While impacts remain high, the more aggressive global GHG mitigation trajectory (that is, RCP4.5) would avoid approximately 1 percent of GDP losses.

Table 9: Scenario analysis on the economic impact of coastal flooding aggravated by SLR and land subsidence driven by groundwater overabstraction by 2045 (% GDP change from base case)

Effect	Moderate scenario *Moderate land subsidence Low SLR*	High scenario *High land subsidence High SLR*
	2045	2045[a]
Subsidence only	−1.01	−1.32
SLR only	−1.98	−2.40
SLR + Subsidence	−2.94	−3.66

Note: a. The analysis caps subsidence effects at 2 m to acknowledge the limits of aquifer compression. This assumption dampens subsidence under the 2045 high scenario, and although levels are still higher than in 2030, the relative GDP effect is lower because of economic growth over the period.
b. SLR is predicted based on IPCC estimates and all changes are relative to a base year of 2015.

The incidence and severity of droughts has increased over the years. Indonesia experienced severe drought events in 1997, 2015, and 2019—years coinciding with El Niño events which influenced the hydrometeorology. While El Niño events cannot be predicted, the cycle has been found to return around every four to five years. The drought in 2015 reduced water availability by about 20 billion m^3 in Java and Bali and Nusa Tenggara, affecting about 102 city/districts across 16 provinces and 111,000 ha of agricultural area (BNPB 2015). Indonesia's catastrophic forest fires—particularly on drained peatland—have hit hardest in drought years. About 44 percent of the burned areas were located in peatlands, where fires are harder to suppress once started. The cost of total damage and economic loss from fire in eight provinces in 2019 was estimated at US$5.2 billion, while the cost of the 2015 fires was estimated at US$16.1 billion (World Bank Group 2019b).

The intensity of landslides has increased along with climate variability—but the risks are rarely factored into development planning or even disaster risk management plans. The National Disaster Management Agency (*Badan Nasional Penanggulangan Bencana* or BNPB) categorized landslides as the deadliest hydrometeorological disaster. Landslides also cause severe damage to infrastructure and high economic losses (BNPB 2018b). Landslides are caused by high rainfall, unstable slopes, unsustainable land use, and by types of soil that easily absorb water. The Center for Volcanology and Geological Hazard Mitigation (*Pusat Vulkanologi dan Mitigasi Bencana Geologi*, PVMBG) under the Geological Agency (Badan Geologi) monitors the landslide risks and has issued a landslide vulnerability zone map and a map with 'predicted landslides'. However, these maps have not been used by local governments for developing spatial planning or disaster management plans (PVMBG 2020).

Several other natural hazards that are not directly related to water also pose severe risks to Indonesia's water security, including earthquakes, volcanic activities, and so on. Earthquake risk is particularly high, with some 80 percent of the country located in earthquake-prone areas.[95] According to BNPB's database, Indonesia on average experiences 13 volcanic eruptions every year. These hazards can physically damage water supply and sanitation infrastructure systems and therefore affect the services provided adversely.

Risks are likely to increase with climate change. Overall, the effect of climate change on water resources is expected to be considerable, with impacts varying between a 'dry' scenario characterized by mounting scarcity and a 'wet' scenario with rising levels of water-related disaster. Climate change will also have an impact on water quality, as for example nitrogen and salinity both increase with higher rainfall variability, and hotter temperatures—especially in combination with more nitrogen - lead to higher biological growth and thus to more frequent cyanobacterial and algal blooms. However, the biggest climate change threat is SLR, which risks inundating extensive coastal areas and reducing GDP by up to 2.4 percent by 2045 - and by 3.66 percent if groundwater abstractions continue at current rates (Box 11). [96]

Enhancing resilience requires a system-wide approach across all pillars. Suggested actions across the report contribute to the resilience of (a) water resources (for example, through reduced groundwater overabstraction, reduced pollution, protected ecosystems); (b) water users (through optimized water usage and development); and (c) water institutions (for example, through modernized water monitoring and analytical tools, water modelling and knowledge, increased capacity of water bodies, water governance, and cross-sectoral coordination).

95 National Disaster Management Authority, Director of Disaster Risk Reduction on Safe School Program, 2016.

96 More information and additional CGE scenarios are presented in the underlying report "Indonesia Toward Water Security – Diagnostic Report"

Priority actions

If Indonesia is to achieve its Vision 2045 targets, action is needed now.

- **The GoI's policy, as set out in RPJMN 2020–2024, promotes environmental quality improvement.** Alongside a specific focus on preventing land and forest fires and reducing biodiversity loss, the plan prioritizes investment for (a) the restoration of key ecosystems, including peatlands, ex-mine lands, coastal and marine systems, and biodiversity habitats; (b) sustainable forest management; and (c) water and ecosystem conservation measures, including 'green infrastructure'. A 'major project' will invest in the recovery of four critical watersheds and the restoration of peatlands.
- **To protect watersheds, a structural and long-term strategy and a massive coordinated effort are required.** At present, there is a lack of upstream and downstream coordination and cooperation. PJT I, for example, is struggling with the degraded water quality from upstream areas. Coordination with the responsible provincial government upstream is required to address this challenge.[97] Overall, the management of different water resources needs to be more integrated (see Action 1). Further, managing peat soils is technically difficult, financially costly, and institutionally complex. Conservation, adaptive development, and development zones need to be defined, each with their specific water management requirements. A priority is integrated land and water planning and management based on the characteristics of individual peat hydrology units (PHU), bringing together planning and coordinated management across sectors and integrating agricultural development, water resources planning, and fire management at the landscape level.
- **Improving land use management is curial to enhance sustainable water resource management.** Lack of enforcement of land use plans is seen as one of the key issues for watershed management, causing adverse changes in runoff resulting either in floods or reduced water flows, erosion, landslides and sedimentation. Previous watershed rehabilitation programs, especially in areas with high risk of land erosion, were undone due to unlawful agricultural land uses in these areas. It should be ensured that the 'Zero Delta Q policy' is maintained, that is, the runoff coefficient before development and land use changes must be the same as the runoff coefficient afterwards.[98] Care needs to be taken to protect and conserve upstream catchments.
- **Effectiveness of law enforcement on deforestation and land use changes based on regional spatial planning needs to be increased.** To ensure that watershed rehabilitation programs are effective in terms of outcome and use of funds, spatial plans need to be enforced and any violations penalized by the local government.[99] Clarity is required on how forests will be protected in future, as the 2020 Omnibus Law revoked the requirement to keep 30 percent forest cover in each watershed. Further, regulatory clarity is needed on water management practices of plantations. Legally, plantations are allowed to retain water in their concession area; however, this often affects communities downstream and increases the fire risk in these areas. In collaborative projects, such as 'village to resilience to fire' led by BRG, plantations cooperate with villages downstream to ensure that they have sufficient water and that their assets do not catch fire.[100] Environmental flow requirements need to be assessed and enforced. including considerations on maintaining stretches of free flowing water for dam construction to reduce the impact on aquatic life.
- **Sustainable development needs to be integrated into daily habits and culture.** Besides changes in water governance, people are key to ensure a sustainable path for the future. Valuing water and ecosystem services need to incorporated once again into the peoples' values to allow changes in habits and also demands for sustainable water resources management to the government, industries and agriculture. For this educational and awareness campaigns can support this objective.
- **There is a need to design and implement a regulatory framework and finance options to leverage green infrastructure[101] to complement gray infrastructure and to realize their multiple**

97 Stakeholder consultation with PJT1 on September 24, 2020.

98 Stakeholder consultation with Directorate of River and Coastal (MPWH) on November 11, 2020.

99 Stakeholder consultation with Directorate of Irrigation and Water Resources Management (BAPPENAS) on September 17, 2020.

100 Stakeholder consultation with Centre for Data, Information, and Disaster Communication (Pusdatinkom) on September 23, 2020.

101 Green infrastructure is defined by the EU Green Infrastructure Strategy as "a strategically planned network of high quality natural and semi-natural areas, which is designed and managed to deliver a wide range of ecosystem services and protect biodiversity."

co-benefits including disaster risk reduction. Green infrastructure (or nature-based solutions) was found to be a cost-effective and resilient approach in managing stormwater in urban areas. While single-purpose gray infrastructure, such as drainage systems, just focus on moving stormwater away from built-up areas, green infrastructure reduces and treats stormwater at its sources—thus not only preventing flood events but also providing treated water supplies when needed (EPA 2020). Awareness of the multiple co-benefits and cost-effectiveness of green infrastructure needs to be increased and streamlined into decision-making by including these options into the cost-benefit analyses.

– **To protect peatlands, mapping of their location and condition needs to be completed; moving toward peat-friendly food production, such as paludiculture, needs to be considered; and the opportunity for carbon economics to replace traditional peatland cultivation assessed.** Mapping of peatland areas and their condition at a scale of 1:250,000 needs to be completed and integrated into spatial plans to allow for appropriate land uses. BGR is currently working on a Green Peatland Economy Vision, which analyzes these opportunities of alternative cultivation in peatlands. Paludiculture, which is agriculture and plant cultivation in wet conditions, allows for forestry, agroforestry, crop and feed production, and production of raw material for energy, construction, and biochemical products—while sustaining peatland ecosystem services, such as regulating water dynamics (flood control) and water quality (purification) and accumulating carbon. So far, 165 plant species were found to be suitable for paludiculture in Indonesia (FAO 2016). Regional food security could be enhanced by focusing on native and adaptive species from peatland areas.[102]
– **To reduce the environmental impact from mining and enhance enforcement of regulations, licensing and monitoring of mining activities need to supported with technological solutions.** A study by the Directorate of Water Pollution Control across 92 mining programs found that only 27 were complaint with environmental regulations.[103] A system based on remote sensing and geospatial datasets for local, regional, and national mining activities can increase the monitoring and make it more valid, rapid, and representative.[104] Further, it can ensure that mining permits consider the ecosystem and thus avoid mining damaging the morphology of water bodies—either directly through mining in the river or indirectly though sediment being washed into the river.[105] Law 4/2009 on Mineral and Coal Mining was recently amended with Law 3/2020 and places stronger emphasis on implementation of reclamation and post mining activities to protect the environment, including the quality and or quantity of surface water and groundwater. The potential for reclaiming ex-mine land to use it to create clean water sources for the community or flood retention ponds should be explored and added to Ex-mine Reclamation Policies.[106] The revised Law 3/2020 further transfers the tasks of providing business licenses for mining activities, as well as the authority to develop and supervise these mining activities, from the provincial government to the central government. The impact of this law will be seen over time.

Gaps in disaster preparedness and emergency management systems need to be closed to reduce disaster risk.

– **To avoid costly future losses, extra emphasis is needed on preparedness and a risk-based approach to disaster prevention and management needs to be adopted.** The RPJMN underlines the need to develop disaster-resilient infrastructure and to combine structural and nonstructural measures, integrating 'green infrastructure' wherever possible. The RPJMN also proposes convergence between policies, strategies, and measures for disaster risk reduction and those for climate change adaptation. Within this framework, a GoI priority is to adopt integrated strategies for management of disaster-prone areas, notably for flood risks in urban areas. A priority is to develop hazard risk maps, update these periodically, and mainstream risk assessment into local and national spatial plans. This can be done through considering identified areas of disaster zones (such as for floods) as one of the bases for formulating spatial structures (struktur ruang) and spatial patterns

102 Stakeholder consultation with Badan Restorasi Gambut (BRG)/Peatland Restoration Agency on September 18, 2020.

103 Stakeholder consultation with Directorate of Water Pollution Control (MoEF) on November 2, 2020.

104 Stakeholder consultation with Directorate of Technical and Environmental Affairs of Mineral and Coal, Directorate General of Mineral and Coal, Ministry of Energy and Mineral Resources (MoEMR) on October 14, 2020.

105 Stakeholder consultation with Directorate of River and Coastal (MPWH) on November 11, 2020.

106 Expert opinion of Directorate of Technical and Environmental, DGMC, MEMR on 25 May 2021.

(pola ruang) and—for example—by defining this water disaster-prone area as a certain zone in spatial plan maps.[107] Water-related risk prevention and reduction should be prioritized over disaster response. Indonesia is also part of the UN Sendai Framework for Disaster Risk Reduction and is required to submit annual progress reports.

- **Collaboration between water agencies and agencies for disaster risk management needs strengthening for a coordinated disaster response system across sectors and levels of government.** In particular, (a) a coordinated disaster response system is needed across different sectors and levels of government—priorities are to develop protocols for coordinated disaster risk response and to clarify the functions of each party together with coordination mechanisms and (b) information exchange among line ministries and national and local government needs to be strengthened. Policy coherence across climate change adaptation, water management, land management, spatial planning, ecosystem and biodiversity protection, and disaster risk reduction needs to be improved.[108] To 'risk proof' infrastructure on the one hand and on the other hand ensure that the infrastructure itself will not cause increased disaster risk, MoPWH should consult BNPB during infrastructure development.[109]
- **Strengthening information dissemination and early warning systems and, in particular, reinforcing decentralization and community engagement.** The Multi Hazard Early Warning System has got off to a good start but there is scope to improve its accuracy and its ability to network effectively across multiple agencies. It should be connected to the national water information system, which is currently being developed (see Action 8).
- **Investing in prevention and resilience to reduce the disaster risk and impact—and if unavoidable to recover quickly.** This includes coordination in planning and investment in resilience between upstream and downstream; recovery of watersheds, peatlands, as well as coastal mangroves and seagrass beds; and strengthening of the resilience of water infrastructure and institutions through investment and O&M. While BNPB cooperates with provincial governments and RBOs after a disaster has occurred, this cooperation needs to be expanded to risk prevention and building resilience. To ensure disaster preparedness, cooperation across BNPB, MoEF, MoPWH, local government, local NGOs focusing on river basin management (such as river volunteers) and communities is required. Flood risk management should be included as an integral part of river basin management and basin management plans. The potential of nature-based solutions, such as afforestation of upstream watersheds and protection of mangroves and seagrass beds, should be explored—in cooperation with universities and research institutions—and implemented whereever possible.

Dam safety should be improved

- **Although it is effective, the national dam safety program has only partial coverage and needs to be strengthened.** Indonesia has developed a risk-based asset management approach that is applied at both national and basin levels. However, as the dam inventory ages and risks increase, the program needs to be expanded. Emergency action plans need to be prepared for each dam and updated every five years. This is of particular importance considering the GoI's plans on expanding dam capacity further and focusing on hydropower to meet its renewable energy targets. Emergency Action Plans should be available—and updated regularly—for all key water resources infrastructure, not just for dams.[110]
- **Full financing of O&M is essential.** The current underfunding of dam management, O&M, and a bias toward new construction impair efficiency and exacerbate risks of dam failure.

Climate change adaptation in water infrastructure development and planning needs to be mainstreamed.

- **Although the impacts of climate change will be varied across Indonesia's vast archipelago, there is a need for preparedness.** As mentioned earlier, the RPJMN emphasizes the need for convergence between policies, strategies, and measures for disaster risk reduction and those for climate change adaptation. To move toward resilience, the *pola* and *rencana* need to be improved, particularly with a focus on climate change

107 Stakeholder consultations with Directorate of Survey and Thematic Mapping—Ministry of Agrarian Affairs and Spatial Planning (MoASP) on November 2, 2020.

108 Stakeholder consultation with Directorate of Irrigation and Water Resources Management (BAPPENAS) on September 17, 2020.

109 Stakeholder consultation with Deputy for System and Strategy (BNPB) on November 4, 2020.

110 Stakeholder Consultation with Directorate of River and Coastal (MPWH) on November 11, 2020.

impacts, environmental degradation, and disaster risk management.[111]

– **Climate change scenarios need to be developed per island and incorporated into future planning and investment decisions and guidelines and technical standards for climate-resilient infrastructure need to be developed.** This is of particular importance to mitigate flood and drought risk and to manage disasters. SLR is posing a particular risk to coastal flooding and saline water intrusion into aquifers (Box 12). Greater rainfall variability is aggravating flood risk and impact as well as droughts. Agriculture is at risk and there is a need to develop and promote climate-smart agriculture systems. Climate change scenario modelling—per island—is required to also consider impacts on rainfall and runoff as well as on extreme rainfall events.[112] Regional planning will be essential—for example, to develop cropping patterns adapted to a changing climate, create livelihood systems in coastal areas that respond to the growing risks of flooding and seawater inundation, adjust storage systems to accommodate changes in extreme rainfall, and consider overall land use in and around urban areas to reduce the risk and impact of flooding and water shortages.

Pillar II. Improving the inclusivity, sustainability and efficiency of water service delivery

To achieve Vision 2045, measures under RPJMN 2020–2024 should aim at the following:

- Increase the coverage, efficiency, and sustainability of urban and rural water supply.
- Increase access to sanitation through an 'adaptive sanitation strategy' and through expansion of rural sanitation programs.
- Create an enabling environment to attract private sector participation in water supply and sanitation.
- Provide efficient and sustainable water services for agriculture to boost rural growth and incomes and to meet changing food security needs.

Action 4: Accelerating inclusive, sustainable and efficient water supply for all Indonesians

Action 4 - Key takeaways

- Overall access to 'improved water supply' increased from 76 percent in 2000 to 90 percent in 2020.
- Only 23 percent of Indonesians have access to piped water.
- Only 9 percent of total domestic water demand is provided by water utilities; private groundwater wells are the dominant water source.
- Only 30 percent of the total national raw water demand can be provided with current bulk infrastructure capacity.
- Yet around 24 percent of bulk water available for water supply is not utilized.

Threats and challenges

Water services fall well short of usual standards at Indonesia's level of development and far below the aspirations of Vision 2045, increasing the risks of transmission of COVID-19. Access to 'piped' and 'safely managed' water supply services is low. Overall access to 'improved water supply' has increased from 76 percent in 2000 to 90 percent in 2020 (BPS 2020c).[113] Rural areas have made great progress (increase from 66 percent in 2000 to 80.5 percent in 2020) but still lag behind urban areas (increase from 89.5 percent in

111 Stakeholder consultation with Directorate of Technical Development for Water Resources Management (BINTEK SDA) (MoPWH) on November 11, 2020.

112 Stakeholder consultation with Directorate of Technical Development for Water Resources Management (BINTEK SDA) (MoPWH) on November 11, 2020.

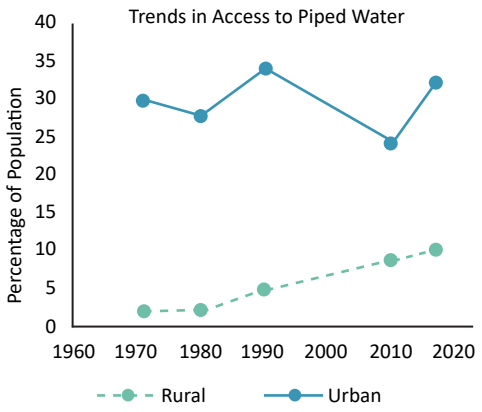
113 'Access to improved water' is measured 'akses air minum layak' in BPS. This includes piped water on premises (piped household water connection located inside the user's dwelling, plot, or yard) and other improved drinking water sources (public taps or standpipes, tube wells or boreholes, protected dug wells, protected springs, and rainwater collection).

2000 to 95.5 percent in 2020)(BPS 2020c). Access to improved water differs across regions, with 95 percent on Java—the richest island and only 66 percent on Papua—one of the poorest islands.[114] Access to 'piped' water supplies remains low (23 percent in 2018)(BPS 2018). About 32 percent of urban dwellers had access to piped water in 2017, compared to only about 9 percent of rural residents (Figure 22). This falls far short of the last RPJMN 2014–2019 target of 60 percent access to piped water nationwide. Piped water distribution infrastructure has struggled to keep pace with the rapid urbanization of the last three decades. In light of the COVID-19 pandemic, access to adequate water supplies for augmented hygiene needs, such as frequent handwashing, has become even more critical. The importance of inclusive development and access to WASH services for all has been highlighted in this pandemic to not only protect the poor but for society as a whole (Box 12).

Box 12: The provision of safe water, sanitation, and hygienic conditions is essential to protecting human health during all infectious disease outbreaks, including the COVID-19 outbreak

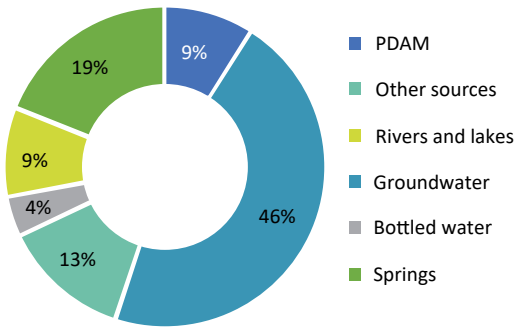
Hand hygiene is extremely important to prevent the spread of the COVID-19 virus—as well as of other viruses and bacteria causing common colds, flu, and pneumonia, thus reducing the general burden of disease. Current evidence indicates that the COVID-19 virus is transmitted through respiratory droplets or contact. Contact transmission occurs when contaminated hands touch the mucosa of the mouth, nose, or eyes; the virus can also be transferred from one surface to another by contaminated hands, which facilitates indirect contact transmission. As part of the COVID-19 response, the GoI is supporting the installation of handwash facilities in communal areas. This push should be used to also increase household water and handwashing facilities.

Figure 22: Trends in access to piped water, rural and urban (1970–2017)



Source: Authors' calculations based on Census Data (1970, 1980, 1990, and 2010) from Integrated Public Use Microdata Series(IPUMS) and Demographic and Health Survey (DHS) 2017.
Note: Methodological changes are in part responsible for the seemingly higher coverage in 2017.

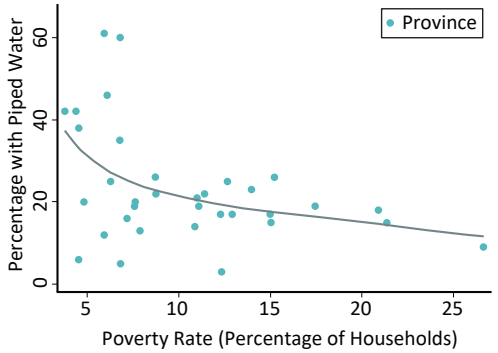
Figure 23: Water sources for domestic demand (2019)



Source: RPJMN 2020–2024.

Unsurprisingly, access to piped water is highest in richer provinces. Access to piped water is highest in provinces in which less than 10 percent of the households fall below the poverty line (Figure 24). The province of Bali has the lowest percentage of households below the poverty line (3.78 percent, 42 percent access to piped water), while the province of Papua has the highest percentage of households below the poverty line (26.64 percent, 9 percent access to piped water). Access to piped water is highest in North Kalimantan (60 percent access, 6.8 percent below poverty line) and lowest in Lampung (3 percent access, 12.34 percent below poverty line). Targeted support is required to provide access to piped water to households with high poverty rates.

Figure 24: Correlation of access to piped water and percentage of households below poverty line



Source: BAPPENAS (processed by BAPPENAS from SUSENAS 2019) and BPS 2020c.
Note: Poor are defined as people who have an average monthly expenditure per capita below the poverty line set for each province.

114 Interestingly, access to improved water supply is very different across urban (91 percent) and rural (56 percent) areas in Papua.

In fact, much demand is met from privately developed groundwater—and if left unaddressed, the effects of groundwater overabstraction are estimated to reduce GDP by up to 1.42 percent by 2045 (Box 4). Only 9 percent of domestic demand nationally is provided by PDAMs, while about 46 percent of domestic water demand is met by privately developed groundwater (Figure 23). The resulting groundwater overexploitation has led to widespread land subsidence in urban and industrial areas (see Action 1). The lack of reliable and sufficient public water supply services drives industries, commercial establishments, and households to resort to largely unregulated groundwater abstractions to access adequate supplies.[115] Figure 25 shows how the population in provinces with low access to piped water supply predominantly uses groundwater. However, even if piped water supplies are accessible, water users may prefer to use groundwater to avoid the water tariff on piped water. Metering and charging for groundwater for industrial and commercial establishments is recent and has been inconsistently applied.

Box 13: Strengthening local governments and village authorities is required to increase access to clean water supply in rural areas—key to reduce stunting and spread of contagious diseases, such as COVID-19

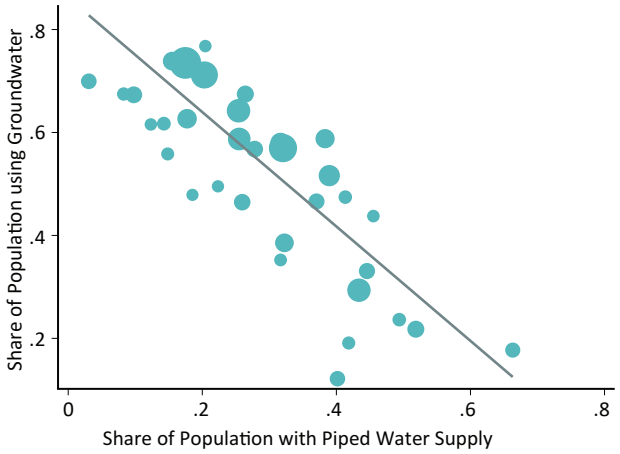
The availability of sufficient water in terms of quantity and quality is paramount in ensuring good health by preventing gastrointestinal diseases, which contribute to higher stunting rates, and the transmission of contagious diseases, such as COVID-19. In Indonesia, local governments are responsible for service delivery. In rural villages, water services are operated and maintained by village water and sanitation organizations (KP-SPAM). If a village is unable to secure funding for the development of drinking water services from supra-village sources, or is unwilling to contribute the 20 percent of the project cost to be part of the PAMSIMAS program, villages can develop small-scale water facilities using their village budgets (Dana Desa and Alokasi Dana Desa). In this case, the village relies on a village technical facilitator who often oversees more than 200 projects and is not provided with any standard technical drawings to support the process. Further, there is no mechanism for the village to request for additional support from the Public Works Department, for example, for more complicated programs. Water quality testing is not an automatic procedure for water supply systems, but needs to be requested from the health department. A further complication is the ability of village authorities to support water supply projects financially. As per the 2019 Water Law, village water management committees and village water enterprises are prioritized to receive water permits. However, in these cases the infrastructure is not assigned as village asset and thus village funds cannot be used for financing O&M. While water user fees may be able to cover the day-to-day operations, any larger expenses to maintain the system may prove to be a challenge with the system potentially falling into disrepair.

By allowing the financing of water infrastructure with village funds, optimizing the processes of local governments receiving technical support in designing and constructing the water supply infrastructure will accelerate the provision of water supplies across rural areas and thus provide an important step forward in maintaining and improving good health. Good health is paramount to increase Indonesia's human capital as foundation for achieving Vision 2045.

Source: World Bank 2020g.

115 While Ministerial Regulation 40/2016 on Technical Guidance for Industrial Estate Development allows industrial zone operators to extract the groundwater on certain condition for their needs, they are not permitted to distribute the groundwater to the tenants, that is, the industries.

Figure 25 Groundwater usage and access to piped water supply by province



Source: Data from DHS 2017. Markers represent provinces (weighted by population size), and the line shows a linear ordinary least squares fit.

Women and poor usually bear the brunt of lack of water access. The percentage of people below the national poverty line in rural areas—around 13 percent—is nearly double the percentage of those in urban areas, around 7 percent in 2020.[116] This is also reflected with access to WASH—with rural areas lagging behind urban areas. In Indonesia, around 38 percent of water fetchers are women. However in rural and less-affluent households—which in many cases include indigenous households—women and children are more likely to collect water (Irianti and Prasetyoputra 2019). Further, as women and girls are mostly responsible for washing, they are disproportionality more exposed to polluted river water, for example, from upstream small-scale gold mining in West Kalimantan (Down to Earth 2003). Given that women and girls are primarily responsible for ensuring WASH access for their family and are the main caregivers in case a family member falls sick, it can be expected that COVID-19 has placed a further burden on them. [117]

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. Water supply systems are often highly inefficient, with low utilization of treatment capacity and high rates of non-revenue water due to physical or commercial losses. Offically one-third of the water that enters the distribution supply system ends up as non-revenue water (Figure 26).

PDAMs are struggling to secure reliable bulk water supplies. Current bulk infrastructure capacity can only provide 30 percent of the total national raw water demand. Many PDAMs provide only intermittent service due to lack of bulk supplies. The construction of dams can have considerable delays, caused by lack of communication between MoPWH and the water suppliers. The construction of Jatibarang Dam in Semarang, for example, has been pending since 2015 as the water supplier requires a different intake than the one constructed, requiring additional investments to fix this problem.[118] However, in some areas bulk water has been developed but there is no capacity or infrastructure to distribute it. Nationwide, as much as 24 percent of bulk water available for water supply is not utilized. At the same time, bulk water availability from the preferred source, groundwater,[119] is affected by depletion, pollution, and seawater intrusion and PDAMs are increasingly sourcing raw bulk water from rivers, often at a distance, which is leading to higher costs and to conflict across jurisdictions (Royal HaskoningDHV 2019). Unmet demand for water is as much about inadequate planning, inadequate investment in infrastructure, and lax management as it is about water shortages (Figure 26).

Box 14: Improving household level water quality while reducing stunting, deforestation and CO2 emissions through social enterprises for water filters

Even if households have access to an improved water supply, the water can still be contaminated, for example with E.Coli which contributes to Indonesia's high stunting rates as nutrients are lost through diarrheal diseases. While boiling the water can reduce the risk of infection, this requires time and money spent for the households (mostly women!) to buy fuel or collect firewood. In addition, this practice increases Co2 emissions, and increases deforestation. Indonesian manufactured low cost household level water filters can address this challenge by purifying the water at the point of use. For example, the social impact enterprise Nazava has

116 Measured as 'Percentage of Poor People', which is defined as people's average monthly expenditure per capita below the national poverty line. The Indonesian poverty line differs across provinces; the national average is around US$1 per capita per day. https://www.bps.go.id/indicator/23/192/1/percentage-of-poor-people-by-province.html

117 Research on the impact on women on WASH in times of COVID-19 is ongoing by the Australia-Indonesia Center. https://pair.australiaindonesiacentre.org/news/the-impact-of-covid-19-on-womens-access-to-water-sanitation-and-hygiene-in-an-indonesian-fishing-village/

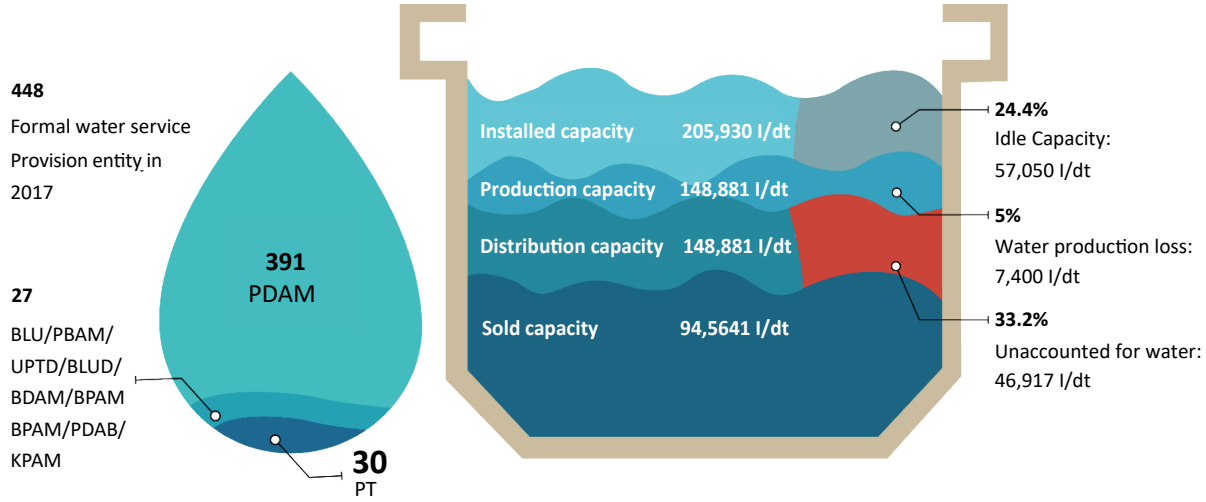
118 Stakeholder consultation with Directorate of Water Resources and Irrigation (BAPPENAS) on September 19, 2020.

119 Spring water is also used but in some areas is affected by depletion or conflict of use with villagers.

developed low cost water filters, which are the only ones on the Indonesian market that are verified by the WHO. To increase their distribution, Nazava cooperates with micro-finance institutes across Indonesia. To date around 500,000 filters have been distributed. Besides health and environmental benefits, households can save an average of 100 USD/ year when using this filter making this an attractive choice for low income households. These entrepreneurial activities can be further enhanced when increasing the budgets PAMSIMAS and for village enterprises (BUMDES) and informing them about market opportunities that are beneficial for their communities around WASH.

Source: Nazava 2019.

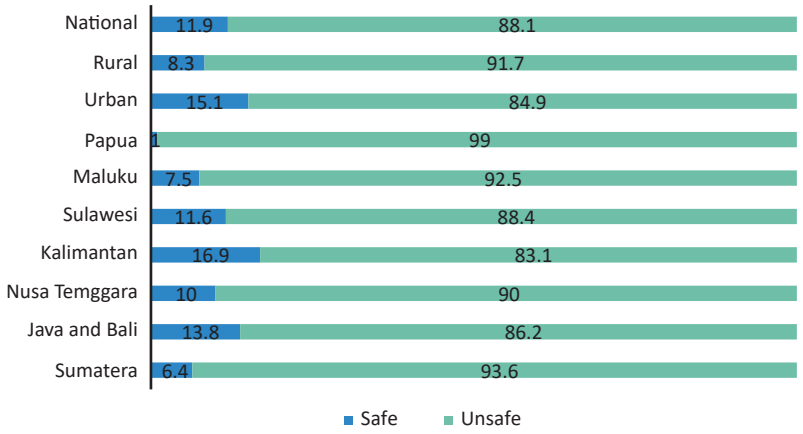
Figure 26: Water service providers (left) and water suppy capacity (right) in Indonesia



Source: Royal HaskoningDHV 2019.

Nationwide – and considering all water sources – only 11.9 percent of the population has access to "safe water". Safe water is defined as water samples being below the safety thresholds for TDS, E-Coli, pH, Nitrite, and Nitrate. While 15.1 percent of the population has access to safe water in urban areas, only 8.3 percent of population in rural areas do. Hardest hit is Papua in which only around 1 percent of the population has access to safe water (Figure 27). Kalimantan, as well as Jawa and Bali, have the highest rates with 16.9 percent and 13.8 percent respectively. While groundwater from private wells meets about 46 percent of domestic water demand nationally, it is often found to be contaminated, particularly in dense urban areas where the seepage of unsanitary septic tanks pollutes the very aquifers used for domestic water demand; and in high agricultural areas where nitrate and nitrites seep into water sources.

Figure 27: Percentage Access to Safe Water, by Main Island Groups



Source: Research Centre for Public Health Effort (Puslitbang Upaya Kesehatan Masyarakat), Ministry of Health, 2020.
Note: Considers contamination from TDS, E-Coli, pH, Nitrite, and Nitrate

Even piped water quality is becoming an increasing concern and monitoring capacity is low. Currently, the capacity of water supply operators is below standard even after treating relatively unpolluted raw water.[120] Accredited water quality testing laboratories are not available in all districts/cities, and local governments can designate other laboratories to conduct this task, affecting the reliability of results.[121] Many lab facilities of the Health Department at the local level are inadequate for monitoring drinking water quality.[122] While MoH Regulation 492/2010 mandates the examination of 26 water quality parameters, the examination of 73 additional parameters—subject to the areas' characteristics—is at the discretion of the local governments.[123] With the ongoing revision of MoH Regulation 492/2010, the mandatory parameters may be reduced to 16.[124] As the local government is responsible for—and has to finance—the capacity of the laboratory to measure the 73 additional parameters, there is an adverse incentive to minimize the number of parameters measured and thus leave potential water risks – such as the occurrence of hazardous and toxic materials including heavy metals - undetected. As PDAMs are tasked with generating profits for the local government, there is a misalignment of incentives to expand water quality monitoring to ensure safe water.

Pollution is putting significant pressure on water bodies and thus raw water supplies and public health (see Action 2). In the absence of adequate water quality monitoring, many pollutants remain undetected and thus untreated by PDAMs and direct consumers.[125] However, even if detected, some pollutants may be too costly and too complicated to remove. Currently, PDAMs just need to accept the current raw water quality—with the related increased cost in water treatment—and there is no mechanism to connect upstream water pollution with downstream impact.[126]

While minimum service standards (MMS) for water supply and wastewater service exist at the national level, the parameters are not determined in a way that would allow citizens to make claims for these standards. In 2004, the central government has set MSS (*Standar Pelayanan Minimal*, SPM) for absolute basic services for citizens which need to be provided by the local government. MSS are measured in terms of percentage (of coverage, access, and so on), which is useful for monitoring purpose at the national level. However, failure to provide these minimum standards by providers does not directly allow consumers to request for provision of these or compensation. Further, drinking water quality standards should be included as part of the MSS. While the local government has the power to enforce that utilities compensate consumers for violation of MSS, only few cities regulate such scheme in their regional bylaw. The provisions by community-based water supply providers are even less formal, although in some cases water supplies are regulated on the village level. The service standard for community-based local-scale sanitation is usually unclear. The achievement of MSS should be priority for regional governments and MSS should be included in regional planning, regional budgeting, monitoring, reporting and be one of the key component of the accountability report (*Laporan Keterangan Pertanggungjawaban*, LKPJ) submitted by the local government to the regional government to assess the progress of the cities/districts. The progress on achieving MSS should be monitored and tracked real time online to create accountability of the regional governments to the people.

Further, there is also a lack of awareness on the importance of access to improved WASH by local governments and people living in remote areas. In remote areas, such as outer islands, stunting and water-related diseases have become part of life, with little awareness that access to clean water and improved sanitation can significantly improve the situation. Without this awareness it is unlikely that investments on WASH will be prioritized in the spending of the village funds (dana desa). The awareness of the importance of improved WASH needs to be increased at the village level and at the local government level.[127]

The regulatory framework for water services in general is inadequate. The 2019 Water Law does not contain provisions on how water 'services' should

120 Expert opinion of World Bank staff Alizar Anwar on September 20, 2020.

121 MoH Regulation 736/ 2010 on Procedures for Supervision of Drinking Water Quality. Article 13.

122 Expert opinion of World Bank staff Alizar Anwar on September 20, 2020 and Prof Etty Riani on 13 April 2021.

123 It is noteworthy that antibiotic residues are not part of these parameters.

124 Stakeholder consultation with Directorate of Environmental Health, Directorate General of Public Health, Ministry of Health on October 13, 2020.

125 Expert opinion of World Bank staff Alizar Anwar on September 20, 2020 and Prof Etty Riani on 13 April 2021 .

126 Stakeholder consultation with Directorate of Drinking Water (MoPWH) on November 5, 2020.

127 Stakeholder consultation with Directorate of Natural Resources Utilization and Appropriate Technology, Directorate General of Village Development and Community Empowerment, Ministry of Village Development of Disadvantage Regions and Transmigration (MoVDDRT) on October 15, 2020.

be regulated. Water supply services are currently regulated through Government Regulation 122/2015. However, Government Regulation 122/2015 does not address how water utilities should be regulated as natural monopolies—which may result in low service levels. Regulating natural monopolies creates incentives for water utilities to be competitive and charge the right tariffs.

Priority actions

To meet its objectives of universal access, Indonesia needs to continue expanding and improving water supply services in both urban and rural areas while developing sustainable and efficient utilities and increasingly leveraging local government, private sector, community, and household resources. It will require stepping up ongoing programs for investment and institutional strengthening, seeking cost-effective approaches, and mobilizing new financing sources.

Continuing expansion and improvement of water supply services in both urban and rural areas requires the following actions:

- **The GoI's overall strategy for water supply (RPJMN 2020–2024) is to increase water supply delivery and access and to strengthen governance.** Investment is proposed to expand systems to provide 10 million new connections during the plan period and to develop regulatory and institutional capacity, along with public awareness of water saving.
- **Local governments require support to build capacity to switch from a supply-focused approach to an integrated urban water management (IUWM) approach in urban water supply planning and investment.** IUWM provides a framework to assess the potential for unconventional water sources for non-potable uses (for example, recycled water, stormwater, groundwater recharge), providing 'fit-for-purpose' quality water and developing projects with co-benefits for flood management, tailored to local conditions. This change in approach could reduce the need for new bulk supplies and storage infrastructure. Options for inter-municipal services should also be explored.[128]
- **In areas where water supply networks exist, users need to be encouraged to connect to these.** PDAMs need to be held accountable – either via national policy targets or local political pressure – to meet ambitious water service coverage targets. Further, the incentive structure for PDAMs to meet these targets need to be assessed. Currently higher tariffs for industrial water usage may re-direct PDAMs priorities toward prioritizing industrial water over household level water access, particularly for low income households.[129] This can be done via exploring a combination of targeted marketing on the benefits of PDAM water services to households of all income levels and offering financial support.
- **Financial support is required for households unable to afford the connection to water supply services.** Financial support can be provided in the form of instalment plans for connection charges, and seasonal promotions or connection fee discounts for the low income households.
- **Effective current programs—Water Hibah and PAMSIMAS—to improve coverage for the poor and vulnerable should be enhanced, continued and scaled up.** Improving service delivery for the poor and for rural people would have a significant poverty reduction impact. The Water Hibah Program provides performance-based grants for connections for the urban population. To reach the 'bottom 20 percent', the Water Hibah Program should be complemented with schemes such as master meters, micro-credit, or micro-saving. Further, the target parameters to effectively identify and support the poor should be further refined to maximize outreach. Further, water supply and sanitation should be integrated as part of the urban slum upgrading program to ensure that those living in informal areas without property rights are not forgotten. The rural poor benefit from the extensive and successful community-based rural water supply program PAMSIMAS. Building on the experiences gained, suggested actions to further increase the effectiveness are: (1) Clarify and strengthen the role of the local government; (2) Develop a field supervision program of KPSPAMs by the local government, which includes pre-PAMSIMAS Community Drinking Water User Associations (Himpunan Penduduk Pemakai Air Minum dan Sanitasi or HIPPAMS) and similar village water boards; (3) Gain legal clarity on the KPSPAMs status as micro-scale enterprise; (4) Facilitate contract sales of master-metered bulk water to KPSPAMs, especially for KPSPAMs lacking a reliable water source; (5) Introduce matching grants for improving household service coverage of existing PAMSIMAS villages;

128 Expert opinion from Focus Group Discussion on Water Services – Water Supply and Wastewater – on 5 May 2021.

129 Expert opinion of Don Johnston (Senior Operations Director, Water.org) received on 7 April 2021.

(6) Expand capacity (continuous) building around business planning and financial access to improve KPSPAMs sustainability and full service coverage, as well as on the optimal functioning of water supply schemes as part of the hand-over process to local governments, particularly in poorer and more remote regions; (7) Evaluate the effectiveness of the different water supply technologies and approaches used in different contexts under the PAMSIMAS program, with lessons learned used as a basis for rural water supply expansion; (8) Provide a partial risk guarantee in lieu of collateral to incentivise lending by financial institutions to KPSPAMs; and (9) improve the business model or sanitation services to match accomplishments in water supply provision.[130] PAMSIMAS should be expanded and/or complemented with the new community-based rural water supply and sanitation program, with priority for areas with low access to improved water supply.

- **Targeted programs to provide water supply to rural areas with unreliable water sources—in terms of quality and/or quantity—need to be developed.** As PAMSIMAS does not develop water sources for rural water supply, villages suffering from an unreliable water source (around 15 percent of all villages) require additional support. The 'Rural Water Supply and Sanitation System (SPAM Perdesaan)' program under the Directorate of Human Settlements (MoPWH) as well as the special allocation fund 'Physical DAK' scheme needs to be further targeted and expanded. An inventory of cost-effective, appropriate, and sustainable technologies, such as deep boreholes with solar panel and small desalination plant for areas with lack of fresh water sources, needs to be developed to allow for informed decision-making. Building local capacity and ensuring proper O&M will be crucial for the sustainability of these solutions.
- **Promote household level solutions to improve drinking water quality.** As only 11.9 percent of the population have access to safe water and systematic changes may take some time to show benefits, household level solutions such as (low cost) water filters should be promoted. These have the potential to improve (a) the family's health, (2) reduce the financial burden from buying bottled water or buying fuel to boil water and (3) reduce environmental impact such as deforestation and CO2 emissions. To increase uptake, awareness of low cost household level water filters needs to be increased – including the financial savings – and payment plans, such as microcredit, offered to those in need. Household water filters can purify water at the cost of USD 2.15/m3, at an investment around USD 25 (Nazava, 2019). Further, quality control and standards for water sold at water refill stations should be enhanced.
- **Linking COVID-19 pandemic response with increasing access to water at the household level.** Maintaining high hygiene behavior is critical to reduce exposure to COVID-19 and thus not only of relevance to the urban and rural poor but also to the nation as a whole. While COVID-19 measures and priorities have been introduced in a recent circular and propose the construction of handwashing facilities in community areas, it could be even more effective when linked to programs to increase access to water in households and behavioral change campaigns on WASH. The importance of inclusive development for society at large has been highlighted during the COVID-19 pandemic.
- **An assessment of current and future infrastructure and institutional development needs should be carried out.** This assessment would allow the central government to assess and rank investment needs, prioritizing key areas, for example, underserved and poor areas or those with bulk resource challenges such as groundwater overabstraction. Currently, there is no database benchmarking villages on their water supply situation. A database with information on the overall water supply situation of all villages, that is, whether a water source is available or not, access to piped water, needs to be set up and villages categorized accordingly. On the basis of this assessment, a phased investment program could be developed, with outcome-based indicators.
- **Provide detailed MSS for district levels and track progress publicly.** While general MSS exist at the national level, they are unclear on the ground. This uncertainty prevents consumers to claim their right to the provision of services. Enforceable service standard parameters should be made mandatory gradually—in conjunction with each providers' capabilities—at the city/regency/village levels and/or at the utility or provider level. These should be accompanied with compensation schemes (rebate, monetary compensation, or others). Clear and binding MSS will improve the water and sanitation provision levels. Further, to increase accountability, the progress of providing MSS

130 Considers expert opinion of Don Johnston (Senior Operations Director, Water.org) received on 7 April 2021.

should be publicly available and benchmarked against targets.

- **Increase the awareness of the importance of access to safe water across all levels—from households to the central government.** Particularly in rural areas and disadvantaged regions, local governments and households may not prioritize safe drinking water as (a) the connection to diseases and stunting may not be as clear and (b) generations have lived in these situations increasing the level of acceptance. While demand for safe water needs to be developed from bottom-up, greater attention also needs to be given to water supply by the local government and to rural areas by the central government. Access to water and sanitation should be prioritized by the Ministry of Village Development of Disadvantage Regions and Transmigration (MoVDDRT).[131]

Tackling the growing challenges of access to clean water sources and of dwindling groundwater requires the following actions:

- **In areas where there are challenges of water quality or quantity, the complementary usage of surface water and groundwater needs to be optimized.** The 2019 Water Law prioritizes surface water over groundwater and there is a need for MoPWH and MoEMR to work together to ensure further development of surface water combined with measures to control groundwater overabstraction. The coordination mechanism for conjunctive planning, licensing, and use of surface water (MoPWH) and groundwater (MoEMR) needs to be strengthened. An expanded water quality and quantity monitoring network provides the foundation for these actions (see Action 1). Further, water tariffs for groundwater from private borewells and water supply from PDAMs should be structured to incentivize a PDAM connection over groundwater abstraction.[132]
- **Raw and drinking water quality testing needs to be enhanced and alternative water supplies secured, if required.** In areas downstream of pollution hotspots, such as large urban areas, industrial zones, and mines, targeted water quality testing is required. If drinking water parameters exceed the thresholds and water treatment is not feasible or cost-effective, alternative potable water and/ or adequate water filters needs to be supplied.
- **A mechanism is required to allow cooperation and coordination of upstream actions and downstream impacts—on water quantity and quality.** The cost of raw water treatment is increasing for PDAMs as raw water quality deteriorates. There should be a cost-benefit analysis to understand the financial and economic impact of lack of adequate wastewater treatment upstream on water treatment costs downstream. These insights should inform national policy and infrastructure development priorities. A mechanism is required to allow for collaborative action between upstream and downstream actors.[133]
- **In locations in which surface water is to be prioritized to reduce groundwater overabstraction, surface water supply solutions for water users need to be developed**. For households, commercial establishments, and smaller industries, access to piped water supplies needs to be expanded. Once piped water is available, a combination of regulatory, financial, and social outreach measures is required to incentivize connection to these piped water networks. Specific measures are needed to address industrial water supply which is currently overdependent on unregulated and dwindling groundwater supplies. This needs to be addressed, for example, through specific bulk water arrangements or business-to-business (B2B) agreements between PDAMs and industrial areas—if found to be cost-effective and are compliant with the regulatory setting.
- **Increase the effectiveness and efficiency of developing regional bulk water supply schemes (*Regional Sistem Penyediaan Air Minum* or regional SPAMs) in areas where bulk water supplies fall short of meeting demand.** Currently, the GoI with assistance from the World Bank is developing an operational framework that will improve existing guidelines. It will further transform the framework into an operational document that addresses various types of regional schemes, considering different issues and problems in their development. The regional SPAM framework is designed to (a) screen whether a regional scheme is needed, (b) ensure that regional SPAM development processes are practicable and consistent, and (c) assist regional

131 Stakeholder consultation with Directorate of Natural Resources Utilization and Appropriate Technology, Directorate General of Village Development and Community Empowerment, Ministry of Village Development of Disadvantage Regions and Transmigration (MoVDDRT) on October 15, 2020.

132 Note that this is possible only in selected areas, where borewells are registered and metered. In future, it is suggested to increase registration of borewells, and metering, particularly in areas facing groundwater stress.

133 Stakeholder consultation with Directorate of Drinking Water (MoPWH) on November 5, 2020.

SPAM developers in the development processes. The framework is designed to be used by all levels of government, that is, central, provincial, and local.[134] An integrated river basin approach is an essential foundation.

- **Improve the readiness of (raw) water suppliers to future demand increases.** To allow for effective and secure water supply provisions, mandate the sharing of future development plans and related water demand projections annually with (raw) water suppliers. Currently, for example, MoA shares its water demand assessment for each growing season with PJT II, but it does not share future projects and its related water usage.[135] To allow water supplier such as PJT II to prepare for increases in water demand, planned projects should be captured in the RENSTRA and be updated and shared with water suppliers annually.
- **Given the huge water demand, cost-effective approaches to increase supply and reduce demand will be needed.** Excess capacity and high non-revenue water indicate that a cost-effective strategy in many locations would be to combine loss reduction with network extension. Institutional measures, including the strengthening of the government's National Urban Water Supply Project (NUWAS), will help ensure improvement in PDAM performance and cooperation across government departments responsible for the development of water sources and water supply distribution. In areas facing water stress, good practices for water demand reduction measures such as 'reduce, reuse, recycle' and the overall circular economy approaches, particularly for industrial water demand, should be promoted and incentivized.
- **Strengthen local governments to follow the principles of integrated (urban) water management.** As responsibility for service delivery of water supply, sanitation, stormwater and solid waste management, spatial planning, and disaster risk reduction lies with local governments—within frameworks set out by the national government—the local governments can conduct cross-sectoral integrated planning at the local level without the need for institutional changes in the central government. Some initiatives by local governments following IUWM principles have already taken place. In Greater Jakarta, infiltration wells were constructed upstream with the dual benefit of reducing flood risks and recharging aquifers. Awareness of IUWM principles needs to be increased at the local government level, while incentive and coordination mechanisms need to be enhanced to pave the way for more initiatives (see complementary World Bank study on Indonesian National Framework for more information.)

Improving institutional performance and financial resource allocation requires the following actions:

- **Consider adding a regulatory framework on managing water utilities as natural monopolies.** Government Regulation 122/2015 currently does not consider the particularities of water utilities as natural monopolies. The regulatory framework should provide incentive for water utilities to be competitive, for example, by facilitating benchmarking and encouraging mergers to achieve economies of scale and scope. To accomplish this, an additional specific law (primary legislation) designated for water services may be required.
- **Effective programs to improve PDAM performance need to be scaled up and accelerated.** Institutional weaknesses—weak service orientation, poor accountability, low management and technical capacity, weak financial autonomy, and viability—combined with inadequate O&M and aging infrastructure all contribute to inefficiency and poor services. Some PDAMs are simply too small to be viable. The NUWAS framework is addressing the problems with well-designed measures to improve PDAM governance and performance, but considerable challenges remain. The project needs to be continued and deepened, with support packages adapted to the needs of each utility.
- **Improve governance and performance of PDAMs with measures such as building capacity and strengthening financial viability.** PDAM debt rescheduling has just been completed, with future subsidies limited and based on business plans. Tariffs should progressively cover costs, following the MoHA regulation on tariffs on full cost recovery. Where PDAMs are unlikely to be sustainable—that is, able to charge tariffs that fully recover costs—measures may be required to merge smaller, nonviable PDAMs, downgrade their performance outcomes, and thereby change ownership to the province.
- **Financing responsibility needs to be better targeted and increasingly devolved to local levels.** Financial resource allocation can be tied to improved service performance, for example, to increased levels of access to piped water. Benchmarking of key performance indicators across PDAMs could be

134 Economic Consulting Associates and World Bank. 2019. Presentation on Regional SPAM Framework at a Focus Group Discussion on December 3, 2019.

135 Stakeholder consultation with PJT II on October 15, 2020.

linked with incentive schemes such as additional investment, awards, and promotion of key officials responsible. Investment in institutional development and capacity building should be integrated as a package with infrastructure investment. Financing responsibility needs to be increasingly devolved to local levels—for example, the central government may invest in bulk water development and water treatment conditional on local government commitment to financing distribution and household connections.

Tackling the twin challenges of the high cost of achieving targets but limited finance requires the following actions:

- **Match available finances to water sector targets.** Capital spending on water supply and sanitation is small as a share of GDP (0.2 percent)—far lower than the levels recommended for East Asian countries (0.5 percent) (Estache 2010) or by the United Nations (1 percent) (United Nations Development Programme 2006). The achievement of Indonesia's water sector targets needs significantly higher investment. In the current framework there is insufficient public investment and at the same time scant scope for attracting private participation.
- **Central government investment can be used more strategically to improve efficiency and effectiveness in the sector, emphasizing four approaches.** First, central government support could target outcomes, particularly incentivizing increased access and improved efficiency and performance. Second, resources could be allocated in priority to low-capacity areas and areas where water resources are scarce or which require higher capital investment. In particular, the GoI support to rural water supply could be increased for areas with low fiscal capacity or low water access or higher investment and operating costs (for example, remote areas and small islands). Third, financing should give greater emphasis to institutional development and capacity building compared to infrastructure investment. Finally, central government financing should be used to leverage the maximum investment cost sharing, requiring higher levels of local government and beneficiary financing and, wherever possible, leveraging nonpublic financing.
- **The planning and construction of dams needs to be better coordinated across government levels and based on (future) water demand**. Some dams, such as in Jatigede, were constructed in areas which do not have sufficient water demand to optimize the resource, while other areas remain water stressed. Further, to meet the RPJMN targets, it was found that MoPWH may prioritize dams that are easier and less costly to construct rather than focusing on the most important dams to enhance water security, such as the dam in Matenggeng. For some dams, such as Jatibarang Dam in Semarang, completion has been delayed as it was found that the water supplier had differing technical requirements from the dam's intake.[136] It is essential to conduct a thorough feasibility assessment before constructing any dams, including an assessment on future water demand and on technical requirements of the water supplier.
- **Central government investment in developing sources and bulk water supply infrastructure needs to be complemented by local government financing for water distribution infrastructure and household access.** Central government investments need to be aligned with local governments' needs and investment plans. Further it needs to be ensured that adequate budget is allocated in local governments' budget documents and institutions and arrangements for O&M are in place before the implementation of construction (World Bank 2020d). Central government financing could be conditional on commitment from local governments to develop and maintain distribution infrastructure commensurate with water availability
- **Financing sources need to be diversified, increasing participation of the private sector and use of commercial financing and full cost recovery from consumers.** PDAMs need to improve their performance and creditworthiness to be able to access different sources of financing, including private finance. Further, regulatory certainty is needed on the ability of SOEs, such as PJTs I and II, to expand into alternate revenue streams, such as in renewable energy, raw water treatment for PDAMs, and other water demand centers, to cover at least O&M expenditures (in addition to revenues from the [BJPSDA]).[137] Over time, there is a need to move toward full cost recovery tariffs in line with the MoHA regulation on tariffs, with adequate protection for the poor.

136 Stakeholder consultation with Directorate of Water Resources and Irrigation (BAPPENAS) on September 19, 2020.

137 Stakeholder consultation with PJT II on October 15, 2020.

– **In the longer run, the central government should withdraw toward a more strategic role.** Over time, the central government should shift from the role of infrastructure provider to a broader role as the regulator, standards enforcer, and collaborator of local governments and the private sector, which would increasingly take the lead for service provision.

The water supply sector needs to be made more attractive for private investments and private participation needs to be made viable (see Action 9).

Action 5: Expanding and financing inclusive, sustainable and efficient sanitation services and wastewater treatment

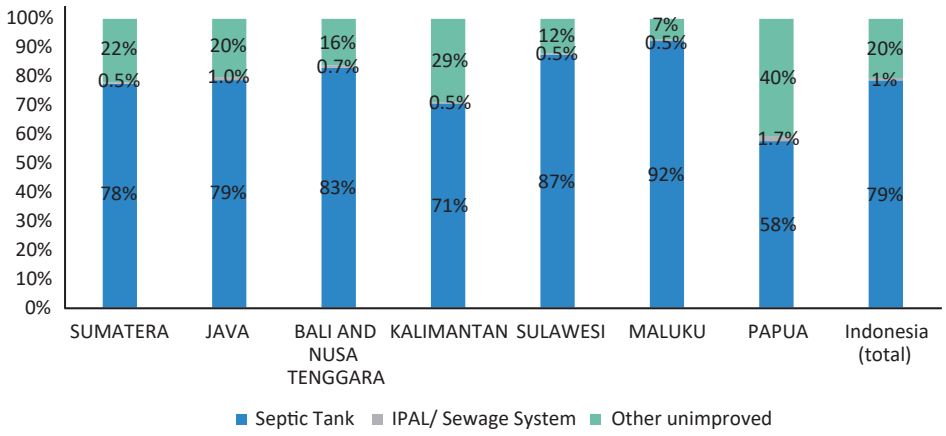
Action 5 - Key takeaways

- Only around 2 percent of the population is connected to the sewerage network—only 13 out of 98 cities have a sewerage system (+ 4 systems under construction).
- About 10 percent of population—and 17 percent of rural population—practice open defecation.
- Around 88.6 percent of the population depend on open-bottom septic tanks—only 8 percent are of sufficient quality—and many cities do not have a fecal sludge treatment plant.
- Only 7.4 percent of municipal wastewater is safely collected and treated—92.6 percent is discharged untreated to water bodies.
- Only few industries and mines treat their effluent.
- Solid waste, agricultural runoff, and aquaculture also pollute the environment.
- Around 35 percent of children under 5 years are stunted - water pollution and lack of improved sanitation are key causes
- Indonesia's next generation will only be 53 percent as productive as it could be if stunting was addressed
- Impact on GDP by 2045.
  - Increase by up to 1.17 percent if 100 percent coverage of improved WASH is achieved.

Threats and challenges

Indonesia has not achieved its ambitious targets for universal access to sanitation by 2019 and has lower levels of access to basic sanitation than would be predicted based on its GDP levels. A sewerage connection is available to around 2 percent of the population—and far less in many areas. With 79 percent nationwide, septic tanks are the predominant choice for sanitation.[138] Around 20 percent of the population rely on unimproved sanitation, with vast differences across the islands. Figure 28 shows the lowest rates are on Maluku (7 percent) and the highest in Papua (40 percent). Open defecation is still practiced by about 10 percent of the population nationwide in 2017—17 percent of the rural population and 4 percent of the urban population (JMP 2019).

Figure 28: Comparison of access to sanitation, by type and by island (2020)

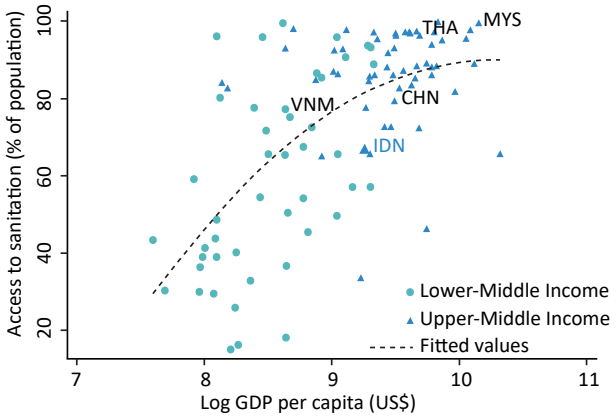


Source: BPS 2020c.

Note: 'Other unimproved' includes pond, rice field, river, lake, sea, land hole, beach, open field, yard, and others.

138 In urban areas, 88.6 percent of households depend on septic tanks.

Figure 29: GDP and access to at least basic sanitation across countries



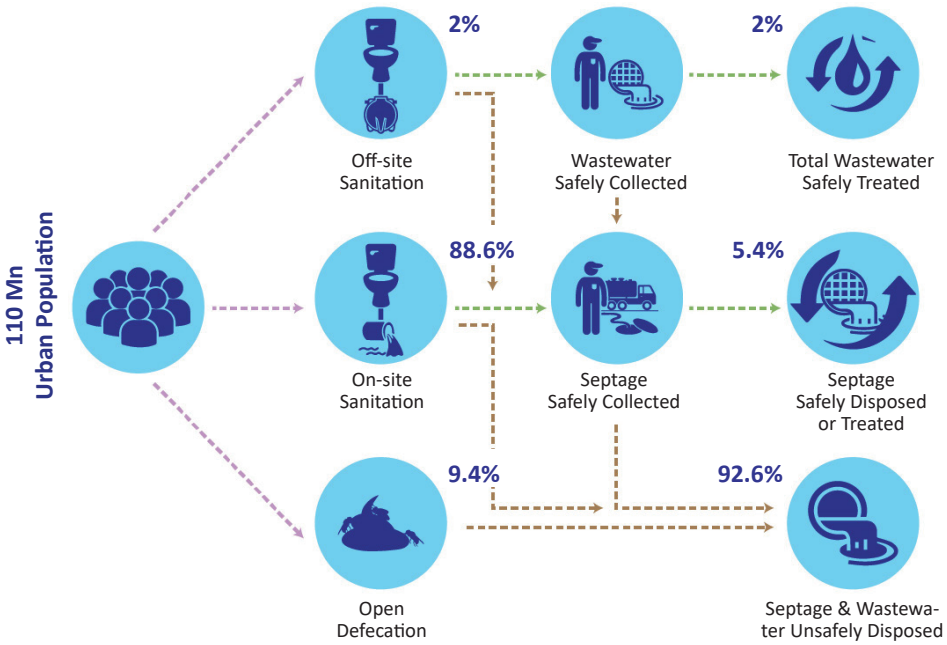
Source: World Bank Data for 2010–2020.
Note: Predictions based on simple regression with a quadratic term.

Indonesia falls 'below the curve', that is, it has a lower level of access to basic sanitation services than would be predicted by its GDP. Figure 29 shows the comparison with other middle-income countries. With rapid urbanization, the country faces a considerable challenge in catching up and meeting the target for 2024—90 percent of households with access to improved sanitation and for the country to be free of open defecation.

Urban sewerage systems are limited and only 7.4 percent of urban wastewater is safely collected and treated (Figure 30). Currently, citywide sewerage systems exist only in 13 out of 98 cities with a further four systems under construction.[139] However, even the existing systems have unutilized capacity due to low rates of household connections (World Bank 2019c). Nationwide, most households (62 percent) depend on open-bottom septic tanks, and only 8 percent of households have septic tanks of sufficient quality (World Bank 2015b). This means that 92.6 percent of water supplied is returned as 'unsafe' wastewater which, in the absence of a sewerage network and adequate fecal sludge collection and treatment, is discharged into surface water bodies, agricultural fields, and groundwater sources through leakage and unsafe disposal (World Bank 2019c). Even in the capital metropolitan region of Jakarta,[140] only 2.5 percent of the population are connected to the sewerage system and in total only 14 percent of wastewater is treated safely off-site and on-site (BAPPENAS 2020; World Bank 2016a). The government's indicator on urban sanitation focuses mostly on access but masks significant problems with the proper collection and disposal of wastewater and fecal sludge.

While 88.6 percent of the urban population depend on septic tanks without sewerage, many cities do not have a Fecal Sludge Treatment Plant (Instalasi Pengolahan Lumpur Tinja, IPLT) and even if they do, many of these plants are either not maintained and operated properly or have not been designed optimally. In many cases, facilities that have been completed under central government projects are not

Figure 30: Wastewater and septage flow in urban Indonesia



Source: BAPPENAS 2019.

139 In the cities of Palembang, Pekanbaru, Makassar, and Jambi, financed by the Asian Development Bank (ADB) loan fund.

140 DKI Jakarta stands for Daerah Khusus Ibukota Jakarta (Special Capital Region of Jakarta).

maintained properly by the local authority, in part because the assets have not been transferred from the central government. Out of 299 IPLTs constructed by 2019, only less than 10 percent are working properly and linked to a regular desludging mechanism.[141] Further, many IPLTs are not used optimally. Some IPLTs are located far from the sludge sources and there is no control or incentive to ensure that trucks bring the fecal sludge they collect to the IPLTs. As a result, the fecal sludge is too often discharged instead into water bodies or waste sites. Yet, while total sludge treatment capacity falls well below volumes generated, the utilization of installed capacity is also low (World Bank 2015a) because of low collection rates and the low share of the fecal sludge collected which is actually delivered to IPLTs.

Community Based Sanitation Programs (Program Sanitasi Berbasis Masyarakat, SANIMAS) have been built but there are challenges around O&M. The responsibility for support from local governments is not clear, while many community-based organizations managing SANIMAS do not have adequate resources and revenue to ensure sustainable O&M and rehabilitation. As a result, many SANIMAS are not functioning well and some have even been abandoned. Further, most constructed SANIMAS are based on the MoEF Ministerial Regulation 5/2014 which has less stringent water quality parameters than the latest MoEF Ministerial Regulation 68/2016. However, even with the less stringent parameters, the quality of effluent from SANIMAS generally does not meet the standards.[142]

About 70 percent of Indonesia's groundwater pollution comes from leaking septic tanks and septage disposed into waterways (World Bank and Australian Aid 2013). Further, due to a lack of managed solid waste collection and management, about 75–80 percent of all household waste enters water systems (World Bank 2019d). Rivers account for more than 80 percent of the plastic leaking to the marine environment from land-based sources in Indonesia[143]—and solid waste poses challenges to dam operations.[144]

In addition to untreated domestic wastewater and solid waste, industries, including mining, as well as agriculture and aquaculture also pollute water (World Bank 2015a). Pollution is left unchecked due to weak regulation of discharges and wastewater flows and due to limited public education and awareness. Although the legal and regulatory framework is generally sound, the responsible ministry—MoEF—and the local Environmental Departments lack the institutional capacity, resources, and political support for effective action. A case in point is the legal restriction on PFAS—the notorious 'forever-chemical'—that was brought in 2010. This restriction is widely disregarded leaving PFAS essentially unregulated and not even included in monitoring programs.[145] A further case in point is the lack of enforcement of the government regulation on capping aquaculture production to 10,000 tons of fish per year in the National Priority Lake Toba, to address the key pollution source responsible for 76 percent of total nitrogen and 68 percent of total phosphorous loads. Instead licenses were provided to produce 66,000 tons of fish, while small-scale operations without licenses are estimated to produce an additional 40,000 tons of fish (World Bank 2018d). Mine water pollution—particularly from coal mines—is a pronounced problem in South and East Kalimantan and in South Sumatra. Further, Indonesia is a global hotspot of mercury pollution, which originates from illegal (including artisanal) gold and silver mining, as well as from production of batteries, and electrical appliances (Riani 2020a, 2020b, and 2020c). Nearly all small-scale artisanal—and often illegal—gold miners use mercury to extract gold in Indonesia, even though the practice has been banned by the government since 2014 through MoEMR Decree 1827/ 2018 (Paddock 2016). Mine water discharges for nickel and gold mining are regulated under the MoEF Ministerial Decree No 113, and supervision of compliance of business actors has been carried out by the government.[146]

As a result, pollution is severe, entailing high economic and health costs. Since many households continue to depend on groundwater for their water supply, poor groundwater quality in combination with poor access to WASH services was found to contribute

141 Stakeholder consultation with Directorate of Sanitation, DGHS (MoPWH) on 7 October 2020.

142 Expert opinion from World Bank Staff Irma Setiono on September 22, 2020.

143 World Bank (ongoing).

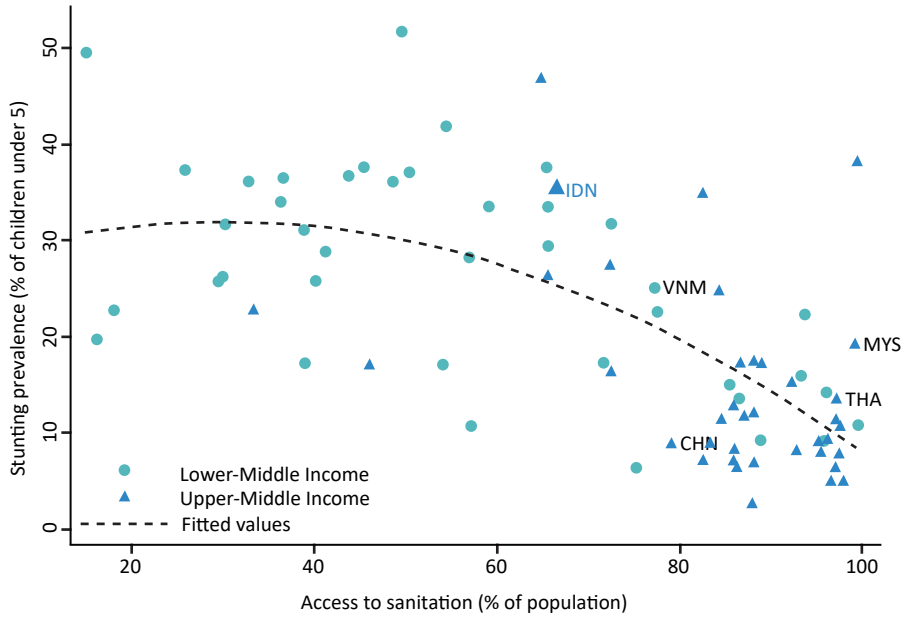
144 Interview with PLN on September 29, 2020.

145 PFAS are a large class of more than 4,500 persistent fluorinated chemicals that include PFOS, perfluorooctanoic acid (PFOA), Genx, and many other fluorinated chemicals. Indonesia became a party to the Stockholm Convention in 2009, and the treaty added PFOS to its global restriction list in 2009.

146 Expert opinion from Directorate of Technical and Environmental, DGMC, MEMR on 25 May 2021.

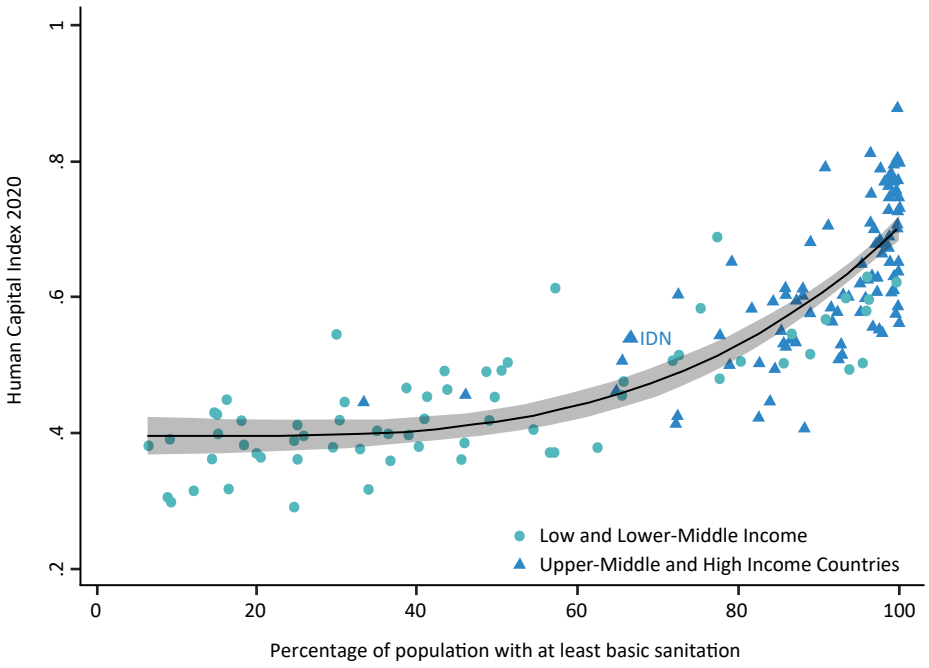
to increased infant mortality, particularly in low-income areas of Indonesia (World Bank 2019c).[147] Indonesia's severe child stunting problem (35 percent of children under 5) is in part linked to water pollution and poor sanitation (Figure 31; World Bank 2019c). Stunting leads to reduced cognitive development and decreased productivity and wages. Indonesia's next generation will only be 53 percent as productive as it could have been if stunting is fully addressed.[148]

Figure 31: The impact of lack of access to sanitation on stunting rates



Source: World Bank data for 2010–2020.
Note: Predictions based on simple regression with a quadratic term.

Figure 32: Improved sanitation and the Human Capital Index



Source: Gatti et al. 2018 in World Bank 2019p.
Note: Each dot signifies a country included in the Human Capital Index of the World Bank Human Capital Project.

147 The mortality rate was 212 per 1,000 births, which is 3.5 times higher than in other middle-income countries in Southeast Asia.

148 Spending better to reduce stunting in Indonesia. Findings form a public expenditure review.

Box 15: INSIGHT 6: The economic impact of inadequate sanitation on GDP by 2030 and 2045

Action is predicted to increase GDP by up to 1.17 percent by 2045.

The analysis of the economic impact of inadequate WASH coverage considers two scenarios:

1. **BAU,** where the percentage of the population that has access to clean water[c] and improved sanitation in 2030 and 2045 remains at 2015 levels (that is, 67 and 60 percent, respectively [ADB 2016a]).
2. **Full coverage,** where Indonesia increases WASH expenditures and achieves 100 percent coverage of improved supply and improved sanitation by 2045. Government expenditures on WASH coverage are included.

The following impacts are captured: (a) increase in future productive labor hours due to reduced sickness, childhood stunting, and childhood mortality; (b) direct savings in health care cost; (c) reduced fuel expenditures for boiling water; and (d) improved fishing yields from improved water quality from investments in sanitation.

Table 10 shows that the combined labor-related impacts result in an improvement of 0.74 percent in 2045 compared to the base case. This is mostly driven by the impacts of reduced childhood mortality. The combined effect on GDP from improved water supply and sanitation is 1.0 percent in 2045 (Table 10). The costs of these investments are 0.36 percent of GDP in 2045, leading to net benefits of 0.64 percent in 2045.

Note that these WASH investments would come from international donors and not from the government. GDP gains would be higher, approximately 1.0 percent in 2045.

It needs to be noted that this is a conservative estimate, and benefits of full coverage are likely to be higher. This estimate does not consider (a) exposure to industrial pollutants and mine effluent; (b) bioaccumulation of heavy metals in fish and crops (due to irrigation with polluted water) and resultant ecosystem and health impacts; (c) higher cost of centralized water treatment caused by polluted raw water; (d) (irreversible) pollution of groundwater reserves; and (d) ecosystem damages and loss in amenity value. Further, it needs to be noted that only the impact of diarrhea from inadequate sanitation was considered. The impact on GDP would likely be higher if other illnesses related to inadequate sanitation, such as typhus and polio, were considered.

Table 10: The economic impact of adequate WASH on GDP by 2045

Effect of enhanced coverage relative to base	**2045 (%)**
Labor productivity gains due to sickness	0.07
Labor productivity gains due to childhood mortality	0.43
Labor productivity gains due to stunting disabilities	0.06
Labor productivity gains due to time loss due to poor sanitation	0.19
Total labor productivity gains	**0.74**
Health care cost savings	0.07
Energy cost savings	0.05
Fishing productivity benefits[a]	0.13
Total labor productivity gains + Health and energy cost savings	**1.00**
Cost of 100% WASH coverage	**–0.36**
Net benefits	**0.64**
Policy B-C ratio for WASH coverage	**2.78**

Source: World Bank 2020b.

Note:

a. Effects run separately through the CGE model will not sum exactly to the results of a CGE model run with all effects combined.

b. The base case in the CGE model uses a default assumption of constant sanitation-related pollution over time. However, sanitation-related pollution is expected to increase over time, which would cause fishing productivity to fall relative to this base case. Accounting for this additional pollution causes the 2030 and 2045 GDP to be 0.03 percent and 0.17 percent lower, respectively, than in the base case.

c. Note that "clean water" is defined by MoPWH as "clear water, odorless, tasteless and colorless" and does not refer to "safe water" as it can still contain pollutants beyond safe thresholds.

There are clear benefits from improved sanitation, which has a major impact on human health and thereby on the economy. Providing full WASH coverage is expected to increase GDP by 1.17 percent by 2045 (Box 15). Further, improved sanitation is linked to improvements in the Human Capital Index—an essential precondition to achieve Indonesia's Vision 2045 (Figure 32).

There is a legal and regulatory void on sanitation and wastewater treatment. Adequate regulation is possible only when the mandate for sanitation and wastewater services is provided in primary regulation (law). However, the 2019 Water Law contains no provision on how water 'services' should be regulated. While the 2019 Water Law briefly mentions sanitation in the context of surface water protection and

conservation in the elucidation, it does not regulate sanitation nor defines it as a basic service. However, as sewerage provision requires huge investment with long-term horizon, a solid regulatory framework is needed for the sustainability of such wastewater systems.

Priority actions

Significantly increase access to safely managed sanitation, including wastewater/fecal sludge collection and treatment as well as solid waste management.

- **Given the high costs of improved sanitation and the availability of limited funds, a phased and targeted risk management approach can be applied to prioritize expansion of sanitation services and wastewater treatment.** A step-by-step approach based on risk management is needed, guided by a hotspot analysis. The approach could prioritize (a) highly polluted parts of big cities, (b) highest impact on water resources, (c) upstream cities, and (d) areas where pollution is impeding development. The wastewater database, introduced by Presidential Decree No.39/2019, needs to be established to assess the status of sanitation and wastewater treatment infrastructure. This database, as well as the national water quality information system, once developed, can be used as a basis for prioritization (see Action 2).
- **The action plan should consider adaptive sanitation strategies tailored to the situation of each city and rural area across the entire sanitation service chain.** The diversity of solutions across the entire sanitation service chain needs to be considered to find the most cost-effective solution to the greatest benefit of citizens and the environment. Technological options include centralized and decentralized solutions as well as off-site and on-site solutions with fecal sludge management. Some cities already have modern sewerage and wastewater treatment in place and some will need to start developing it for at least some areas. Some cities will not need citywide sewerage for some decades and often decentralized solutions may be more cost-effective. Local governments' capacity needs to be strengthened to design and implement the most cost-effective sanitation plans suitable for local characteristics.
- **Create an incentive for urban households to connect to the 'better' or 'more modern' services where available, that is, an existing sewerage network.** The current tariff structure does not provide an incentive for households to be connected to sewerage networks, as the use of septic tanks requires no payment (or only an occasional payment for desludging the septic tank). Applying the 'polluter pays' principles by charging the same tariff to households regardless of whether they use off-site or on-site services may provide an incentive for households to connect to the services. In addition, households' interest in modern sanitation will need to be raised through public awareness campaigns.
- **In places without sewerage network, the development and improvement of off-network approaches, such as fecal sludge management, is crucial.** IPLTs need to be constructed in areas where these currently not exist, while operation of existing IPLTs needs to be significantly improved, as currently only less than 10 percent are working properly. The payment system for private-sector desludging ("sedot") operators needs to be revised to incentivise the usage of their services. A viable business model and network needs to be developed, built on local tariff and mandatory service regulations for periodic emptying of sealed-bottom household septic tanks which can then be transported to relatively nearby fecal sludge treatment plants for processing.
- **Expand the community-led 'Total WASH Program' (Sanitasi Total Berbasis Masyarakat or STBM) for rural sanitation and link it to sanitation marketing and financing schemes to achieve even greater impact.** The program focuses on generating and sustaining demand of households in rural areas for five key WASH issues: (a) use of toilets; (b) washing hands with soap; (c) safe storage and handling of drinking water, including household water treatment and food preparation; (d) solid waste management; and (e) liquid waste management. The program is based on the finding that once a rural community realizes the need for WASH, the implementation can be greatly accelerated, WASH behavior changed, and open defecation eliminated. Nationally, 58,124 rural villages have taken part in STBM, which generated demand for basic toilets by more than 42 million people.
- **Ensure SANIMAS systems meet water quality parameters under the revised regulation.** Most existing SANIMAS systems are designed to meet the parameters of the outdated MoEF Ministerial Regulation 5/2014 and not of the revised and more stringent MoEF Ministerial Regulation 68/2016. The technologies for the existing SANIMAS systems need to be upgraded, while it need to be ensured that the design for all future SANIMAS systems meets the effluent standard of the revised regulation.
- **Improve solid waste management practices in larger urban areas as well as in rural areas and also aim to reduce plastic use and increase community-based recycling.** The household

practice of improperly disposing of waste (including plastic) directly into waterways suggests that behavioral change, regulations, and associated monitoring and enforcement can play an important role in reducing plastic waste pollution. National sanitation campaigns already exist at the household level, but these will need to be strengthened in rural areas, with a focus on the solid waste management pillar. This would need to be supported by solid waste management infrastructure and improved collection rates in these areas. Besides urban centers, priority rural areas include those adjacent to the Musi River, the Serayu River on Java, and the Barito River on Kalimantan where significant proportions of uncollected plastic waste are deposited directly into water.

Prevent pollution from industries and mines.

- **Following the 'polluter pays' principle—as stipulated in Regulation 22/2021—polluters must cover the expenses for treating wastewater and be held accountable for any environmental and human health damage caused by their actions.** This principle needs to be enforced and monitored.
- **Water quality and discharge monitoring needs to be expanded and made tamperproof.** All industries must have technical approvals in compliance with DTBP and pollution load allocation. Monitoring of industrial and mining effluent discharge needs to increase and this needs to be cross-checked with the water quality data of surrounding water bodies. To make water quality and discharge monitoring tamperproof, blockchain technologies and smart contracts can be applied. Smart contracts,[149] when coupled with automatic monitoring of water quality, can offer a fully automated solution for imposing tariffs or penalties on companies found discharging pollutants in excess of permitted levels.
- **Sanctions and penalties need to be higher than the costs of noncompliance and need to be enforced to incentivize companies to reduce pollution and act responsibly.** Currently, the risk of being penalized for polluting behavior is too low. Low levels of monitoring and enforcement, in combination with too low penalties for those caught, result in businesses treating the risk of incurring a penalty simply as a cost of doing business.
- **Discharge standards and related Wastewater discharge permits (Ijin Pembuangan Limbah Cair or IPLC) and Technical Approvals should be revised to include harmful pollutants such as pharmaceuticals, heavy metals, PFAS, hazardous and toxic waste, and micro- and nano-plastics, while wastewater quality standards for municipal wastewater (PermenLHK 68/201) also need to be updated.** As removing these pollutants from water is costly and at times nearly impossible, prevention is key. Particularly for high-risk industries such as medical facilities and pharmaceutical industries and mines, discharge standards should be strictly enforced.
- **Initiatives that incentivize sustainable behavior, such as the Program for Pollution Control, Evaluation and Rating (PROPER), should be expanded.** PROPER color-codes factories to indicate their performance, thus allowing consumers to 'vote with their purchase'.[150] As a result, pollution emissions have reduced, especially for low compliance companies engaged with global enterprises. This kind of information disclosure allows public opinion to be informed and thus public support needed for policy changes can be gauged (World Bank 2019p).
- **Reducing water pollution from acid mine drainage and developing an integrated strategy to tackle pollution from ore – such as gold - mining are a priority.** If not done adequately, mining can cause serious damage to the ecosystem and to human health, through acid mine drainage, and inadequate disposal of tailings and chemicals used etc. Although mining companies are required by Indonesian law to fill in closed coal pits and to restore mining sites, these regulations are not well enforced, partly because (coal) mine ownership in Indonesia is often unclear. As a result, (coal) mine owners are rarely held accountable for dealing with closed (coal) mines which, if not properly handled, can cause detrimental impacts to surrounding water bodies and affect drinking water safety and human health. Measures may include (a) enforcing drainage treatment and recycling; (b) adopting advanced technologies to control acid water, such as bacteria inhabitation and electrochemical protection (Sahoo et al. 2013); (c) applying nature-based solutions; (d) enhancing information disclosure about

149 Smart contracts are contracts built on blockchain technology and include all necessary information such as conditions and expiry dates and can automatically execute when the conditions are met.

150 PROPER, the first major public disclosure program in the developing world, was launched in Indonesia in June 1995. Labels are color-coded black, red, blue, green, or gold, where black labels represent the worst performers and gold labels the best performers.

coal mine ownership and holding mine owners accountable for closed coal mine restoration and revegetation; (e) conducting a full life cycle assessment before issuing further mining licenses; and (f) requiring "dry stack" tailings as opposed to storing and discharging tailings in water bodies, particularly in areas of high environmental risk. Similarly, Indonesia is a global hotspot for mercury pollution from (illegal, including artisanal) gold mining – and nickel mining and processing is increasing rapidly.. Specific regulations and penalty systems are required to reduce mercury pollution from legal and artisanal–often illegal– gold mines. These regulations need to be supplemented with livelihood transition programs as well as programs to train artisanal gold miners in mercury-free methods and in conducting clean-ups. RPJMN 2020–2024 has specified restoration of ex-mining land as a specific strategy to achieve its policy direction in environment quality improvement.

Improve legal and institutional frameworks

- **Create a specific law regulating water and wastewater services.** The 2019 Water Law does define sanitation as a basic service nor does it require regulation. As such, there is no adequate legal basis to develop a regulatory framework for sanitation and wastewater services. Legal and regulatory clarity is needed to address Indonesia's water pollution challenges.
- **The GoI should develop a national sanitation management policy to guide local governments.** The institutional framework for the development of sanitation infrastructure and service provision is fragmented. A national sanitation management policy should include cost-effective technology and business models that can be adapted to each local situation and cover the whole chain from household level through clean disposal of treated wastewater. In preparation for this policy, a study could be carried out to identify the range of technologies and alternative institutional models, together with the likely associated needs for institutional development.
- **Create incentives for local governments to invest in sanitation and wastewater and to enforce regulations.** While the commitment of district governments in funding sanitation has increased over the last 10 years—increasing the average APBN budget from 0.5 percent to 1.0 percent and with some districts allocating even 5.0 percent—much remains to be done.[151] There are significant resource mobilization challenges and consumer willingness to pay is low. An evaluation and incentive system should be established to improve sanitation sector performance. For example, the current target and evaluation matrices for the sanitation sector only include access indicators and additional indicators and targets on system performance should be added. Performance monitoring should be improved and linked to investment.
- **Further strengthen coordination of housing, settlement, drinking water, and sanitation development sector across all government levels.** Following Decree of the Minister of Bappenas No. Kep. 9/M.PPN/HK/ 01/2017 a National Housing, Settlement, Drinking Water and Sanitation Working Group (Pokja PPAS) was established. Further, working groups at provincial and district levels were established (Ministerial Regulation 12/2020). Coordination across all government levels shall be ensured through regular meetings between the Pokja PPAS and the working groups. The commitment of local government heads is still the key in accelerating sanitation access.[152]

Viable business models and secure revenue streams are required to meet the massive investment needs and attract private investment (see Action 9).

Action 6: Modernizing irrigation and improving its productivity

Action 6 - Key takeaways

- Third highest paddy yields among the top global rice producers.
- 80 percent of water used for irrigation.
- 46 percent of irrigation systems classed as 'in poor condition'.
- 35 percent of rice production is in river basins experiencing severe or high water stress.
- Only 12 percent of irrigation is supplied from reservoirs (premium irrigation).
- 17 percent of total subsidies are allocated to poorly targeted and not cost-effective fertilizers.

151 Stakeholder consultation with Directorate of Sanitation, DGHS (MoPWH) on October 7, 2020.

152 Stakeholder consultation with Directorate of Sanitation, DGHS (MoPWH) on October 7, 2020.

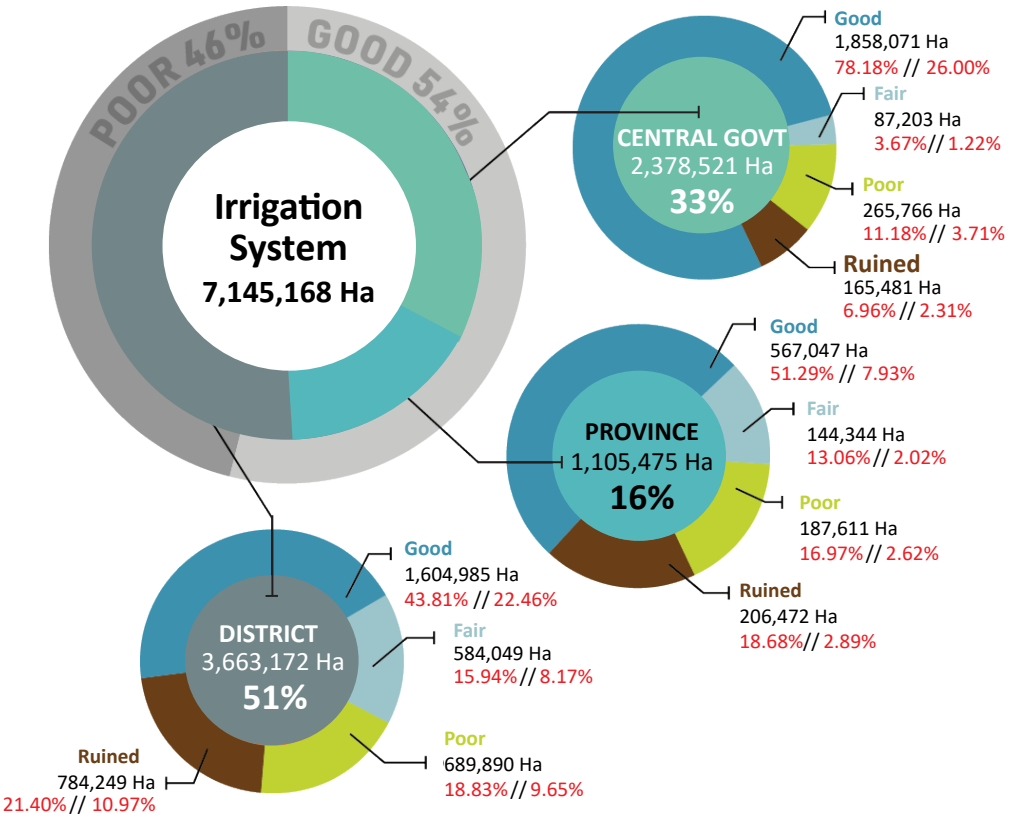
Threats and challenges

Agriculture is a vital sector of the economy and, by far, the major water user. Agriculture, forestry, and fisheries contribute about 12.4 percent of GDP and provide incomes for a quarter of the total workforce. More than 22 million smallholdings, of an average size of little more than half a hectare (0.6 ha), contribute three-fifths of agricultural value added. The fast-growing large plantation sector contributes two-fifths. The sector uses one-third (31 percent) of land and about 80 percent of the nation's water. Rapid growth and urbanization are changing patterns of demand for agricultural products. On the supply side, farm incomes are lagging far behind average incomes in other sectors and farmers are facing increasing constraints of water, land, and labor. Thus, the irrigated sector is under pressure, particularly in Java where massive conversion of farmland to other uses is taking place.

Concerns remain about the food and nutrition security situation in Indonesia, especially in the eastern parts of the country, although important improvements are being made. The weakest points in food and nutritional security in Indonesia are weak dietary diversity, weak micronutrient availability, and low protein quality. These, combined with poor access to clean water and hygiene, are key drivers for the high stunting rates.[153] Domestic production of rice is nearly sufficient to meet domestic demand, especially as overall and per capita rice consumption have been decreasing over the years. However, concerns regarding food security have been sharpened during the COVID-19 pandemic.

While irrigation has long been key to Indonesia's highly productive agriculture, now 46 percent of irrigation systems are categorized as being in a 'poor' state. Today, a total of 7.4 million ha are irrigated. Nearly two-thirds (60 percent) of all arable land and the great majority (85 percent) of paddy production is irrigated. Irrigation is largely by direct diversion from rivers or by impoundment of runoff; only 12 percent of irrigation is supplied from reservoirs. The functioning of irrigation systems differs widely between the government levels managing them. Systems managed by the central government seem to perform best overall, with only 7 percent categorized as 'ruined', while systems managed by districts overall perform worst, with 21 percent categorized as 'ruined'. About 51 percent of the irrigated area is managed by districts (Figure 33), and water use efficiency and agricultural productivity are lower in these areas.[154]

Figure 33: Overview of irrigation system functioning across national, provincial, and district management (2014)

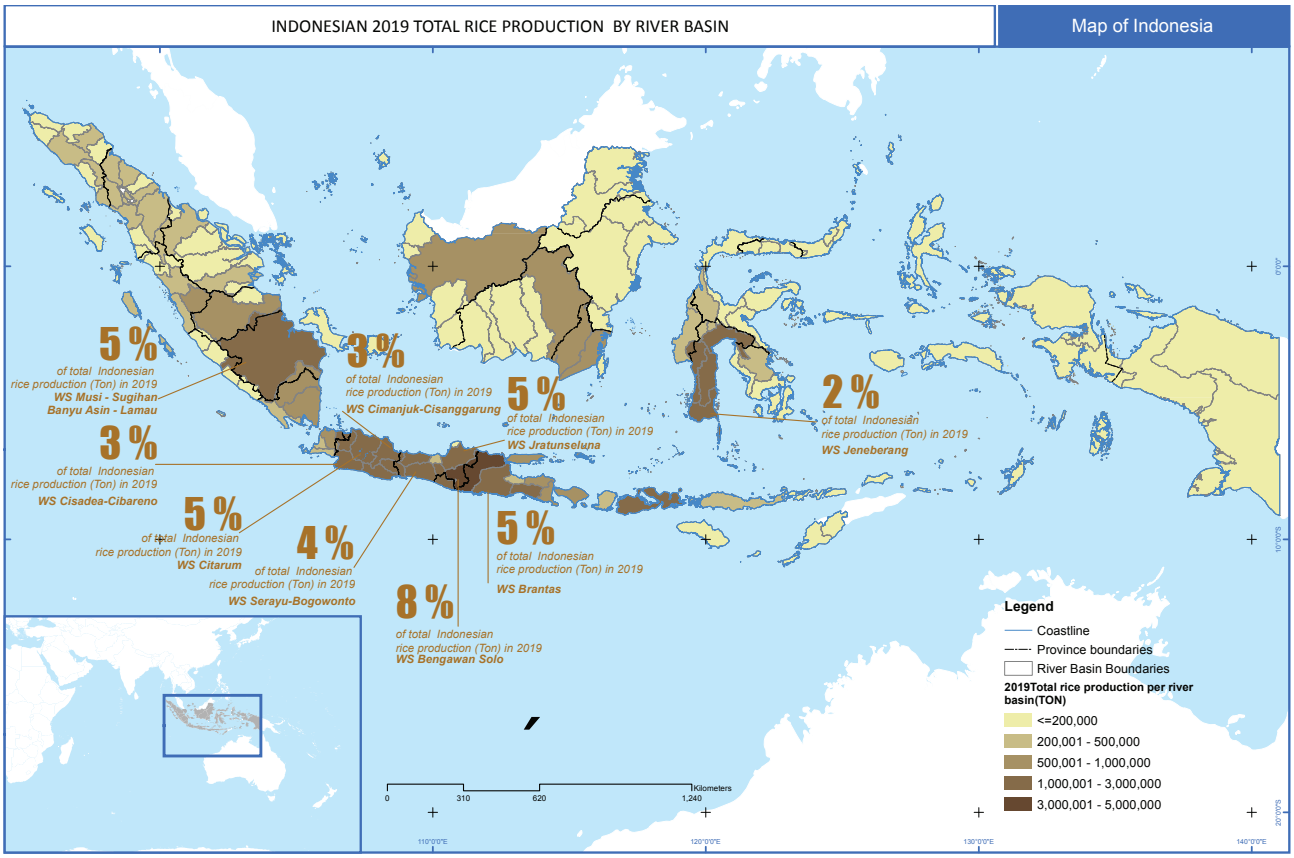


Source: Strategic Plan 2015–2019 Directorate General of Water Resources, MoPWH.[155]
Note: In 2019, the total area of irrigation systems (outside of lowland areas) amounts to 7.4 million ha (RPJMN 2020–2024). However, this is the latest overview available on the status of irrigation systems.

153 The subscores of the Global Food Safety Initiative (GFSI) on quality and safety are as follows: a very weak dietary diversity (19/100); a weak micronutrient availability, as represented with dietary availability of vitamin A, iron, and zinc (37.7/100); and protein quality (18.9/100).
154 For definition of water stress, please refer to Chapter 1.
155 https://www.globalforestwatch.org/dashboards/country/IDN.

Java contains about 33 percent of the total of irrigated rice fields and accounts for nearly 52 percent of the national output of rice (BPS 2020b). The top nine rice producing river basins, which jointly produce 40 percent of Indonesia's rice, are shown in Figure 34. Of these, four are located on Java. The Jatiluhur Irrigation System[156] alone, located in the West Java Province, provides approximately 40 percent of the rice needs for West Java Province and 9.4 percent of total national production on an irrigation area of 240,000 ha (World Bank 2018a).

Figure 34: Paddy rice production (tons) by river basin (2015)



Source: Amended from PUS AIR 2016 and BPS 2020b.

Despite Indonesia's overall water abundance, localized water stress in key rice producing river basins is becoming an increasing challenge. Currently, 31 percent of paddy areas—which produce 35 percent of Indonesia's paddy production—are located in river basins with severe or high water stress (Table 11). Causes for this stress can be increased demand or reduced availability or a combination of the two. Besides increased demand for domestic, municipal, and industrial purposes, the demand for irrigation water has increased due to the pressure to increase rice production often beyond the capacity of the water resources available.

156 In the context of this report, rainfed agriculture is defined as agriculture not provided with irrigation water from public or private multiuser irrigation systems. Agriculture where individual farmers collect water or use on-farm wells for supplementary watering for crop production outside official irrigation systems is considered rainfed.

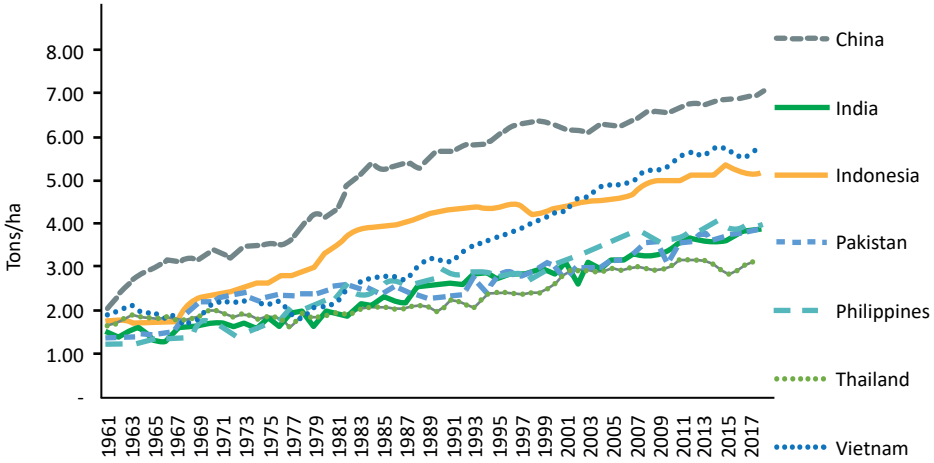
Table 11: Overview of paddy in river basins accross water stress categories (2015)

River basin water stress status[157]	Paddy area (ha)	% total paddy area	Paddy production (tons)	% total paddy	Average yield (ton/ha)
Severe stress	1,895,253	*13*	11,239,564	*15*	5.56
High stress	2,557,558	*18*	14,942,253	*20*	*5.35*
Medium stress	4,187,452	*30*	23,971,631	*32*	*4.95*
No stress	5,473,967	*39*	25,230,162	*33*	*4.21*
Total	**14,114,229**	***100***	**75,383,611**	***100***	

Source: World Bank calculations, based on data from PUS AIR and BPS.

Indonesia has the third highest paddy yields among the top global rice producers, but paddy yield varies greatly across the river basins in Indonesia. With average paddy yields of 5.19 tons per ha, only Vietnam and China have higher yields (Figure 35). The lowest paddy yield is just 2.86 tons per ha in *RBT* Bangka (Sumatera), while the highest is 6.08 tons per ha in *RBT* Bali-Penida (Bali and Nusa Tenggara). Table 11 shows that farmers have already started to adjust to water stress—the higher the water stress, the higher the yields. While the river basins producing 80 percent of total national paddy rice production have an overall higher yield, there are still some differences across these river basins. Although there will be differences in soils, agronomic practices, water management, or market access which affect production, the variation in yields suggests that there is potential to increase production even in the top producing river basins by bringing up yields in the currently lower-yielding areas.

Figure 35: Paddy yields of the top 10 paddy producers globally across time (1961–2018)



Source: FAOSTAT 2020.

Development of lowland areas for food crops and plantation has driven deforestation and drainage of peatland areas, leading to serious challenges of fire, land subsidence, and reduced productivity and downstream water availability. Eastern Sumatra had forest cover reduced by 40 percent between 2001 and 2018[158] with millions of hectares of concessions granted for large-scale industrial oil palm and pulpwood plantations. Much of this development has been on marshy peatlands requiring large-scale drainage for the land to be productive. Such drainage leads to carbon emissions and land subsidence due to oxidation of the exposed material from both biological decomposition and fire. The combination of land subsidence and SLR also increases the risks of inundating vast areas of lowland Indonesia, leaving these areas unsuitable for many crops unless polder systems are introduced

Large agricultural areas in the lowlands are already unsuitable for productive agriculture. Some lowland areas, primarily those located in deep peat zones on Sumatra and Kalimantan, face higher environmental risks and externalities as well as low productivity (World Bank 2020c). Only 42 percent of the existing

157 https://www.spott.org/palm-oil-resource-archive/impacts/environmental/.

158 https://www.globalforestwatch.org/dashboards/country/IDN.

agricultural systems in the lowlands are located in areas with suitable biophysical characteristics (World Bank 2020c). Over the years, agricultural production on non-peat soils is more profitable (Box 9).

Horticulture is predominantly rainfed[159] but faces multiple challenges. Horticulture is essential for the provision of necessary nutrients for a healthy diet, especially in isolated areas. Horticulture is usually practiced in home gardens and for commercial purposes. The main challenges in the horticulture sector are the low level of competitiveness in domestic markets compared to imported products, caused by low productivity and quality; inefficient cultivation and processing; high marketing costs; scarcity of suitable land; and difficulty in accessing irrigation systems (sprinkler and drip) and electricity.

Agriculture affects water pollution through effluent discharge and runoff of pollutants. Water pollution occurs due to runoff of fertilizer and pesticides/herbicides (Obidzinski et al. 2012). This applies to all agricultural production, including food crops, plantation crops, horticulture, and aquaculture. Runoff from fertilizers—containing nitrogen and phosphorous—can lead to eutrophication of water bodies and cause algal blooms. Pesticides contain heavy metals and ingredients grouped under the toxic and hazardous waste (B3) category. There is a widespread lack of farmer knowledge on appropriate fertilizer, herbicide, and pesticide use (World Bank 2020c). Discharge of effluent from processing of plantation crops can also cause water pollution. For example, 2.5 tons of palm oil mill effluents are generated for every ton of palm oil produced and the effectiveness of treatment before discharge is often limited.[160] Antibiotics and hormones enter water bodies through livestock rearing and aquaculture.

Water pollution is also affecting agricultural production. The steady flow of nutrient-rich wastewater year-round has been a blessing for many farmers, particularly in water-stressed areas with falling groundwater tables. Nevertheless, if not carefully managed, wastewater irrigation can harm crop quality and cause health concerns and environmental damage. Urban wastewater is often high in concentrations of heavy metals, particularly in cities where heavy industry is present. When fields are repeatedly irrigated with this water, concentrations of heavy metals build up in the soil. This can be harmful both to crop production—reducing the yield benefits of wastewater irrigation over time—and to humans and animals who consume the metal-rich plants (Meng et al. 2016 in World Bank 2019p).

Climate change will increase the already considerable pressure on water and food security in Indonesia, while paddy production is a key GHG emitter. Without necessary interventions, climate change is expected to decrease total agricultural productivity by 17.9 percent per unit area by the 2080s. Globally, it is estimated that around 19 percent of total methane emissions come from rice fields (US-EPA 2006). Irrigation water and fertilizer usage were found to be the largest GHG contributors in Indonesia. Interestingly GHG emissions from paddy production vary across Indonesia. The highest carbon footprint for paddy production was found in the drier East Nusa Tenggara province and the lowest in Yogyakarta province, where more water efficient agricultural practices are applied, such as System of Rice Intensification and Alternate Wetting and Dry (Afiyanti and Handoko 2018). Thus, water efficient practices also reduce overall GHG emissions.

After 50 years of World Bank involvement in the irrigation sector in Indonesia, much has been achieved in terms of food production capacity and associated food security, as well as development of irrigation management institutions—yet some challenges continue. The development of Water User Association and Federations (WUAFs) as partners of the irrigation agencies in the provinces and districts—as a result of the decentralization policies—proved to be essential for improved service provision and productivity (Alaerts 2020). However, many challenges could not yet be fully addressed, such as the viability of irrigated agriculture for smallholders, sustainable O&M for irrigation services, climate change, and land conversion. The organization, funding, and implementation of adequate O&M for reliable service delivery proved to be an issue since the 1970s and remains a main challenge.[161]

Priority actions

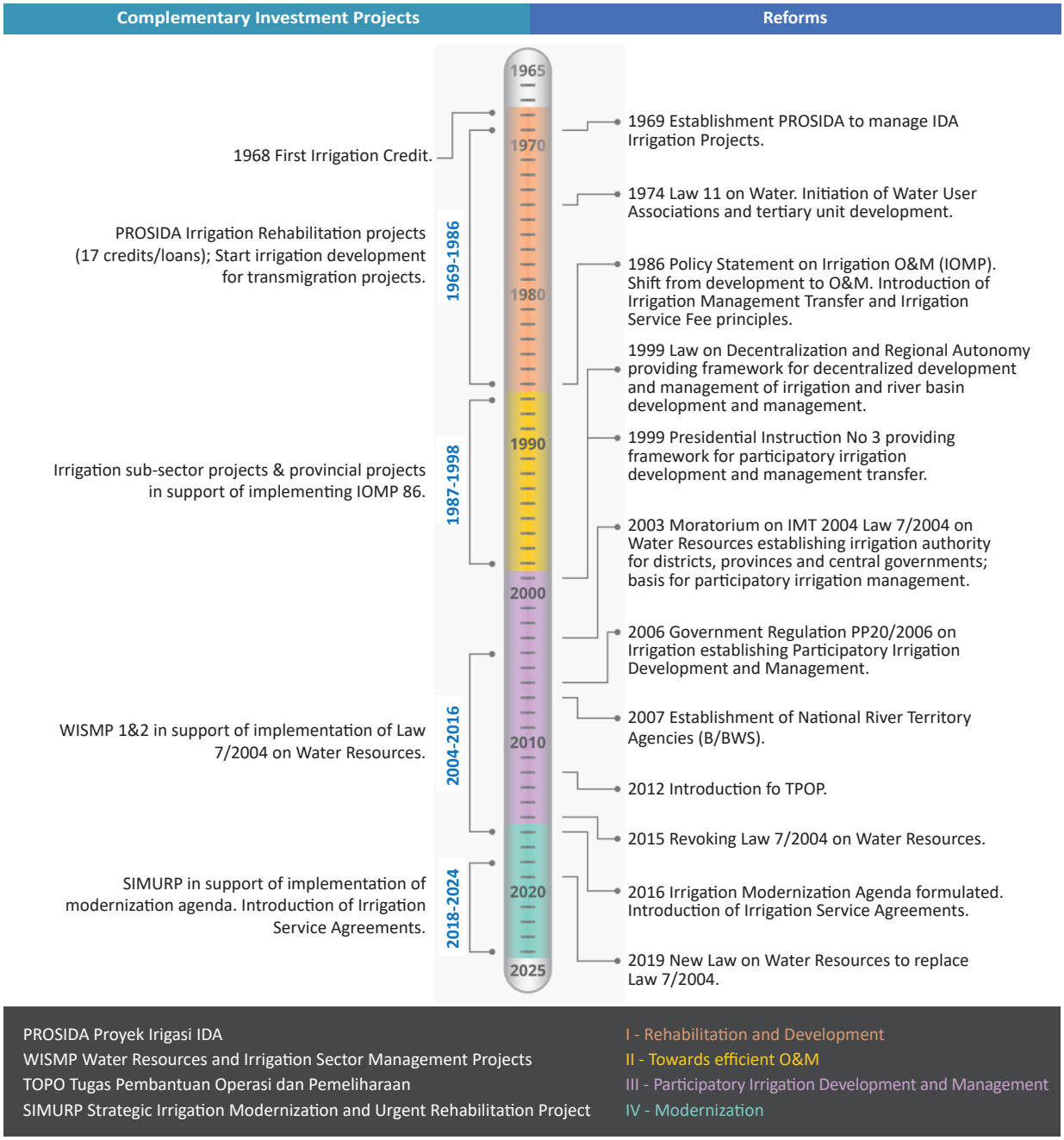
The following priority actions build upon the 50-year reform history in which the World Bank supported the GoI. Figure 36 provides an overview of past irrigation reforms since 1968 and complementary investment projects.

159 In the context of this report, rainfed agriculture is defined as agriculture not provided with irrigation water from public or private multiuser irrigation systems. Agriculture where individual farmers collect water or use on-farm wells for supplementary watering for crop production outside official irrigation systems is considered rainfed.

160 https://www.spott.org/palm-oil-resource-archive/impacts/environmental/.

161 An overview of the irrigation sector reform can be found in the underlying report "Indonesia Toward Water Security – Diagnostic Report.

Figure 36: Overview of past irrigation reforms and complementary investment projects (1968–today)



Transformation of the agricultural economy will require modernization of the provision of irrigation services and improved income generation for farmers.

– **RPJMN 2020–2024 aims to improve the irrigation systems and to modernize irrigated agriculture.** The goal is to increase agricultural GDP at an annual rate of 3.8–3.9 percent by (a) increasing the percentage of premium irrigation system from 12.3 to 16.4 percent of total irrigation systems, that is, from 913,000 ha in 2020 to 1,413,000 ha in 2024 (an increase of 500,000 ha); (b) expanding the total irrigation network by 500,000 ha from 7.4 million ha (RPJMN 2015–2019) to 7.9 million ha by 2024; (c) rehabilitating 2 million ha of irrigation systems by 2024; (d) increasing the area suitable for high-value agricultural commodities by 30,200 ha by 2024; (e) increasing the number of multipurpose reservoirs by 63 (18 of which are part of the 'major projects', which will supply 20 percent of water for the 51 premium irrigation systems); and (f) improving the efficiency and irrigation performance to above 70 percent through the introduction of suitable technologies in nine irrigation systems (RPJMN 2020–2024). The GoI further plans to enhance water security—in terms of quantity and quality—by limiting deforestation.

– **Further, steps have been taken to improve tertiary (farm level) irrigation networks.** MoA has made several efforts including (a) tertiary irrigation network rehabilitation to improve and optimize the function of irrigation networks at the farm level covering an area of 3,276,749 ha (2015–2019); (b) construction of 3,706 pumping irrigation and piping irrigation units (2016–2019) for additional

planting areas for food crops, plantations, horticulture and animal husbandry; (c) construction of 3,079 units of reservoirs/damtrenches/storage (2016–2019) along with efforts to encourage water conservation and environmental management of agricultural businesses to adapt and mitigate climate change impacts; and (d) application of participatory irrigation schemes to empower and strengthen communities/farmers using water.

– **Investment in new capacity should proceed prudently.** Development of new multipurpose dams with storage and conveyance for 'premium irrigation' should proceed but only where this is economically and hydrologically efficient. Some investment in new irrigation areas and in upgrading swamp development areas may be justified, given the accelerating pace of reduction in the irrigated area in Java. However, integrated river basin planning is required and only modern, flexible, and water-efficient designs should be considered.

Harness the considerable scope to increase both '$ per drop' and 'nutrition per drop' and thus promote a transformation toward a more profitable, commercialized agriculture sector.

– **Intensify climate-smart agriculture practices and the promotion of Good Agricultural Practices (GAP) for both rainfed and irrigated farmers while enhancing market access in promising areas**. Particularly in water-stressed areas, this may allow for a transition from rice-based agriculture to a more commercially-oriented, diversified, and profitable smallholder sector, growing more diversified, and nutritious crops that return 'more income and nutrition per drop'. A more profitable commercialized agriculture will increase farmer incomes and reduce incentives for land conversion to other purposes. In 'premium irrigation' areas, horticulture zones could be developed and provided with advanced water management facilities.
– **To successfully implement a shift towards more water efficient and higher income generating agricultural practices, the entire value chain needs to be addressed.** Structural changes are required to allow for the availability of required agricultural inputs, such as seeds as well as (organic) fertilizers and pesticides, in addition to enabling access to off-taking markets for the final produce. In many regions, supply chains – including storage and transport – are not yet developed making it barley possible for farmers to switch to less water intensive and higher value crops. Further, agricultural extension workers need to be trained to support farmers and build their capacity on growing and marketing new crop choices.[162]
– **The institutional responsibility for Water User Farmer Associations needs to be clarified.** Currently, the regulation is unclear whether MoPWH or MoA is responsible for managing Water User Farmer Associations (Perkumpulan Petani Pemakai Air, P3A) and with this supporting them in identifying and improving water sources if they are not connected to the irrigation systems, increasing their productivity and water efficiency, and supporting their crop choices and production methods, and so on. MoPWH Regulation 30/2015 on Development and Irrigation System Management needs to be revised to enhance clarity.[163] Support is required from local governments for P3As to gain legal status, which will then make them eligible to support programs from MoPWH, such as SIMURP. [164]

Increasing water security for local food security requires location-specific strategies.

– **Protect highly productive agricultural land in spatial plans. In certain areas, such as in Java, productive agricultural land is being rapidly converted.** However, legal documents exist to limit this land conversion through adequate spatial planning: (a) Law No 41/2009 regarding the protection of sustainable food farming and (b) Government Regulation 1/2011 regarding the establishment and land function of sustainable food farming. However, in the regency/city spatial plans (*Rencana Tata Ruang Wilayah*, RTRW) formulated between 2008 and 2012, only about 50 percent of the existing agricultural land is currently protected.[165] Particularly in areas with high urbanization, care needs to be taken to protect highly productive lands.
– **Location-specific strategies can be translated into roughly three categories:**
    - **Zones of mass production of staple food (rice-corn-sugar) in designated areas with adequate land and water resources and well connected to the markets to ensure competitive production.** Enhancing water security would mean modernization of

162 Expert opinion from Focus Group Discussion on Water Services – Agriculture – on 3 May 2021.

163 Stakeholder consultation with Directorate of Agriculture Irrigation (Ministry of Agriculture) on 21 January 2021.

164 Expert opinion from Focus Group Discussion on Water Services – Agriculture – on 3 May 2021.

165 Stakeholder consultation with Directorate of Irrigation and Water Resources Management (BAPPENAS) on September 17, 2020.

the conventional irrigation systems as is foreseen for the 'premium irrigation' systems with connection to adequate multiyear storage and with an increase in efficient farming practices. In tidal lowlands, better water management technology to ensure adequate irrigation and drainage needs to be introduced, avoiding drainage of peatlands as much as possible.

- **Concentration of fruit and vegetables in horticulture zones near urban areas and with fertile land and free of flood risks.** Concentration of horticulture in these zones will minimize processing, storage, and transportation costs, thereby helping improve quality and reduce costs and thus helping increase competitiveness. These horticulture zones may rely on independent small-scale irrigation facilities developed and managed by the cultivators themselves but provided with long-term water use licenses from the water resources manager in the basin. One challenge would be to avoid the use of wastewater for irrigation in these zones and to ensure that neither groundwater nor surface water were polluted. In particular, urban centers need to upscale their wastewater treatment to avoid coliforms and heavy metals entering the food supply chain.
- **Development of community subsistence food security zones in remote areas that are poorly connected to markets but have access to land and water.** Such zones need to be developed with government assistance but need to be managed by the communities or local water user associations (WUAs) with 'maintenance support' from the local government.

Enhance the organization, funding, and implementation of adequate O&M for reliable service delivery.

- **Introduce a combination of financial, institutional, and physical interventions to enhance the service orientation of irrigation agencies and to bring the sustainability of reliable service delivery to a higher level.** Important contributions to achieving this goal will be (a) the development of a synchronized effort to modernize irrigation management institutions equipped with capable staff and adequate and reliable management information systems, (b) modernization or upgrade of irrigation infrastructure and facilities for effective, responsive, and reliable provision of irrigation services; and (c) the introduction of irrigation service agreements and better financial arrangements between the various tiers of management and service provision. The Strategic Irrigation Modernization and Urgent Rehabilitation Project (SIMURP) intends to work on all these aspects in selected national irrigation systems.
- **O&M for irrigation systems needs to be fully financed on a sustainable basis, with a sharing of the financial burden.** Adequate financing of irrigation O&M needs to be ensured using multiyear, needs-based budget plans and allocations based on asset management plans. Local governments need to be given incentives to increase investment in O&M of dam and irrigation schemes, for example, through transfers conditional on O&M plans. The current apparent incentives to neglect O&M so as to get the central government to finance rehabilitation need to be eliminated. Further, there is a need to enforce Local Governments' compliance with using budget allocations toward irrigation O&M for this purpose, instead of diverting these to cover other expenditures.[166]
- **To create more certainty and accountability of irrigation services, 'irrigation service agreements' should be introduced.**[167] A more responsive and reliable service is required that will increase productivity and enable the production of higher-value and more remunerative crops. 'Irrigation service agreements' provide for contractual commitments between basin manager and schemes and between schemes and farmer organizations to set out the respective responsibilities, rights, and obligations of service providers and clients. Agreements between schemes and farmer organizations would be based on formalized water rights and agreed irrigation service standards and should provide for irrigators to participate in O&M.
- **There would be advantages if RBOs were to collect revenues, especially for O&M, and to increase WUA and stakeholder participation.** Financial contributions for maintaining this

166 Expert opinion from Focus Group Discussion on Water Services – Agriculture – on 3 May 2021.

167 National irrigation systems are managed as follows: (a) the primary basin water supply systems is managed by the 34 RBOs under the MoPWH and two river basin corporations: PST I and PST II under the MSOE; (b) the secondary system is managed by the provincial/district irrigation agencies; and (c) the tertiary units are the responsibility of the farmers, organized in WUAs as well as WUAFs. Clear service agreements that describe the roles, responsibilities, rights, and obligations of the service provider and the recipient of the service are currently absent (World Bank 2020d).

infrastructure are still inadequate and, according to the 2019 Water Law, smallholder farmers are exempt from irrigation service fees (ISF). If RBOs were permitted to collect fees or develop mechanisms, such as SOE-public partnership, to engage farmers in contributing to irrigation financing, this would improve the efficiency and sustainability of irrigation services, strengthen WUAs, and create greater mutual accountability. MoPWH might prepare a policy for progressive farmer contributions to help finance the cost of irrigation services. Where dams and reservoirs are considered, ways to optimize benefits through having them serve multiple purposes should always be considered.

Increase the efficiency, effectiveness, and reliability of irrigation to optimize water usage in water-stressed areas and provide water security to produce higher-value crops.

- **Irrigation strategy needs to be refocused on a least-cost, maximum-value model, rebalancing infrastructure investment and management and irrigated farming systems toward efficiency and productivity and prioritizing getting more out of existing water diversions**. Investment should prioritize modernization (for example, irrigation efficiency, investment in micro irrigation) and should promote high-value crops and efficient water use. Potential of available technological solutions domestically and internationally needs to assessed and recommendations for the ideal application to achieve water security and income augmenting objectives made.
- **Cooperation between MoA, MoPWH, and Water User Farmer Associations needs to be enhanced to ensure that primary, secondary, and tertiary irrigation function coherently and ultimately supply water to the farms.** While MoPWH is responsible for providing primary and secondary irrigation in irrigation areas covering more than 3,000 ha, Water User Farmer Associations are responsible for the development and management of tertiary irrigation (farm level). To ensure optimal usage of irrigation water, all three levels of irrigation need to be coherent and functioning. To ensure this, the responsibility for supporting Water User Farmer Associations needs to be clarified and coordination between MoPWH and MoA needs to be strengthened.[168]
- **Sector investment needs to shift from output based to outcome based.** The balance of public finance allocation could be shifted from output-based to performance-based transfers to incentivize local government action on modernization, asset management, and O&M. For example, the central government could introduce performance-based transfers to incentivize lower-level governments' irrigation asset management plans, adequate O&M allocation, and achievement of performance targets aligned with sector objectives such as irrigation modernization and agricultural productivity, promotion of high-value crops, efficient water use, and intensive husbandry practices.
- **New investment should be subject to economic analysis and should be optimized within a basin framework.** Plans for dams, irrigation expansion, and swamp development should be reviewed against economic criteria and should be integrated into broader spatial planning and provide for complementary infrastructure investment to optimize benefits.
- **Strengthen water measurement at the basin and scheme levels to provide detailed information on water availability, water use, and water needs.** Currently there is not enough information on water demand for the crop cycle, which significantly impedes irrigation planning and scheduling to ensure continuous and sufficient water supplies.[169] Establishing water accounts is necessary to improve water allocation and distribution and to enhance responsiveness, reliability, and efficiency of water delivery and water use. This requires an increase in the frequency and density of observations at the basin level as well as at the irrigation system level and consequently a modernization of the observation network and data processing.
- **Finalize ongoing work on a system of irrigation water entitlements.** The 2019 Water Law refers to water entitlements and licenses as essential elements in the planning of water allocation, delivery systems, and infrastructure development. The development of a system that includes these elements is an ongoing process, and a clear and unambiguous water licensing system is increasing in importance in areas with high water stress.
- **Scale up participatory irrigation at the subnational level including by strengthening the role of irrigation commission and water resource boards as local/multistakeholder platforms.** Participation of water users in all aspects of development

168 Stakeholder consultation with Directorate of Agriculture Irrigation (Ministry of Agriculture) on 21 January 2021.

169 Expert opinion from Focus Group Discussion on Water Services – Agriculture – on 3 May 2021.

and management of irrigation systems and the establishment of irrigation commissions as multistakeholder coordination and decision-making platforms became mandatory at each district and province and has been rolled out since 2004. Between 2004 and 2015, dry husked rice yields increased by 18 percent as a result of the increased participation and commitment of subnational governments in managing irrigation services. However, particularly for national irrigation schemes the implementation of the participatory principle is more challenging due to fragmented mandates at the national level and responsibility for capacity and development of WUAFs lying with local governments (World Bank 2020d).

Reduce agricultural production in peatland areas and rehabilitate degraded peatland areas.

- **For peatland areas, ensure integrated land and water planning and management based on individual PHUs.** A full life cycle cost assessment should be conducted before cultivating peatland areas. To minimize damage and increase productivity, planning and coordinated management is required, integrating agricultural development, water resources planning, and fire management at the landscape level. For peatland areas selected for cultivation – if any – the crop choice needs to reflect the water management requirements to minimize damage to the peat.[170]
- **Expand provincial-level landscape planning within Indonesia's Green Growth Program.** Rewetting drained areas, including through canal blocking, should be considered where appropriate. The larger peat domes should be the priority. Livelihood transition plans can be implemented to support conservation of peatland and forest areas.
- **Land recovery programs in swamp areas need to be carefully reviewed against economic, social, and environmental criteria.** The Ex-Mega Rice Project (EMRP) in Central Kalimantan was one of these areas. After early development in the mid-1990s, the project, initially planned to cover 1 million ha of peatland, was abandoned due to low productivity that resulted from growing rice on the nutrient-poor peat soils and insufficient land and water management.[171] Only 85,000 ha of the EMRP are currently productive for paddy cultivation The project also had a deleterious effect on the environment, including biodiversity loss, peat fires, and GHGs. In May 2020, amid food security concerns related to the COVID-19 pandemic, the GoI announced a new project to revitalize 75,000 ha by improving land and water management. While the revitalization of this area will also reduce the flood and fire risk from the abandoned land, the drainage infrastructure required for paddy is costly. Other crops, such as sago, which are native to peatlands may be more cost-effective in improving food security.[172] Economic cost-benefit analysis for the entire life cycle of the project should be conducted to assess trade-offs with other areas.

Tackle the dual challenge of water pollution in agriculture—reduce pollution from the runoff of agricultural chemicals and protect crops from irrigation with wastewater containing harmful pollutants such as heavy metals.

- **Develop a 'Smart Fertilizer Subsidy Program' to simultaneously reduce the environmental impact and improve farmer productivity and profitability.** Currently, 17 percent of total subsidies are allocated to fertilizers. However, fertilizer subsidies are poorly targeted and not a cost-effective way to increase production. The inappropriate usage of fertilizers is a key cause of water pollution.
- **Enforce restrictions and prohibitions on harmful pesticides, insecticides, and herbicides and on antibiotics and strengthen the role of the Civil Servant Investigator (*Penyidik Pegawai Negeri Sipil*, PPNS) to tackle illegal pesticide markets.** Currently, prohibited chemicals are still available in the market, polluting water supplies. Given the size of the country, restricting the illegal trade in pesticides is a challenge. Currently, farmers need to alert the PNNS on the illegal trade and usage of prohibited chemicals who—following an investigation—would pass on the case to the police. Awareness on the harmfulness of applying prohibited chemicals needs to be increased for farmers and PPNS.[173] Further, the usage of antibiotics and hormones in livestock rearing and aquaculture needs to be more strongly regulated, and effluent from these industries needs to be treated before discharge.

170 Expert opinion of Focus Group Discussion on Water Services – Agriculture – on 3 May 2021.

171 Stakeholder consultation with Badan Restorasi Gambut (BRG) / Peatland Restoration Agency on September 18, 2020.

172 Stakeholder consultation with Directorate of Agriculture Irrigation (MoA) on January 21, 2021.

173 For example, from China (Khan et al. 2008), India (Sharma, Agrawal, and Marshall 2006), Pakistan (Mahmood and Malik 2014), and Saudi Arabia (Balkhair and Ashraf 2016), among many other places.

- **Provide capacity building for farmers on the right application of agricultural inputs and organic farming techniques.** Insufficient knowledge on use of fertilizers and pesticides, particularly in vegetable production, reduces farmer incomes and contributes to water pollution.
- **Extend the MoA program of distributing Organic Fertilizer Processing Units to farmer groups and retrain farmers in organic farming techniques.** Organic agriculture is increasingly being supported by MoA. To increase the application of organic fertilizer, MoA has distributed around 3,000 Organic Fertilizer Processing Units to farmer groups between 2017 and 2019. This program needs to be scaled and capacity for farmers enhanced.
- **Until wastewater is treated adequately, crops produced in water pollution hotspot areas should be sampled for pollutant residues beyond thresholds before entering the markets.** Numerous studies from around the world[173] show that vegetable crops grown using wastewater have often significantly high levels of heavy metal concentration, exceeding World Health Organization (WHO) thresholds. Thus, consuming food grown from untreated wastewater irrigation may lead to slow poisoning over time (World Bank 2019p). In addition to increasing wastewater treatment and ultimately bringing it to tertiary treatment levels, a monitoring and regulatory system for fresh produce is required to protect consumers.

Pillar III. Strengthening governance and institutions for sustainable and efficient water management

The challenge of water resources management is geographically complex—surface water is managed in 128 river basins, and groundwater management is based on 421 groundwater basins.

Water security is hindered by differing regional priorities, lack of fiscal resources, and weak institutional capacity.

Indonesia is among the countries with the lowest spending on water and sanitation. At only 0.2 percent of the national GDP, it is far lower than the levels recommended for East Asian countries (0.5 percent) or by the United Nations (1 percent).

To move Indonesia toward achievement of Vision 2045, measures to accelerate RPJMN 2020–2024 implementation should prioritize the following:

- Provide a sound legal basis for water management.
- Support an integrated and coordinated water governance system.
- Improve human and technical capacity for integrated water management.
- Improve fiscal policies and public spending in the water sector.

Action 7: Strengthening the governance framework

Threats and challenges

The passing of the 2019 Water Law and the 2020 Omnibus Law provides an opportunity to address coordination and implementation challenges and to move toward more integrated water resources management. Box 16 illustrates the most relevant changes. Up to now, there is some regulatory uncertainty on responsibilities, with some tasks overlapping.

With time, it needs to be ensured that all regulations are aligned with the 2019 Water Law and are harmonized to avoid any potential contradictions and overlapping responsibilities. The National Policy on Water Resources Management (Jaknas) needs to be revised. In addition, there are at least 12 government regulations and at least 42 ministerial regulations relevant to water management that appear to be in force. In addition, additional implementing regulations for the 2019 Water Law need to be issued and coordinated across all relevant government agencies. While implementing government regulations require a consultation and coordination mechanism to consider inputs from all relevant ministries, ministerial regulations are mostly coordinated within the implementing ministry only. This can lead to overlaps and gaps in responsibilities across government bodies. Key areas for clarification concerning the 2019 Water Law include jurisdiction and accountability for water resources and principles and practice for water allocation.

The passing of the 2020 Omnibus Law will necessitate the revision of implementing regulations

Box 16: Salient features of the 2019 Water Law (considering subsequent amendments from the Omnibus Law)

State Control on Water Resources

- Water resources cannot be owned or controlled by individual, groups, or business entities (Art 7).
- Right to water is guaranteed for daily basic needs, smallholder farming, and drinking water provision systems (Art 8).
- If water is still available, the next priority for allocation are public interest noncommercial activities and commercial interests for which licenses are already issued (Art 8).
- In considering those priorities, national and regional governments shall calculate the need for water for the environment (Art 8).

Allocation and Licensing

- Main priority for 'commercial use' is for state-, region-, and village-owned corporations (Art 46).
- Private sector's commercial water use is subject to tight restrictions (Arts 46, 51).
- (Business) licensing shall be tightly issued with the following priority: daily basic needs in large scale, daily basic needs that change natural condition of the water source, people's farming outside of existing irrigation system, drinking water provision system, public interest noncommercial activities, commercial use of state/region/village-owned enterprises, and finally individual and the private sector (Art 49).

Institutions

- National and/or regional governments (provinces, cities, and regencies) can delegate some of their tasks in managing an RBT to 'Water Managers' (Art 19).
- Major regulatory, policy, and licensing functions as well as enactment of water resources plans cannot be delegated to 'Water Managers (Art 19).
- Coordination shall be conducted at the national, provincial, and regency/city levels through water resources councils on those levels and through coordinating bodies at the RBT level (Arts 64, 65, 66).

Information

- Water resources information system is a network of information managed by various institutions (Art 54) and must be accessible to various stakeholders (Art 54).
- Water resources information comprises hydrological, hydrometeorological, hydrogeological, policy, infrastructure, and technology, as well as environment and socioeconomic activities related to the water source (Art 54).

Planning

- Water resources plans (*pola and rencana*) shall be formulated at the RBT level (Arts 10, 11, 38, 39).
- Water resources plan is one of the basics in formulating and reviewing spatial plan (Art 39).

Drinking water

- The national, provincial, and city/regency governments are responsible for developing drinking water provision systems in accordance with their authorities (Arts 10, 13, 15).
- Business licensing for drinking water provision shall be provided to state-, region-, and village-owned enterprises (Art 50).

Conservation

- Prohibition on water utilization in natural reserve and conservation areas, except for daily basic needs (Art 33).
- Conservation shall be conducted on springs, rivers, wetlands, recharge areas, aquifers, natural reserve, protected areas, forests, and coastal regions (Art 26).

across various ministries, providing an opportunity for an improvement in the water governance system beyond the areas covered in the 2019 Water Law.

There is a legal void on regulating water and wastewater services. Adequate regulation is possible only when the mandate for sanitation and wastewater services is provided in primary regulation (law). However, the 2019 Water Law contains no provision on how water 'services' should be regulated. While the 2019 Water Law briefly mentions sanitation in the context of surface water protection and conservation in the elucidation, it does not regulate sanitation nor defines it as a basic service. However, as water supply and wastewater services require huge investments with long-term horizon, a solid regulatory framework is needed for the sustainability of such systems. A special law on water and wastewater services is required for legal and regulatory clarity—and to thus address Indonesia's water pollution challenges (see Actions 4 and 5).

The current regulatory framework on managing water utilities does not incentivize efficient and effective management. Government Regulation 122/2015 currently does not consider the particularities of water utilities as natural monopolies. The regulatory framework should provide incentive for water utilities to be competitive, for example, by facilitating benchmarking and encouraging mergers to achieve economies of scale and scope. To accomplish this, an additional specific law (primary legislation) designated for water services may be required (see Action 4)

There is currently a legal and regulatory void regarding groundwater planning, conservation, utilization (except for licensing), and damage control. Before the 2015 Judicial Reviews, Government Regulation 43/2008 on groundwater regulated the planning, implementation, monitoring, conservation, utilization, and damage control on groundwater.[174] However, the 2015 Judicial Review rendered Government Regulation 43/2008 void. While Government Regulation 121/2015 (under revision) does contain some provision on groundwater, nevertheless, it is focused on a general licensing framework for the commercialization of water supply than on managing surface or groundwater. As a result, the groundwater planning mechanism has no clear legal basis. There are guidelines on determining conservation zones (issued by MoEMR) but these guidelines are not anchored in higher-level regulation. Also, there is no strong legal basis for preventing saltwater intrusion and land subsidence or for taking countermeasures.

Priority actions

Implementing regulations for the 2019 Water Law and 2020 Omnibus Law need to be issued and harmonized across existing laws and regulations.

- **The 2019 Water Law carries forward a mixed regulatory framework, necessitating harmonization across all regulations.** Following Article 76 of the 2019 Water Law, which states that "all implementing regulations governing water resources are declared to remain effective as long as they do not contradict and have not been replaced based on this Law," Indonesia is currently being governed by a mix of regulations from different eras.[175] Currently, there are at least 12 relevant government regulations and at least 42 relevant ministerial regulations that appear to be in force. With time, it needs to be ensured that all regulations are aligned and harmonized with the 2019 Water Law and 2020 Omnibus Law to avoid any potential contradictions and overlapping responsibilities.
- **A detailed regulatory review is needed to understand which regulations are missing or need to be amended following the 2019 Water Law.** For several of the requirements of the new law, there appears to be relatively little in terms of provisions currently available in the regulatory framework. Thus, the development of new regulations may be necessary, including for aspects related to water resources information system, takeover of responsibilities from decentralized levels, dispute resolution, and community participation. For other requirements, there are at least some current provisions that are relevant and still in force in the regulatory framework. In these cases, simple amendment to existing regulations is an option.
- **Ministries need to cooperate to develop implementing regulations related to water, including implementing regulations of the 2019 Water Law and 2020 Omnibus Law.** A close

174 Peraturan Pemerintah Nomor 43 Tahun 2008 Tentang Air Tanah.

175 Article 76 (a) states that Law Number 11 of 1974 concerning irrigation (State Gazette Number 65 of 1974, Supplement to State Gazette Number 3046) was repealed and declared ineffective.

collaboration between MoEF and MoPWH is required for the revision of the government regulation concerning water protection and management led by MoEF. Further, regulations need to be updated to reflect Indonesia's commitments on hazardous and toxic substances made in international conventions. Indonesia has made commitments by ratifying the Stockholm and Rotterdam Convention to reduce hazardous and toxic substances.[176] Implementing regulations are now required to enforce the commitments made. All relevant government institutions—including those indirectly affected—need to be involved in developing implementing regulations. To date, BNPB has not been part of this process for water-related implementing regulations although it is responsible for managing risks upstream and downstream.[177]

The new legal framework is an opportunity to address specific governance and implementation challenges.

- **Jurisdiction for groundwater management.** Regulations need to clarify which agencies are responsible for which aspects of groundwater management and regulation (see Action 1).
- **Water quality management.** The issue of the implementing regulations will be an opportunity to bring clarity and accountability to the complex institutional arrangements for environmental water quality management and regulation (see Action 2).
- **Precedence in water allocation and provision for conflict resolution.** The law provides a clear hierarchy of precedence in water allocation but implementing regulations will need to clarify how, for example, the precedence of agricultural uses over industrial water supply will work out as competition for scarce resources grows. The regulations will also need to specify how precedence among water uses within the same category will be adjudicated, for example, upstream irrigation over downstream irrigation. Water allocation should be evidence based, considering criteria such as economic value, equity, and efficiency. In addition, clear and equitable conflict resolution mechanisms will be essential (see Action 1).
- **Allocation of water to the private sector.** The requirements in the new law for granting water licenses to the private sector appear stringent and may act as a deterrent to private investment. In the implementing regulations, there is scope to clarify the definitions of 'commercial' and 'noncommercial' uses and to provide for reasonable mechanisms to encourage private investment in water. Further, provisions could be added to grant water licenses conditional to a site-level water management plan and requirements for discharge treatment, zero runoff, and onsite recycling (see Action 4).
- **Requirements and institutional accountability for environmental flows.** The law assigns a generalized requirement for all departments and levels of governments to maintain water sources and the environment. Regulations need to allocate specific responsibility for the maintenance of environmental flows including considerations on maintaining stretches of free flowing water for dam construction to reduce the impact on aquatic life (see Action 1).

Ensure alignment between high-level visions and sectoral actions.

- **Update the National Policy on Water Resources Management (Jaknas) as part of the revisions following the 2019 Water Law.** As the Jaknas is issued based on the 2004 Water Law, the promulgation of the 2019 Water Law—as well as of the 2020 Omnibus Law - will require the Jaknas to be updated accordingly. In addition to considering recommendations from this note where adequate, Jaknas should be aligned with Indonesia's Vision 2045. A long-term national water security policy or strategy is a fundamental instrument for integrated water resources management that orients and coordinates the policies around a common long-term vision, available resources and management.

176 The convention has now become effective.

177 Stakeholder consultation with Deputy for System and Strategy (BNPB) on November 4, 2020.

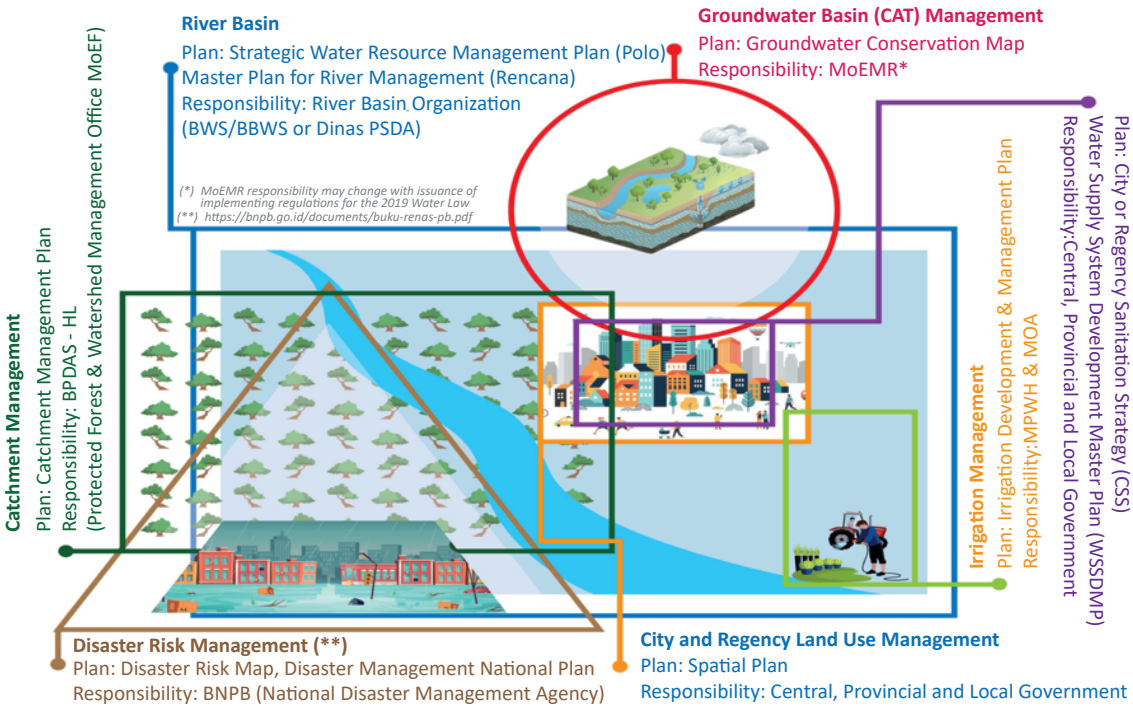
Action 8: Strengthening institutions: Coordination and capacity building

Threats and challenges

Indonesia's surface water is managed in 128 river basins, and groundwater management is based on 421 groundwater basins. Planning, management, and protection of water concerns many sectors and agencies and all levels of government, complicating fully integrated water management at the basin level.

Responsibility for managing and protecting water resources is fragmented among agencies. This pertains particularly to the following responsibilities: surface water (MoPWH) and groundwater management (MoEMR); water quality and catchment management (MoEF); spatial planning (MoASP); water service delivery for agriculture, domestic, and industrial uses (MoPWH); economic activities affecting water resources (MoEMR, MoF, MoEF, MoMAF); water-related disaster prevention and management (BNPB); and drinking water quality standards (MoH). This also results in overlapping planning documents, which—if not integrated and coordinated—do not allow for efficient implementation of any of these plans (Figure 37).

Figure 37: Overlapping responsibilities and planning documents in a river basin



RBOs currently face a plethora of challenges that limit their efficient and effective functioning. Key challenges include a lack of focus on maintenance and operation, lack of clarity in terms of actual cost of service, overlap of function and task between PJTs and RBO as well as other entities involved in river basin operations, inability to fully recover its cost, and lack of stakeholder participation (ADB 2016b; World Bank 2015c). Further, water quality issues and pollution control are outside of RBO's legal remit. Particularly for PJTs, there are issues with respect to a consistent financial reporting model between the two PJTs, separation of core and non-core business functions, and generation of revenues through efficiency enhancement rather than tariff increase (World Bank 2015c).

The priority is to clarify responsibilities, strengthen the coordination framework, and align all the multiple planning processes so that water resources management genuinely integrates all interests within each basin. RBOs and National as well as Provincial Water Councils need to be strengthened.

As challenges multiply and grow in complexity, water management must become increasingly knowledge based. This requires investment in modern monitoring and information systems, research, and studies, as well as the development of professional capacities.

Priority actions

The clarity of responsibilities across ministries and all government levels needs to be improved.

- **Responsibilities across ministries and departments need to be made clearer to avoid overlaps.** Although Indonesia has adopted good practice in integrated water resources management and basin planning, the lead agency, MoPWH, has

limited jurisdiction for water. Responsibility for managing and protecting water resources is fragmented among agencies, with significant gaps in the jurisdiction of MoPWH. This pertains particularly to the following responsibilities: surface water (MoPWH) and groundwater management (MoEMR); water quality and catchment management (MoEF); spatial planning (MoASP); water service delivery for agriculture, domestic, and industrial uses (MoPWH); economic activities affecting water resources (MoEMR, MoF, MoEF, MoMAF); water-related disaster prevention and management (BNPB); and drinking water quality standards (MoH). To ensure for integrated and harmonized planning, one agency such as BAPPENAS should take on the role of creating an overarching blueprint for the water sector – considering other sectors – while the Ministries act as implementors of this blueprint based on their responsibilities.

– **Planning between central and local governments needs to be synchronized.** The lack of synchronization between the central government and local governments leads to a delay in achieving the required readiness criteria for projects, especially around land acquisition. Consequently, delays in project execution occur with related suboptimal utilization of central government funds. Processes need to be put in place—and enforced—to only release central government funding when planning steps are aligned between all levels of government. Water security concerns should also be included in the Regional Mid-Term Development Plan (RPJMD).[178]
– **MoHA can support in defining clear authority between central, provincial, and local governments.** The challenge of water resources management is geographically complex—surface water is managed in 128 river basins and groundwater management is based on 421 groundwater basins. In addition to this geographical challenge, there is an institutional challenge of integrating management across the different tiers of government. The resulting complex system of water governance aims to align integrated water resources management with political, administrative, and fiscal decentralization. To resolve the multiple issues that arise, MoHA should provide further guidance on implementation, notably on the tasks mentioned in Law 23/2014 as well as on how to enforce the integration of planning documents across government levels and departments.

Coordination and cooperation across institutions responsible for key areas of water resources management need to be significantly enhanced.

– **RPJMN 2020–2024 provides for three ambitious mechanisms to improve coordination.** First, the introduction of *program-based funding* is designed to ensure integration of the planning and budgeting processes and to align them with RPJMN targets. Second, and in line with the same objectives, all agencies will be required to *ensure consistency and integration* between RPJMN 2020–2024 and other plans, notably the RENSTRA (the sectoral ministry strategic plans) and the RPJMD. Third, the planning agency BAPPENAS is responsible for *incentivizing key aspects* of all plans and following up on integration and smooth implementation.[179]
– **MoHA can facilitate local government cooperation as part of its mandate under Government Regulation 21/2018 on Local Government Cooperation.** The regulation provides clarity on local government roles in each specific field of cooperation. For water, the regulation should promote effective local government participation in preparing and implementing basin and local planning, development, and management. Water should be included as a specific area for mandatory cooperation between local governments within urban regions.
– **River basin planning and management can be improved by strengthening collaboration among government agencies horizontally and vertically.** Horizontal collaboration could be achieved by preparing a workable scheme of cooperation and joint work between the RBOs and the different planning agencies and processes in the water sector. Given the shared responsibilities for each basin between the RBOs and the MoEF *balai*, special attention is needed to strengthen cooperation on the catchment plans and between organizations working under MoEF. While RBOs cooperate with BNPB after a disaster strikes, cooperation on improving prevention of

178 Stakeholder consultation with Directorate of Irrigation and Water Resources Management (BAPPENAS) on September 17, 2020.

179 Specifically, BAPPENAS is responsible for ensuring the integration of RPJMN with the RENSTRAs and RPJMDs and for following up on implementation of the RPJMN. The synchronization between national (RPJMD, RPJMN, RKP) and the regional (RPJPD, RPJMD and RKPD) planning documents, which are further detailed through the strategic plans (RENSTRA) and work plans (Renja) are integrated in an Integrated Information System.

disasters is also required.[180] Vertical coordination and relations with the local government can be enhanced by defining the assignment of tasks among the various agencies and developing a joint work program—tasks within MoPWH's remit, tasks delegated to the deconcentrated level, and tasks related to co-administration, including assignments to PJTs.

- **Coordination mechanisms, such as the National and Provincial Water Councils, Dewan *Sumber Daya Air* (SDA), and TKPSDA, need to be strengthened and given more authority to take decisions.** The effectiveness of the existing platforms for coordinating various water users, such as TKPSDA, could be strengthened if they are empowered to advise on the annual work plans and related budgets of water-related activities. This would enable TKPSDA to balance between construction and O&M projects within RBO in addition to ensuring that it receives adequate resources from RBO. It needs to be assessed whether the members of the TKPSDA should be expanded; for example, the Directorate of Pollution Control (MoPWH) and BNPB stated that they were not included in initiatives from the beginning.[181,182] Further, while water council meetings allow for discussions, there is no authority to take binding decisions. Also, the water council is perceived by some stakeholders to be part of MoPWH aggravating inter-ministerial coordination.[183] Provincial governors should be involved in making decisions on the proposals as the governors have the authority to coordinate different provincial agencies (World Bank 2012).
- **More coordination between MoPWH and MoEMR on water planning is required to identify areas in which surface water needs to be prioritized over groundwater usage (as mandated by the 2019 Water Law) as well as to integrate groundwater (resource availability, groundwater usage and conservation, and so on) into river basin planning and management (as required by the 2019 Water Law).**

Enforcement of regulations needs to be significantly enhanced.

- **Local governments need to increase their commitment to implementing national-level plans.** While the local governments are expected to be the implementing hand of the central government, this can be complicated at times, if the local government head disagrees with these plans, for example, plans for disaster risk management and river and coastal areas. As the local government head is elected by the people, there can be a perception that guidance from the central government does not need to be followed. To allow for sustainable, long-term planning a better and more inclusive planning mechanisms is required.[184]
- **Coordination between the central government and district governments needs to be strengthened, especially in the area of licensing.** While policy and strategic plans are set by the central government, district governments are responsible for implementing these. On the practical level, water use license applications need to be sent to the central government, including technical recommendations from the relevant agency at district or provincial levels. Licensing is then completed at district and provincial levels. However, in the case of Lake Toba, aquaculture firms did not obtain technical recommendations from the responsible river basin management organization and yet received the water use license. This resulted in licenses to produce 66,000 tons of fish from aquaculture, while the carrying capacity of Lake Toba was set at 10,000 tons per year by MoEF and the Governor of North Sumatra. Close coordination across government agencies and following established protocols are required to enforce sustainable water resources management (World Bank 2018d). The Integrated licensing system introduced under the 2020 Omnibus Law provides a good opportunity to streamline the coordination of licensing between central and regional governments.

Strengthening integrated planning at the basin level

- **To implement 'one basin, one plan, one management' as stipulated in the 2019 Water Law, overlaps or disagreements between the *pola* and *rencana* as well as between the plans,**

180 For example, BNPB started a Disaster Risk Mitigation program in which it taught communities how to manage water resources and understand risks as part of 'river schools'.

181 Stakeholder consultation with Directorate of Water Pollution Control (MoEF) on November 2, 2020.

182 Stakeholder consultation with Deputy for System and Strategy (BNPB) on November 4, 2020.

183 Stakeholder consultation with Directorate of Forestry and Conservation of Water Resources (BAPPENAS) on October 12, 2020.

184 Stakeholder consultation with Directorate of River and Coastal (MoPWH) on October 27, 2020, and Stakeholder consultation with Centre for Data, Information, and Disaster Communication (Pusdatinkom) on September 23, 2020.

responsibilities, and activities of other agencies need to be resolved. The *pola/rencana* cover only the river itself and not the watershed and they are poorly integrated with broader spatial or sectoral plans—plans for watersheds and forest protection; plans for water supply, sanitation, wastewater, and solid waste; plans for irrigation development and management; and plans on disaster risk and hazard maps. In addition, institutions have used differing spatial data and definitions in their planning documents, further aggravating synchronization. RPJMN 2020–2024 underlines the importance of aligning local plans and budgets with the *pola* and *rencana*. However, this is hindered by differing regional priorities, lack of fiscal resources, and weak institutional capacity.

– **In practice, implementing the 'one basin, one plan, and one management' approach requires a more coordinated and integrated planning system.** Guidelines are required to show how to strengthen integrated planning at the basin level by integrating basin water management strategies (*pola* and *rencana*) with the other spatial and sector plans at the regional and local levels. The guidance set out in the *pola* and *rencana* also needs to be integrated into the regency/city spatial plans. There is also a specific need for cross-sector coordination related to the water-energy nexus. Specifically, dam development and management need to be integrated within spatial planning and basin management processes. The challenge then will be to ensure that integrated water management plans are reflected in overall development planning, notably the RPJMN/RPJMD, and are used as a reference in budget preparation.
– **This kind of integration will require strong political commitment at both central and decentralized levels and strengthened capacity and skills at all levels.** Strengthened water councils (see above) could play a key role in supporting integrated planning across all sectors, overseeing the integration of plans and coordinating management among agencies. MoHA can support local government capacity through guidelines and training. Priorities for integrated planning are for the most vulnerable areas and where the challenges are the most complex, particularly urban regions, upland watersheds and forestland, lowland/peatland areas, and vulnerable coastal zones. The 2020 Omnibus Law has created a new institution—a Forum for Spatial Planning—to address differences on perceptions across government levels. Currently, urban-, provincial-, and national-level spatial plans differ—while in theory they should build upon each other. The implementing regulations are being drafted and will provide more information on operating details. Spatial plans should be accessible for the public to allow for citizen scrutiny and an easy complaint mechanism should be in place.[185]
– **A forward-looking spatial planning process could be envisaged that incorporates not only the existing basin planning instruments (*pola* and *rencana*) but also land use zoning, hazard maps, catchment plans, and groundwater conservation maps.** Currently, the spatial plans only focus on land usage, without considering other factors such as disaster risks, water availability, and water quality. The 2019 Water Law requires that water will be considered in spatial planning; however, it is not specified how this can be accomplished. The spatial plans should integrate the findings of the long-term water management strategic plans and should provide groundwater protection zones to direct development away from groundwater-sensitive or aquifer recharge areas and prohibit potentially polluting activities.[186] The land use scheme must be aligned with environmental policies and plans; therefore, zoning codes and schemes must address site-specific ecological conditions. For example, the regulations about the area around river, lake, and springs (littoral zones) should be included in the spatial plan.[187] Further, water availability and demand as well as water quality should be considered to optimize development. To support the local government in its task of preparing the spatial plans and awarding development licenses, its capacity and awareness on the importance of integrated water resources management needs to be strengthened. Further, at the moment spatial plans in Indonesia are administration bound, meaning that each provinces/cities/municipalities can only regulate what is in its territory. A cooperation mechanism needs to be developed to

185 Stakeholder consultation with Directorate of National Spatial Planning - Ministry of Agrarian Affairs and Spatial Planning on October 15, 2020.

186 This is also relevant as spatial plans are legally binding, while long-term water management strategic plans are not.

187 Stakeholder consultations with Directorate of Survey and Thematic Mapping - Ministry of Agrarian Affairs and Spatial Planning (MoASP) on November 2, 2020. The specific terminology is sempadan sungai, sempadan danau, and sempadan mata air.

allow for a coordinated approach for downstream and upstream areas.[188] This would help address several pressing nexus where effectiveness of water resource development and management depends on coordination between basin management and the following:

- Urban development
- Management of upland watersheds and catchments in hilly terrain, as well as hydropower operations, is key to safeguarding the hydrology of the region, which is dependent on soil and forest management
- Lowland/peatland management, notably in Sumatera, Kalimantan, and Irian Jaya, where excessive drainage and lowering of the groundwater table for development of plantations are causing peatland subsidence and carbon emissions
- Management of coastal zones that are vulnerable to erosion, mangrove and seagrass bed loss, tidal surges, flooding, and land subsidence
- Disaster risk management
- Groundwater conservation
- Coordinated management of upstream and downstream catchments.

– **To support integrated planning, it is essential to improve knowledge management, monitoring, and information systems (see Action 1).** Priorities are to increase the accuracy and timeliness of the delivery of data and information; strengthen data and information services; ensure the compatibility of data, information, and processing devices across agencies; and ensure sustainability of services with adequate resources. Several different mapping systems can be synchronized based on the 'One Map' initiative. Key will be to establish performance standards to underpin water resources planning and risk management. Spatial data need to be improved to capture peatlands in maps.[189] Further, basin planning needs to go beyond technical and economic goals to consider social and environmental goals and to ensure that trade-offs do not compromise sustainability.

Improving basin management and the performance of the RBOs

– **Enhancing the technical and financial capability of the *balai* or RBOs is key to water resources management.** Following good practice, the primary instruments for long-term (20 years) planning for river basin management are the water resources management plans (*pola*) and their implementation programs (*rencana*). Five-year strategic plans and annual work programs and budgets are prepared within the *pola* and *rencana*. Implementation of the *pola* and *rencana* is delegated to local RBOs or *balai*. However, there are constraints of capacity, budget, and ownership. The budget process contains contradictions—an annual time frame that constrains longer-term programming and yet provides too little for the annual needs of O&M. While the RBOs are close to local governance and planning, they lack technical and financial capacity.
– **Realigning incentives and increasing accountability—for example through an economic regulator—would help RBOs improve their performance.** Currently, the incentive structure encourages a focus on infrastructure development and too little on accountable and efficient service delivery. Improving RBOs' performance would require definition of services in quantitative and qualitative terms and accountability to their representative assembly for their performance.[190] Once defined, the PJTs as well as RBO should be benchmarked on their performance and some form of economic regulator would enhance overall operations. A first step to start economic regulation might be to set up an independent commission under MoPWH to advise on water resources management fee increase proposals. In addition, the commission can be tasked with benchmarking of RBOs and eventually develop reporting and regulatory accounting guidelines for corporatized river basins. A model of service level agreements, such as maintenance or management contracts, with budgets can be developed and more formalized dispute resolution mechanism can be introduced by MoPWH. Pilots have been discussed but not yet put into practice.
– **Explore options to allow RBOs to raise revenues to finance O&M expenses.** RBO could be encouraged to be formed as not-for-profit public

188 Stakeholder consultation with Directorate of National Spatial Planning—DGSP—Ministry of Agrarian Affairs and Spatial Planning on October 15, 2020.

189 Stakeholder consultation with Badan Restorasi Gambut (BRG)/Peatland Restoration Agency on September 18, 2020.

190 This can build on PJT's annual workplans which already require key performance indicators and has to be approved by MoPWH.

service agency (Badan Layanan Umum) to enable it to collect water resources management fees, with a focus on O&M. A separate river operation business unit under RBO could be set up and is required to comply with the same reporting requirement as PJTs. Construction of new infrastructure can be encouraged to be conducted through an ad hoc task force such as a non-vertical task force (Satuan Kerja non-vertikal Tertentu).

- **PJTs are promising and may provide a replicable model to corporatize river basin operation and management.** In several large basins, O&M is the responsibility of state-owned corporations—PJT. The two PJTs so far established may provide a model that can be replicated to ensure focus on service delivery and life cycle asset sustainability—particularly for more complex river basins. However, they only manage a limited portfolio of assets, essentially those that can produce financial returns. Most of the less 'profitable' or more problematic assets remain under the RBO. An assessment is required of the need and means of corporatizing RBOs or incentivizing RBOs to transfer more assets to PJTs, if they meet strict eligibility criteria. If it is found that PJTs may be a preferred model, the transition is expected to take around five years and—to avoid changes due to a new government—should be completed within one electoral period of five years.[191]
- **Define and ring-fence PJT's core functions to enhance transparency of costs and performance.** As an SOE, PJTs need to generate some income for the state and as non-core functions are more profitable, there is an incentive to focus on and invest in non-core function at the expense of core functions. Core functions traditionally consist of bulk water supply, construction, O&M of river infrastructure, and so on.[192] These need to be defined through regulation and be financially ring-fenced. To perform non-core functions, such as hydropower and drinking water provision, PJTs should be required to create subsidiaries for such purpose (World Bank 2015c). PJTs should treat these subsidiaries at arm's length[193] and there should be a consistent and uniform financial and assets accounting framework across PJTs (World Bank 2015c). For non-revenue generating tasks, a subsidy mechanism from local, provincial, or national government can be developed (World Bank 2015c). The transfer of non-core function to subsidiaries is currently being proposed through the revision of PJT II regulation.
- **Clarify responsibilities on managing river basins and assign only one institution with this task.** Currently, tasks held by PJTs and RBO overlap. The 2019 Water Law (considering the amendments of the subsequent 2020 Omnibus Law) provides an opportunity to reform RBO as it states that only *one entity—either* a corporatized RBO (such as PJTs) *or* a government/regional government technical unit (such as RBO)—shall be entrusted with the task of managing the river basin.[194] Further, the 2019 Water Law opens the possibility for not only state-owned enterprises (*Badan Usaha Milik Negara* or BUMN) such as PJT but also for local government-owned enterprise, (*Badan Usaha Milik Daerah* or BUMD) to manage RBTs.
- **Expand and strengthen institutional mechanisms for interjurisdictional cooperation on water, particularly in mega-urban regions where several local governments are responsible for planning and service delivery within a single hydrological system.** Inter-jurisdictional cooperation is guided by MoHA by Regulation 18/2018 and distinguishes between areas of voluntary cooperation and mandatory cooperation. Water supply and watershed management fall under the 'mandatory' category, along with spatial planning and public works. Mechanisms to enforce cooperation exist, notably the transfer of authority to a higher level of government, but these have not been employed. Currently, the Jabodetabekjur Development Cooperation Agency (BKSP) for Greater Jakarta is the only formal agency for inter-jurisdictional coordination to address flooding, water resources management, transport, and other issues. Although BKSP is recognized by the local governments, it has no authority to enforce collaboration or budget for project implementation and collaboration has been limited to small-scale well and dam rehabilitation projects. Requirements for joint planning and project evaluation, both in general and specifically for water issues, need to be clarified or effective incentive frameworks for cooperation designed.

191 Stakeholder consultation with PJT 2 on December 16, 2020.

192 See Water Law 17/2019 (unamended version) Article 19 (4); see also GR 7/2010 on PJT II, Art 4.

193 This has been partially adopted through PJT 2's Corporate Governance Guidance Manual. 'Pedoman Tata Kelola Perusahaan' (PT Jasa Tirta 2 2019). However, to ensure enforcement, public regulation is required. The Government Regulation on PJT2 is currently being revised and it is expected that this will be clarified in the revised document.

194 Undang-Undang Republik Indonesia Nomor 17 Tahun 2019 Tentang Sumber Daya Air. Article 19(2).

Initial implementation can be prioritized for Kartamantul region around Yogyakarta, Greater Surabaya, Bandung Raya, Kedungsapur (Greater Semarang), Mebidangro (Greater Medan), and Maminasata (Greater Makassar).

Enhance the cooperation between the government and the private sector and civil society and create incentives for sustainable water management behavior

- **Increase awareness around water threats and required sustainable water management practices.** Moving toward sustainable water management requires the support of every citizen of Indonesia. Currently, awareness on Indonesia's water challenges are low amongst the general public – and thus the awareness and willingness to shift to more sustainable behavior, such as water saving in stressed areas, ensuring septic tanks are sanitary, avoiding littering waste into the environment etc. are low. Communities need to be empowered to take actions, such as protecting their water sources, engaging in water pollution control activities downstream of wastewater treatment plants and industries etc., to contribute to sustainable water management.
- **Incentives need to be created for industries that are following sustainable water management practices and corporate water stewardship needs to be promoted.** Particularly in water stressed and polluted areas, industries need to be made aware about the future consequences for their bottom line, if business as usual continues. Industries that are already incorporating sustainable water management practices, such as water saving technologies and improved effluent treatment, should receive benefits, such as tax rebates, preferential loans etc. Programs that incentivize sustainable behaviour, such as the Program for PROPER, should be expanded. Participation in international reporting standards on sustainable water management, such as CEO Water Mandate, Alliance for Water Stewardship, Integrated Reporting, UN Global Compact, GRI, Science Based Targets etc., should be promoted.
- **Incorporate private sector representatives in coordination committees.** While the National and Provincial Water Councils and TKPSDA consider civil society inputs, the private sector has no opportunity to participate. Given that industries are key water users – and polluters – it is important to include these in discussions and solution development.

A national water information system, including real-time monitoring for both surface and groundwater quality and quantity, is needed for sustainable water resources management.

- **Data need to be shared easily across government agencies and the 'One Data Policy' enforced.** Currently, government agencies do not have easy access to water-related data collected by other government agencies. Lengthy bureaucratic procedures to access these data reduce the effectiveness and timeliness of water management actions. For example, the Directorate of National Spatial Planning (MoASP) does not have (easy) access to river basin management data, including water supply and demand data.[195] Clear data sharing mechanisms, incentives, and penalties could be outlined in Presidential Regulations 88/2019 on H3 Information systems and 39/2015 on one data policy as part of the revision process following the promulgation of the 2019 Water Law. Further, while Presidential Regulation 39/201 addresses information systems on the national level, it needs to be revised to also create clarity on information systems and data sharing on river basin level, including between river basins and between river basin and the central government.[196] In the meantime, relevant ministries, local governments, and RBOs can sign memoranda of understanding agreeing on type, frequency, and mechanism of data sharing. A memorandum of understanding was signed between PUS AIR (MoPWH) and Meteorology Climatology and Geophysics Agency *(Badan Meteorologi, Klimatologi, dan Geofisika or BMKG)* and could be followed by many other cooperative agreements. Further, this data needs to be publicly accessible.[197]
- **Indonesia needs to modernize water monitoring, enhance analytical tools, and invest in water knowledge, building an open access and real-time centralized information system and providing incentives for stakeholders to share data.** Water resources management is a knowledge-based

195 Stakeholder consultation with Directorate of National Spatial Planning - Ministry of Agrarian Affairs and Spatial Planning on October 15, 2020.

196 Stakeholder consultation with Directorate of Technical Development for Water Resources Management (BINTEK SDA) (MoPWH) on November 11, 2020.

197 Government Regulation 22 Year 2021 on the Protection and Management of the Environment. Article 157 (a)

activity and measurement is important. *You cannot manage what you cannot measure*. Indonesia has already invested in some cutting-edge information systems, for example, the *STBM - Smart for Public tool* of the MoH that monitors the progress of sanitation programs at provincial, district, and community levels.[198] A similar approach is needed for water resources. Data from river basins have not yet been consolidated on a national scale. Currently, there is a resistance to share water-related data, even within government institutions and with the public. Reasons could be the concern that the data underwent insufficient quality control and another concern could be that data are seen as a valuable asset and something is expected in return. To allow for open sharing, these concerns need to be addressed and incentives need to be designed.[199] Quality controls on data sources need to be enhanced. For example, it was found that the data on irrigated areas from MoPWH did not match with the paddy area data from MoA.[200] Overall, information systems need improvement and quality control to underpin water resources planning and risk management, while under the 'One Map' policy data across ministries need to be harmonized.

– **Given the low density of water quality monitoring stations in Indonesia, data may be supplemented with the latest remote sensing technologies and computer-generated data built from machine learning models.** Remote sensing reduces reliance on river and lake monitoring stations and shows the spatial variation of a water body rather than just a single monitoring point, while results cannot be modified by parties with vested interests. However, measuring is mainly restricted to environmental parameters such as chlorophyll, total suspended solids, turbidity, floating vegetation, colorized dissolved organic matter, algae blooms, and temperature. Chemical and bacterial parameters on the other hand are not visible to satellites. Given how sparse the monitoring network is, remote sensing can thus be deployed as a complement to monitoring station data and also to verify that data. Remote sensing data can also be used to monitor the number of floating fish cages on lakes. The remote sensing data would have to be calibrated with the in situ measurements. The roles of National Institute of Aeronautics and Space of Indonesia and BAPPENAS may be explored.
– **Water quality and quantity sampling needs to be done more frequently and be more standardized, and measured parameters need to be expanded.** As the water quality changes across seasons, it is important to understand pollution levels at different times of the year. At the very least, samples should be taken in a predetermined period in the dry and wet seasons every year and labelled accordingly. Ideally, the water quality could be monitored with automated, continuous sampling providing real-time data for key water pollution hotspots. The measurement of the number of parameters needs to be reevaluated to understand whether more samples on, for example, POP, microplastics, heavy metals, and antibiotics are required in areas at risk.
– **The national water information system should be developed in cooperation with all levels in the government—both central and local—academia as well as community members to enhance its robustness and credibility.** In the past, a patchwork of efforts and initiatives across the country existed to develop inland water monitoring programme—led by research institutes, community-based monitoring groups, managed mostly by provincial agencies. However, all these efforts differed in terms of their approach, focus, and specific objectives and often had severely limited resources. Creating the national water information system as an 'open source' will allow civil society to stay informed on water quality in its surrounding and also allow for awareness raising on the importance of protecting water sources. Ongoing and planned initiatives, such as the RC Limnology-LIPI's proposed project to develop an Indonesian Lakes Information System, need to be incorporated into the overall system.[201] A governance framework to facilitate this cooperation needs to be set up early on.

198 For the STBM-Smart program, see https://play.google.com/store/apps/details?id=com.stbmsmart.publik&hl=en.

199 Stakeholder consultation with Research Center for Limnology, Deputy for Earth Sciences, Indonesian Institute of Sciences (LIPI) on September 17, 2020.

200 Stakeholder consultation with Directorate of National Spatial Planning - Ministry of Agrarian Affairs and Spatial Planning on October 15, 2020.

201 Stakeholder consultation with Research Center for Limnology, Deputy for Earth Sciences, Indonesian Institute of Sciences (LIPI) on September 16, 2020.

– **Data need to be digitalized and data systems across government levels integrated into one management system.** Currently, Ministries have their own data collection mechanisms which are not integrated which each other. As such the MoEF has data systems to monitor the water quality for rivers (Sistem Pemantauan Kualitas Air Sungai Sungai secara real time, or *ONLIMO*); Water Quality for Industrial Waste (Sistem Pemantauan Kualitas Air Limbah Secara Terus Menerus dan Dalam Jaringan, or *SPARING*); Groundwater level monitoring (Sistem Informasi Muka Air Tanah Gambut or *SiMATAG-0.4m*); Ocean Water quality (Sistem Informasi Kualitas Air Laut, or *SIKAL*); and Environmental Report (Sistem Pelaporan Elektronik Lingkungan Hidup, *SIMPEL*). To integrate data systems across Ministries, Departments and other sources, the MoA developed an "Agriculture War Room" (AWR) to centralize data on agricultural activities. It may be assessed whether this approach is replicable for water and water-related data.[202] Without the integration of data systems, integrated management of water resources, including the enforcement of water pollution control and overabstraction will be hardly manageable. Given the high investment requirements for sanitation and wastewater treatment, an assessment of the monitoring data will aid the prioritization of investment in pollution hotspots.
– **Implementation of the monitoring network could be phased.** Investment in monitoring could initially be for key water bodies prioritized in RPJMN 2020–2024 and—if different—for the most economically important river basins under water stress as well as for pollution hotspots. These initial programs can form the basis for a national water information system to support planning, investment, and management.
– **MoPWH has made a detailed proposal.** MoPWH has included a 'Modernization of National Water Resources Information System' in its List of Proposed Activities (*Daftar Isian Pengusulan Kegiatan* or DIPK) and Project Proposal Document (*Dokumen Usulan Kegiatan* or DUK) submission as a part of the River Basin Improvement Program under the Blue Book agenda. The objectives are to (a) prepare a road map and plan for implementing a modern and nationally integrated water resources information system (*Sistem Informasi Sumber Daya Air* or SISDA), (b) establish the related legal and regulatory framework, (c) establish a modern monitoring system, (d) improve analytic tools, and (e) establish the necessary management institutions. Care needs to be taken to integrate data across ministries (MoPWH, MoEMR, MoEF) and government levels (central, provincial and district).

Developing professional capacity to manage the increasingly complex challenges will also be vital.

– **Programs are needed to develop the capacity of water professionals, practitioners, and skilled workers.** Although the central agencies, particularly MoPWH, have a large and relatively well-qualified staff, the scale and intensity of problems have outstripped the capacity to deal with them. In addition, many local governments have limited technical and managerial capacity. To bridge these gaps, assessments and certain tasks are outsourced to consultants. Skills need to be developed and capacity strengthened—for government employees and consultants alike. There is a need for a comprehensive skills gap analysis and skills development program.
– **Policy priority should be given to ensuring institutional readiness to implement the new legal framework of the 2019 Water Law**. The 2019 Water Law opens real opportunities for achieving Indonesia's vision—but implementation issues come to the fore. Capacity needs to be enhanced to allow for institutional readiness—particularly related to (a) integrated planning and accountability across tiers of government, (b) developing operational procedures to implement established regulations and the new law, and (c) enforcement powers in key areas such as pollution control.

Action 9: Improving the efficiency of public expenditures for water and mobilizing finance

Threats and challenges

Resources allocated to the water sector are insufficient to meet sector targets—and are below international averages. While public expenditure on the water supply sector has increased threefold in real terms over 2001–2016 and now accounts for 1.7 percent of total national spending for the entire water sector, Indonesia is among the countries with the lowest spending on water and sanitation. At only 0.2 percent of the national GDP (2016), it is far lower than the levels recommended for East Asian countries (0.5 percent) (Estache 2010) or by the United Nations (1 percent) (United Nations Development Programme 2006).

202 Expert opinion from Focus Group Discussion on Water Threats on 4 May 2021.

Compounding the issue of insufficient budget allocation, the execution rate by MoPWH is low. Between 2015 and 2017, the Directorate General departments across MoPWH have all shown decreasing execution rate (ratio of spending to budget allocated). Currently, the execution rates of Directorate General Human Settlement and Directorate General Water Resources are below 90 percent (World Bank 2020d). Key challenges to increasing the execution rate are coordination across government departments, inadequate capacity, and issues around land procurement.

A variety of issues hinder the efficiency and effectiveness of government spending in the water sector, as highlighted by the following sectoral challenges discussed in Actions 1–6:

- **Irrigation system: Irrigation O&M is the responsibility of the subnational governments, whereas investment in rehabilitation and new infrastructure is primarily financed through the central government budget.** This arrangement creates perverse incentives for subnational government to skip cost-efficient regular O&M of irrigation systems for deferred maintenance as more costly 'rehabilitation' (World Bank/Australian Government 2018).
- **Agricultural subsidies: Subsidies are having a negative effect on the water sector.** Fertilizer subsidies have proved an ineffective way to boost production, encouraging overuse with heavy impacts on water pollution.
- **Dams: Spending is also focused on the construction of new dams under the strategic plan (Nawacita) with inadequate budget for O&M, a weak framework for cost recovery and high levels of subsidy.** While RBOs under MoPWH are responsible for dam O&M, they are not allowed to generate revenues under current legislation. Neglecting O&M hinders investment efficiency by deferring simple regular O&M to larger capital requirements for rehabilitation, which can ultimately lead to public safety issues (World Bank/Australian Government 2018).
- **Water supply and sanitation: A lack of coordination between MoPWH departments and local governments has resulted in significant amounts of idle bulk water capacity, while households remain disconnected to piped water supplies.** Poor households struggle to pay the connection fees for PDAM services, while payment plans and micro-credits for this purpose are mostly absent. Central government investments on dams and water treatment plants are often not complemented by local spending on water supply distribution infrastructure, such as distribution networks and household connections (World Bank 2015b).
- **Disaster management in lowland areas: A large portion of spending on water-related disaster management in lowland areas may inadvertently increase the risk of disasters.** Around 55 percent of water management expenditure by MoPWH in lowland areas is used to improve households'

Box 17: Private sector opportunities under the new 2019 Water Law

After the Constitutional Court struck down the 2004 Water Law, a new water law was needed that would fulfill the requirements of the Constitution while permitting private sector involvement to improve water services delivery. The new water law sets out these principles and carves out space for the private sector to partner with PDAMs to deliver public services under public private partnership (PPP) arrangements, creating certainty in the medium to long term. For example, while the new water law makes clear that the state should maintain control of water and have first priority for its use, it does permit private sector to subcontract with PDAMs on improving services. Implementing regulations need to be issued for the 2019 Law on Water Resources providing for additional detail and certainty regarding private participation in water. New implementing regulations for the 2019 Water Law will replace current Government Regulation Nos. 121/2015 and 122/2015, which are expected to bring further clarity and detail on the role of the private sector in water and the procedure for obtaining licenses and PPPs.

Historically, most private sector participation in the water supply sector has occurred in bulk water supply (that is, construction of water treatment plants). These have generally taken the form of long-term refurbish-upgrade-operate-transfer and build-operate-transfer (BOT) bulk water supply contracts between a private sector entity and a PDAM. The current pipeline of potential PPP projects (as reflected in the BAPPENAS PPP Book, KPPIP list of National Priority Projects, and the MPWH project list) likewise comprises predominantly water treatment plants. There have been growing interests and practices of private sector involvement in the construction of transmission and distribution systems, although in a smaller scale, through the 'trade credit' (vendor financing) mechanisms and performance-based contracts for O&M.

There is significant market potential for private investment in water supply. Urban domestic demand for water is predicted to increase from about 160,000 liters per second (lps) to 260,000 lps from 2015 to 2030. The corresponding rural demand is projected to decline from 110,000 lps to 100,000 lps, signaling an urbanization shift that will expand the market for urban water supply. In addition, industrial demand is expected to double from about 14,000 lps to 29,000 lps from 2014 to 2030.

At the same time, despite political pressure to keep tariffs low, average PDAM tariffs grew by an average of 11 percent per year from 2011 to 2015, twice the average rate of inflation in the same period. Issuance of the MoHA Regulation No. 21/2020 on Tariff for Water Supply Services will 'force' subnational governments to approve full cost recovery tariffs for PDAMs. All of the above points increase potential for the urban water supply sector to mature into a market that can generate stable and attractive revenue streams.

Sources: 2019 Water Resources Law, World Bank 2019i.

water access and irrigation. Without consideration of PHU, this may threaten to drain out peatland, with consequent land subsidence which aggravates flooding, forest fires, and GHG emissions (World Bank/Australian Government 2018).

The achievement of government targets for sector development also depends significantly on the ability to mobilize private investment in water supply. Under the last RPJMN, 2015–2019, MoPWH aimed to attract US$1.5 billion in private sector financing through PPPs and B2B schemes as well as US$860 million in commercial bank financing. While details on the amount of private financing needed for the sector under the next RPJMN 2020–2024 are not yet available, achieving sector development targets is likely to continue to depend heavily on attracting private investment. Overall, RPJMN 2020–2024 foresees an investment of more than US$470 billion in infrastructure, with around 42 percent to come from the private sector (KPPIP 2020). This is reflected at the project level in the indicative financing for the 10 million household piped water connection project in the RPJMN, which anticipates that nearly IDR 30 trillion (US$2.1 billion) of the IDR 123.5 trillion (US$8.7 billion) in financing for this project will come from the private sector (see Action 4). (World Bank 2019i, RPJM 2020–2024).

There has been comparably less focus on attracting private investment in wastewater treatment, but now the GoI is exploring alternative revenue and financing schemes. The high capital costs and limited revenue streams make investments in wastewater treatment less attractive than in other sectors. However, sale of recycled gray water, hybrid annuity models, and blue bonds could create more opportunity for private investment in wastewater treatment. There also may be opportunities to pursue specific first-mover projects in wastewater under a design-build-operate contract for commercially built-up areas and high tourism value assets. To make such pilot projects viable, potential PPPs in the subsector should not only feature significant capital buy-down by the public sector, potentially supported by multinational development banks, but also be pursued in highly commercial circumstances, for instance, for services in commercially developed areas (for example, central business districts or industrial zones) or in zones that have high-value tourism assets. Zone 8 of the Jakarta sewerage project had been proposed as a PPP project, though the status of this project is unclear (see Action 5) (World Bank 2019i).

The GoI needs to improve its public spending in the water sector by increasing the amount of spending and improving the quality, both efficiency and effectiveness, of its spending. There is also a need to share the financing burden more broadly and to diversify funding sources. This has become particularly important in light of the COVID-19 pandemic as economic activity has slowed and public finance had to be redirected to crisis response.

Priority actions

Resources need to be allocated to meet the GoI's ambitions and targets – and optimized across central and decentralised levels - while targets need to be realistic and outcome based.

- **Adequate resources need to be allocated to meet RPJMN targets.** An estimated US$10 billion of public funds were allocated to water for RPJMN 2015–2019, which has increased substantially from the levels in 2011 and 2014 (World Bank/Australian Government 2018). However, resources were insufficient to meet RPJMN 2015–2019 targets—overall, only two-thirds of 2015–2019 targets were met. Only 68 percent of the new irrigation targets of 1 million ha in the MoPWH strategic plan could be met by 2019 (World Bank 2020d). Achievement of RPJMN 2015–2019 target of 100 percent access to clean water and 60 percent urban access to piped supply would have cost IDR 253 trillion (US$29 billion), compared to the US$10 billion of total public budget allocated (World Bank 2020d).
- **Resource allocation needs to be balanced between the central and decentralized levels.** Despite a requirement in the law for fair allocation of budget, it appears that resources for water management at the decentralized level are proportionally less. For example, there is a large gap between budget allocations to irrigation schemes managed at the provincial level compared to the higher allocations to those managed by the center. The lack of budget results in reduced O&M expenditures and thus degradation of costly infrastructure assets.

- **To optimize investments, all relevant government departments need to agree on their responsibilities and on arrangements for O&M before investments are executed.** For example, central government expenditures on water treatment plants are often not complemented by local government investment in the distribution network and household connections. Integrated planning and execution is essential to use scarce funds wisely. The usage of an escrow account, to safeguard the O&M payment, can be explored.
- **To economize on central government resources, investment may be focused in provinces with low fiscal capacity, with incentives to provinces with high fiscal capacity to use their own resources.** In provinces with high fiscal capacity, the central government needs to progressively transition from an infrastructure developer and service provider to an institutional facilitator, regulator, and enforcer and to create an enabling environment (that is, a conducive institutional and regulatory framework) to leverage private sector and community resources.
- **Implementation capacity—and the related rate of execution of investment projects—needs to be improved to optimize allocated budgets.** The Directorate Generals within MoPWH have all shown decreasing execution rates (ratio of spending to budget allocated). In particular, the execution rate of the key water department, the DGWR, is structurally lower than that of other departments and has decreased from just below 95 percent in 2015 to only 85 percent in 2016 (World Bank 2020d). The budget execution rate in sanitation is lower than for water supply, averaging about 81 percent (World Bank 2015b). Such low execution rates result from several planning and implementation challenges, including land acquisition, time to minimize the social interruptions, necessary revision of detailed engineering designs, delays in procurement, and lack of coordination between multiple local governments within a service area. Underlying all this is the need to improve the planning and implementation capacity of the departments and agencies concerned.

Investment decisions need to be optimized to increase spending efficiency and effectiveness.

- **Full life cycle cost assessments and outcome-based targets have the scope to improve the effectiveness of public expenditure.** The focus of public investment in water is typically on infrastructure development outputs such as the number of dams or irrigated hectares rather than on outcomes such as improved irrigation efficiency or agricultural productivity, percentage of wastewater treated, or improved processes such as more integrated planning. As such, dam construction may be prioritized for those that are 'quick and easy' to construct rather than those which would significantly improve water resources management. To obtain better and more sustainable results, planning and budgeting reforms should include planning based on full life cycle cost of assets and on outcomes and economic efficiency rather than on outputs. Further, costs considered are usually incomplete, resulting in challenges to ensure sustainable operations. It is suggested to consider the following categories of costs: (a) Capital expenditure (CapEx); (b) Operating and minor maintenance expenditure (OpEx); (c) Capital maintenance expenditure (CapManEx), which includes expenditure on asset renewal, replacement and rehabilitation; (d) Cost of capital (CoC), which includes the cost of accessing the funds to finance a programme or project; (e) Expenditure on direct support (ExpDS), which includes expenditure on both pre- and post-construction support activities directed to local-level stakeholders, users or user groups; and (f) Expenditure on indirect support (ExpIDS), which includes macro-level support such as capacity building, policy, planning, and monitoring that contribute to the sector's working capacity and regulation but are not particular to any programme or project (IRC, 2019)[203]
- **Investment prioritizations should be based on economic cost-benefit analysis and integrated into broader spatial planning.** Planning for water infrastructure, notably dams and irrigation schemes, is usually incorporated in the strategic plan (*pola*) and master plan (*rencana*) for the basin but should also be integrated into broader spatial planning and should provide for complementary infrastructure investment to optimize benefits. Often water investments, particularly dam construction projects, miss the opportunity to serve multiple objectives—few dams are multipurpose dams. Similarly, green-blue infrastructure for flood risk management has the potential to meet additional water quality and groundwater replenishment objectives, which should be considered in investment planning. The quality of investments could be significantly enhanced

203 Expert opinion from Focus Group Discussion on Water Services – Water Supply and Sanitation – on 5 May 2021.

when the broader economic impact—beyond just financial cost-benefit analyses—is considered and subsequently optimized. This broader view of purposes and benefits requires cooperating across ministries and departments as well as ensuring that water investments and their impacts are considered in the planning documents of other sectors.

- **Subsidy schemes need to be revisited to understand their full economic impact.** Indonesia is funding its own water pollution through high fertilizer subsidies. After fuel and electricity subsidies, fertilizer subsidies make up the largest share of subsidies (17 percent of total). Indonesia spent about IDR 30 trillion on subsidizing fertilizer in recent years, making up 1.5 percent of its total budget in 2018 and 36 percent of its agriculture spending in 2016. However, fertilizer subsidies are poorly targeted, regressive, open to abuse, and not a cost-effective way of increasing production. A 'Smart Fertilizer Subsidy Program' would simultaneously reduce the environmental impact and improve farmer productivity and profitability (World Bank 2020d).[204]
- **The financial challenges of poor households to connect to WASH services needs to be addressed.** The connection fee to PDAM services, as well as wastewater service provisions often pose a challenge to poor households as the lump sum payment is difficult to make upfront. Subsidy schemes to poor households, or arrangements with financial institutions need to be explored. While microfinance exists in Indonesia, the rules are rigid, allowing the usage of credits only for "productive and income generating activities". To allow for the usage of microcredit to pay for connection fees, either (a) WASH services need to be considered as "productive and income generating activities" or (b) a new microcredit line needs to be developed. Further, selected PDAMs are cooperating with financial institutions to develop payment plans. These initiatives should be scaled up.[205] Following their project experience, USAID IUWASH and Bappenas conclude that the following is needed (1) Special funding policy and strategy for microcredits related to drinking water and sanitation microcredit for households (targeted date 2022); (2) Special funding in the form of government investment (revolving fund scheme); (3) Enable that existing government funding programs (KUR, UMI, and LPDB) can be accessed by sanitation entrepreneurs / contractors; (4) Ensure that financial institutions that have access to special funding must have microfinance products for water and sanitation; (5) Develop a national guarantee scheme and an interest subsidy to support the development of micro credits and payment plans provided by PDAMs.[206] This requires the support from MoF, as well as from MoHA to encourage regional government owned banks to participate in water and sanitation microfinance; Financial Service authority (OJK) to recognize WASH microfinance as part of the banks' sustainability reporting; and from the Ministry of Village as well as the Ministry of Public Works to improve the managerial and technical capacity of Community-Based Water and Sanitation and increase their bankability.
- **Tax facilities should be granted on essential and efficient water and wastewater related infrastructure.** Water sales from PDAM to consumers is VAT-exempt. Recently the government also exempted connection fees and fixed charges by PDAM from VAT.[207] However, the VAT exemption should also cover household-level water treatment devices, as well sewerage connection fees and fixed charges. To increase uptake and affordability, assets should be free from import tax.[208]

Increase spending effectiveness and efficiency by adequate financing of O&M, thereby improving infrastructure performance and lifespan.

- **Increase O&M financing to improve the asset life and performance of infrastructure.** There is a 'capital bias' in public finance allocation, with allocations to O&M far too low. Recurrent spending typically underfunds O&M, leading to infrastructure failing or underperforming and creating the need for more frequent costly replacement of assets. Budgets for dams are largely for construction and inadequate O&M results in degradation of dam infrastructure and increased risk of dam failure. In irrigation, less than one-fifth of the budget is allocated to O&M, and O&M budgets are typically less than half the level required. There may even be incentives for local governments to neglect irrigation O&M, as when the performance of a system drops below 55 percent, it is eligible for rehabilitation at the expense of the central government. Inadequate O&M of urban water supply networks is a major reason why non-revenue water averages 33 percent nationwide.

204 Indonesia PER 2020.

205 Expert opinion from Focus Group Discussion on Water Services – Water Supply and Sanitation – on 5 May 2021.

206 Expert opinion from Focus Group Discussion on Water Services – Water Supply and Sanitation – on 5 May 2021

207 See Government Regulation No. 58 Year 2021 the Exemption of Clean Water Transfer from VAT

208 Expert opinion from Focus Group Discussion on Water Services – Water Supply and Sanitation – on 5 May 2021.

– **Enhance revenue raising.** One challenge is how fees can be collected for river basin management, especially for dam O&M, as RBOs (*balai*) are not currently empowered by law to collect fees. One suggested approach would be to develop and strengthen the BUMN/PJTs and BUMD. Currently, only PJT is collecting water service fees (BJPSDA) in 7 out of the 128 river basins.[209]

For RPJMN 2020–2024, there is an opportunity to restructure spending to achieve improved and more sustainable results. There is a need to improve the effectiveness of sectoral spending, including through many of the measures discussed earlier in this note.

– **For *water supply*, financing needs to be targeted on outcomes, particularly increased access, and on improved efficiency and performance.** As discussed earlier (Action 4), in *urban supply*, opportunities for PPP could be created, for example, by continuing and strengthening efforts to improve the financial viability of PDAMs, amalgamating nonviable PDAMs, restructuring balance sheets, and establishing stable revenue streams. Tariffs for water supply are low and over time should be increased to full cost recovery, considering affordability concerns for low-income households. Further, merging PDAMs with wastewater treatment and solid waste services can be explored to enhance cost sharing.[210]
– **For *rural water supply*, central government funding could be increased for areas with low fiscal capacity and low water access as well as for those areas that face higher investment and operating costs due to their water resources situation.** These are mostly concentrated in Papua, Sumatra, and Kalimantan.
– **For *sanitation*, investment needs to include both on-site and off-site systems (centralized and decentralized) and to broaden its scope from focusing on infrastructure spending to the full sanitation value chain.** As discussed earlier (Action 5) this requires allocating funds to (a) infrastructure investment in improving the quality of septic tanks, desludging and sludge collection systems, and sludge treatment plants; (b) policy investment in planning, monitoring, and enforcement; and (c) investment in advisory activities and in behavioral change and communications to increase demand for sanitation. Outcome-based targets for system performance should be added to the current indicators which only measure access. Tariffs for sanitation and wastewater are low or nonexistent. Over time an incentive structure needs to be devised that puts sanitation and wastewater on a sustainable financial footing.
– **For *irrigation*, investment should be mainly in rehabilitation and modernization and in agricultural productivity, including in institutional change such as farmer-led irrigation development and management.** As discussed earlier (Action 6), investments in new irrigation should only be made where there is a clear economic case as well as where equitable development and readiness criteria are met. There needs to be long-term planning for O&M, with provinces and districts financing an increased share of both O&M and rehabilitation costs. Charging voluntary ISF would help finance services and create accountability and incentives for a service culture. Here the approach could be to engage farmers in contributing to irrigation financing through collaboration in irrigation management and by strengthening WUAs. MoPWH might prepare a policy for progressive farmer contributions to help finance the cost of irrigation services.
– **For *resilience to disasters*, expenditures should shift from damage control to prevention and be aligned with sectoral management objectives.** Setting up a disaster pooling fund may reduce the institutional complexity and fiduciary risks of emergency response and improve the effectiveness of post-disaster expenditure. Streamlining the verification and approval process of rehabilitation and reconstruction grants is also important to ensure that urgently needed disaster recovery funds can be accessed effectively.

Making the water supply and wastewater sector attractive and viable for private participation requires the following actions:

– **The GoI policy is to promote private sector involvement in urban water supply and there is limited private sector participation in bulk water supply and wastewater treatment.** Experience globally is that private participation in bulk water development, water supply and wastewater treatment can increase investment and efficiency. However, more certainty on a business case is required—at present, questions remain over incentives, particularly tariffs and collection rates, and over the financial condition of PDAMs.

209 Stakeholder consultation with Directorate of Operation and Maintenance Development (MoPWH) on November 26, 2020.

210 Note that the local government would still likely have to continue paying subsidies for wastewater treatment services and that budgets need to be ringfenced to ensure sufficient spending on wastewater. Expert opinion from Focus Group Discussion on Water Services – Water Supply and Sanitation – on 5 May 2021.

- **The priorities lie in reducing legal uncertainty by finalizing and implementing the public-private partnership (PPP) framework for the water supply and wastewater sector and revising the PPP contractual structure to leverage private investment.** This framework will establish a supportive legal and institutional environment, establish the basic financial conditions and policy on subsidy (viability gap fund), and revise the PPP contractual structure to leverage private investment. Regulatory functions would need to be assigned to a ministry department (for example, the Directorate General of Human Settlements in MoPWH).
- **Implementing regulations for the 2019 Water Law need to clarify allocation of water to the private sector.** The requirements for granting water licenses to the private sector appear stringent and may act as a deterrent to private investment. In the drafting of the regulations to implement the new law, there is scope to clarify the definitions of 'commercial' and 'noncommercial' uses and to provide for reasonable mechanisms to encourage private investment in water.
- **Viable business models and secure revenue streams for wastewater management services need to be developed.** As demand for wastewater and sanitation services is low and the sector has practically no revenue stream, better options for generating revenues are needed. An environmental charge for wastewater management services on the water bill has been a relatively common practice in Indonesia. However, this is only useful if the PDAM's coverage is already quite high. A further potential revenue stream is through property tax. There should also be more emphasis on reuse/recycling of treated water and sludge, which could also be a potential revenue stream. Revenue streams make investments more attractive to the private sector.
- **To ensure sustainability in the wastewater sector, it will be necessary to develop business and institutional models that cover the whole chain from household level through clean disposal of treated wastewater.** The models need to build in incentives for households, local government, communities, and the private sector. The pilot by the Netherlands Development Organization (*Stichting Nederlandse Vrijwilligers*, SNV) on Sustainable Sanitation and Hygiene for All Urban (SSH4A) seeks to identify business models that can generate jobs and income, improve services, ensure occupational health and safety, and facilitate the safe disposal and reuse of effluent.[211] Initiatives like these may be explored for the potential to scale them up.
- **Options could be developed for attracting private sector participation and investment through risk sharing and assured revenue streams.** Local government payment obligations could be supported through central government guarantees and intercepts. Innovative financing could be sought through a hybrid annuity model or through 'blue bonds'. There is also a need to conduct a market assessment to identify first-mover projects for private sector participation.
- **Setting up a dedicated PPP one-stop shop.** An assessment of current infrastructure and future needs should be carried out that prioritizes key areas. On this basis an action plan on investments could be developed, with outcome-based indicators that can be tracked. To build a pipeline of PPP projects and to facilitate the PPP process, a dedicated PPP one-stop-shop needs to be set up. Responsibility could be assigned to the PPP center at BAPPENAS or as part of the responsibilities of the Directorate General of Infrastructure Financing in the Ministry of Finance (MoF). Alternatively, MoPWH could take responsibility.
- **Readying selected PDAMs for PPP and launching pilots.** Promising PDAMs could be selected to be prepared for PPPs by, for example, improving their financial viability, amalgamating nonviable PDAMs, restructuring balance sheets, and establishing stable revenue streams. PPP transactions should be piloted as a learning exercise and to establish benchmarks for the sector. Unsuccessful attempts to do this in the past need to be evaluated and adjusted accordingly to make it more effective.

Over time, the GoI may embark on a progressive shift in the role of the central government from predominant infrastructure provider toward a broader role as the regulator and standards enforcer and as collaborator with local governments in delivering services.

- **This process should continue so that direct provision of infrastructure by the central government is progressively concentrated only in a small number of low-capacity areas and areas where water resources are scarce and require higher capital investment.**
- **This repositioning should be accompanied by increased allocation of resources to strengthen institutions and management to achieve sector targets and objectives and by strengthening of the responsibility and accountability of local governments for service provision.**

211 https://snv.org/project/improving-urban-sanitation-hygiene-indonesia.

Conclusions and Main Recommendations

The agenda on water is vast—nine key areas for action—but experience from other countries shows it is doable. Carrying out this agenda for Indonesia will require political commitment at both central and decentralized levels together with the collaboration of many institutions. Urgent action should be taken to avoid downside risks and costs. Concerted and sustained action on the nine challenges can put Indonesia on the pathway to realize the ambitious and noble goals for Indonesia@100.

Threats to water security are avoidable if decisive actions are taken and can support the achievement of Vision 2045. The CGE analysis assessed five water-related threats. These threats are (a) water pollution from inadequate WASH coverage, (b) effects from SLR and land subsidence on coastal flooding, (c) impacts of subsidence caused by groundwater overabstraction, (d) impact of land degradation and climate change on inland flooding, and (e) impact of water shortages. Without action on water-related threats, GDP is likely to be 7.3 percent lower by 2045 in the high-impact scenario—with the largest impact from shocks to water availability (a 2.5 percent reduction in GDP by 2045) as well as from coastal flooding and due to SLR and land subsidence (a 2.4 percent reduction). By considering the actions assessed in this study alone, a up to 3.2 percent increase in 2045 GDP can be achieved, a significant buffer to soften the negative impacts from water threats, and a boost toward Vision 2045 targets. The greatest benefits would come from providing full water and sanitation coverage (1.2 percent increase to 2045 GDP) and from increased water storage (1.1 percent increase to 2045 GDP).

The majority of challenges are a result of development outcomes—rather than nature based-shocks—and thus can be transformed. Some threats, such as climate change and natural disasters, are nature based and the best strategy to address these is to find coping and adaptation mechanisms. The majority of the threats, however, including unsustainable patterns of water usage, water pollution, and watershed degradation are manmade and a result of current development outcomes. These threats can be transformed and once that is achieved, they will not pose the same threats and impacts on Indonesia's people, economy, and environment. Nine high-level actions are presented in Table 12: Key recommendations in 3×3 matrix and are further elaborated in the tables below.

Table 12: Key recommendations in 3×3 matrix

	Action 1	Action 2	Action 3
Pillar I. Managing water resources sustainably and strengthening resilience to water threats	Take action to reduce localized water stress and optimize scarce resources in future development planning.	Significantly reduce water pollution by increasing wastewater treatment (municipal, industrial, and mining), reduce nonpoint water pollution from agriculture and aquaculture, and strengthen water pollution control.	Enhance sustainability and improve resilience to disasters.
Pillar II. Improving the inclusivity, sustainability and efficiency of water services	Accelerate inclusive, sustainable, and efficient water supply for all Indonesians.	Expand and finance inclusive, sustainable, and efficient sanitation services and wastewater treatment.	Modernize irrigation and improve its productivity.
Pillar III. Strengthening governance and institutions for sustainable and efficient water management	Strengthen the governance framework.	Strengthen institutions through better coordination and capacity building.	Improve the efficiency of public expenditures for water and mobilize finance.

Develop benchmarks to tailor solutions to specific localized needs across the vast archipelago. Given Indonesia's vast diversity of water security challenges—spanning from water stress in Java to lack of access to safe water in Papua—a system needs to be established to accurately and quickly determine the region's challenges to then tailor targeted solutions to address these. A benchmarking system can capture and rank different water security outcomes (water stress, water pollution, floods, lack of WASH access, and so on) for each locality, which can then be aggregated to river basin level. The National Water Council is currently developing water security indicators based on administrative units which can be used as a basis for this benchmarking once completed.

The passing of the 2019 Water Law and the 2020 Omnibus Law creates an opportunity to implement many of the recommendations in this Policy Note. Many of the recommendations can be implemented through the process of issuing and revising regulations that has been set in train by the passing of the 2019 Water Law and the 2020 Omnibus Law. These opportunities are summarized in this chapter and detailed in Annex 1. Please note that to provide pertinent action, the focus lies on implementing regulations that are currently being revised or will be revised in the near- and mid-term. The implementation of all recommendations provided in this note will require additional implementing regulations to be revised—some of which are also mentioned in this note.[212] The harmonization of revised and existing (and other regulations being revised simultaneously) needs to be ensured.

As the revision of key implementing regulations is scheduled to be completed between 2021 and 2024, action needs to be taken urgently to allow for key recommendations of this note to be discussed and—if found supportive—reflected in the revised implementing regulations.

This concluding chapter summarizes the main challenges, highlights recommendations for policies and actions, and proposes first steps toward implementing the actions. The table below links key priority actions and sub-actions to regulations that are either currently being revised or will be revised in the close future. It further provides details on the responsible institution leading the revision of the regulations and highlights desirable targets to be included in the revision. Further details can be found in Annex 1.

212 Note that the stakeholder consultation on recommendations and suggested revisions on implementing regulations is ongoing and is likely to change.

Pillar I. Managing water resources sustainably and strengthening resilience to water threats

Themes and priorities	Suggested sub-actions	Regulation	Potential targets
Relieving growing water stresses: Mitigate the aggravating water stress and groundwater overexploitation issue as well as the consequent land subsidence.			
Although water is generally abundant in Indonesia, it is unevenly distributed, and demographic and economic pressures are leading to localized water shortages. Already, half of the country's GDP is produced in river basins that suffer 'high' or 'severe' water stress in the dry season—and these stresses are expected to increase. By 2045, 31 river basins, out of 128 in total, are expected to face a water supply-demand deficit. Overpumping of groundwater has depleted groundwater around key cities. Insufficient water supply could reduce GDP by as much as 2.5 percent by 2045.	• **Incorporate water resource carrying capacity into spatial and development planning,** analyzing local water stress in hotspot basins and planning development to optimize economic activity in line with economically available water resources. • **Adopt an integrated approach to bulk water supply for urban areas facing (future) water stress**, encompassing demand management, efficiency improvements, and non-traditional water source development. • **Implement a groundwater management strategy** and curb groundwater abstraction, matching this with *expansion of alternative sources of bulk water and of piped water supply*. For prioritization, delineate groundwater conservation priority zones, such as areas vulnerable to land subsidence. • **Where required, seek ways to expand bulk water supply**, particularly in areas of high or growing water stress, prioritizing surface water over groundwater and investing in water storage capacity where feasible and cost-effective.	**Regulation:** Draft Government Regulation (RPP) on water resources management **Responsibility:** DGWR, MoPWH **Target Date:** 2023 **Regulation:** Implementing Regulation of GR 21/2021 on Spatial Planning **Responsibility:** MoASP **Target Date:** Still in progress	• Provide for an integrated surface water and groundwater management strategy. • Regulate priority of surface water over groundwater usage in areas of groundwater overabstraction to mitigate land subsidence. • Regulate water management in peatland areas to mitigate land subsidence. • Mandate a national water information system. • Mandate requirement for all spatial plans to incorporate or consider river basin plans to incorporate carrying capacity of water resources into spatial development planning.
Managing water quality sustainably by tackling pollution: Take a series of policy actions to curb the deteriorating water quality issues arising from increasing urbanization and socioeconomic development.			
With increasing urbanization and socioeconomic development, three-quarters of Indonesia's rivers have become heavily polluted and two of the country's major river systems are among the most polluted in the world. With the majority of the population now exposed to water pollution, the human and economic cost is very high indeed.	• **Regulate polluting discharges** by expanding the water quality monitoring network, determining the assimilation capacity of all water bodies, and limiting the issuance of technical approvals for wastewater discharge in line with the assimilative capacity. • **Incentivize, enforce, and monitor treatment of domestic and industrial wastewater**. Enforcement and performance of water pollution control by district and city governments should be monitored and evaluated. • Assess the potential for the application of **PPP models for river quality improvement**.	**Regulation:** Government Regulation 22 Year 2021 on The Protection and Management of the Environment **Responsibility:** MoEF, local governments **Target Date:** (in progress) **Regulation:** **Government Regulation 22 Year 2021 on The Protection and Management of the Environment** Various MoEF decrees on DTBP Responsibility: MoEF Regulation: • Law No. 3 Year 2020 on the Amendment of Law 4/2009 on Mineral Mining and Coal • Government Regulation 23/ 2010 on the Implementation of Mineral and Coal Mining Activities • Government Regulation 22/2010 on Mining Regions • Responsibility: MoEMR • Various guidelines (see Diagnostic Report for details) • Responsibility: MoPWH	• Mandate coordination between 'in-stream' (MoPWH) and 'off-stream' (MoEF and regional governments) initiatives and specify coordination mechanism, such as Provincial Water Councils. • Incorporate a 'polluter pays' mechanism in which water suppliers and other stakeholders treating water supplies are compensated for higher treatment costs by institutions that do not enforce treatment of wastewater discharges.

Enhancing sustainability and improving resilience to disasters: Enhance sustainability, improve resilience toward (water-related) disasters, including disaster reduction, response, and recovery, especially under future climate change and integrate livelihood transition as both mitigation and adaptation strategies.			
Indonesia faces severe land subsidence and related flood risks, especially in urban centers and lowland areas. The main driver of subsidence is overabstraction of groundwater. If no action is taken, land subsidence is predicted to reduce GDP by up to 1.42 percent by 2045. Development of peatland, which has only short-lived economic benefits, has induced irreparable damage to a crucial ecosystem and caused high levels of carbon emission, with impacts on a global scale. Indonesia is among the countries in the world most vulnerable to natural disasters, particularly water-related disasters which have caused considerable loss of life, and average economic losses of US$2–3 billion each year between 2007 and 2018.	• **To protect watersheds and prevent disasters, a structural and long-term strategy and a massive coordinated effort across at least MoPWH, MoEF, BNPB, MoEMR, MoASP, RBOs and local governments are required.** Upstream and downstream activities need to be coordinated and investments in resilience need to be made. • **Adopt an integrated land-water-environment management approach in peatland areas**, including stopping drainage of peatlands, rehabilitation of damaged landscapes, and development of a livelihood transition programs for affected rural people.	**Regulation**: • MoPWH Regulation 10/2014 on Guidance on Disaster Mitigation on Housing and Settlement • MoPWH Regulation 16/PRT/M/2013 on the Guidance of Disaster Mitigation caused by Water Hazards • MoPWH Regulation 13/PRT/M/2015 on Emergency Response due to Water Hazards **Responsibility:** MoPWH **Target Date:** (existing, no revision planned yet) **Regulation:** Draft President Regulation (PERPRES) concerning the acceleration of lake rehabilitation **Responsibility:** MoPWH **Target Date:** TBD	• Adopt a risk-based approach in disaster prevention and management as current regulation focuses mostly on mitigation and disaster response. • There is a need to (a) create a flood risk management plan as a part of the river basin plan, (b) adopt a flood risk management plan into the spatial plan, and (c) publish flood hazard maps by the local government. • Consider provisions to enhance integrated lakes management. • Determine specific guidelines and monitoring and enforcement mechanisms on how to determine minimum forest coverage in each watershed (in response to deletion of this clause by 2020 Omnibus Law)

Pillar II. Improving the inclusivity, sustainability and efficiency of water services

Themes and priorities	Suggested sub-actions	Regulation	Potential targets
Accelerating inclusive, sustainable and efficient water supply for all Indonesians: To meet the objectives of universal access, continue improving water supply services, in both urban and rural areas, while increasingly leveraging private sector and community resources.			
Only 14 percent of Indonesians have access to piped water, and the service is often poor. Rural people and the urban poor have the lowest access and pay the highest prices for water. They are particularly at risk during the COVID-19 pandemic. Almost half of households and most industries rely on supplies from groundwater wells that they have developed themselves, contributing to massive depletion of aquifers	• **Strengthen inclusivity by expanding effective programs to increase access to water for the poor and vulnerable.** Water Hibah in urban areas, PAMSIMAS, and community programs in rural areas. • **Increase the effectiveness of public investment in water supply**, adopting an IUWM approach, coordinating different levels of government, ensuring that investment in bulk water infrastructure is aligned with development of water distribution, and making investment conditional on both need and performance, especially in provinces with low water supply access and fiscal capacity. The NUWAS framework needs to be employed and strengthened.	**Regulation:** Amendment to Government Regulation (RPP) on Drinking Water Provision System **Responsibility:** DGHS, MoPWH **Target Date: (in progress)** **Regulation:** Draft Ministerial Regulation (MOPWH Rapermen) concerning Amendments to the MoPWH Regulation on Duties, Functions, Composition Organization, and Management of the Agency for the Drinking Water Supply System Development and Secretariat of the Supporting Agency for the Drinking Water Supply System Development **Responsibility:** DGHS, MoPWH	• Include compliance and incentive mechanism for water providers toward water safety planning and 'safe water'.

	Improve efficiency and sustainability of water supply by **strengthening the governance, financial viability, and performance of the water utilities (PDAMs**) including moving toward full cost recovery tariffs, amalgamating of nonviable PDAMs, restructuring balance sheets, and reducing non-revenue water. **Increase piped water supply access and use**, developing surface water sources particularly in areas with groundwater overabstraction or polluted water supplies. Increase household usage of piped water by improving water supply quality and reliability accompanied by incentives and awareness campaigns. **Open the door to private finance** by enhancing regulatory certainty, improving the business case, and setting up institutional mechanisms to facilitate private participation.	**Regulation:** Revised Government Regulations 46/ 2010 on Public Company (perum) Jasa Tirta I and 7/2010 on Public Company (perum) Jasa Tirta II I **Responsibility:** MoPWH, MoSOE **Target Date:** TBD **Regulation:** Draft Presidential Decree (Raperpres) regarding the amendment of Presidential Regulation Number 90/2016. Regarding the Enhancement of Agency for Drinking Water Supply System **Target Date**: 2021 **Responsibility**: MoPWH (DGHS)	
	Ring-fence core functions of PJTs financially from non-core functions and mandate the creation of subsidiary to perform non-core functions, such as hydropower and drinking water provision to allow for revenue streams for cost recovery.	**Regulation:** Revised Government Regulations 46/ 2010 on Public Company (perum) Jasa Tirta I and 7/2010 on Public Company (perum) Jasa Tirta II **Responsibility**: MoPWH, MoSOE *Additional opportunities are listed in Annex 1*	• Clarify the role and responsibilities of SOEs, such as PJTs I and II. • Include provisions for SOE, such as PJTs I and II, to generate alternate revenue stream to cross-subsidize at least O&M expenditures. • Include requirement for a service-level agreement between parties on BJPSDA.
Expanding and financing inclusive, sustainable and efficient sanitation services and wastewater treatment: Continue improving wastewater and sanitation services with a special focus on the improvement of sanitation sector performance in addition to access.			
Improved sanitation is available to less than two-thirds of the population and modern sewered sanitation is available only to a small minority of households. Only 5 percent of municipal wastewater is safely collected and treated; the remaining 95 percent is discharged untreated to water bodies. The resulting pollution is a major hazard to ecosystems, human health, and the economy. If adequate sanitation services are not developed, GDP in 2045 could be 0.17 percent lower.	• **Adopt a risk-based and adaptive national sanitation policy** and **develop a public investment program** based on priorities and outcome targets. The policy and investment program should be tailored to the situation of each city and rural area, broadening the scope beyond just infrastructure to the full sanitation value chain, considering both on-site and off-site (centralized and decentralized) systems to find the most cost-effective solutions, with priority to areas that face high health and environmental risks due to inadequate sanitation services. Incentives need to be provided to connect to safe sanitation systems.	**Regulation:** Amendment to Government Regulation 122 on Drinking Water Provision System **Target Date:** 2021 **Responsibility:** DGHS, MoPWH **Regulation:** Ministerial Regulation No. 03/2013 concerning Implementation of Infrastructure and Facilities for Solid Waste in Handling Household Waste and Similar Household Waste **Target Date:** 2023	• Revise to encompass all wastewater cycle from desludging to treatment and incorporate all on-site and off-site wastewater system—decentralized and centralized systems. • Revise to stipulate local government responsibility to support the long-term use of decentralized and community-based wastewater systems and establish MSS for wastewater services. • Revise to include the full sanitation service chain in accordance with current developments and conditions. • Revise to allow regular aid to support community assets.

	• **Expand the community-led 'Total WASH Program'** for rural sanitation and link it to sanitation marketing and financing schemes to achieve even greater impact. Expansion of this program will privilege the poor and increase resilience in the light of the COVID-19 pandemic. • **Design institutional and business models for sanitation and wastewater**, including new options for generating revenues for the local government and for leveraging a broader range of financing sources, including from the private sector. • **Increase the incentives for industries and mines to comply with pollution control.** Sanctions and penalties need to be increased and enforced so that the cost of non-compliance is higher than the costs of compliance. Programs that incentivize sustainable behavior, such as the PROPER, should be expanded. • **Improve solid waste management practices in larger urban areas** as well as in rural areas and also aim to reduce plastic use and increase community-based recycling.	**Responsibility:** DGHS, MoPWH **Regulation:** Various guidelines **Target Date:** 2020-24 **Responsibility:** MoPWH *Additional opportunities are listed in Annex 1*	
Modernizing irrigation and improving its productivity: Focus on an integrated approach to agriculture, including maximizing economic efficiency of irrigation performance, optimizing production to water availability, and boosting farmer incomes.			
Water productivity in Indonesia is low by global standards and among the lowest in Asia. While agriculture uses 80 percent of the country's water, irrigation services are often poor, with nearly half (46 percent) of irrigation systems classed as 'in poor condition'. There is a large productivity gap. More efficient irrigation together with agricultural policies and programs that improve the value derived from each drop of water can help drive an agricultural transformation toward higher output, increased farmer incomes, and better nutrition.	• **Improve water service to farmers** by establishing irrigation service agreements across different levels of governments and identifying options for the RBOs to collect voluntary revenues so that they have sufficient budget for O&M. • **Increase the efficiency and effectiveness of infrastructure investment and planning**, basing sector investment on outcomes such as increases in '$ per drop' and 'nutrition per drop' rather than on outputs and considering the full life cycle cost of assets. Increase reliability of irrigation to optimize water usage in water-stressed areas and provide water security to produce higher-value and less water intensive crops. • **Improve the sustainability of agriculture** by reducing or optimizing production in lowland areas and by tackling agricultural pollution—training farmers, enforcing regulations, and incentivizing best management practices, for example, through a 'Smart Fertilizer Subsidy Program'. Increase water security for local food security. • **Intensify climate-smart approaches and GAP** for both rainfed and irrigated farmers while **enhancing market access** in promising areas.	**Regulation:** Draft Government Regulation (RPP) on irrigation **Responsibility:** DGWR, MoPWH **Target Date:** 2023	• Increase efficiency and effectiveness of infrastructure investment and planning based on full life cycle cost of assets and allocate sufficient budget for O&M. • Establish irrigation service agreements across levels of government. • Incorporate targets on irrigation efficiency, particularly in water-stressed areas. • Incorporate provisions of suggested crop choices with lower water requirements in water-stressed areas.

Pillar III. Strengthening governance and institutions for sustainable and efficient water management

Themes and priorities	Suggested sub-actions	Regulation	Potential targets
Strengthening the governance framework: To provide a sound legal basis for water management, formulate implementation policies to support the new 2019 Water Law, which provides an opportunity to address coordination and implementation challenges and to move toward more integrated water resources management.			
Key areas for clarification in the 2019 Water Law include jurisdiction and accountability for water resources, and principles and practice for water allocation.	• **Harmonize the new water law with the existing legal framework**, including other sector laws and existing water sector regulations. • **Issue regulations on key outstanding points requiring clarification from the 2019 Water Law** including (a) jurisdiction and accountability for groundwater management, water quality, and environmental flows and (b) principles and practice on water allocation issues, including consideration of priority uses in areas of growing water scarcity and on how the allocation process can encourage the private sector to invest. • **Develop a coordination mechanism** for all ministerial regulations concerning water across all relevant ministries. • **Streamline improvements to water governance** into revisions of implementing regulations for the 2020 Omnibus Law.	**Regulation:** Draft Government Regulation on Water Resources Management **Responsibility:** MoPWH **Target Date: TBD**	• Specify the list of noncommercial uses to implement Water Law 17/2009 Article 49. • Specify the types of water licenses and consistently apply similar terminologies in all ministerial regulations on water resources. • Clarify the specific requirements to grant water licenses to the private sector. • Clarify how conflict arising out of allocation mechanism under *pola/rencana* as well as RAAT/RAAR can be addressed in a formal dispute resolution mechanism.
Strengthening institutions through coordination and building capacity: Develop integrated and coordinated water institutions and enhance their capacities.			
The priority for strengthening integrated water management is to clarify responsibilities, strengthen the coordination framework, and align all the multiple planning processes so that water resources management genuinely integrates all interests within each basin. RBOs need to be strengthened. As challenges multiply and grow in complexity, water management must become increasingly knowledge based. This requires investment in modern monitoring and information, research and studies, as well as development of professional capacities.	• **Improve water governance and accountability** by clarifying responsibilities and strengthening coordination mechanisms such as water resources councils (Dewan SDA) and coordination teams for Water Resources Management (TKPSDA), including by involving governors in decision-making and follow-up. • **Strengthen integrated planning at the basin level** by implementing the 'one basin, one plan, one management' approach required in the 2019 Water Law and harmonizing the *pola* and *rencana* with other sector plans as well as with land use zoning and spatial plans. • **Strengthen coordination between subnational governments** on water issues. • **Enhance capacity across the government to manage increasingly complex water challenges** by developing the technical, financial, and managerial skills of water professionals, practitioners, and key workers, especially in the RBOs. • **Establish a national water information and knowledge management system**, including real-time monitoring for both surface water and groundwater quality and quantity as well as better knowledge management. Incentives for sharing knowledge will support bridging fragmented data sources.	**Regulation:** Ministerial Regulation 09/2018 regarding the Review of Medium-Term Regional Development Plan (RPJMD) **Model Regulation:** Ministerial Regulation 06/2006 on Organization and Working Arrangement of the Secretariat of Development Cooperation Agency Jakarta, Bogor, Depok, Tangerang, Bekasi and Cianjur[213] **Responsibility:** MoHA **Target Date:** TBD	• Foster the integration of *pola* and *rencana* with RPJMD by including the consistency of RPJMD with *pola/rencana*. • Improve interjurisdictional cooperation by clarifying requirements for joint planning and project evaluation, both in general and specifically for water issues and by designing more effective incentive frameworks for cooperation.

213 Prioritize revisions within this RPJMN 2020–2024 period of Presidential Regulation 88/2018 on H3 Information Systems and Presidential Regulation 39/2015 on One Data Policy to incorporate a clear data sharing mechanism across central government agencies and across government levels, including RBOs, specifying type, frequency, and mechanism of data to be shared.

Improving the efficiency of public expenditures for water and mobilizing finance: Improve public spending in the water sector by increasing the amount of spending (adequacy) and improving the quality, both efficiency and effectiveness, of spending.			
In public spending plans, there is a gap between ambitions and resources—but also scope to obtain better and more sustainable results from current levels of spending. Prioritization of investments, improvement in the efficiency, effectiveness of spending through an emphasis on outcomes and life cycle costs, and rebalancing toward full financing of O&M are required. To afford the high costs, priority should be on leveraging more financing from local governments, users, and beneficiaries and from the private and voluntary sectors.	• Link expenditure to clear, realistic, policy targets. • Develop outcome-based rather than output-based targets. • **Increase budget allocations for the water sector**, rebalancing between central and decentralized levels, and **improve budget execution capacity** to realize Indonesia's ambitious sector targets. • **Focus investment on provinces with low fiscal capacity** and encourage provinces with high fiscal capacity to use their own resources and to increasingly leverage financing from the private sector. • **Improve the quality of public spending in the water sector**, both in terms of efficiency and effectiveness by considering the full life cycle costs and allocating sufficient budget for infrastructure O&M. A 'Smart Fertilizer Subsidy Program' would reduce environmental impacts and fiscal outlays and improve agricultural productivity and profitability. • **Leverage more financing from local governments**, users, and beneficiaries and from the private and voluntary sectors to afford the high costs of achieving the water-related targets of RPJMN 2020–2024 and Vision 2045 while responding to the effects of the current pandemic.	**Regulation:** Ministerial Regulation 09/2018 regarding the Review of Medium-Term Regional Development Plan (RPJMD) **Responsibility:** MoHA **Target Date:** TBD	Increase budget allocation to KP-SPAMS (or ring-fence a percentage of dana desa and ADD budget to be used for water and sanitation.

Moving forward

The Water Law of 2019 and the 2020 Omnibus Law provide an opportunity to begin to put many of the recommendations in this Policy Note into practice. Operationalizing the water law requires implementing regulations to be drafted or updated, and the new Omnibus Law requires consolidation and alignment of the existing regulations. As we have seen in this chapter, many regulations are either being drafted or amended, and the Omnibus Law mandates the amendment of a wide range of existing regulations. This creates an ideal opportunity for the GoI to consider the recommendations of this Policy Note and to initiate the implementation of at least some of the actions.

Anchoring the proposed actions in what is already a subject of revision within the government makes the recommendations both pertinent and practical. Building on the implementation proposals accompanying the recommendations in this chapter, Annex 1 makes detailed and specific suggestions on how many of the proposed actions may be implemented through the ongoing process of issuing or revising regulations. Other regulations beyond those suggested may also be used to take forward these actions. The suggestions in the annex are proposals to start the process.

Further research

While this report contains a wealth of information, implementation of solutions would benefit from the following additional research:

- **Develop benchmarks to tailor solutions to specific localized needs across the vast archipelago.** More research is required on the localized water insecurities and possible solutions. A benchmarking index would facilitate prioritizing which areas and water insecurities need to be addressed, given limited budgets.
- **Understand cost-effective and local water supply augmentation and water demand reduction solutions.** While this study identified water stress at the river basin level, more research is needed to identify the most cost-effective solutions to reduce this water stress. Marginal abatement cost curves can be estimated at even more localized levels for key priority areas. These can be used as a foundation for future water management and investment programs
- **Develop sustainable business models for operation of existing for private-sector desludging ("sedot") operators and IPLTs**
- **Shed light on additional water quality risks.** This study provided some high-level insights on water quality concerns, while it became apparent that significant risks for the Indonesian people, environment, and economy lie in what is not known to date. This includes water pollution impacts from industries, including pharmaceuticals, mining, plantation farming, agricultural runoff, and so on. Many health impacts are expected to be chronic—rather than acute—and thus less obvious. Preventing water pollution impacts will be key for sustainable development.
- **Understand the role and impact of women around WASH.** Little research has been done so far on how women are affected around WASH. More detailed insights will allow for more targeted policy interventions.

Annex 1. Legal and Regulatory Opportunities[214]

This Annex provides additional details on the legal and regulatory opportunities to implement the recommendations made in this report.

While the section below does not present a comprehensive overview of implementing regulations that may need revisions to capture all of this note's recommendations, it provides an action-oriented and immediate starting point for transforming Indonesia toward a water secure future.

Note that the implementing regulations under (future) revision may be plentiful for some actions and lesser in number for others. This presents the current dynamic of the reform process and does not suggest differing levels of importance across actions. Also note that with the promulgation of the Omnibus Law, more implementing regulations are likely to be revised in future.

For more details on the recommended actions, refer to the preceding chapters.

Action 1: Relieving the growing water Stresses

No.	Regulation	Responsibility/ Completion target (if any)	Target
1	Draft Government Regulation (RPP) on Water Resources Management	DGWR, MoPWH 2023	• Provide for an integrated surface water and groundwater management strategy. • Regulate priority of surface water over groundwater usage in areas of groundwater overabstraction to mitigate land subsidence. • Regulate water management in peatland areas to mitigate land subsidence. • Mandate a national water information system. • Include requirement for a service-level agreement between parties on BJPSDA. • Introduce a conflict resolution mechanism for disagreements on water allocation and BJPSDA (services provided, amount invoiced, and so on).
2	Revision of Government Regulation 15/2010 on the Implementation of Spatial Planning	Revised through Government Regulation 21 Year 2021 in the Implementation of Spatial Planning.	Implementing regulation of GR 21/2001 could mandate requirement for all spatial plans to incorporate or consider river basin plans to incorporate carrying capacity of water resources into spatial development planning.

214 Note that this annex is currently being verified, specified, and expanded upon as part of the ongoing stakeholder consultations.

Action 2: Managing water quality sustainably by tackling pollution

No.	Regulation	Responsibility/Completion target (if any)	Target
1	Government Regulation 22 Year 2021 on The Protection and Management of the Environment	MoEF, local governments (Development of Implementing regulations is in progress)	• Mandate coordination between 'in-stream' (MoPWH) and 'off-stream' (MoEF and regional governments) initiatives and specify coordination mechanism such as Provincial Water Councils. • Determine DTBP of all rivers, lakes and relevant water bodies and re-evaluate all existing wastewater discharge licenses. • Determine Ambient Water Quality and Allocation of Pollution Load within 2 (two) years (required by GR 22 Article 531) • For discharge approvals under local government's authority, MoEF can establish a program to encourage the local government to evaluate discharge licenses or approvals that have been issued by local governments before DTBP enactment. • Previous Environmental Impact Agency (Bappedal) decrees 03 and 04/09/1995 contain some polychlorinated biphenyls (PCBs), polychlorinated dibenzofurans (PCDFs), and polychlorinated dibenzo-para-dioxins (PCDDs) parameters but may no longer be deemed enforceable. These standards have not been included in Government Regulation 22/2021. • Strengthen the mechanism of taking action following reported violations, for example, reported by PJTs I and II, on water quality and wastewater discharges. • Incorporate a 'polluter pays' mechanism in which water suppliers and other stakeholders treating water supplies are compensated for higher treatment costs by institutions that do not enforce treatment of wastewater discharges. • Regulate implications on changing environmental licensing to environmental approvals, new framework for environmental impact assessment, technical approvals for hazardous and toxic wastes, water pollution control, and the possibility of emission trading.
3	Various MoEF decrees on DTBP	MoEF (in progress)	• Revise existing standards to include emerging pollutants, including additional POP[a], as well as revisit whether additional B3 hazardous and toxic pollutants, such as microplastics, heavy metals, pharmaceuticals, and so forth, need to be added. • Include toxic-free procurement, that is, prohibit government offices from purchasing POP articles (this also requires changes in National Public Procurement Agency regulation - *Lembaga Kebijakan Pengadaan Barang/Jasa Pemerintah* or LKPP).
4	Law No. 3 Year 2020 on the Amendment of Law 4/2009 on Mineral Mining and Coal GR 23 Year 2010 on the Implementation of Mineral and Coal Mining Activities GR 22 Year 2010 on Mining Regions	MoEMR	• The issuance of the new Law 3/2020 will require a revision of the implementing regulations GR 23/2010 and GR 22/2010. • Adopt regulatory framework to enable livelihood transition programs for ex-miners as well as policies to promote trainings of artisanal gold miners in mercury-free methods, conducting clean-ups and interventions. • Adopt regulatory framework to require a full life cycle cost analysis before issuing mining licenses and require a deposit payment by miners for mine closure activities.
5	Various guidelines	MoPWH	• Guideline for Domestic Waste Water Minimum Services Standard (2020) • Guidelines for Integrated Water and Sanitation Services (2020) • Guidelines for the Construction of Sewer (2020) • Guidelines for Monitoring and Evaluation of Domestic Wastewater Minimum Services Standard (2021) • Guidelines for Domestic Wastewater Financing Scheme (Public Private Partnership) (2021) • Guidelines for the Establishment of a Government-Owned Enterprise and / or state-owned corporation Domestic Wastewater (2024) • Indonesian Qualification Framework for Domestic Wastewater Management (2022) • Guideline on Wastewater Sludge Reuse (2022) • Guideline on Reuse of Treated Wastewater (2023) • Wastewater Infrastructure Permits Guidance (2023) • Wastewater Enterprise Permits Guidance (2024)

Note: a. While some POPs have already been included in the water quality parameters, there is a need to include more parameters to accommodate the list of POPs under the Stockholm following a risk-based approach.

Action 3: Enhancing sustainability and improving resilience to disasters

No.	Regulation	Responsibility/ Targeted completion date (if any)	Target
1	MoPWH Regulation 10/2014 on Guidance on Disaster Mitigation on Housing and Settlement MoPWH Regulation 16/ PRT/M/2013 on the Guidance of Disaster Mitigation caused by Water Hazard MoPWH Regulation 13/ PRT/M/2015 on Emergency Response due to Water Hazard	MoPWH (existing, no revision planned yet)	• Adopt a risk-based approach in disaster prevention and management as current regulation focuses mostly on mitigation and disaster response. • There is a need to (a) create a flood risk management plan as a part of the river basin plan, (b) adopt a flood risk management plan into the spatial plan, and (c) publish flood hazard maps by the local government.
2	Draft President Regulation (PERPRES) concerning the acceleration of lake rehabilitation	MoPWH	Consider provisions to enhance integrated lakes management

Action 4: Accelerating inclusive, sustainable and efficient water supply for all Indonesians

No.	Regulation	Responsibility/ Targeted completion date (if any)	Target
1	Amendment to Government Regulation) on water Drinking Supply System (GR 122/2015)	DGHS, MoPWH (TBC)	• Include compliance and incentive mechanism for water providers toward water safety planning and 'safe water'. • Clarify the roles of City/Regency and Village Governments with respect to Community-Based Water Supply • Consider imposing economic regulation to water utilities and treating them as natural monopolies
2	Draft Presidential Decree (Raperpres) regarding the amendment in Presidential Decree Number 90/2016. Regarding the Enhancement of Agency for Drinking Water Supply System	DGHS, MoPWH (2021)	• Specify institutional responsibilities of the now inactive BPPSPAM institution. • Develop a utility benchmarking mechanism, which includes the water safety plan and water quality parameters.
3	Draft Ministerial Regulation (MOPWH Rapermen) concerning criteria for utilization of income tax facilities for investment in certain business fields and/or in certain regions in the Drinking Water Supply System Sector	DGHS, MoPWH (2020)	• Revise to enhance the financial viability of PDAMs.
4	Draft Ministerial Regulation (MOPWH Rapermen) on implementation of guarantee and interest subsidies by the central government in the context of accelerating the drinking water supply	DGHS, MoPWH (2020)	• Revise to allow for a guarantee and interest subsidies by the central government in the context of accelerating the drinking water supply expansion.
5	Draft Ministerial Regulation (MOPWH Rapermen) on business to business (B2B) contractual arrangements	DGHS, MoPWH (2021)	• Specify government and/or local government support in Drinking Water Supply System (SPAM) Cooperation.
6	Draft Ministerial Regulation (MOPWH Rapermen) amending MOPWH Regulation Number 27 of 2016 on Regulation the drinking water provision system	DGHS, MoPWH (2021)	• Further recognize the multiplicity of water provision models (pipe and non-pipe, decentralized and centralized, rural and urban) • Integrate water supply planning across different model provisions

7	Draft Ministerial Regulation (MOPWH Rapermen) concerning Amendments to the MOPWH Regulation on duties, functions, composition organization and management of the Agency for the Drinking Water Supply System Development and Secretariat of the supporting Agency for the Drinking Water Supply System Development Draft Ministerial Regulation (MoH Rapermen) amending Regulation Number 492 of 2010 on determining drinking water quality	DGHS, MoPWH (ongoing) (2021) MoH	• Specify changing duties, functions, and institutions of the BPPSPAM and the Secretariat of BPPSPAM - DGHS. • Revise the list of water quality parameters to include emerging pollutants as well as toxic and hazardous pollutants, such as heavy metals, pesticides, POPs, and PFAS.
	Draft Ministerial Regulation (MoH Rapermen) amending Regulation Number 736 of 2010 on the Procedure of Drinking Water Supervision	MoH (ongoing)	• Provide specific guidelines and potential recommendations in which 'additional water quality parameters' are required in key areas. • Mandate the establishment of 'accredited laboratories' for all local governments or allow for a sharing mechanism of existing accredited laboratories. • Provide detailed guidance/circular on actions to be taken in case drinking water quality parameters exceed thresholds (building on Article 15).
8	Government Regulation 122 Year 2015 on Drinking Water Provision System	(existing, no revision planned yet)	• Add clear typology of water supply provision, that is, technology (piped vs non-piped), management structure (community-based approach versus others) to allow for the subsequent development and implementation of water safety plans. • Revise to outline local government's obligations in supporting the long-term use of community-based water and sanitation facilities.
9	Revision of Government Regulation 46/ 2010 on Public Company (perum) Jasa Tirta I Revision of Government Regulation 7/ 2010 on Public Company (perum) Jasa Tirta II	MoPWH MoSE (ongoing)	• Ring-fence core functions financially from non-core functions. • Mandate creation of subsidiary to perform non-core functions, such as hydropower, drinking water provision. • Clarify the role and responsibilities of SOEs, such as PJTs I and II. • Include provisions for SOE, such as PJTs I and II, to generate alternate revenue stream to cross-subsidize at least O&M expenditures.

Action 5: Expanding and financing inclusive, sustainable and efficient sanitation services and wastewater treatment

No.	Regulation	Responsibility/ Targeted completion date (if any)	Target
1	Amendment to Government Regulation 122 (RPP) Drinking Water Provision System	DGHS, MoPWH (2021)	• Revise to encompass all wastewater cycle from desludging to treatment and incorporate all on-site and off-site wastewater system—decentralized and centralized systems. • Revise to stipulate local government responsibility to support the long-term use of decentralized and community-based wastewater systems and establish enforceable Minimum Service Standard for wastewater services.
2	Ministerial Regulation No. 03/2013 concerning Implementation of Infrastructure and Facilities for Solid Waste in Handling Household Waste and Similar Household Waste	DGHS, MoPWH (2023)	• Revise to include the full sanitation service chain in accordance with current developments and conditions.
3	Regulation 19 Year 2016 on regional assets	MoHA (existing, no revision planned yet)	• Revise to allow local governments to finance WATSAN facilities.
4	Regulation 32 Year 2011 on grants and social aid	MoHA (existing, no revision planned yet)	• Revise to allow regular aid to support community assets.

5	Guideline for Domestic Wastewater Minimum Services Standard (MSS)	MoPWH (2020)	• Include a phased and targeted risk management approach to prioritize sanitation service and wastewater treatment expansion to meet MSS. • Create an incentive, for example, through the tariff structure, for urban households to connect to an existing sewerage network, where available. • Create incentives for local governments to invest in sanitation and wastewater and to enforce regulations.
6	Guidelines for Integrated Water and Sanitation Services	MoPWH (2020)	• Consider adaptive sanitation strategies, including a range of technological options, that is, centralized and decentralized solutions as well as off-site and on-site solutions, to allow for tailored and cost-effective solutions of each city and rural areas across the entire sanitation service chain. • Include behavioral change, regulations, and associated monitoring and enforcement to reduce solid waste pollution. • Create Guideline for Private Sector Participation on the Provision of Desludging Service and Treatment Plants
7	Guidelines for the Construction of Sewers	MoPWH (2020)	• Ensure coordinating mechanisms across sectors and plans, that is, groundwater conservation map, disaster management national plan and disaster risk map, irrigation development and management plan, and spatial plans, as well as *pola* and *rencana*.
8	Guidelines for Monitoring and Evaluation of Domestic Wastewater Minimum Services Standard	MoPWH (2021)	• Consider outcome rather than output related standards.
9	Guidelines for Domestic Wastewater Financing Scheme (Public Private Partnership)	MoPWH (2021)	• Consider risk sharing and assured revenue streams to attract private investment. • Consider supporting local government payment obligations through central government guarantees and intercepts. • Consider innovative financing, for example, through a hybrid annuity model or through 'blue bonds'.
10	Guidelines for the Supervision (Monitoring, Evaluation and Reporting) of Domestic Wastewater Management	MoPWH (2021)	• Consider using new technologies such as blockchain to make domestic wastewater management tamperproof. • Create incentives (and penalties) for supervisors to monitor domestic wastewater management
11	Guidelines for the Establishment of a Government-Owned Enterprise and/or state-owned corporation Domestic Wastewater	MoPWH (2024)	• TBD
12	Indonesian Qualification Framework for Domestic Wastewater Management	MoPWH (2022)	• Clarify management and sustainability of decentralized domestic wastewater management systems (SPALD S) and centralized domestic wastewater management systems (SPALD T).
13	Guideline on wastewater sludge reuse	MoPWH (2022)	• Consider incentives, such as tax rebates, reusing wastewater sludge.
14	Guideline on reuse of treated wastewater	MoPWH (2023)	• Consider incentives, such as lower tariffs for recycling water and reusing wastewater.
15	Wastewater infrastructure permits guidance	MoPWH (2023)	• Ensure coordinating mechanisms across sectors and plans, that is, groundwater conservation map, disaster management national plan and disaster risk map, irrigation development and management plan, spatial plans, as well as *pola* and *rencana*. • Discharge standards should be revised to include harmful pollutants such as pharmaceuticals, heavy metals, PFAS, micro- and nano-plastics, as well as other hazardous and toxic waste.
16	Wastewater enterprise permits guidance	MoPWH (2024)	• Encourage private investment in centralized industrial effluent treatment.

Action 6: Modernizing irrigation and improving its productivity

No.	Regulation	Responsibility/ Targeted completion date (if any)	Target
1	Draft Government Regulation (RPP) on irrigation	DGWR, MoPWH (2023)	• Increase efficiency and effectiveness of infrastructure investment and planning based on full life cycle cost of assets and allocate sufficient budget for O&M. • Establish irrigation service agreements across levels of government. • Incorporate targets on irrigation efficiency, particularly in water-stressed areas. • Incorporate provisions of suggested crop choices with lower water requirements in water-stressed areas.

Action 7: Strengthening the governance framework

No.	Regulation	Responsibility/Targeted completion date (if any)	Target
1	Draft GR on Water Resources Management	MoPWH	• Specify the list of noncommercial uses to implement Water Law 17/2009 Article 49. • Specify the types of water licenses and consistently apply similar terminologies in all ministerial regulations on water resources. • Clarify the specific requirements to grant water licenses to the private sector. • Clarify how conflict arising out of allocation mechanism under *pola/rencana* as well as RAAT/RAAR can be addressed in a formal dispute resolution mechanism.

Action 8: Strengthening institutions: Coordination and capacity building

No.	Regulation	Responsibility/ Targeted completion date (if any)	Target
1	Ministerial Regulation 09/2018 regarding the review of Medium-Term Regional Development Plan (RPJMD)	MoHA (existing, no revision planned yet)	• Foster the integration of *pola* and *rencana* with RPJMD by including the consistency of RPJMD with *pola/rencana.*
2	Ministerial Regulation 06/ 2006 on Organization and Working Arrangement of the Secretariat of Development Cooperation Agency Jakarta, Bogor, Depok, Tangerang, Bekasi and Cianjur	MoHA (ongoing revision)	• Improve inter-jurisdictional cooperation by clarifying requirements for joint planning and project evaluation, both in general and specifically for water issues, and by designing more effective incentive frameworks for cooperation.

Action 9: Improving the efficiency of public expenditures for water and mobilizing finance

No.	Regulation	Responsibility/ Targeted completion date (if any)	Target
1	Ministerial Regulation 09/2018 regarding the review of Medium-Term Regional Development Plan (RPJMD)	MoHA (existing, no revision planned yet)	• Increase budget allocation to KP-SPAMS (or ring-fence a percentage of dana desa and ADD budget to be used for WATSAN).

Annex 2. Overview of Ministries Responsible for the Water Sector

National agency	Water-related responsibilities
Ministry of National Development Planning (BAPPENAS)	Responsible for national development planning matters. This is undertaken through (a) developing five-year plans (RPJMN) and annual plans (Rencana Kerja Pemerintah or RKP) in cooperation with line ministries, (b) conducting monitoring and evaluation of national development priorities, (c) conducting studies to improve public policies based on scientific basis, and (d) coordinating all ministries related to the implementation of national development programs. According to the RPJMN 2020–2024, BAPPENAS is responsible for ensuring the integration of RPJMN and the RENSTRAs and RPJMDs, and for following up on implementation of RPJMN.
Ministry of Finance (MoF)	Responsible for government financing of water resources management through the normal government budgeting processes. Funds for water supply investments and developments are provided through three key channels: (a) budgets of line ministries—line ministries, such as MoPWH, can apply for budget allocation from MoF for water supply projects; for example, MoPWH is the implementation agency for the 10 million household connections; therefore, budget is allocated to MoPWH to deliver this program; (b) fund transfers to subnational governments—this may be for general allocation fund (*Dana Alokasi Umum,* DAU or special allocation fund (*Dana Alokasi Khusus*, DAK) that can be earmarked for water supply development or special grant for water supply projects; and (c) guarantee and other government support for PPP projects as some water sector PPP projects are eligible for government financial support. To allow for successful implementation of plans and projects, it is critical that budgets have been allocated for these purposes.[215]
Ministry of Foreign Affairs (MoFA)	Responsible for the diplomatic aspects of transboundary (trans-country) river basins insofar as the management affects international relations and national government's foreign affair policies.
Coordinating Ministry for Economic Affairs (CMEA)	CMEA is the Chairman of National Water Resource Council (NWC). It is responsible for coordination and synchronization of the formulation, stipulation, and implementation of policies related to the economy; manages National Priority Porgrammes and other policies decided by the President and the Cabinet Meeting; and solves and coordinates issues across multiple Ministries. CMEA coordinates the Ministry of Finance, Ministry of Industry, Ministry of Trade, Ministry of Agriculture, Ministry of Manpower, Ministry of State Owned Enterprises, Ministry of Land and Spatial Planning Affairs, Ministry of Cooperation and Small & Medium Enterprises, as well as other state institutions which are deemed to be necessary.

215 World Bank ECA SPAM framework Discussion Paper 1.

Ministry of Public Works and Housing (MoPWH)	Responsible for water and river basin management as well as for potable water supply and sanitation, including dam safety and standard operating agreements with, for example, hydropower developers. MoPWH owns and operates river infrastructure (multipurpose dams and weirs) and primary and secondary canals of irrigation systems. Water Resources Directorate General is responsible for planning and investment in water resources, water resources allocation and management, and regulation. Human Settlements Directorate General (Perumahan) is responsible for urban and rural housing and for public health engineering. Directorate General Cipta Karya is responsible for water supply and sanitation, including for national policy and strategy for potable water supply services and sanitation services, preparation of legislation and administrative regulations, issuance of technical standards for water supply and sanitation infrastructures, technical oversight, and guidance and support to water supply providers. Directorate General of Infrastructure Financing is responsible for the drafting and implementation of policy and regulation on infrastructure financing including the acceleration of PPPs in the public works and housing sector.
Ministry of Energy and Mineral Resources (MoEMR)	For the present, it is responsible for groundwater management and for energy policy and programs. Future responsibilities for groundwater management—as per Water Law No. 17/2019—are yet to be determined.[216] Centre for Groundwater and Environmental Geology, Geological Agency: Responsible for groundwater management and monitoring, both with regard to quantity and quality; licensing of groundwater drilling and use (minor abstractions can be licensed by local authorities); maintaining of databases of groundwater use; and so on. Directorate General of Electricity: Oversees the PLN, which is tasked with power generation and distribution. Directorate General of New, Renewable Energy and Energy Conservation: Responsible for hydropower development. About 35 hydroelectric dams and pumped storage facilities are currently operated by PLN, independent operators, and water agencies.
Ministry of Agriculture (MoA)	Responsible for food production, farmer welfare, sustainable agriculture, and economic development through agriculture. MoA cooperates with MoPWH on irrigation—a relationship that has strengthened over the last decade. MoA provides extension services and other assistance to farmers, including on irrigation and on-farm water management and acts in an advisory role to farmer associations and agribusiness. MoA is a partner in many irrigation projects implemented by MoPWH and by local authorities.
Ministry of Environment and Forestry (MoEF)	MoEF combines three key functions that affect the water sector: (a) is responsible for managing catchments, which are key to the water cycle and to water risk management; (b) plays an important role in the preparation of zoning and spatial plans for forested areas which is again highly relevant to water resources management; and (c) is responsible for the monitoring of water quality and wastewater discharges and for the issuance of permits and enforcement of discharge standards (mainly for industrial and estate discharges). MoEF is also responsible for environmental impact assessment of major projects.
Ministry of Home Affairs (Interior Ministry) (MoHA)	Responsible for the domestic governance, public order, and regional development at provincial and district levels. This includes decentralizing policies and laws and local autonomy and increasing community empowerment and poverty reduction. According to the RPJMN 2020–2024, MoHA is responsible for ensuring synchronization of RPJMN and RPJMD and other local governments' budgeting and planning document, for monitoring the implementation of RPJMD.
Coordinating Ministry for Maritime Affairs and Investment (CMMAI)	The Deputy for coordination of environmental and forestry management has the task of coordinating and synchronizing the formulation, determination, and control of the implementation of Ministry/ Agency related policies related to the field of environmental and forestry management including watershed and natural resources conservation.
Ministry of Transport	Responsible for transport facilities, infrastructure, community access, and quality of service. This includes navigation on rivers and lakes.
Central Bureau of Statistics	A non-departmental government responsible for the provision of basic statistical data, both for the government at all levels and for the general public.
Ministry of Agrarian Affairs and Spatial Planning (MoASP)	Responsible for formulation of land policies and spatial policies and for land mapping, land titles, and rights over land.
Ministry of Marine Affairs and Fisheries (MoMAF)	Responsible for increasing the contribution of the marine and fisheries sector, including aquaculture, to national economic growth.
Ministry of Health (MoH)	Responsible for the protection and improvement of public health. The ministry sets standards and monitors drinking water quality.
Ministry of State-Owned Enterprises (MoSOE)	Responsible for state laws and regulations in relation to the Limited Liability Companies Act and for monitoring and improving the competitiveness of SOEs, including SOE Jasa Tirta.

Source: Adjusted from ADB 2016a.

216 With the promulgation of the new 2019 Water Law, there is legal uncertainty who is responsible for groundwater. This has to be clarified in subsequent regulations. See section on 'legal framework'.

Annex 3. Participants List of Focus Group Discussion

No	Name	Institution
1	A Muh Ilhamsyah	Directorate General of Water Resources, Ministry of Public Works and Housing (MPWH)
2	Abdul Malik Sadat	Directorate of Water Resources and Irrigation, Ministry of National Development Planning (BAPPENAS)
3	Abedalrazq F. Khalil	World Bank
4	Aditya Putra	Municipality of Water Resources - DKI Jakarta Province
5	Agus Prabowo	United Nations Development Programme (UNDP) Indonesia
6	Agus Sunara	the Association of Indonesian Water Supply Companies (PERPAMSI)
7	Agustin Peranginangin	Borobudur Authority Board, Ministry of Tourism and Creative Economy
8	Ahmad Taufiq, PhD	Experimental Station for Ground water, Directorate of Ground Water and Raw Water, Ministry of Public Works and Housing (MPWH)
9	Akhmad Andayani	Water User Association Federation (WUAF/IP3A) Jurang Sate and Jurang Batu
10	Andy	O&M Division, BBWS Citarum
11	Angela Sari Ulina Barus	Directorate of Ground Water and Raw Water, Ministry of Public Works and Housing (MPWH)
12	Anggi Pertiwi Putri	Directorate of Environmental, Ministry of National Development Planning (BAPPENAS)
13	Anom	Region IV, PJT II
14	Anton Mardiyanto	O&M Division, PJT II
15	Aozora Insan Kamil	Directorate of Water Resources and Irrigation, Ministry of National Development Planning (BAPPENAS)
16	Arlen	Directorate of Environmental, Ministry of National Development Planning (BAPPENAS)
17	Ary Setyorini	Directorate of System and Strategy of Water Resources Management, Ministry of Public Works and Housing (MPWH)
18	Basja Jantowski	Alliance for Water Stewardship Indonesia
19	Bella Nathania	Indonesian Center for Environmental Law (ICEL)
20	Beria Leimona	World Agroforestry (ICRAF)
21	Budi Joko Purnomo	Centre for Ground Water and Geological Environment , Agency of Geology, Ministry of Energy and Mineral Resources (MoEMR)
22	Candra Samekto	International Fund for Agriculture Development (IFAD)
23	Catur Wiweko	NMC (National Management Consultant) Pamsimas
24	Cécile Laborderie	Stiching Nederlandse Vrijwilligers (SNV)
25	Chaikal Amrullah	Directorate of Water Resources and Irrigation, Ministry of National Development Planning (BAPPENAS)
26	Chrisandini	World Wildlife Fund (WWF) Indonesia
27	Cici	Municipality of Environment - Bandung City

28	Desy	Municipality of Environment - West Java Province
29	Devyanda Putri	Directorate of Environmental, Ministry of National Development Planning (BAPPENAS)
30	Didi AS	Municipality of Environment - West Java Province
31	Don Johston	Water.org
32	Dr.rer.nat. Thomas Triadi Putranto, ST, M.Eng	Engineering Faculty, University of Diponegoro (UNDIP)/ Hydrogeologist
33	Dulsalim	Water User Farmers Association (WUFA/P3A) Mulya Tirta - Karawang
34	Dyah Paramita	Center for Regulation, Policy and Governance (CRPG)
35	Endah Shofiani	US Agency for International Development (USAID) Indonesia
36	Eric Quincieu	Asian Development Bank (ADB)
37	Etty Riani (Professor)	Aquatic Resources Management Department, Faculty of Fisheries and Marine Science, Insitute of Agriculture - Bogor (IPB)
38	Fany Wedahuditama	Water Global Partnership, South East Asia
39	Firman Kusuma	Danone
40	Gracia Plenita Agnindhira	Alliance for Water Stewardship Indonesia
41	Grita Anindarini	Indonesian Center for Environmental Law (ICEL)
42	Habibie	Water User Farmers Association (WUFA/P3A) Sanrego, Bone Regency, South Sulawesi Province
43	Handoko	Municipality of Environment - East Java Province
44	Helmi	Water User Farmers Association (WUFA/P3A) Bakulan, Purbalingga Regency, Central Java Province
45	Hendarmawan (Prof)	Vice Rector of Research and Innovation, University of Padjajaran/ Ground Water Expert Association Indonesia
46	Hera	Municipality of Environment - Bandung City
47	Herry Widjanarko	World Bank
48	Heru Hendrayana, DR.Ir.	Geological Engineering, Faculty of Engineering, University of Gadjah Mada (UGM)
49	Idham Effendi	Centre for Ground Water and Geological Environment , Agency of Geology, Ministry of Energy and Mineral Resources (MoEMR)
50	Iin Warsinta	Water User Farmers Association (WUFA/ P3A) Tirta Tani
51	Ikhsan	Directorate of Water Resources and Irrigation, Ministry of National Development Planning (BAPPENAS)
52	Ikhwan Jaelani	Makna
53	Ilham Abla	World Bank
54	Indratmo Soekarno	Faculty of Civil and Environmental Engineering, Institute of Technology Bandung (ITB)
55	Irfan Sudono	Directorate for Technical Development of Water Resources, Ministry of Public Works and Housing (MPWH)
56	Irwan Iskandar	Faculty of Mining and Petroleum Engineering, Institute of Technology Bandung (ITB) / Ground Water Expert Association Indonesia
57	Isniatul W	Directorate of Forestry and Water Resources Conservation, Ministry of National Development Planning (BAPPENAS)
58	Jamaluddin Toro	Water User Association Federation (WUAF/IP3A) Pamukkulu Sejahtera , Takalar Regency, South Sulawesi Province
59	Jennifer M Gulland	World Bank
60	Kamelia Octaviani	World Bank
61	Kirana Rahmi	Indonesian Center for Environmental Law (ICEL)
62	Lambok Hutasoit (Prof)	Faculty of Eearth Sciences and Technology, Institute of Technology Bandung (ITB) / Ground Water Expert Association Indonesia
63	Laode Bakti	Directorate of System and Strategy of Water Resources Management, Ministry of Public Works and Housing (MPWH)
64	Laurens Trebes	Urban Ponics
65	Leo	Division of Grond Water Planning, Municipality of Public Works, Settlements, Mineral Water Resources - DI Yogyakarta Province
66	Leo Sembiring	Directorate of River and Coastal, Ministry of Public Works and Housing (MPWH)
67	Lieselotte Heederik	Nazava Water Filters
68	Lintang Hariwati	Municipality of Environment- East Java Province
69	Lita Endang	Municipality of Environment - Bandung City
70	Micahel P Rossou	Curran Rosschou Venture Capital I Pendiri dan CSO @Silicon Valley Int.
71	Mira Fajar Aviatri	Jakarta Resilient Cities

72	Mohamad Fadli	Pacific Disaster Center
73	Mohamad Mova Al'afghani	World Bank
74	Monika Kristyana	Japan International Cooperation Agency (JICA) Indonesia
75	Muhamad Nafi A	Directorate of Forestry and Water Resources Conservation, Ministry of National Development Planning (BAPPENAS)
76	Muhammad Hasbi Azis	Parliament/ the House of Representatives Indonesia (DPR) – Commission V (Communications, Telecommunications, Public Works, Public Housing Affairs, Acceleration of Development of Disadvantaged Regions, Meteorology and Geophysics)
77	Muhshonati Syahidah	Experimental Station for Ground water, Directorate of Ground Water and Raw Water, Ministry of Public Works and Housing (MPWH)
78	MURSALIN TUWO	Water User Association Federation (WUAF/IP3A) Tabo-Tabo, Pangkep Regency, South Sulawesi Province
79	Nanda	Municipality of Environment, West Java Province
80	Nadia Astriani PhD	Taskforce - Citarum Harum
81	Nato Tapen	Organic Farmer - Banjarnegara Regency, Central Java Province
82	Nia Yuniarti	World Bank
83	Nila Ardhianie	Amrta Institute
84	Nita Kartika	Directorate of Forestry and Water Resources Conservation, Ministry of National Development Planning (BAPPENAS)
85	Nita Yuliati	Directorate of Irrigation and Lowlands, Ministry of Public Works and Housing (MPWH)
86	Noor Rachmaniah	Directorate of Water Pollution Control, Ministry of Environment and Forestry (MoEF)
87	Nurashila	Municipality of Environment - West Java Province
88	Okta	Municipality of Water Resources - DKI Jakarta Province
89	Onny Trijunianto	World Bank
90	Paksi Yudha Sasmita	MUSA Green
91	Perencanaan Teknis Dit Sungai	Directorate of River and Coastal, Ministry of Public Works and Housing (MPWH)
92	Prawoto	Farmer Group, Kasilib Village, Wanadadi, Banjarnegara Regency
93	Purba Robert M Sianipar	National Water Resources Council (NWC)
94	Qisthi Almaydea	Municipality of Environmental – East Java Province
95	Rachmad Hidayad	Water.org
96	Rachmat Hidayat	National Water Resources Council (NWC)
97	Rangga	Municipality of Environment - Bandung City
98	Ristia	Municipality of Environment - West Java Province
99	Saut Sagala, Ph.D.	School of Architecture, Planning, and Policy Development; Institute of Technology Bandung (ITB)
100	Solistiana Bintang	Directorate of System and Strategy of Water Resources Management, Ministry of Public Works and Housing (MPWH)
101	Syaiful	Municipality of Environment - East Java Province
102	Tarasinta Perwitasari	World Bank
103	Tommy	University of Brawijaya (UNBRAW)
104	Trigeany Linggoatmodjo	US Agency for International Development (USAID) Indonesia
105	Udien Yulianto	Perum Jasa Tirta (PJT) II
106	Wayan Tambun	Food and Agriculture Organization (FAO)
107	Winda Diana	Directorate of Water Resources and Irrigation, Ministry of National Development Planning (BAPPENAS)
108	Wulan Seizarwati	Experimental Station for Ground water, Directorate of Ground Water and Raw Water, Ministry of Public Works and Housing (MPWH)
109	Yatimin	Water User Farmers Association (WUFA/P3A) Margo Harjo, Banyuurip Sub District, Purworejo Regency, Central Java Province

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