Organisation for Economic Co-operation and Development

ENV/WKP(2021)3

Unclassified

English - Or. English

23 March 2021

ENVIRONMENT DIRECTORATE

FINANCING WATER SECURITY FOR SUSTAINABLE GROWTH IN THE ASIA-PACIFIC REGION - ENVIRONMENT WORKING PAPER No. 171

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Authorised for publication by Rodolfo Lacy, Director, Environment Directorate.

Keywords: water security, water supply, sanitation, wastewater, flood protection, irrigation, infrastructure finance, Asia, Pacific

JEL Classification: H23, H41, H54, L95, L98, Q25, Q53, Q54, Q58.

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JT03473347

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Abstract

The Asia Water Development Outlook – a flagship publication by the Asian Development Bank - monitors progress in water security in the Asia Pacific region. For the first time, the 2020 edition documents financing flows that contribute to – or that are needed to enhance – water security in the region.

Working in close collaboration with the Asian Development Bank and partners, the OECD endeavoured to characterise funding needs and financing flows for water security in the region. The approach and methodology derive from a similar endeavour covering the European region, but were adjusted to reflect the distinctive features of the region, in terms of the state of play, policy, and data availability.

This paper compiles available data and analyses, and derives policy messages, for countries in the region and their partners (including development finance institutions). It characterises an enabling environment that can facilitate and expedite financing for water security commensurate with the challenges and distinctive opportunities in the region.

Keywords: water security, water supply, sanitation, wastewater, flood protection, irrigation, infrastructure finance, Asia, Pacific

JEL Classification: H23, H41, H54, L95, L98, Q25, Q53, Q54, Q58

Résumé

Le rapport Perspectives pour le développement de l'eau en Asie - une publication phare de la Banque Asiatique de Développement - mesure les progrès réalisés dans la région Asie Pacifique dans le domaine de la gestion des risques liés à l'eau. Pour la première fois, l'édition de 2020 rend compte des flux financiers qui contribuent à – ou qui sont nécessaires pour – la gestion de ces risques.

Travaillant en étroite collaboration avec la Banque Asiatique de Développement et ses partenaires, l'OCDE a essayé de caractériser les flux et les besoins de financement pour la gestion des risques liés à l'eau dans la région. La méthode s'inspire d'une initiative similaire mise en œuvre en Europe, qui a été adaptée pour tenir compte des caractéristiques de la région Asie Pacifique relatives à l'état des lieux, aux politiques publiques et aux données disponibles.

Ce document présente les données, les analyses et les recommandations en matière de politiques publiques, destinées aux gouvernements des pays de la région et à leurs partenaires (notamment les institutions d'aide publique au développement). Il esquisse les éléments d'un environnement politique et institutionnel qui peut encourager et accélérer les financements dans le domaine de l'eau, à la mesure des défis et des opportunités qui existent dans la région.

Mots clé : risques liés à l'eau, approvisionnement en eau, eaux usées, collecte et traitement, protection contre les inondations, irrigation, financement des infrastructures, Asie, Pacifique

Classification JEL : H23, H41, H54, L95, L98, Q25, Q53, Q54, Q58

Acknowledgements

The paper was drafted by Hannah Leckie (policy analyst) and Harry Smythe (data and research analyst), under the supervision of Xavier Leflaive (Team leader, Resilience – Adaptation – Water), OECD Environment Directorate, Climate, Biodiversity and Water Division. Earlier drafts benefitted from contributions and comments from Kathleen Dominique and Stephanie Lyons (policy analysts, OECD Environment Directorate). Policy messages benefitted from discussions at the regional meeting of the Roundtable on Financing Water, co-convened by the Asian Development Bank (ADB) in November 2019 (more information is available at here). Ines Reale managed the process seamlessly.

The authors are most grateful to the ADB for invaluable support throughout the process, most notably Silvia Cardascia, Coral P. Fernandez Illescas, and Pia Corrina Romero Reyes. Thomas Panella, Chief of Water Sector Group, ADB, has been a most supportive and patient partner from the outset. Other ADB colleagues provided valuable comments on method, data and policy messages at dedicated technical workshops. Eelco van Beek facilitated coordination and alignment with the various dimensions of the Asia Water Development Outlook.

The OECD is grateful to the ADB for its financial support, which made these analyses possible. The OECD is also grateful to the Ministry of Environment of Korea, for financial support of related research.

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Executive summary

The Asia Water Development Outlook, spearheaded by the Asian Development Bank, monitors progress in - and issues affecting - water security in Asia. Its recurrent publication helps increasingly to fine-tune assessments and develop monitoring capacity. For the first time, the 2020 edition attempts to document financing flows that contribute to – or that are needed to enhance – water security in the Asia Pacific region.

Working in close collaboration with the Asian Development Bank and experts involved in drafting the Asia Water Development Outlook, the OECD endeavoured to characterise funding needs and financing flows for water security in the region. The approach and methodology derive from a similar endeavour covering the European region, but were adjusted to reflect the distinctive features of the region, in terms of the state of play, policy, and data availability. This paper compiles available data, information and analyses, and derives policy messages, for countries in the region and their partners.

Consistency with other Key Dimensions of the Asia Water Development Outlook has been checked, and no major discrepancy was identified. However, full consistency was difficult to assess, as coverage and definitions can differ, essentially driven by (lack of) data availability.

Two difficulties that relate to policy and data

Tracking and projecting financing flows for water security in Asia is compounded by two difficulties.

First, countries in the region lack a common ambition for water security or water management more generally. The SDGs – in particular SDG 6 – set a 2030 horizon for action at national level. However, they remain generic, and do not contribute to coordination of national responses to water-related risks. In comparison, European countries benefit from common objectives, tailored to the situation in the region, captured by a set of regulations and supported by cooperation at regional level. While such a level of coordination may be challenging in the vast and diverse Asia Pacific region, further coordination could be considered through the thematic regional platforms in place (the Asia Pacific Water Forum, the Asia Water Council) or regional political fora (e.g. APEC, already active on related issues, such as food security); sub-regional coordination also seems most appropriate.

Second, data on water-related financing flows and needs is essentially lacking. Of particular significance, financing flows for agricultural water (irrigation extension and efficiency) are not documented. Additional coordinated efforts to monitor financing flows at (sub-)regional level would provide invaluable support to policy making and to the design of financial mechanism that are up to the challenge and tailored to regional and country needs. Regional financial institutions have a role to play, at least to compile information on the projects and financing mechanisms they contribute to.

With these caveats, the paper delivers data and analyses that countries and partners can build upon to finance water security in Asia and the Pacific. It should be read in combination with other Key Dimensions of the Asia Water Development Outlook (in particular KD2), which confirm that the economic case for investment in water security is solid and well documented in the region.

Known and unknown drivers for financing needs for water security in Asia

Many drivers of water-related expenditures are well known. These include: demographics and urbanisation (1 billion additional city dwellers will need to be connected to water services in the next 30 years); operation, maintenance and renewal of (expanding) assets; compliance with international commitments and national regulations; people, assets and GDP exposed to flood risks (30 million more people will be exposed to flood risks between 2010 and 2030); food security and global markets for agriculture (the area under irrigation in Asia is projected to expand by 22% between 2010 and 2050; by 30% in South Asia); and adaptation to a changing climate (which generates uncertainty on future water demand and availability).

In addition, the region is facing a number of emerging issues, which will drive expenditure needs further. These include: the improvement of individual and other appropriate sanitation systems (IAS), which should deliver water policy objectives; the need to address problems associated with combined water drainage and sewerage systems and risks of overflows (CSOs); urbanisation, the extension of impervious surfaces and changes in precipitation patterns; contaminants of emerging concern (CECs); and sludge management, as more wastewater is collected and treated.

What we know about financing needs and capacities for water security in Asia

Projections indicate that most countries in the region will need to allocate between 1 and 2% of GDP on water supply and sanitation infrastructure over the period 2015-2030. Irrigation investment needs could vary between 0.05 to 0.25% of annual GDP between 2015 and 2030, depending on scenarios and the sub-regions.

In the few countries where data is available, governments - and in places international donors - are the main sources of funding for water supply and sanitation. Households only contribute significantly in a few countries in Central Asia (Azerbaijan, Kyrgyz Republic), South Asia (Bangladesh, Nepal, Pakistan) and some small states (Solomon Islands). This reflects either an effort to cover costs through revenue from water bills (in Bangladesh) or the paucity of public budgets allocated to water supply and sanitation (WSS).

Affordability of water bills is an issue in several countries, including in urban environments. Based on (sparse) available data, Bangladesh, Indonesia, Mongolia, Myanmar, the Philippines, or Viet Nam face high affordability constraints, with annual tariffs in select cities representing more than 10% of the annual income of the middle quintile household. Conversely, there may be room for manoeuvre to increase water supply and sanitation tariffs in a number of countries, such as Armenia, Bhutan, Kazakhstan, Malaysia or Tajikistan.

Policy options to bridge financing gap for water security in Asia

The magnitude of capital investment needs and operating and maintenance costs for WSS services, flood protection and irrigation infrastructure calls for a shift in the way the sector is currently operated, regulated and financed. Countries in the region would benefit from more systematically exploring a combination of policy options, tailored to national and local circumstances.

First, there is room to make better use of existing assets. Improving the operational efficiency and effectiveness of existing infrastructure and service providers contributes to better services for the population, the economy and the environment. This can enhance the willingness to pay of beneficiaries and postpone the need for additional investments to rebuild decaying assets. Operational efficiency can take different forms. In the case of water supply and sanitation, it may combine appropriate – potentially non-conventional - technical choices, agglomerating utilities at the right scale, or considering other appropriate sanitation systems (IAS) in the context of national strategies for water supply and sanitation

services. Economic regulation has a central role to play, in monitoring and incentivising operational efficiency.

Second, the efficiency of public expenditure programmes is a major driver of financing needs and capacities, now and in the future. Planning is critical. Robust planning can increase the coherence of water development with changes in related sectors (most importantly urban development; land use and forestry; agriculture expansion and modernisation). It builds on robust projections for demographics and urbanisation; food security and diets; climate change. It considers optimal sequencing of individual projects along investment pathways, preferably at basin, landscape or catchment levels, to exploit synergies across projects.

Plans that drive decisions should be backed by realistic financing strategies. And financing strategies can benefit from output-based budgeting, or performance-based contracts, to promote investments that contribute to policy objectives. (Regional) international financing institutions and public institutions can promote such mechanisms.

Prevention of (or at a minimal planning and mitigating) future liabilities can significantly minimise future financing needs. For instance, managing water demand and strengthening water allocation regimes can go a long way in mitigating scarcity risks, postponing the need to augment water supply through costly investments. Similarly, flood risk mapping and land-use planning can be cost-effective ways to reduce exposure to flooding. Nature-based solutions can be more systematically explored in the region, as they may be able to adjust to shifting circumstances and generate multiple co-benefits.

Third, the capacity to harness private sources of finance is essential, an area where few emerging economies and developing countries in the region have experience. Private investment is concentrated in only a few of Asia's lower-risk economies (China, India, Malaysia, the Philippines), as a result of efforts to encourage private investment in infrastructures and financiers' appetite to invest in more established economies.

Most countries in the region have the capacity to leverage existing public funding, including through increased user and beneficiary contributions. For instance, land value capture mechanisms can be designed so that property developers finance water security investments that add value to their properties. Similarly, greater user contributions towards the cost of irrigation infrastructure and the value of water can generate revenue and incentivise water use efficiency.

Data from the OECD Creditor Reporting System signals that official development assistance remains a low share of investment in water infrastructure and may not be targeting those countries most in need: India and Indonesia received considerable amounts of ODA for the water sector in comparison to other countries in the region, which may be less able to rely on domestic sources of finance. There is room to improve the allocation of ODA across countries – with a focus on poor, risky countries where private capital will not go – and sectors or projects – with a priority for the ones that have no associated revenue stream. There is room to use ODA strategically to crowd in domestic commercial capital. The region already witnesses pioneer developments in the combination of development and other sources of finance. Lessons wil be learned, to replicate and scale up what works well.

1 Introduction

1.1. Background

In 2020, the OECD and the ADB signed a knowledge partnership agreement for the purpose of supporting the 2020 edition of the Asia Water Development Outlook. Both institutions agreed to jointly work on two dedicated chapters of the Asia Water Development Outlook, one on governance, and one on financing.

The AWDO is a flagship publication of ADB aimed at highlighting important water management issues in the Asia-Pacific region. The first edition was published in 2007, which underlined the need to address water security with a broader perspective than traditional sector-focused approaches. It highlighted governance as a major factor that has constrained efforts to increase water security in Asia and the Pacific. The second edition released in 2013 provided the first quantitative comprehensive assessment of water security in the countries of Asia and the Pacific. It developed a water security framework based on five key dimensions (KD). The third edition released in 2016 further refined the KD indicators and associated methodologies for assessing water security. The fourth edition is planned for release in 2020. It will refine the analytical framework and associated indicators to provide more detailed analysis and greater confidence in water security assessments. This edition will also introduce dedicated chapters on water governance and water financing, both being important factors for achieving water security.

This paper reflects the analyses and recommendations developed by the OECD in the context of the partnership agreement. It will inform the 4th edition of the AWDO, in particular the dedicated chapter on financing water security. The paper is intended to be released as a Working Paper.

1.2. Scope

Financing water security is rising on the political agenda as population growth and climate change intensify scarcity, floods, shocks and access inequalities. Meeting the water-related sustainable development goals will require institutional and technological innovations to supply, allocate, and manage water, as well as a substantial and sustained financial commitment to address those who may be left behind. This reinforces the need to rethink typical water financing approaches.

For the first time, the 2020 AWDO includes a specific chapter on financing water. This paper assesses challenges and opportunities related to financing investments that contribute to water security and sustainable growth in the Asia-Pacific region. The analysis covers the following three water-related sub-sectors:

- Access to water supply and sanitation
- Flood protection (riverine and coastal)
- Irrigation infrastructure (for both efficiency upgrades and expansion).

The Asia Water Development Outlook (in particular Key Dimension 2, on economic water security) demonstrates that there is a compelling economic case for investment in water. Water risks affect not only livelihoods and ecosystems, but also the economy. When water risks are not adequately managed,

economic impacts are significant. In terms of monetary costs, weather-related disasters have amounted to USD 750 billion losses from 2003 to 2013 in the region, with Myanmar, the Philippines, Bangladesh, Viet Nam, and Thailand among the most affected (UNEP, 2015). Water management and related infrastructure have been crucial for economic growth, food and energy security, resilience to climate change, and social wellbeing. Harnessing water's productive potential and mitigating water-related risks remain key priorities to achieve and maintain sustainable and inclusive growth in the Asia-Pacific.

This paper analyses investment needs and financing capacities to the extent possible in light of available data. It outlines policy options and institutional arrangements that can scale-up the effective and efficient financing of water-related investments that contribute to sustainable growth. A full explanation of the methodologies used in this paper is presented as Annex A.

2 Investment needs

2.1. Water supply and sanitation

According to recent assessments by the WHO and UNICEF Joint Monitoring Programme (JMP 2019), access levels to safely managed water supply and sanitation services vary considerably in the Asia-Pacific region. This is reflected in investment needs for water supply and sanitation infrastructure.

Drivers of investment needs in water supply and sanitation include:

- Maintaining current, and achieving universal access to, safe water supply and sanitation services for a growing and urbanising population. Sixty percent of the world's population lives in Asia (4.5 billion), which is projected to grow to more than 5 billion by 2050 (UN DESA, 2017). Of that population, 50% currently reside in urban areas. By 2050, the share of the population living in urban areas is projected to reach 66% (UN DESA, 2018). This translates into the need to connect 1,050 million additional city dwellers in 30 years.
- Maintaining and replacing ageing infrastructure assets, including additional investments required to reach an acceptable standard of operational efficiency (e.g. minimising non-revenue water).
- Achieving compliance with increasingly stringent national and local regulations related to urban wastewater treatment, ambient water quality and wastewater reuse.
- Adapting to climate change, including the potential need for additional water supply augmentation and storage (e.g. wastewater reuse, desalination, dams, managed aquifer recharge), and increased capacity to collect and treat stormwater, as well as the need to protect or strengthen existing water infrastructure to increase resilience to climate-related disasters.

The total annual estimated investment needs required over the period 2015-30 to achieve universal access to safely managed water supply and sanitation services in the Asia Pacific region amount to USD 198 bn/yr. This includes capital, maintenance and operation costs. The estimate, based on World Bank figures, is derived from the gap in access to services as of 2015 (and the cost of connecting those without access), as well as improving the level of service for those with access to reach SDG 6.1 and 6.2 targets[1]. The estimate of investment needs is higher than that of other similar studies (Table 1), which do not make this SDG 6 assumption of first connecting populations to a basic water supply and sanitation connection, before then giving populations a high quality, more safely managed connection. For more details on the methodology, please refer to Annex A.

[1] Sustainable Development Goal (SDG) 6.1: By 2030, achieve universal and equitable access to safe and affordable drinking water for all. SDG 6.2: By 2030, achieve access to adequate and equitable sanitation [and hygiene] for all and end open defecation, paying special attention to the needs of women and girls and those in vulnerable situations.

Table 2.1. Comparison of total expenditure needs in WSS infrastructure in the Asia-Pacific region

Annual average total expenditure need, 2015-2030, USD billions (2015 prices)

AWDO 2020 (this study)	UNESCAP 2019	ADB 2019	Hutton and Varughese 2016
198	70	53	51

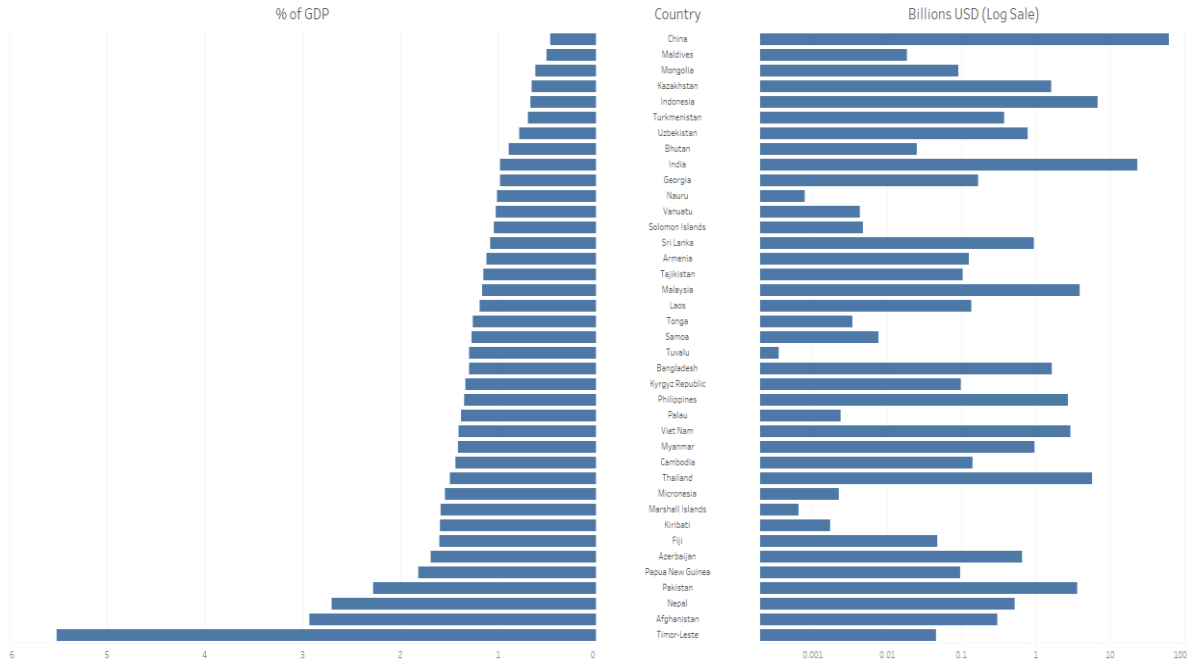
Note: The AWDO 2020 projection is based on the World Bank Paper written by Rozenberg and Fay et al. (2019) using the scenario in which countries first connect citizens using to SDG 6 quality connection, and then go back and install a higher quality safely managed connections. The other projections do not make this SDG 6 assumption. The Hutton and Varughese 2016 paper is a projection of capital costs only.

Figure 2.1 presents the total estimated annual expenditure needs (investment gap) required over the period 2015-30 to achieve universal access to safely managed water supply and sanitation services for countries in the Asia Pacific region. The drivers of cost to delivery services are based on World Bank calculations at national level and include: labour costs, cost of materials and public spending efficiency, and the prevalence of corruption. China (USD 60bn/yr) and India (USD 22bn/yr) have the highest annual investment needs in water supply and sanitation due to the sheer size of their populations. Achieving universal access to safe water supply and sanitation services will require much more than a one-off injection of capital; operations and maintenance of existing and new-built assets represent a significant share of total expenditure needs.

Figure 2.1 illustrates that with the exception of a few notable outliers (Timor Leste, Afghanistan, Nepal, Pakistan), most countries will need to allocate between 1 and 2% of GDP to invest in water supply and sanitation infrastructure over the period 2015-2030 (based on extrapolations of growth forecasts).

Figure 2.1. Projected annual expenditure needs for WSS 2015-30

% of GDP - Billions USD / year

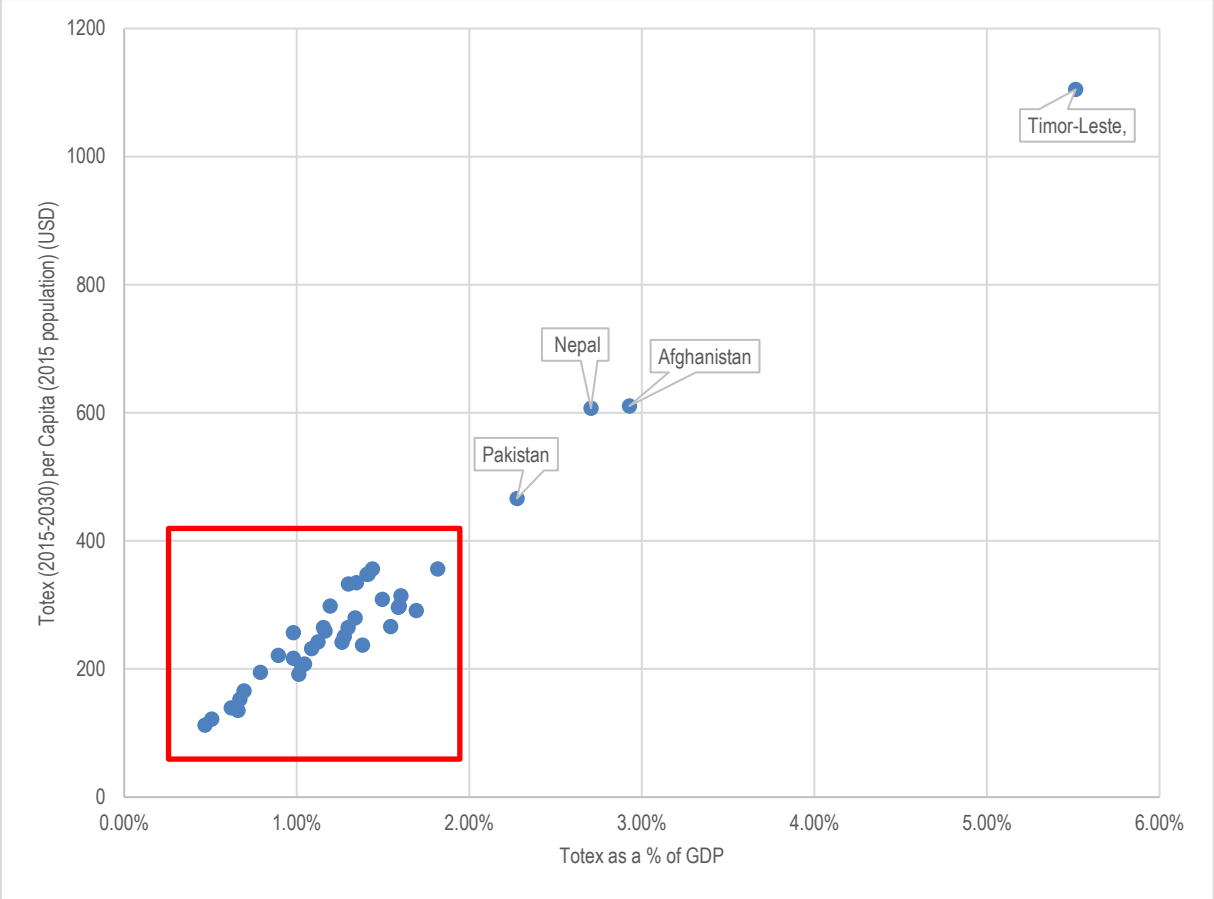


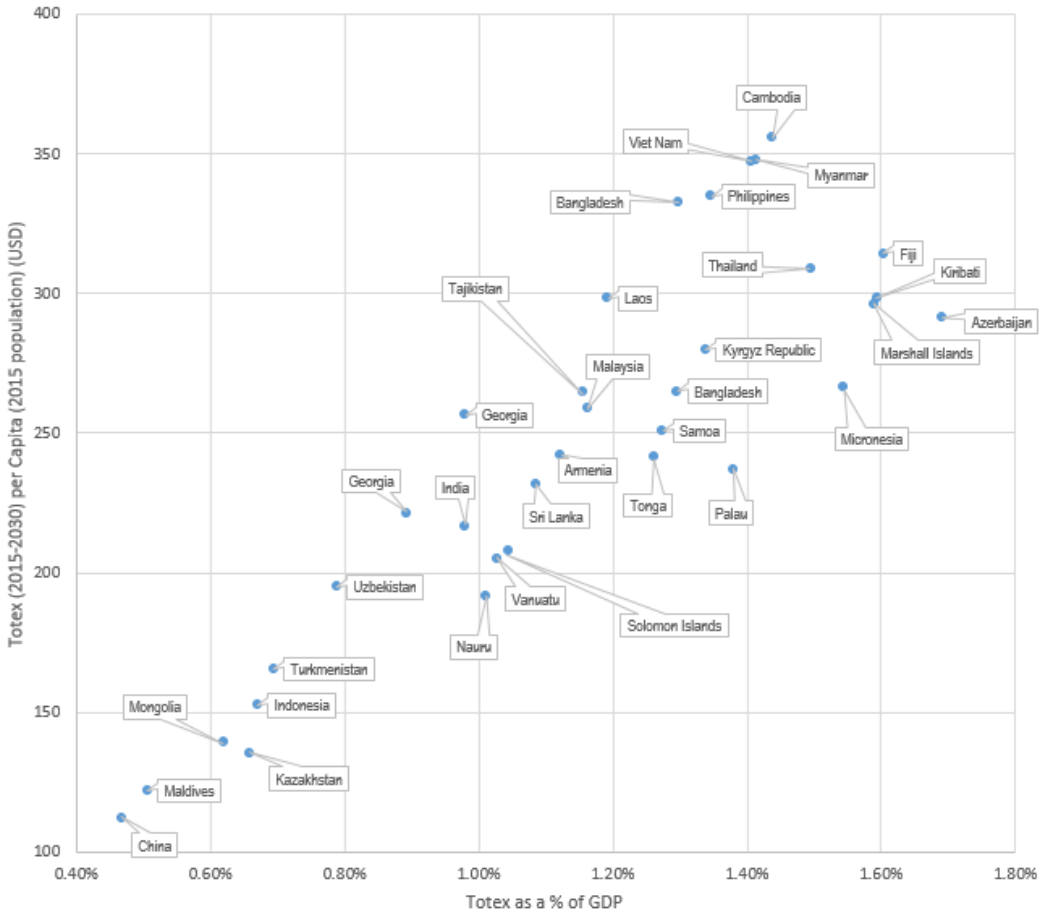
Note: No data for Australia, Singapore, New Zealand, Brunei, South Korea, Japan, Hong Kong (SAR China), Niue, Cook Islands. Scenarios: indirect pathway of basic connection first, and then safe managed connection; SSP2. Calculation for GDP over the period derived from actual GDP in 2015-18, forecast of GDP over the period 2019-24 and extrapolation of average growth rate until 2030.
Source: OECD calculations based on cost of service delivery from Rozenberg and Fay (2019), 2015 dollars. GDP data from IMF.

Figure 2.2 compares countries in the region in terms of the total investment needs to achieve SDGs 6.1 and 6.2 by 2030 as both a share of GDP and per capita. This figure provides insights into the macro-economic affordability of investments in water supply and sanitation. Timor Leste, Afghanistan, Nepal, Pakistan, Cambodia, Myanmar, Viet Nam, the Philippines and Bangladesh all have water supply and sanitation investment needs of greater than USD20 per capita per year. Countries with investment needs constituting a larger share of total GDP can expect to face greater challenges to meet investment needs. Timor Leste, Afghanistan, Nepal and Pakistan all have investment needs of >2% of GDP.

Figure 2.2. Comparative expenditure gap of water supply and sanitation infrastructure required by 2030 to achieve SDGs 6.1 and 6.2

Cost per capita (USD) and as a percentage of GDP





Notes: Please note the different scale of the two graphs. Calculation of GDP same as for Figure 2. Calculation for per capital expenditure required based on 2015 population data. No data for Australia, Singapore, New Zealand, Brunei, South Korea, Japan, Hong Kong (SAR China), Niue, Cook Islands.
Source: OECD calculations based on Rozenberg and Fay (2019).

2.2. Flood protection

Flood damages are expected to increase significantly over the 21st century as sea-level rise, more intense precipitation, extreme weather events, and socioeconomic developments (population and economic growth and urbanisation) result in an increasing number of people, and value of assets at risk, in coastal and riverine floodplains.

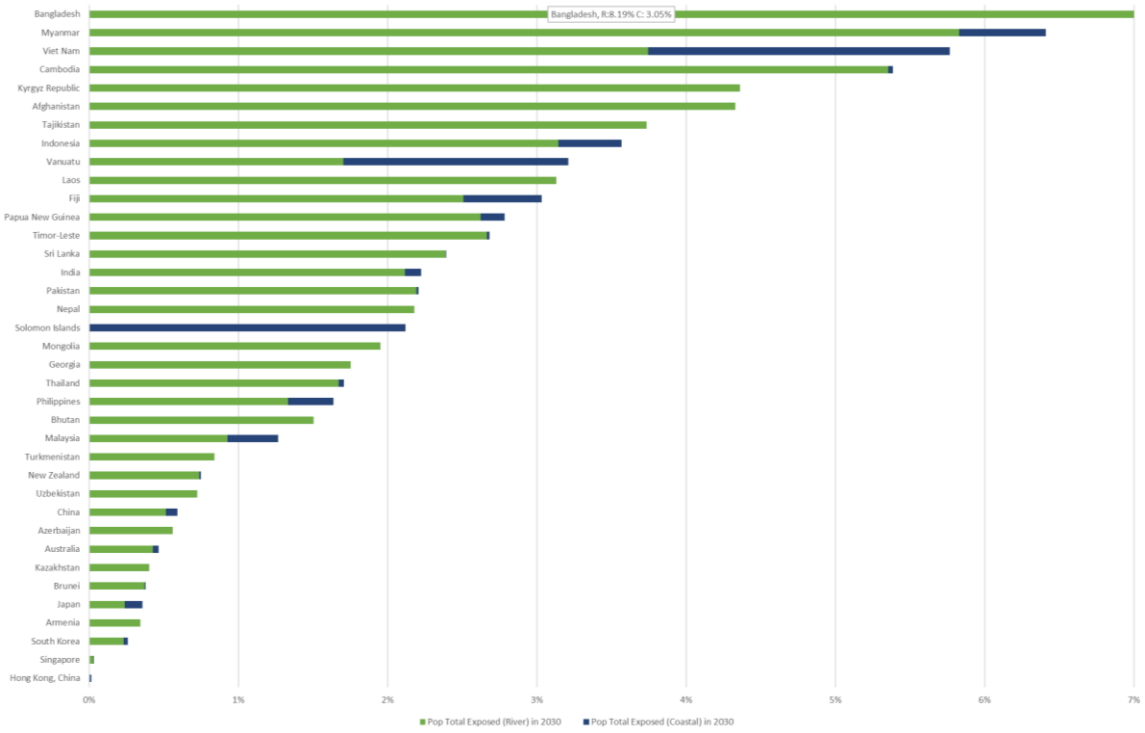
The analysis from the World Resources Institute's Flood Analyser allows the determination of exposed assets, and the current and future projected level of flood risk. Flood projections cover riverine floods and coastal floods, and account for the compounding risk of land subsidence. The key drivers of increasing flood risk are climate change and socio-economic development, namely economic and demographic growth. The impact of these drivers is projected on three variables: the value of assets at risk of flooding, the number of people affected by floods, and the value of GDP affected by floods. This approach results from the paucity of data on baseline expenditures for flood protection.

Population exposure and the need to protect people and economic growth (GDP) are strong drivers of investment in flood protection. Investment costs for protection against flood risks will depend primarily on the level of risk that is acceptable to local populations and the uncertainty pertaining to construction costs. Like water supply and sanitation, the impacts on people and the scale of investment needs in flood

protection are, for the most part, concentrated in low- and middle-income countries. Bangladesh, Myanmar, Viet Nam and Cambodia have the greatest percentage of the population exposed to flood risks; Bangladesh in particular is a hotspot for flood risk in the Asia-Pacific region with over 11% of the population projected to be exposed in 2030 (Figure 2.3).

Figure 2.3. Projected share of the population exposed to flood risk, 2030

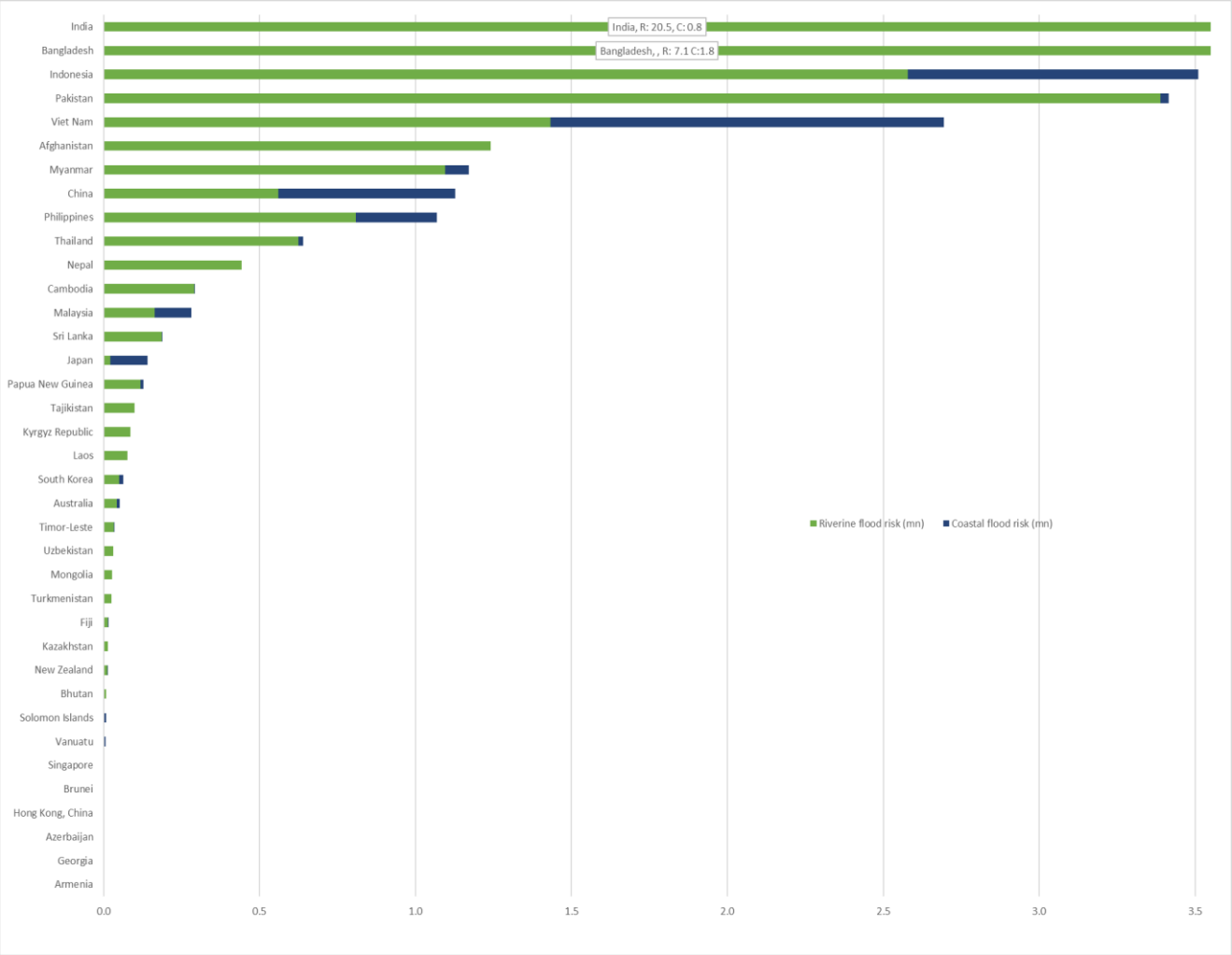
Flood risk as a percentage of the population in 2030



Note: Subsidence included in coastal flooding.
Source: WRI (2020).

Figure 2.4 shows the increase in absolute numbers of people exposed to flood risks between 2010-2030. The greatest increases are in India (over 20 million additional people), Bangladesh (approximately 8 million additional people), and in Indonesia, Pakistan and Viet Nam (each over 3 million additional people).

Figure 2.4. Increase in population exposed to flood risk: 2010-2030 (millions)

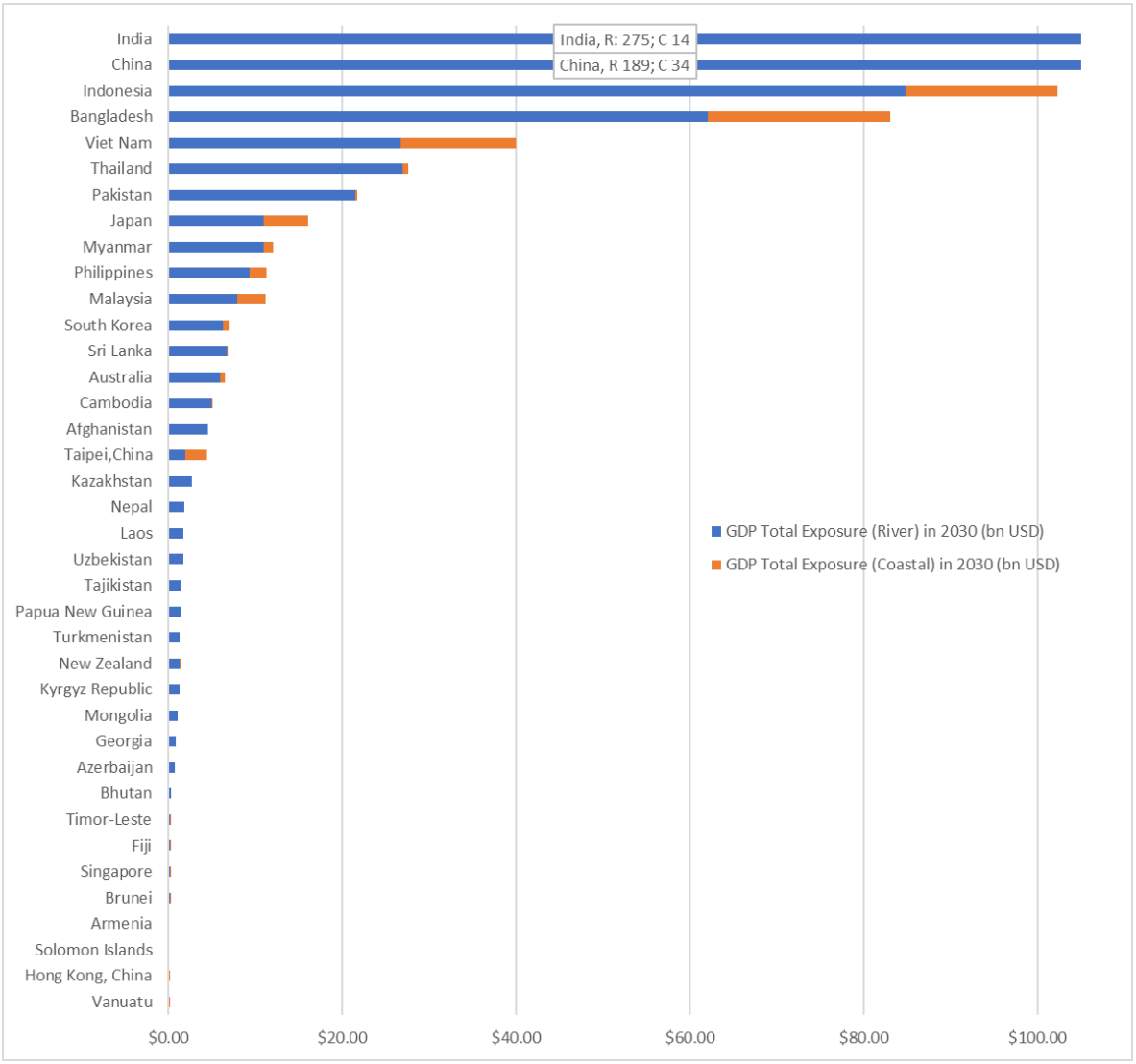


Source: OECD calculations based on WRI (2020).

Figure 2.5 shows the projected flood risk exposure to GDP in 2030, which represents the increase in the value of assets and the number of people exposed, under a business as usual scenario, and includes the effects of land subsidence. The exposure is substantial in some countries, most notably in India (over USD 280 billion), China (USD 220 billion) and Indonesia (over USD 100 billion). Riverine flood risks are a greater risk to the Asian economy than coastal flood risks.

Figure 2.5. Projected flood risk exposure to GDP, 2030

USD billions

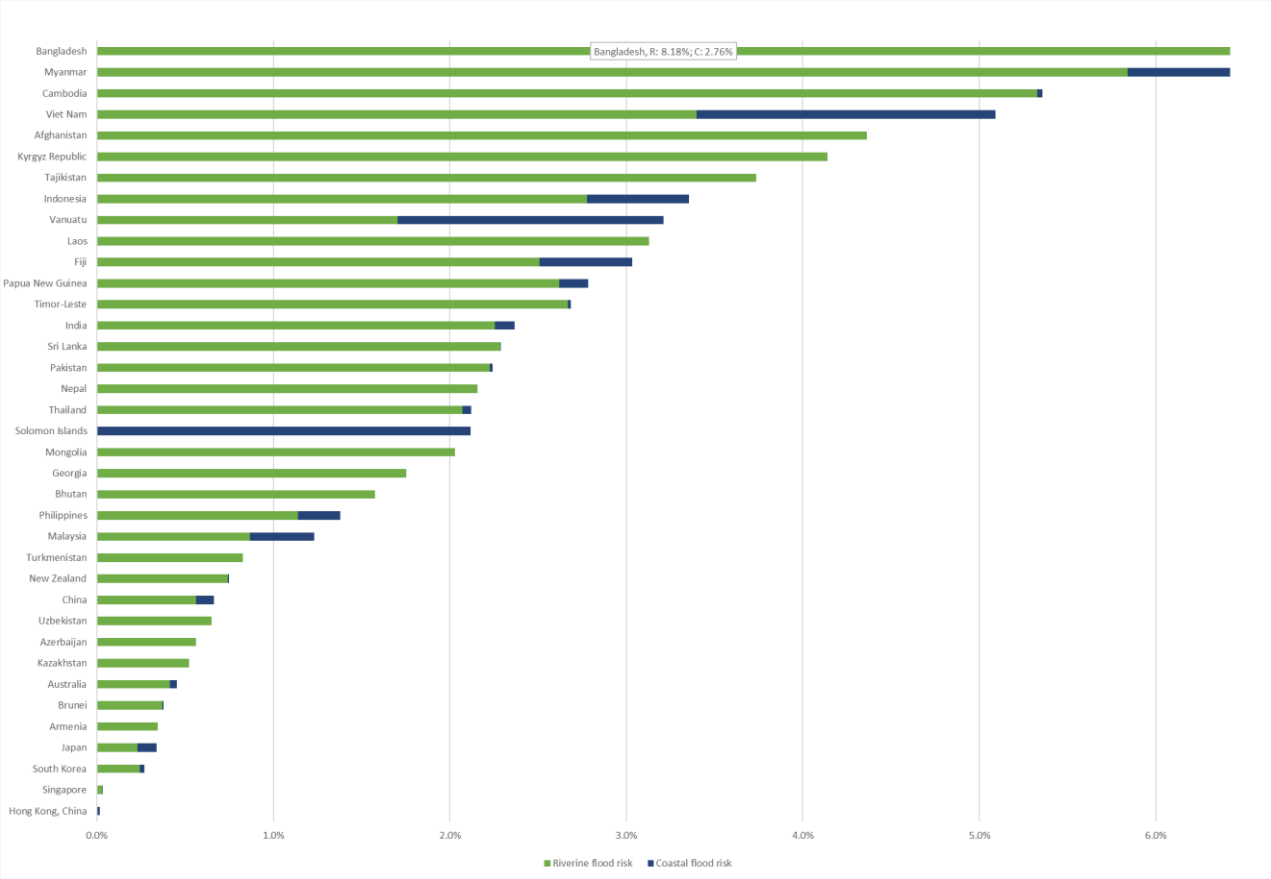


Source: WRI (2020).

This flood risk exposure expressed as a percentage of GDP shows that Bangladesh, Cambodia, Afghanistan, Kyrgyz Republic, Tajikistan and Viet Nam all have flood risks exceeding 6% of GDP in 2030 under a business-as-usual scenario, with land subsidence (Figure 2.6). Coastal flood risks are projected to strongly affect the GDP of the Solomon Islands, Bangladesh, Vanuatu and Viet Nam.

Figure 2.6. Projected flood risk exposure to GDP, 2030

Percentage of GDP



Source: WRI (2020).

2.3. Irrigation

Irrigation plays a key role in Asia's agricultural economy. As food demand increases from a growing population, dietary preferences change and the effects of climate change intensify, so too will the need for irrigation, both in terms of irrigation expansion, and efficiency improvements of existing irrigation infrastructure (ADB, 2017).

The largest expansion in irrigated area globally is projected to be in Asia. Approximately 2.6 million km^2 of agricultural land in Asia is irrigated (about 70% of the world's total irrigated land) (Meier et al., 2018). The largest share of irrigated land is found in South Asia (India and Pakistan) and Eastern Asia (China). Existing projections suggest that the area under irrigation in Asia is set to expand by an additional 570,000 km^2 by 2050, a 22% expansion from 2010 levels (Rosegrant et al., 2017). Irrigation expansion is projected to be particularly high in South Asia (up to 30% increase from 2010 to 2050)[2].

Expansion of irrigation requires investments in water infrastructure such as irrigation technologies, dams, canals, and other conveyance systems. Country-level data is not available on investment needs or current

[2] Of note: this paper does not discuss the potential impacts of irrigation extension on groundwater resources and risks of stranded assets in water tables are depleted.

expenditure on irrigation; the data availability of irrigation costs is exceedingly sparse and makes for a challenge when estimating investment needs for the sector. A more useful exercise is to project costs at the sub-regional level. Two recent attempts to model investment costs in irrigation at the sub-regional level provide insight: one by IFPRI (Rosegrant, 2017), and one by the World Bank (Rozenberg and Fay, 2019).

Across developing countries in the sub-regions of East Asia and Pacific, and South Asia, the investments required to achieve projected irrigation expansion are estimated to cost on average a total of USD 3.1 billion per year, over the period 2015-2030 (Rosegrant et al., 2017) (Table 2.2).

However, irrigation expansion alone will not be enough. Water scarcity will lead to declining average yields in the face of irrigation expansion (particularly in South Asia). Most of the gains from expanding irrigation area will only be realised if they are accompanied by investments to modernise systems and increase the water use efficiency of existing irrigation assets (Rosegrant et al., 2017).

Projected investments in improved water use efficiency across developing countries in the East Asia and Pacific, and South Asia sub-regions are a significant (USD 1.7 bn/yr) share of the cost, given the large share of land under irrigation. Baseline investments in soil-water management technologies (e.g. technologies such as no-till agriculture and water harvesting that increase the water holding capacity of soil) are estimated at USD 500 mn/year across the two sub-regions.

An alternative scenario is proposed by Rosegrant et al. (2017), whereby accelerating irrigation expansion, and further improving irrigation efficiency and soil-water management can increase agricultural output while conserving more water. Under this scenario, the total annual investment in irrigation for East Asia and Pacific, and South Asia, are USD 6.8 bn/yr and USD 5.1 bn/yr respectively (Table 2).

Table 2.2. Average Annual investment in irrigation and additional investments - developing countries, 2015-30

USD billions per year (2005 prices)

Sub-region	Reference investment scenarios			Alternative investment scenarios (*additional* investment relative to reference scenario)			Total
	Irrigation expansion	Water use efficiency (WUE)	Soil-water management (ISW)	Accelerated irrigation expansion (IX)	IX + WUE	ISW	
East Asia and Pacific	1.29	0.94	0.34	0.66	2.86	0.68	6.77
South Asia	1.82	0.76	0.17	0.45	0.95	0.95	5.1

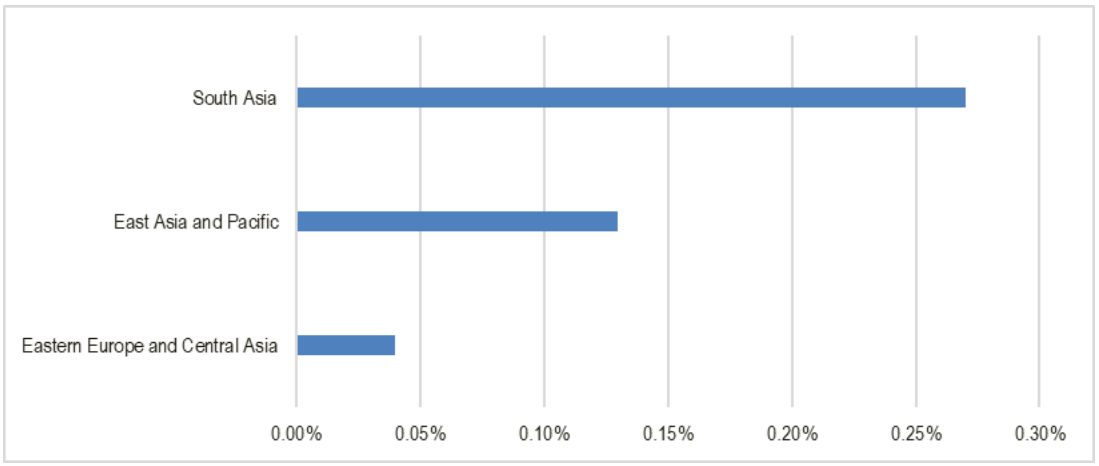
Note: Figures are average annual investments over 2015-2050. Regions include developing countries only.
Reference scenarios are based on historical trends (from literature) combined with expert opinion about future pathways, and using SSP2/ RCP 8.5 to model socioeconomic and climate change. Alternative scenarios focus on investments and improvements in agricultural water resource management, developed by IFPRI in consultation with IWMI.
Scenarios: WUE- Water Use Efficiency; ISW- Investments in Soil-Water Management (e.g. no-till agriculture and water harvesting); IX- accelerated investments in irrigation expansion; IX+WUE- combination of accelerated investments in irrigation expansion with improved water use efficiency; ISW- improvements in rainwater harvesting and soil water holding capacity.
Source: Rosegrant et al. (2017).

Figure 2.2 presents regional estimates of annual irrigation investment needs from 2015-2030 as a percentage of GDP. The estimates, modelled by Rozenberg and Fay (2019), account for irrigation expansion and irrigation efficiency, socioeconomic and climate change (SSP2/RCP8.5), moderate public investment support for capital costs, and assume farmers will cover the costs of parts and materials for farm irrigation equipment and a water price which reflects the relative scarcity of water due to increasing demand from other sectors.

Irrigation investment needs vary by sub-region, with South Asia bearing the highest annual investment costs of 0.27% of GDP. In terms of absolute costs, East Asia and the Pacific face the greatest investment costs of approximately USD 20 bn / year (Figure 2.7).

Figure 2.7. Annual irrigation investment needs 2015-2030

Percentage of GDP / year



Note: EECA region includes 13 ADB countries, as well as 10 non-ADB countries.
Source: Rozenberg and Fay (2019).

2.4. Emerging issues

The paper does not cover emerging issues, which are likely to substantially increase the costs of water management, in particular in urban environments. These include improvement of individual and other appropriate sanitation systems (IAS), combined sewers and risks of overflows (CSOs), contaminants of emerging concern (CECs), or sludge management.

In selected areas, such as mountainous and isolated territories, and also in some peri-urban areas, cost-effective decentralised wastewater collection and treatment can be considered. However, these should not be considered as a cheap option or a licence for complacency. Compliance monitoring and enforcement will be crucial to ensure environmental protection (i.e. to prevent freshwater and groundwater contamination from leaking septic tanks, and inappropriate wastewater disposal without treatment to rivers). IAS should be considered in the context of national strategies, with mechanisms to ensure reliable performance of services. This is likely to increase the costs of IAS, in places making connection to existing pipes competitive. Policy guidance and institutional strengthening are likely to be required to accompany transaction towards sustainable and effective IAS.

Combined sewers are common practice, but they risk discharging untreated wastewater, including priority hazardous substances and other substances, into the environment in cases of heavy rains. The issue is likely to intensify, as cities and assets are built, and climate change exacerbates the intensity of rain episodes. Cities that are not yet equipped with sewers have the opportunity to build resilient infrastructure from the start and avoid the difficult transition more advanced countries face. When combined sewers are being built, regulation should ensure that appropriate storage and flow constraints are put in place to at least moderate the potential impacts at proportionate costs.

Where combined sewers are in place, traditional ways of managing CSOs include increasing capacity for storm water storage (including underground storage chambers) to reduce the frequency and amount of

overflows. Another option is to separate existing combined sewers into a sanitary network and a storm water network, combined with downstream treatment using wetlands, ponds, filtration or other suitable systems (in particular to control substances washed from pavements by rainwater).

An alternative approach is to prevent storm water from entering the sewer network by using green infrastructure. This is invariably cheaper, more adaptable and more resilient than the traditional subterranean storage approach. Certain green infrastructures are better able to handle pollutants. Countries in the region would benefit from exploring these options more systematically, which requires appropriate institutional and other arrangements.

More work is needed to characterise additional pressures from contaminants of emerging concern (e.g. pharmaceutical residues and microplastics in freshwater) and to understand the financial implications. Extremely high pharmaceutical concentrations, in the order of mg/L have been detected in some industrial effluents and recipient streams, for example in China, India, or Korea (Larsson, 2014). A range of antibiotics, analgesics, anti-inflammatories, anticonvulsants, beta-blockers and blood lipid modifying agents have been detected in various concentrations in both WWTP effluent and receiving surface waters in Australia and Asia.

Advances in analytical methods and risk assessment provide opportunities to build a policy-relevant knowledge base. The Box 2.1 below illustrates prioritisation of pharmaceuticals via suspect and non-target screening in Korea.

Box 2.1. Prioritisation of pharmaceuticals via suspect and non-target screening, Korea

The Yeongsan River is one of four major river basins in Korea. It is the most water scarce basin and has suffered from declining water quality from an increase in diffuse urban and agricultural pollution and toxic point source discharges. In a study by Park et al. (2018), pharmaceuticals and personal care products (PPCPs) in the Yeongsan River, Korea were prioritised using suspect and non-target analysis by Liquid chromatography–high resolution mass spectrometry (LC-HSMS) (QExactive plus Orbitrap) followed by semi-quantitative analysis to confirm the priority of PPCPs.

The screening identified more than 50 PPCPs, of which 26 could be confirmed with reference standards. The confirmed substances were prioritised based on a scoring and ranking system. Twelve additional substances not included in the first ranking were semi-quantitatively analysed. In the final prioritisation list, carbamazepine, metformin and paraxanthine shared first-ranking place, followed by caffeine, cimetidine, lidocaine, naproxen, cetirizine, climbazole, fexofenadine, tramadol, and fluconazole. The authors suggest that these 12 PPCPs are the most highly exposable substances, and should be considered in future water monitoring of the Yeongsan River.

Source: Park, N. et al. (2018), Prioritization of highly exposable pharmaceuticals via a suspect/nontarget screening approach: A case study for Yeongsan River, Korea, *Science of the Total Environment*, Vol. 639, pp. 570-579, http://dx.doi.org/10.1016/j.scitotenv.2018.05.081.

The OECD identifies five strategies that can cost-effectively manage pharmaceuticals for the protection of water quality and freshwater ecosystems. Different financing mechanisms can be considered to cover and allocate costs. Switzerland – the first country to implement a national strategy on the issue - combines additional revenues from tariffs with subsidies from national budget to cover the additional costs of more stringent treatment of wastewater in large wastewater treatment plants. Other mechanisms could be considered (such as extended producers' responsibility) to minimise costs and allocate them in a fair and equitable manner.

Similarly, as more wastewater is collected and treated, the volume of sludge is likely to increase in most countries in the region. Moreover, progress in treatment will affect the substances captured in sludge. This

can be an issue, when sludge is essentially spread on agriculture land, as farmers or the food industry they supply may be less inclined to accept these substances. This is likely to increase the cost of sludge handling and management, a growing concern in developed countries.

While these issues may seem secondary until significant progress is achieved for wastewater collection and treatment in most countries in Asia-Pacific, they may already be significant in selected countries or urban environments. Awareness raising and anticipating may incentivise action before these issues become more pressing and possibly more costly to address. Developing countries in the region have the opportunity to leapfrog and build resilient water infrastructure from the start.

3 Financing capacities to reach investment needs

The previous sections have highlighted the significant investment needed in infrastructure to manage water-related risks in the Asia-Pacific. Table 3.1 summarises the top ten countries in the region where the annual investment costs required in water supply and sanitation services and flood protection are greatest. Much of the financial burden in terms of cost to GDP falls upon those countries that can least afford it (i.e. low and low-middle income countries).

Table 3.1. Top ten countries for annual investments costs in water infrastructure in the Asia-Pacific region

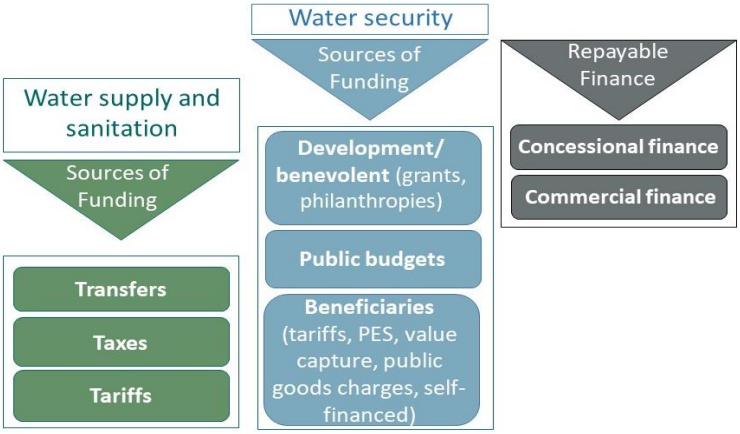
Water supply and sanitation		Riverine flood protection		Coastal flood protection	
% GDP	USD billions	% GDP	USD billions	% GDP	USD billions
Timor-Leste (5.5)	China (60.79)	Bangladesh (8.2)	India (275.24)	Bangladesh (2.8)	China (34.10)
Afghanistan (2.9)	India (23.02)	Myanmar (5.8)	China (188.75)	Solomon Islands (2.1)	Bangladesh (20.93)
Nepal (2.7)	Indonesia (6.76)	Cambodia (5.3)	Indonesia (84.76)	Viet Nam (1.7)	Indonesia (17.53)
Pakistan (2.3)	Thailand (5.74)	Afghanistan (4.4)	Bangladesh (62.06)	Vanuatu (1.5)	India (13.73)
Papua New Guinea (1.8)	Malaysia (3.85)	Kyrgyz Republic (4.1)	Thailand (26.94)	Myanmar (0.6)	Viet Nam (13.31)
Azerbaijan (1.7)	Pakistan (3.59)	Tajikistan (3.7)	Viet Nam (26.70)	Indonesia (0.6)	Japan (5.18)
Fiji (1.6)	Viet Nam (2.90)	Viet Nam (3.4)	Pakistan (21.52)	Fiji (0.5)	Malaysia (3.29)
Kiribati (1.6)	Philippines (2.69)	Laos (3.1)	Myanmar (10.98)	Malaysia (0.4)	Philippines (1.96)
Marshall Islands (1.6)	Japan (2.47)*	Indonesia (2.8)	Japan (10.89)	Philippines (0.2)	Myanmar (1.09)
Micronesia (1.5)	Bangladesh (1.64)	Timor-Leste (2.7)	Philippines (9.33)	Papua New Guinea (0.2)	South Korea (0.67)

Low-Income Economies
Lower-Middle Income Economies
Upper-Middle Income Economies
High-Income Economies

Source: OECD using data from Rozenberg and Fay (2019) and WRI (2020). *Japan water supply and sanitation estimate from UNESCAP (2019). World Bank Income Groups.

An increased and sustained effort will be required to finance the investment gap. The OECD makes a distinction between the three ultimate sources of finance for water-related investments (revenues from tariffs, taxes and transfers from the international community; the so-called “3Ts”) and other sources of repayable finance (loans, bonds, etc.) (Figure 9). Taxes and tariffs are very important for not only raising revenue, but also for demand management and signalling the value of water, water services and water security.

Figure 3.1. Potential sources of funding and financing for water-related investments



Source: Adapted from OECD (2010) Innovative Financing Mechanisms for the Water Sector. https://doi.org/10.1787/9789264083660-en.

Repayable sources of finance require a creditworthy borrower, which can provide a financial return. Notably, there is a growing consensus that mobilising commercial finance (through blended finance or other means, such as a combination of equity and debt) will be instrumental to achieve the SDGs and provide the incentives to put the water sectors' financing on a more sustainable footing. Co-ordination among development finance providers will be essential to making this happen, and to avoid concessional finance crowding out commercial capital (OECD, 2019a). It is also worth noting that any concessional or commercial finance will have to be repaid, largely through public budgets or taxes, and water tariffs and charges.

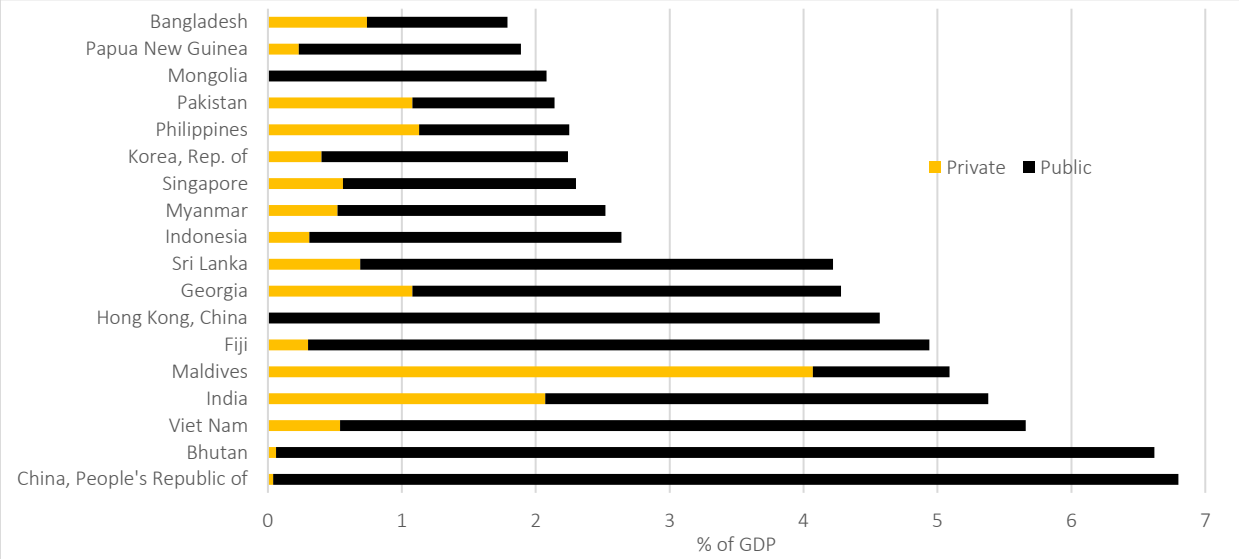
Data availability to characterise current expenditure and sources of finance for water-related investments at country level is limited, which prohibits the possibility to construct a robust and comparable baseline of expenditure and an assessment of room for manoeuvre to mobilise additional finance. However, some elements of funding sources for water supply and sanitation services are available. The following sub-sections provide elements of this overall picture.

3.1. Public taxes are the main source of finance for water-related infrastructure

Figure 10 depicts levels of water supply and sanitation infrastructure expenditure (as a share of GDP) over a limited time period for select countries. Countries for which data are available reflect different shares of public and private sources of finance in water supply and sanitation infrastructure. Public budgets are the dominant funding source in countries for which data is available. Significant levels of public expenditure (> 5% GDP) have occurred in several economies, notably China, Bhutan, Viet Nam, India and the Maldives.

Figure 3.2. Public and private expenditure for water supply and sanitation, select economies, select years

Percentage of GDP



Note: Actual budget expenditure except Armenia, Bhutan, Georgia, Maldives, Myanmar, and Thailand, which are planned or estimated budget expenditure. Periods covered are 2010–2013 average for Indonesia; 2010–2014 average for the PRC, Fiji, and Malaysia; 2010, 2011, and 2014 average for Hong Kong (China); 2011 for Armenia, Bangladesh and Georgia; 2011–2012 average for Nepal; 2012–2013 average for India; 2011–2013 average for Maldives; 2011, 2012, and 2014 average for Singapore; 2011–2014 average for the Philippines, Sri Lanka, and Thailand and 2014 for Myanmar.
Source: OECD calculations based on ADB data (2017). Original sources of country-level data: World Bank Private Sector Participation in Infrastructure (PPI) database, World Development Indicators, ADB estimates.

Many emerging economies and developing countries have little or no experience with private investment in the water sector; private investment is concentrated in only a few of Asia's lower-risk economies. The Maldives and India have attracted a significant share of private investment in water supply and sanitation infrastructure, representing 4% and 2% of GDP, respectively (Figure 10). China has attracted the major share (49%) of private investment in water infrastructure in emerging economies/developing economies in the Asia-Pacific region since 2000, followed by Malaysia (8%), Philippines (6%) and India (6%) (AIIB, 2019). This partly reflects efforts in these countries to expedite and facilitate infrastructure investments, as well as investor appetite to invest in more established economies. China, in particular, took several steps to encourage private investment in public services and infrastructure, including for foreign-based private operators, through guidelines[3] and the creation of dedicated institutions (e.g. the China Public Private Partnership Center). Little or no private investment is taking place in Asia's smaller economies, where the financing needs are higher and opportunities to raise funds are lower (AIIB, 2019).

Table 4 lists the current sovereign credit rating of countries in the Asia-Pacific region. Sovereign credit ratings can give investors insights into the level of risk associated with investing in the debt of a particular country, including political risk. Obtaining a good sovereign credit rating is usually essential for developing countries that want access to funding in international bond markets. However, a number of developing ADB member countries have not been assigned a credit rating, signalling that the economic and/or political environment is not stable.

[3] World Bank (2018), Procuring infrastructure public-private partnerships 2018 in China. https://bpp.worldbank.org/content/dam/documents/bpp/china.pdf.

Table 3.2. Sovereign credit ratings for Asia-Pacific countries

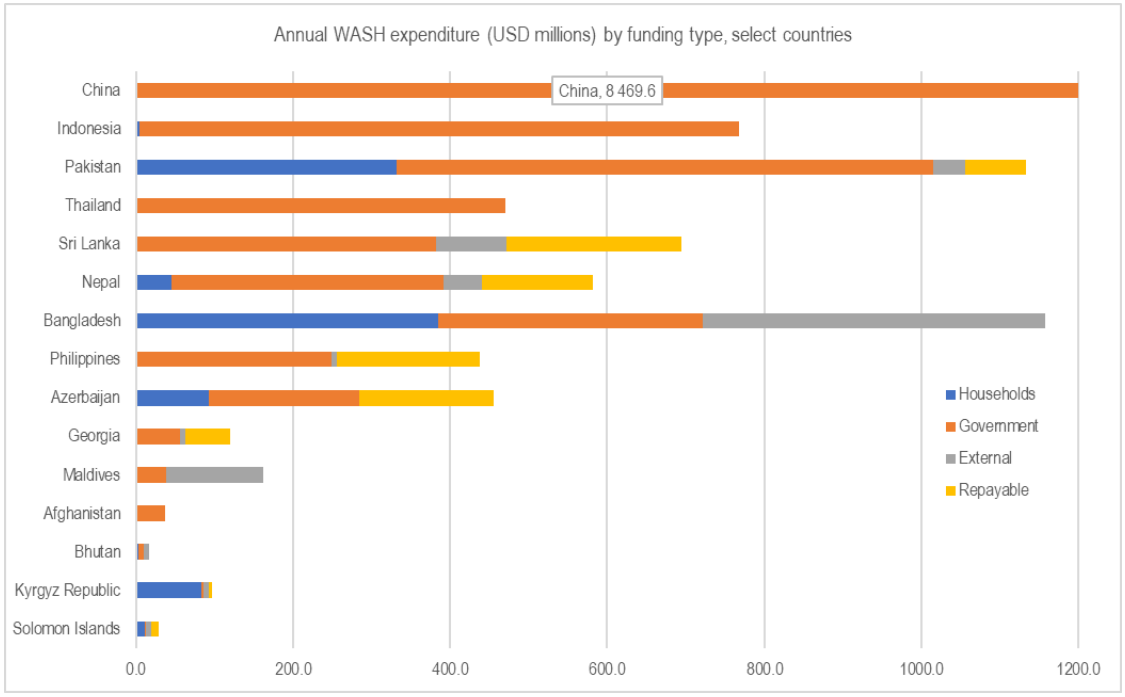
Rating	Description	ADB Member States
AAA	Highest rating assigned by S&P. The obligor's capacity to meet its financial commitments on the obligation is extremely strong.	Australia, Singapore
AA	Only differs from the highest-rated obligations to a small degree. The obligor's capacity to meet its financial commitments on the obligation is very strong.	Hong Kong, Korea, New Zealand
A	Somewhat more susceptible to the adverse effects of changes in circumstances and economic conditions than obligations in higher-rated categories. The obligor's capacity to meet its financial commitments on the obligation remains strong.	China, Japan, Malaysia
BBB	Adequate protection parameters. However, adverse economic conditions or changing circumstances are more likely to weaken the obligor's capacity to meet its financial commitments.	India, Indonesia, Kazakhstan, Philippines, Thailand
BB	Faces major ongoing uncertainties or exposure to adverse business, financial, or economic conditions that could lead to the obligor's inadequate capacity to meet its financial commitments.	Azerbaijan, Bangladesh, Fiji, Georgia, Viet Nam, Uzbekistan
B	More vulnerable to non-payment than 'BB', but the obligor currently has the capacity to meet its financial commitments. Adverse business, financial, or economic conditions will likely impair the obligor's capacity or willingness to meet its financial commitments.	Mongolia, Pakistan, Papua New Guinea, Sri Lanka, Tajikistan

Note: No rating: Afghanistan, Armenia, Bhutan, Brunei Darussalam, Cambodia, Cook Islands, Kiribati, Kyrgyz Republic, Lao People's Democratic Republic, Maldives, Marshall Islands, Micronesia, Myanmar, Nauru, Palau Nepal, Niue, Samoa, Solomon Islands, Taipei, Timor-Leste, Tonga, Turkmenistan, Tuvalu, Vanuatu.
Source: Standards and Poor's (2019).

A similar trend is shown in Figure 3.3 where public/government budget is the main funding type for annual water supply, sanitation and hygiene (WASH) expenditure, as reported by a limited number of countries in the latest GLAAS report. Figure 3.4 illustrates that the majority (on average 79%) of reported expenditure is directed towards drinking water services, as opposed to sanitation and hygiene services. Of the three countries that reported on the funding gap to reach national WASH targets in the Asia-Pacific region, all reported a high funding gap: Afghanistan 83%, Bangladesh 39% and Viet Nam 67% (UN Water and WHO, 2019). Box 3.1 presents the water infrastructure investment profile in Viet Nam, the majority of which comes from the public budget (from central and local government), as well as concessional finance and overseas development assistance.

Figure 3.3. Annual WASH expenditure by funding type, select economies

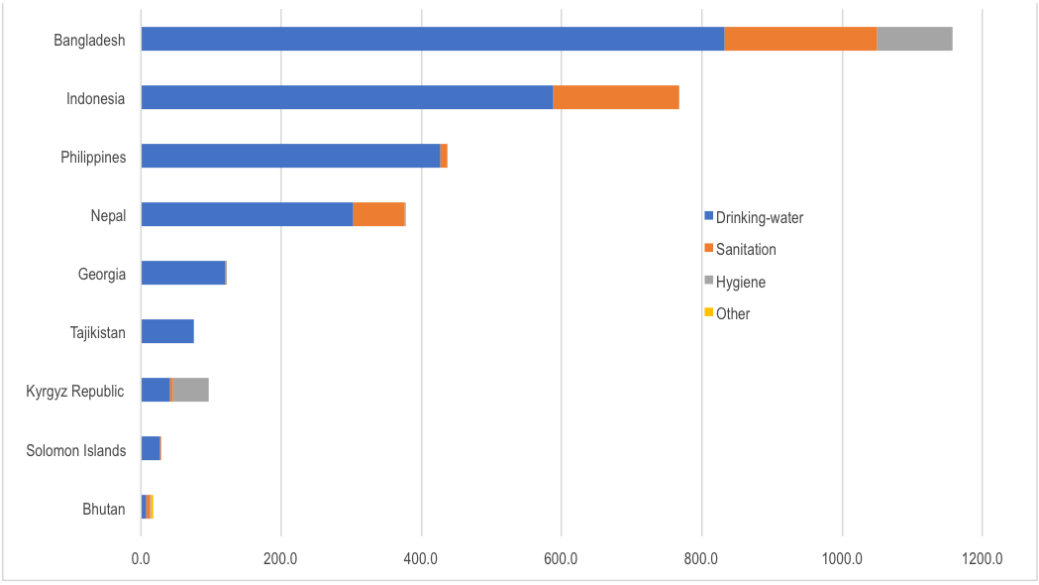
USD millions (constant 2017 USD)



Note: 2017 data for Kyrgyz Republic, Maldives, Georgia, Azerbaijan, Philippines, Bangladesh, Thailand, Pakistan, Indonesia; 2018 data for Solomon Islands, Bhutan, Afghanistan, Sri Lanka, China; 2019 data for Nepal.
Source: UN Water and WHO (2019).

Figure 3.4. Annual WASH expenditure by subsector, select economies

USD millions (constant 2017 USD)



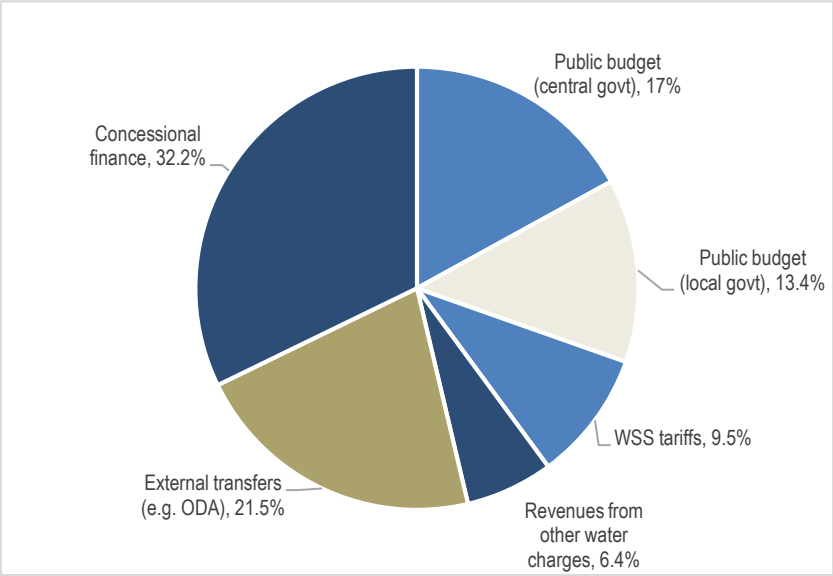
Note: 2017 data for Kyrgyz Republic, Tajikistan, Georgia, Philippines, Indonesia, Bangladesh; 2018 data for Bhutan, Solomon Islands; 2019 data for Nepal.
Source: UN Water and WHO (2019).

Box 3.1. Water management investment profile: Viet Nam

As reported by the government of Viet Nam in a recent 2019 OECD survey of select Asian countries, almost one-third (30%) of finance for water management comes from the public budget (central and local). Viet Nam also relies heavily on concessional finance (32%) and ODA (22%) to finance water management. Water supply and sanitation tariffs (10%) and other water charges (6%) represent a relatively small proportion of financing sources. Viet Nam reported zero experience with commercial finance.

In the recent GLAAS survey (UN Water and WHO, 2019), Viet Nam reported a funding gap for water supply and sanitation of 67%.

Figure 3.5. Financing sources for water management, Viet Nam



Source: OECD data collected by questionnaire sent to select ASEAN countries as part of a project on facilitating water security in Asia with the Korean government and the Asia Water Council.

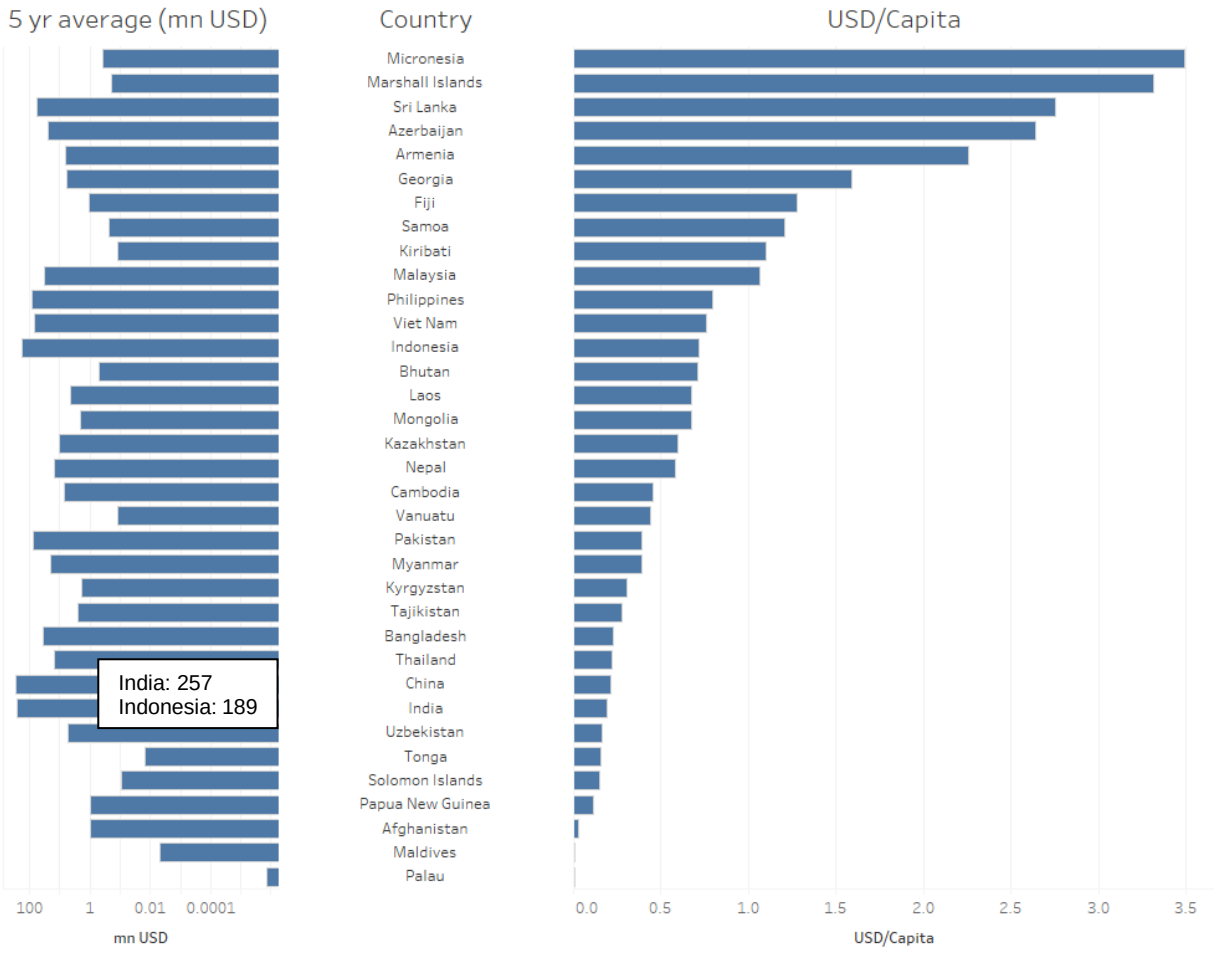
3.2. Official development assistance remains a low share of investment in water infrastructure and may not be targeting those countries who need it most

Figure 3.6 and Figure 3.7 illustrate the extent to which countries have been reliant on official development assistance (ODA) for water-related infrastructure over the period 2013-2017, based on data from the OECD Creditor Reporting System. These figures aggregate ODA categorised as expenditure contributing to water supply and sanitation, water storage, flood protection and irrigation. Since 2011, the amount of the ODA has largely plateaued. The data indicate that India and Indonesia received considerable amounts of ODA for the water sector (on average 257 and 189 million USD/year) in comparison to other countries in the region. Figure 14 shows that ODA may not be reaching some of the countries that most need it, such as Timor-Leste, Bangladesh, Myanmar, Afghanistan and Papua New Guinea.

Overall, ODA represents a small proportion of total expenditure on water infrastructure when compared to Figure 3.3 and Figure 3.4. Despite this, it is worth recognising that any dependency on external funding creates uncertainty for national water planners and policy-makers, as external funds tend to be unpredictable, and may be poorly coordinated with national interventions.

Figure 3.6. Annual ODA for water-related infrastructure in Asia-Pacific countries

Average 2013-2017



Notes: Includes ODA disbursements for the following water-related infrastructure: water supply and sanitation, water storage, flood protection, irrigation. Data are in millions of USD, gross disbursements, constant 2017 prices. 2017 population figures.
Data issues for some countries prevented their inclusion in the graphic. Particularly: Brunei, Cook Islands, Nauru, Niue, Timor Leste, Turkmenistan, and Tuvalu.
Source: OECD (2019b). See Annex B for supporting data.

3.3. Water supply and sanitation tariffs are under-utilised, although affordability acts as a barrier

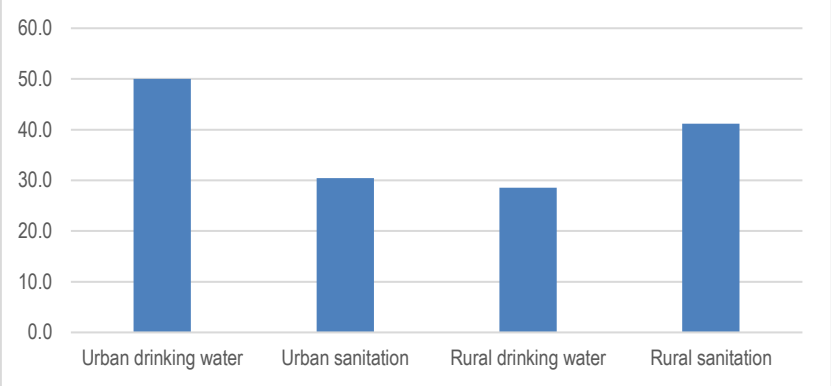
Tariff levels (pricing) are key to making water supply and sanitation services financially sustainable. Getting closer to full recovery of costs through water supply and sanitation tariffs demonstrates an increasing ability to rely on pricing to finance capital, operational and maintenance expenditures, and to access debt finance to cover upfront capital investments. In any given country, accessing debt financing will typically be

restricted to entities and projects that are able to demonstrate a reliable ability to pay back. For water supply and sanitation service providers, such ability is first and foremost dependent on the extent to which costs are recovered through revenues from tariffs or other charges paid by users. In contrast, a reliance on public budgets illustrates an absence or under-utilisation of pricing mechanisms, poorer borrowing conditions and lost opportunity to manage demand.

In practice, pricing is often too low to fully recover operational and maintenance costs (including externalities related to water use) and rarely covers capital expenditure. Figure 3.7 shows that over half of responding countries in the latest GLAAS survey indicated that water supply and sanitation tariffs are insufficient to recover 80% of operation and maintenance costs, let alone capital (refurbishment and replacement) costs. Cost recovery is particularly low in rural areas, although tariffs can vary considerably within countries, and between drinking and sanitation services. For example, in Cambodia, urban drinking-water supply systems are predominantly built and operated by private individuals with full cost recovery, but urban sanitation systems consist of wastewater treatment plants, constructed with external support and with no clear strategy for cost recovery (UN-Water and WHO, 2019).

Figure 3.7. Percentage of countries reporting >80% cost recovery of O&M costs from water supply and sanitation tariffs

Percentage of countries reporting >80% cost recovery, Select Asia-Pacific countries, 2018



Note: Number of countries reporting on cost recovery for: urban drinking water (24); urban sanitation (23); rural drinking water (21); rural sanitation (17).
Source: OECD, using data from UN Water and WHO (2019).

Affordability constraints (perceived or real) affect the capacity of service providers, municipalities and communities to raise additional finance through water supply and sanitation tariffs, additional public finance to cover water-related expenditure needs, and experience with, and opportunities for, mobilising commercial debt. Estimates of affordability of water bills are discussed in more details in the Asia Water Development Outlook (see KD3). The discussion suggests that, aggregated at national level, affordability is only an issue for a small group of small island countries.

The picture is much more contrasted when affordability is analysed for selected categories of the population. Figure 3.8 and Figure 3.9 provide some indication of affordability at the micro-level (urban households) where data is available. They compare the middle household income[4] with the annual water bill in select cities (108 cities in 20 countries) to provide an assessment of potential affordability constraints.

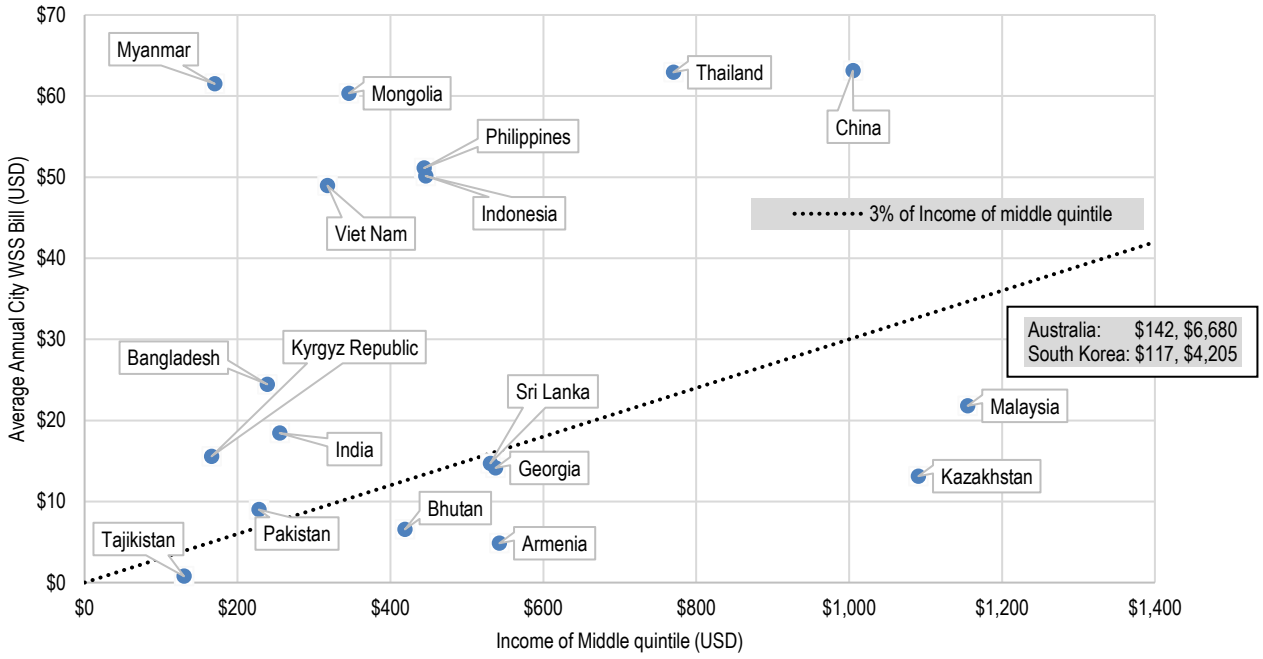
[4] The middle quintile is chosen here because in many developing economies, it is likely to be the quintile residing in cities with access to water supply and sanitation services; the poorest quintile in many situations may not have access to public water supply and sanitation services, such as those living in informal settlements.

For many countries, the water bill is greater than the 3% threshold heuristically recommended as the maximum level of disposable income, which signals limited ability to raise water supply and sanitation tariffs. In particular, Indonesia, Kyrgyz Republic, Myanmar, Mongolia, the Philippines, Thailand, Viet Nam, and Bangladesh face high affordability constraints, with annual tariffs in select cities currently representing more than 10% of the annual income of the middle quintile household.

It is worth noting that affordability constraints will be even direr for the poorest 10% of households, many of which may not be connected to a formal water supply and sanitation service provider, and may be forced to buy from private vendors, some of which operate illegally and charge exorbitant rates for sub-optimal services (Goksu et al. 2017).

Conversely, there may also be opportunities, or room for manoeuvre, to increase water supply and sanitation tariffs in a number of countries, such as Tajikistan, Armenia, Kazakhstan and others.

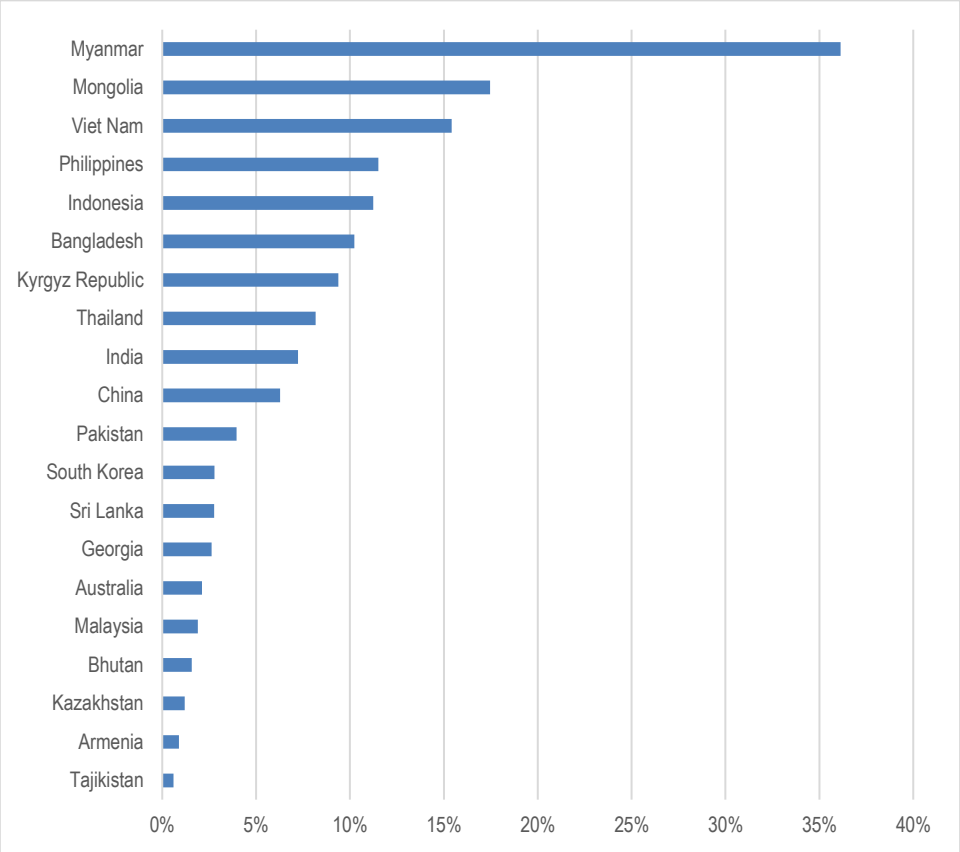
Figure 3.8. Average city water supply and sanitation tariffs as a share of annual disposable middle-quintile household income



Note: Average city tariff represents year 2017, and based on available data for select cities from GWI. Annual disposable income of households is based on the middle quintile of income.
Data for tariffs from 108 cities, in 20 countries. See methodology in Annex for further details.
Source: OECD calculations based on GWI (2019) and World Bank (2019c).

Figure 3.9. Average city water supply and sanitation tariffs as a share of household income of the middle quintile

Percentage of GDP



Note: Average city tariff represents year 2017, and based on available data for select cities from GWI. Annual disposable income of households is based on the middle quintile of income.
Data for tariffs from 108 cities, in 20 countries. See methodology in Annex for further details.
Source: OECD calculations based on GWI (2019) and World Bank (2019c).

4 Policy recommendations to bridge the investment gap

Based on the analyses of this paper, many countries in the Asia-Pacific region are facing severe financing challenges to achieve SDG 6. The gap between current financing and future needs results from a number of barriers (OECD, 2018a):

- Water infrastructure is typically capital intensive, and long-lived with high sunk costs. It calls for a high initial investment followed by a very long pay-back period.
- Prevalent business models often fail to support operation and maintenance efficiency, a condition to sustain service at least cost over time.
- Water services are often under-priced, resulting in a poor record of cost recovery for water investments.
- Water is generally an under-valued resource, not properly accounted for by investors that depend upon or affect its availability, such as land use planners, urban developers, farmers, or energy suppliers.
- Water management generates a mix of public and private benefits in terms of valued goods and services as well as reduced water-related risks. Many of these benefits cannot be easily monetised, undermining potential revenue flows.
- A lack of appropriate data and analytical tools to assess complex water-related investments, and a track record of such investments, can deter financiers.
- Across the water sector in general, projects are often small and context-specific. This raises transaction costs and makes emerging innovative financing models difficult to scale up.
- Financial flows may benefit projects which are bankable, but may not maximise benefits for communities and the environment. This raises the question of how to ensure that the most beneficial investments from a social welfare perspective attract finance at scale.
- Silo-ed approach across sub-sector uses (domestic, industry and irrigation) and poor planning. The result is lack of policy coherence and poor implementation of existing regulations and economic incentives.

The magnitude of capital investment needs and operating and maintenance costs calls for a shift in the way the sector is currently operated, regulated and financed. To reap the economic benefits, water supply and sanitation services, flood protection and irrigation infrastructure require a substantial increase in investment from a range of sources, including households, national and local governments, and external funds from donors and the private sector. Public finance (from governments and donors) for water infrastructure should not only increase but also leverage alternative sources of financing, including commercial finance. However, tapping into more extended sources of funding calls for increased efficiency in the water and agriculture sectors, as well as improvements in the creditworthiness of water and sanitation utilities.

Strategies and recommendations to address the financing challenge are discussed in the following sections:

- Make the best use of existing assets and financial resources;
- Minimise future investment needs;
- Harness additional sources of finance.

4.1. Make the best use of available assets and financial resources

Improving the operational efficiency and effectiveness of existing infrastructure and service providers can postpone investment needs and is a prerequisite to further investment in water security. There will be opportunities to make the best use of available assets, to enhance the operation and maintenance of existing assets delaying the need for investment, and to improve the efficiency of service providers by capturing economies of scale. This can be enhanced through better operation and maintenance of existing infrastructure, economic regulation, and engagement with stakeholders (to set acceptable levels of service, enhance willingness to pay and drive water-wise behaviour). An additional challenge is to operate, maintain and renew existing assets, to guarantee service quality over time.

The ensuing sections present policy insights and guidance for the following recommendations to make the best use of existing assets and financial resources:

- Enhance the operational efficiency of water and sanitation service providers
- Build capacity for economic regulation
- Encourage connections, where central assets are available
- Strengthen capacity to use available funds.

While this section largely focuses on water supply and sanitation infrastructure and service provision, increased agricultural production must also come from getting more from existing irrigation infrastructure assets. This means that investments in irrigation and drainage infrastructure will need to focus on modernisation (both technical and institutional), basin wide efficiency, and improvements to drainage. In particular, under-investment in drainage has meant that large swaths of agricultural land in Asia, particularly in the semi-arid regions of Central Asia (World Bank, 2003) and South Asia (Rasul, 2016), have become unproductive or have low productivity as a result of waterlogging and salinity. Modelling suggests that increased investments in water use efficiency will bring the most productivity gains (Rosegrant et al., 2017).

4.1.1. Enhance the operational efficiency of service providers

Low sustainability of capital investments is an issue in many countries; infrastructure is provided, but lack of funds for operating costs undermines the continuous supply of services, leading in many cases to facilities and systems failing to function (or underperforming). This ultimately results in large investments being lost.

More emphasis should be placed on improving service providers' efficiency in administrative and delivery functions, with the provision of appropriate incentives for performance, a role for independent economic regulation of service provision. Operational efficiency of water service providers is a condition to make the best use of existing assets and financial resources. It is also a requisite to attract other sources of finance, be they public or private. It is essential to establish, maintain or increase water users' willingness to pay for tariffs that reflect the cost of service provision, and to enhance the legitimacy of a government policy to increase tariffs. Efficiency gains, in turn, reduce operating costs and, consequently, the amount of subsidy

needed. Thus, addressing such inefficiencies can ease the burden of a tight fiscal space and can free up resources to support disadvantaged communities or other sub-sectors.

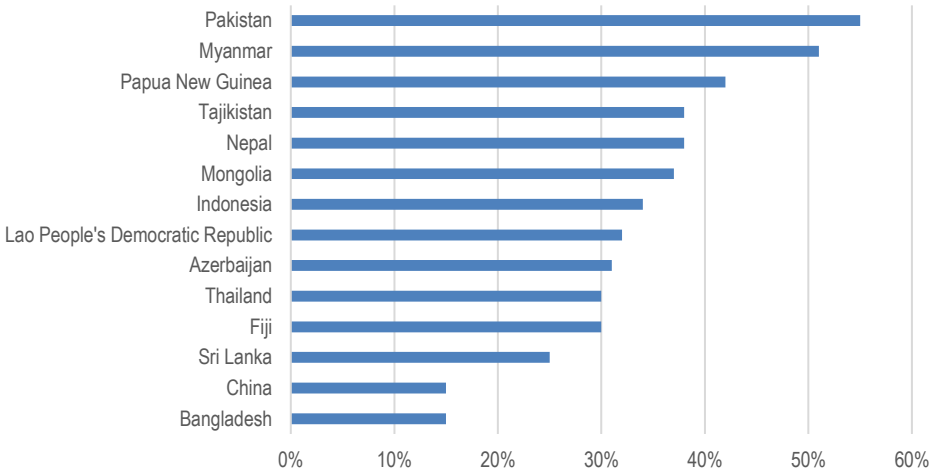
Enhancing operational efficiency of service providers can take different forms depending on the national contexts. Building on international good practices (see OECD, 2018c for a discussion), performance indicators for water supply and sanitation services can focus on the following items. The relevance and relative weight of indicators would reflect local conditions:

- Technical performance indicators
  - Leakage performance and targets for reducing leakage and other unbilled losses, such as illegal connections
  - Mains bursts (as a proxy for distribution network condition)
  - Sewer collapses (as a proxy for sewer asset condition)
  - Number of wastewater pollution incidents, such as from operation of combined sewer overflows, or major failures at wastewater treatment works
  - Unplanned outages (loss of supply because of bursts, contamination etc.)
  - Energy costs
- Compliance with existing regulation
  - Drinking water quality compliance (integrating with and reinforcing the role of the drinking water regulator, where this is separate)
  - Level of compliance with environmental permits and standards (integrating with and reinforcing the role of the environmental regulator, where this is separate). This can also be an indicator of the quality and state of drinking water and wastewater treatment infrastructure assets
- Customers' experience
  - Reducing per capita consumption for households and demand in other sectors on mains supplies
  - Risk of demand restrictions in a drought
  - Indicators of user populations' environmental health, particularly in hard-to-reach areas and informal settlements (as a proxy for the usage rates, quality, effectiveness of local water supply and sanitation services)
  - Accessibility of payment options for customers, how well billing queries are dealt with, information about planned outages and supply interruptions.

Countries would benefit from a proactive approach to maintain and renew existing networks (instead of reacting to incidents such as bursts) to improve operational efficiency of water and sanitation operators, reduce non-revenue water (Figure 4.1) and address the backlog of under-investment in maintenance of water supply and sanitation infrastructure. This includes improving the operation of the existing assets to reduce operational costs (e.g. energy, drinking water chemicals and other material costs) and avoid additional capital investments. It also includes active leakage control in the water supply system and regular maintenance of pipes of the collection systems.

Figure 4.1. Non-revenue water in select Asia-Pacific countries

NRW (%), 2019



Source: UN Water and WHO (2019).

Performance-based contracts may be considered to strengthen incentives for investing in efficiency improvements, including for identifying and investing in appropriate technical solutions for hard-to-reach populations. Technical assistance for service operators could include capacity building for financial and technical dimensions of operations. Targeted maintenance, on a risk-based approach, can help optimise spending, if data on the state of infrastructure is available. When investments depend on official development assistance, performance-based loans provide the right incentives to spend wisely on projects that deliver concrete performance on the ground.

In water-scarce countries and areas, reduction of non-revenue water can minimise pressure on the resource and avoid (or postpone) investments in costly alternative water sources such as desalination. This requires reducing leakage and increasing collection of water bills. Reducing non-revenue water due to illegal connections (often associated with irrigation water use) and under-metering[5] should be prioritised in the short term.

Operational efficiency can benefit from systematic assessment and reference to international good practices. Such assessments can be supported by benchmarking and public reporting of operators of water supply and sanitation services to increase accountability, transparency and incentives for efficiency and financial sustainability. The appropriate level of efficiency would reflect local conditions (for instance, the economic level of leakage will depend on water abundance in a country or catchment; it may also depend on such factors as density of users along the supply network and technical capacity in the country).

Countries may also benefit from exploring mechanisms to enable consolidation/amalgamation of municipal and local services to improve operational efficiency and financial sustainability by reaching economies of scale. Experience from Europe shows that planning, stakeholder engagement and sequencing reforms are essential to avoid capacity bottlenecks and overcome resistance to consolidation of utilities (OECD, 2020a). The Box 4.1 below provides a success story of the reform of water supply and sanitation operations in Dhaka, Bangladesh, and serves as a role model for other water utilities in the region.

[5] Rolling out metering programmes at household level can be costly, with only minimal gains in terms of water conservation. District metering is most often appropriate to manage leakage.

Box 4.1. Reforming the Dhaka Water Supply and Sewerage Authority

The Dhaka Water Supply and Sewerage Authority (DWASA) was established in 1963 with a mandate to manage water supply and sewerage in the Bangladesh capital. The WASA Act of 1996 began a corporatisation process that ultimately professionalised DWASA and made it profitable.

DWASA had substantial water losses and poor service delivery until about 2008. Physical losses due to leakage from pipes were over 50% and collection efficiency (percentage of water bills collected) was just 62%. A Turnaround Program in 2009–2010 was supported by an ADB project. When completed in 2016, about 5.44 million people had continuous potable water supply from taps without requiring further treatment, with pressure sufficient for two-story houses.

The turnaround was anchored in infrastructure investments and policy reforms combined with visionary leadership, technical innovation, social inclusion (by supplying potable water to informal settlements), and a strong focus on public education programs and civil society involvement. In 2018, overall non-revenue water in Dhaka had fallen to 20%, with levels of less than 10% in established District Metering Areas in project areas. Collection efficiency reached 97.5%, with continuous pressurised water supplied to all customers.

Source: ADB (2016), Dhaka Water Supply Network Improvement Project. Manila; and DWASA. 2019. https://dwasa.org.bd/. ADB (2020) Asia's Journey to Prosperity: Policy, Market, and Technology Over 50 Years). http://dx.doi.org/10.22617/TCS190290.

4.1.2. Build capacity for economic regulation

Independent economic regulation, including improved operational performance and tariff reforms, can support the transition towards sustainable financing strategies. Key features of well-defined independent regulation are to separate functions and powers of policy from operations, and to incentivise greater performance and accountability from local authorities, operators of water services and water users. Such oversight could provide technical support to local authorities, strengthen the transition to full cost recovery tariffs, and ensure consistency of tariffs across regions and communities (OECD, 2018c; 2015b).

Experience in England and Wales can inspire other countries where independent regulation is missing; the economic regulator in England and Wales, Ofwat, is a non-ministerial government department, accountable to Parliament rather than a minister. It makes independent decisions, guided by government policy objectives, to ensure that the delivery of water supply and sanitation is efficient, the level of charges fairly reflect and fund the quality of service delivered, and that there are equitable, transparent grievance and remedy mechanisms that allow individuals to complain (OECD, 2018c).

While this model may remain a distant objective in most countries in Asia-Pacific region, other options can be explored. Typically, independent regulation can be achieved by any one, or a combination of, the following four models (OECD, 2015b):

- Regulation by government. The public sector is responsible for the management of the water services and owns the assets. Service provision is delegated to public water operators while regulatory functions are carried out directly by the State at different levels: central, regional or municipal. This is the model adopted in the Netherlands, and to a lesser extent, in Germany. The challenge for this regulatory model is that one public body is regulating another.
- Regulation by contract. The regulatory regimes are specified in legal instruments, and although public authorities are responsible for regulation, water service delivery can be delegated to private operators through contract agreements. These set the rights and obligations for each contracting

entity, and service provision is awarded to private companies following public tender. This model is used in France.

- Regulation by one or multiple independent regulators, where independence has three dimensions: independence of decision making, of management and of financing. This is the model used in the United Kingdom, where the regulatory framework is organised around three dedicated agencies with statutory functions relating to pricing and customer service (Ofwat), drinking water quality (Department for Environment, Food and Rural Affairs), and environmental regulation and security of water supply planning (UK Environment Agency).
- Outsourcing regulatory functions to third parties. This model makes use of external contractors to perform activities such as tariff reviews or benchmarking.

The chapter on governance in the Asia Water Development Outlook sheds some light on prevailing arrangements in the Asia Pacific region. Arrangements at national level need to reflect the fact that in developing countries – especially those with sizable informal sectors – governments and/or utilities may currently oversee and provide water services in coexistence with informal (private) providers, as well as with unregulated direct user access to e.g. surface water or groundwater sources. This makes economic regulation more complex and will affect the appropriate combination of the 4 options listed above.

Where national regulators do exist, they may need to be strengthened. Water supply and sanitation utilities will progressively need to finance larger portions of their investment through revenue collection. This will require enhanced monitoring of operational efficiency, strengthened revenue-raising capacities and the introduction of proper incentives. An important consideration will be how to include depreciation of existing assets in the calculation of allowable tariff levels – an issue for many OECD countries (OECD 2020a).

4.1.3. Encourage connections, where central assets are available

A significant share of the population in the Asia-Pacific region does not have access to adequate, safe water supply and sanitation services. Connection to central supply and water treatment systems, where possible and sustainable, should be encouraged, possibly through regulation, for example with a direct subsidy to households to cover (parts of) connection fees or by allowing one-time connection fees to be paid in smaller increments over time. Increased connection rates provide multiple benefits, not only for health, well-being and productive societies, but also as a source of new revenue for utilities and reduced costs of water pollution.

Of course, in remote or sparsely populated areas, individual and other appropriate sanitation systems (IAS) have comparative strengths. Discussions can be complex about the design of appropriate infrastructures that reflect local conditions (geography and typography, density of settlements, sensitivity of receiving environments, etc.; for a discussion in a European context, see OECD, 2020a).

IAS face limitations as well. Risks of inappropriate management of wastewater streams emerge, where IAS are poorly designed and operated, leading to suboptimal service to the population and potential harmful consequences on human and ecosystems health. The challenge is to ensure IAS contribute to national water policy objectives, which requires proper monitoring of their performance. Lessons can be learned to support the development of national strategies for IAS.

Options to encourage connection to central water supply and sanitation services, where possible, include:

- direct government subsidies for connection fees;
- incorporating the cost of connection into the overall capital cost (and making it eligible for ODA, where available);
- increased monitoring, enforcement and issuance of financial penalties for mismanagement of individual and other off-grid sanitation systems (noting that such policies require thorough assessment and inclusive stakeholder engagement to avoid unduly penalising or marginalising disadvantaged or vulnerable groups);
- public education and awareness on the health and environmental impacts of absent or inadequate water and sanitation services, and the consequences of inaction.

4.1.4. Strengthen capacity and monitoring to use available funds effectively

Financial disbursement and the capacity to use funds effectively play a critical role in allocating funding when and where it creates most value. Many countries face difficulties in utilising all available funding, and to invest available funds in an effective and efficient way. Half of the countries reporting on the absorption of external and domestic funds in the latest GLAAS survey utilised less than 75% of official donor capital commitments and/or domestic funds. These countries were China, India, Kyrgyzstan, Lao, Micronesia, Nepal, Papua New Guinea, Solomon Island, Thailand, Uzbekistan, Vanuatu and Viet Nam (UN-Water and WHO, 2019).

Delays in the disbursement and utilization of funding can affect the robustness of project selection and implementation, or generate tensions with donors and ministries of finance, which may be tempted to redirect available finance to sectors where funding can be used effectively. In such contexts, the capacity to use funds effectively should be strengthened. Along with general capacity building and institutional support, this could be done through developing a strong project pipeline and measures to ensure the sustainability of investments. Other issues will need to be addressed, which go beyond the water sector and the ambition of this report; for instance, political instability, constraints on service providers' authority or accountability for serving certain communities or populations, cumbersome public procurement procedures, or labour shortages in the civil works and construction industries.

4.2. Minimise future investment needs

Options discussed in the previous section contribute to making the best use of existing assets and financial resources. They also minimise investment needs in the future, for instance by postponing the need to renew existing infrastructures. There will also be other opportunities to minimise future investment needs through policies that sustainably manage water resources, through policy coherence, planning and setting priorities, and by avoiding building future liabilities. Sequencing investments within a catchment can enable the costs and benefits to be shared, innovative technological solutions can lower costs, and nature-based solutions can be a cost-effective option with multiple benefits.

The ensuing sections present policy insights and guidance on the following measures to minimise future financing needs:

- Develop plans to future-proof the water sector. This requires plans that set priorities and drive decision-making, manage uncertainties and increase resilience;
- Support plans with realistic financing strategies;
- Encourage policy coherence across water policies and other policy domains;
- Manage water demand, and strengthen water resource allocation;
- Develop flood risk mitigation strategies;
- Exploit innovation in line with adaptive capacities.

4.2.1. Develop climate-resilient plans to future-proof the water sector

To make the best use of existing assets and financial resources, many countries would benefit from improved planning and priority setting. Developing national and local plans to future-proof the water sector of Asia-Pacific countries requires plans that set priorities and drive decision-making, manage uncertainties and increase resilience to future climate and socio-economic change.

Climate change poses new challenges for water-related investment: it requires flexibility in a domain characterised by long-lived, capital-intensive infrastructure, and foresight where projections of future rainfall variability and other climate conditions remain uncertain. Further, investments outside of the water sector – such as urban design or the construction of physical assets in flood plains – influence the exposure and vulnerability of people and assets to water risks. This is especially the case in contexts with informal settlements and urbanising populations that include poor or vulnerable groups. These challenges call for placing resilience at the core of water investment, financing and planning. Resilience metrics can support the design of plans that adjust to shifting circumstances.

Investment planning should also factor in demographic trends. This includes, for example, the depopulation of rural areas and smaller towns[6] to avoid over-investment in oversized infrastructure that will be costly to operate and maintain in the future, and conversely, increased demand triggered by urbanisation, population growth and drought.

Effective planning and sustainable water security require undertaking cost-benefit analysis on sequences (or portfolios) of projects and carefully consider how pursuing a specific project may foreclose future options or inadvertently increase vulnerability to water risks. For example, investment in irrigation systems usually reduces the adverse effects of rainfall variability on agriculture, but may also amplify the impacts of drought by encouraging cultivation of water-intensive crops, which cannot be sustained under extreme conditions (Damania et al., 2017). Setting priorities can also contribute to cost-effective flood protection. Identified flood hazard areas should be reviewed to assess populations and areas at highest risk and to prioritise investments accordingly.

Going beyond the compilation of individual projects, plans should consider how investments can be sequenced over time to improve resilience. This requires a shift from cost benefit analysis at project level to an assessment of the value created by investment pathways that combine and sequence a series of investments.

Effective plans must be consistent with initiatives in other sectors. For instance, water management plans should be accompanied by a viable strategy for irrigated agriculture in line with sustainable aquifer management and water quality objectives. Urban planning, land use control and flood mitigation must also be consistent. For example, Korea's rapid urbanisation has led to the area of urbanised and paved areas

[6] The rural population in Asia is projected to reduce by 16% by 2050 (UN DESA, 2018), which has implications for current infrastructure development.

doubling between 1989 and 2009. Over the same period the area of grasslands decreased by 24% and wetlands by 61%. New factories and other developments are often constructed in flood risk areas, compounding runoff problems rather than seeking a runoff-neutral or positive impact. At both a basin and a local scale, these changes all increase flood risk (OECD, 2018c).

Water plans should embed clear objectives, with a detailed and costed strategy to achieve these objectives and which demonstrate consideration for cost-efficient and socially inclusive measures. Countries should consider three main issues when identifying sustainable financing strategies for the sector:

- planning water supply and sanitation services, flood protection and irrigation expansion and efficiency in line with overall national objectives;
- identifying the costs of reaching national objectives beyond investments; and
- designing a financing strategy based on a sound knowledge of financial flows, leveraging efficiency gains and different sources of funding.

However, one barrier to analytical work and effective planning for the water sector is the lack of data and patchy information on water expenditure, financial flows and financing needs in Asia-Pacific countries – this needs to be addressed as a priority. The appropriate level of effort can only be known with accuracy when member states compile robust knowledge on the state of the assets. Data is fundamental to understanding where the risks are highest, what is driving these risks, and what investment and finance approaches are required in order to mitigate these risks. Data is necessary to inform project preparation and selection by governments, development finance institutions and other partners. More fine-grained analyses can also support exploration of options to minimise financing needs and harness additional sources of finance.

4.2.2. Support plans with realistic financing strategies

Plans and priorities should be accompanied by robust and realistic financing strategies. In reality, governments' reflections on optimal management models for water and sanitation services can only go hand in hand with a reflection on financing options and a realistic financing strategy. It is crucial to understand existing financial flows in the sector when designing a financing strategy. In particular, the water supply and sanitation sector should seek to assess how much is currently allocated from all financing sources (tariffs, taxes and transfers) and who is financing the sector. In this assessment, a critical question for governments is whether public funds are being allocated in the most effective and equitable manner, which is most often not the case. For example, public funds and subsidised tariffs often benefit high-income households and those already connected, or are directed towards urban areas (rural areas often receive less funding than urban areas).

When designing a financing strategy, the following should be considered:

- allocating national funds in priority sub-sectors (i.e. rural settings, informal settlements in urban and peri-urban areas, or for vulnerable groups, etc.), for which other sources of funds (e.g. from users) are difficult to leverage;
- identifying strategies to leverage and increase other financial contributions, particularly from users; and
- identifying mechanisms to increase public funds from national governments and external donors.

Financing strategies should clearly set priorities and drive investment decisions, and be developed in cooperation with national and local authorities. They should include provisions for improved operation and maintenance of water infrastructure, accounting for the backlog of under-investment in maintenance over the past decades. Strategies should also include targeted social measures to address affordability constraints and solidarity mechanisms to help cover investment costs in communities where financing capacities are especially limited.

Prioritising the use of public funds is not only a matter of equity, but also a matter of developing the right incentives for service providers and delivering more value for money. Targeting subsidies to the right scale and type of service can generate more value for money. For example, many governments tend to subsidise sewers and associated wastewater treatment in urban areas while maintaining explicit policies not to subsidise on-site sanitation in peri-urban or rural areas (Goksu et al. 2017). Bangladesh has used the 2005 Pro-Poor Strategy for Water and Sanitation to identify extremely disadvantaged households whose basic minimum need for sanitation is unmet and to establish strategies to allocate resources to those households (UN-Water and WHO, 2019).

The prioritisation of investments should systematically explore opportunities to combine funding to serve multiple objectives (water supply, flood risk management, pollution abatement, improving ecological status, etc.) to improve cost-effectiveness. Prioritisation should be considered in terms of policy objectives as well as geographies. Priorities should reflect cost-benefit analyses and similar metrics.

4.2.3. Encourage policy coherence across water policies and other policy domains

Policy coherence can contribute to minimising future financing needs. Coherence between water supply, sanitation and flood protection with agriculture policy and urban planning is a case in point, as it could deliver a number of significant co-benefits. An assessment of policy alignment between sectors can reflect how much water contributes to – and benefits from – broader economic development. It can also reflect how investments in other sectors contribute to water; this is potentially the case for land use and urban development; energy supply and climate change mitigation; and adaptation to climate change. In particular, the way water is valued in society and the economy can drive investment decisions and motivate willingness to pay by stakeholders who benefit from improved access to water supply and sanitation, flood protection and water security.

Alignment is also required between finance sectors, for example between climate and water finance. Climate finance will remain an important category of aid. National and multilateral institutions are beginning recognise that all water-intensive investments should be assessed for the special risks associated with the water cycle. The transition to converting water finance into water-climate finance is challenging and uneven in application. The broader investment community has been even slower. However, in a time of rapid climate change, investment instruments should be aligned to build climate change resilience (Matthews, 2019). The new Global Commission on Adaptation has addressed some of these issues with the following finance recommendations (Smith et al. 2019):

- Align “climate finance” and “water finance” by using complementary investment criteria to expand the pool of finance available to accelerate mainstreaming of climate-resilient water management.
- Evaluate how to reduce financial risks related to transboundary water cooperation at the project development stage, given the potential for conflict as water regimes shift.
- Expand access to insurance products to manage residual risks of water-related disaster losses, and to broaden the pool of investors sharing shifting risks.
- Treat climate change impacts on water availability, quality and risks as a critical factor in economic analyses, as well as for social and environmental responsibility assessments, giving consideration to the uncertainties of these impacts over both the financing term and the operational lifespan of the investments.
- Water efficiency is often an important consideration in finance and in economic evaluation, but efficiency should more often be seen as one part of a larger suite of adaptation actions, and not all forms of water efficiency result in robust and flexible adaptation. Moreover, efficiency can also promote a net increase in water consumption or the loss of co-benefits that may derive from some less efficient approaches to water management.

4.2.4. Manage water demand, and strengthen water resource allocation

Increasingly, planning for water security (water shortages, floods and coastal erosion) needs to consider resilience to external shocks. Exposure to climate change is growing. Changing patterns of water resources, together with rising demand for water services in urban agglomerations and irrigation in rural areas, are exerting pressure on service providers to diversify sources of water and to manage demand. Illegal or uncontrolled abstractions - from households and farmers - compound the problem of water demand management (see Carrard et al., 2019).

Water demand management can go a long way to minimising future needs to invest in supply augmentation. Options may include tariff reform, abstraction charges and awareness raising campaigns to reduce the need for costly supply augmentation. A water tariff structure can contribute to driving water use efficiency, with a higher proportion of volumetric charges (and a lower proportion of fixed charges).

Abstraction charges in most countries are typically low or non-existent. However, freshwater abstraction charges to all users can signal the value of water and limit the pressure on water resources, particularly groundwater. Groundwater and surface water abstraction charges should be set in a manner coherent with each other, to account for potential substitution effects. When water abstraction is metered, a volumetric charge should be applied. If abstraction is unmetered, a flat abstraction charge or one based on a proxy, such as area of irrigated land (preferably in conjunction with the type of crop), can be used as a more rudimentary alternative in the interim (Ambec et al., 2016).

The price should reflect the trade-off between abstracting water now or in the future, particularly for non-renewable groundwater resources (OECD, 2017a). The revenue raised could be earmarked to fund water restoration activities. In addition, collection of water bills, particularly for unregistered abstractions and dealing with illegal abstractions should be a priority in countries where this is an issue, to manage demand and ensure sustainable water abstractions. Such interventions should consider how penalties for illegal abstraction might affect certain populations' access to and use of safe, sustainable water supply and sanitation services (for example, for vulnerable populations or residents of hard-to-reach areas such as remote regions and informal settlements).

Many countries which face severe financing challenges could benefit from well-designed water allocation regimes. Water is frequently allocated to low-value agriculture uses, driving costly investments in supply augmentation and depleting the resource. A reform of water allocation regimes would contribute to water use efficiency, discourage wastage and low-value uses and secure water for the health of ecosystems (OECD, 2017a; 2015c).

In Australia, inadequate water allocation regimes have led to costly reforms to buy back entitlements to contribute to environmental flows and to allocate water towards higher value uses (e.g. Wheeler and Grafton, 2018). Unsustainable water allocation regimes can also lead to costly investments in supply augmentation via desalination.

Uncontrolled expansion of groundwater irrigation is not sustainable for many Asian countries. Cheap and subsidised electricity has made groundwater pumping a feasible irrigation option for millions of farmers across Asia (Shah, 2010). Although this has had positive implications for food security and poverty reduction, it has also led to widespread groundwater depletion. The Indian subcontinent has some of the highest levels of groundwater depletion in the world, with at least half of the subcontinent's groundwater being extracted faster than it is being replenished (Wada, 2014). Responding to Asia's groundwater crisis is key to ensure the sustainability of irrigation and agricultural production in the region. This will include, among others, reducing perverse subsidies for groundwater pumping and developing institutional incentives for sustainable and conjunctive use of surface and groundwater resources (AIIB, 2019). The Box 4.2 below illustrates two strategies to reverse groundwater depletion, in India and Japan.

Box 4.2. Strategies to reverse groundwater depletion: examples from India and Japan

In several states in India, integrated policies for electricity and groundwater allocation have shown mutual benefits for the conservation of both resources. In a context where metered tariffs for electricity were difficult to enforce because of strong opposition, transaction costs and corruption, the combination of a bifurcated power supply system, flat tariffs and rationing appears to be a practical solution. The scheme has created enhanced predictability in terms of quantity and quality of electricity access for both farmers and non-farmers, resulting in a significant decline in the power consumed by the agricultural sector and cost of related subsidies. At the same time, the scheme has resulted in decreased groundwater consumption, allowing for depletion to slow down. Moreover, water well owners have experienced declined risk in terms of pump maintenance costs and power shortages.

In response to declining groundwater levels, the city of Kumamoto, Japan have utilised a payment for ecosystem services scheme to reverse the groundwater depletion. It also illustrates the importance of policy coherence across agricultural, urban and water policies. Initially launched by the private sector in partnership with farmers, the scheme later expanded to include local government. The integration of the payment for ecosystem services scheme into the local government's broader groundwater management policies has allowed for a more sustained response as well as broader collaboration with an increased number of stakeholders from the public and private sectors as well as civil society. The stakeholders demonstrated a solid understanding of the availability of groundwater resources in the area, the challenges associated with depletion and the possibility to augment supplies through recharge. The programme has facilitated the restoration of groundwater levels and demonstrates how such schemes can provide effective incentives for groundwater recharge while providing greater security of supply for groundwater users.

Source: OECD, 2017a.

Water pricing, typically in the form of abstraction charges, is a key element of a well-designed water allocation regime. Pricing can contribute to cost recovery, internalise negative externalities associated with water abstractions, and send a price signal to users to discourage inefficient and low-value water uses. Scarcity pricing could help to signal the scarcity value of the resource, but has proven difficult to implement to date.

Public support for irrigation can induce a shift towards more water-intensive crops (Damania et al., 2017). Whilst investments in irrigation can increase the productivity of land and reduce the impacts of climate (particularly in areas of rain-fed agriculture, and therefore improve livelihoods, food security and nutrition), the economic and political justifications for future irrigation investments depends on three key factors, which should be carefully considered (Rozenberg and Fay, 2019):

- Local water availability, which is dependent on demand and competition for limited freshwater resources (e.g. for domestic, industry and energy use, and environmental flows), and increased rainfall variability associated with climate change;
- Competition and demand for suitable land for irrigation expansion; and
- Global food markets and the ability to reliably import food from other regions with more reliable, plentiful water resources.

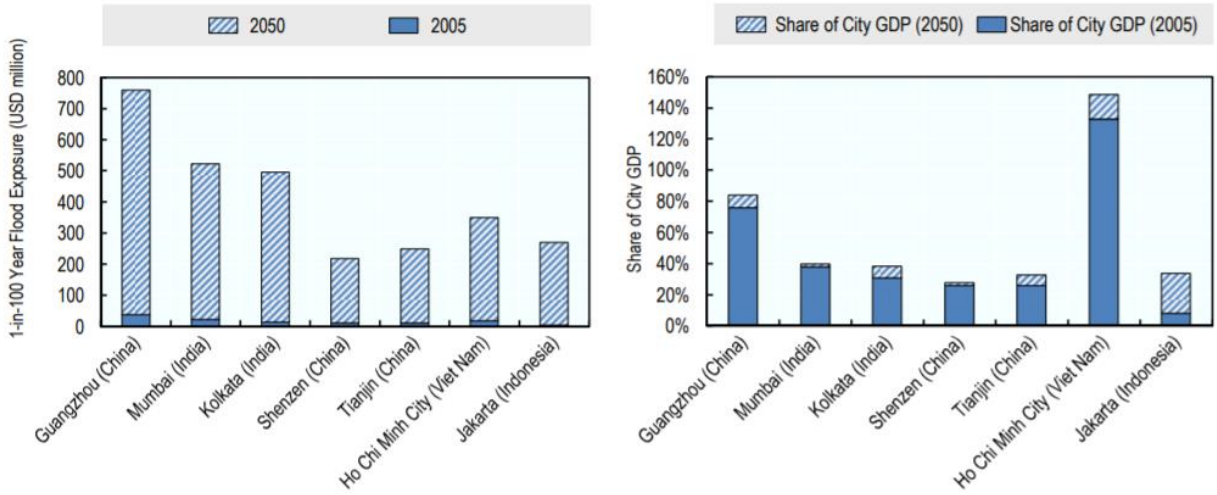
A periodic "health check" of current allocation arrangements can help to assess the achievement of reforms and areas for further improvement. The OECD "Health Check" for Water Resources Allocation can provide useful guidance for such a review (see OECD 2017a; 2015c). It is a tool designed to review current allocation arrangements to check whether the elements of a well-designed allocation regime are in place

and to identify areas for potential improvement. In general, as the risk of shortage increases, the benefits of a more elaborate allocation regime increases.

4.2.5. Develop flood risk mitigation strategies

In Asia, a number of mega-cities are located in coastal areas and are expected to face substantial growth in potential losses as a result of population growth and economic development, sea-level rise and subsidence (OECD, 2016a) (Figure 18).

Figure 4.2. One-in-100-year flood exposure in Asian mega-cities: 2005 and 2050



Source: OECD (2016a).

The probability of major flood events is projected to increase due to climate change-induced impacts on river discharges, sea level rise and extreme weather events. At the same time, economic and population growth – alongside other changes, such as rapid and sometimes uncontrolled urban development – are increasing the risk exposure to, and the cost of damages from, flood events. As illustrated in section 2.2, this means that more investments in flood risk prevention and protection will be required to maintain current flood protection levels in the future.

There are two key areas of investment for flood risk management (OECD, 2016a):

- Investments in lowering flood risk, and thus minimising the need for investments in flood protection infrastructures; and
- Provision of financial protection in case of flood events, thus compensating flood losses and damages.

Strategies to lower flood risks include:

- reducing exposure to flooding and minimising investment needs, through flood risk maps and land-use planning (such as restricting areas to build, or designating water catchment areas in high risk areas);
- investing in structural protection, such as building and maintaining dams and dykes; and
- investing in nature-based solutions, such as wetlands and sustainable drainage systems, which can reduce flood risk and provide additional benefits for biodiversity, recreation, carbon sequestration and water quality.

Financial protection is required in case of flood events. This is typically provided through flood insurance and disaster assistance. Awareness of the link between risk prevention and risk financing is important. Flood events provide a window of opportunity for policy change and demand for government to invest in managing flood risk. At the same time, governments should not wait for a major flood event or a crisis before justifying action.

Flood protection strategies vary with wealth and location. Future investment costs depend on construction costs and risk aversion (tolerance of risk and choice of protection level). To date, flood protection is largely financed through public grants, aid or concessional finance. This can create significant costs for governments in terms of both investments in risk reduction and emergency responses and reconstruction (OECD, 2016a). This can be especially burdensome in times of growing public budget constraints. Given the often limited budgets for flood protection and maintenance, cities will likely have to use a combination of structural approaches and nature-based solutions, as well as residual risk communication and early-warning systems. In rapidly urbanising countries, land-use management to prevent urban expansion in new flood-prone areas is likely to be more cost-effective than hard protection.

Rapidly urbanising contexts and informal settlements represent a particularly complex policy challenge, and require consideration of flood risk in tandem with other socio-economic conditions that can also affect populations' risk exposure. Land tenure policies have a critical role to play.

Countries should explore alternative sources of finance to leverage existing funding including (Koehler et al., 2014):

- Economic instruments, to provide a monetary/economic incentive promoting efficient flood risk management and risk reduction; they can be either administered by the government or by private entities. This includes natural resource pricing, taxes (e.g. property taxes in high-risk areas), subsidies (e.g. tax reduction on land in safe areas), marketable permits, payments for ecosystem services, licenses, property rights, habitat banking and trust funds; and
- Risk financing instruments, comprising all instruments that promote the sharing and transfer of risks and losses. These are pre-disaster arrangements coming into play in a post-disaster phase. They include insurance, weather derivatives and catastrophe bonds.

In the context of an integrated flood risk mitigation strategy, both economic instruments and risk financing instruments can contribute to reducing exposure to flood risks. Economic instruments can often raise new revenues to be invested in flood protection and reduce pressure on public budgets. In addition, some economic instruments can influence behaviour, further reducing exposure levels, for example, by providing incentives for building and buying properties outside of at-risk areas.

Insurance schemes (including micro-insurance schemes), if properly designed, can steer behaviour towards reduced exposure levels, serving as a risk-sharing and risk-communication instrument. For example, mandatory insurance with premiums that reflect flood risk can be required for new buildings in at-risk areas, making it less convenient to develop land in such areas. If risks are correctly priced in premiums, insurance allows location in hazard-prone areas for those who are ready to bear the risk, without increasing a burden on taxpayers (Filatova, 2014). Countries with higher levels of insurance penetration face reduced negative impacts on economic output (OECD, 2016a).

4.2.6. Exploit innovation in line with adaptive capacities

Innovative technologies and management systems are being developed, which provide opportunities to reduce investment needs in water supply and sanitation, flood protection and irrigation. Countries where additional infrastructure is required (e.g. where the gap to compliance with SDG 6 targets is greatest) may find greater opportunity to adopt alternative systems and techniques, and ultimately perform better with less capital costs. Countries already equipped with infrastructure may face challenges to transition towards

alternative systems; technical path-dependency and risks of stranded assets can limit the appetite for and the feasibility of alternative systems, at least in the short term.

Water-related innovation is multifaceted (Leflaive, Krieble, Smythe, 2020):

- In agriculture, innovation is associated with the development of water-efficient irrigation technologies, the design of less water-intensive and more resilient crop cultivars, and the adoption of practices that reduce nutrient flows back to water bodies.
- In manufacturing, it deals with more water-efficient and cleaner production practices, appliances, and more effective treatment techniques. Similar opportunities are associated with water supply and sanitation.
- There are opportunities to transition to a circular economy, for example, to reuse wastewater (particularly in water scarce regions), to provide water quality fit-for-purpose (and therefore reduce water treatment costs), and to convert biogas to energy at wastewater treatment plants. Where economies of scale cannot be reached for large central water and sewerage networks, decentralised infrastructure provides an alternative option.
- Innovation applies to water storage management techniques, monitoring of river flows and pollution loads, and the operation of infrastructure. Smart water technologies cut across these boundaries: they allow the users to monitor, manage and act on data relating to the part of the water cycle that is pertinent to their interests.
- Advancements in data management, associated with optimisation of monitoring systems, can lower costs of monitoring and demonstrating compliance with regulations, and operating water service systems. Online and real time data will become more readily available for flows, pollutants and quality of water at source and at the tap.
- Nature-based solutions, such as restored or constructed wetlands, reclaimed floodplains and sustainable urban drainage systems, can provide multiple benefits and often be less costly to operate and maintain than their engineered alternatives (Box 4.3).

Innovation does not come in isolation; innovation delivers best when combined with financial and governance measures, and when the interface between urban and rural environments is properly addressed. For example, sustainable urban planning, water-sensitive urban design, innovative business models and dedicated policies to drive innovation can all minimise future financing needs (Leflaive, Krieble, Smythe, 2020).

Box 4.3. The case for boosting investments in nature-based solutions

Nature-based solutions (NbS) involve the use of natural or semi-natural systems that utilise nature's ecosystem services in the management of water resources and associated risks. NbS are increasingly part of the response to water-related risks. For example, conservation or expansion of floodplains can increase water infiltration and reduce flooding risks to cities, while simultaneously supporting agricultural production and wildlife, and providing recreational and tourism benefits. Likewise, permeable pavements and the creation of green spaces can enable surface water to infiltrate the soil, replenish aquifers, and reduce polluted stormwater runoff. The equivalent traditional engineered ('grey') infrastructure solutions include dams, dykes, artificial groundwater recharge, and wastewater treatment plants.

The multiple potential benefits of NbS should be factored into investment decisions. For instance, countries could consider the introduction of stormwater taxes to property developers for impermeable surfaces to raise revenue for flood protection measures and incentivise nature-based solutions, such as sustainable urban drainage systems. France has experience with the introduction of a tax on impervious surfaces to finance urban drainage. Restrictions on land development in flood plains, including wetlands, could also be introduced. For example, Canada has a "no-net-loss" wetland policy, meaning if a wetland is lost due to development, if must be off-set by investing in a wetland elsewhere.

In certain cases, it has been shown to be cost-effective for cities to combine investments in both NbS and grey infrastructure (see table below). Apart from having a lower environmental impact, investments in NbS are generally: less capital intensive; have lower operation, maintenance and replacement costs; avoid lock-in associated with grey infrastructure; and appreciate in value over time with the regeneration of nature and its associated ecosystem services (as opposed to the high depreciation associated with grey infrastructure). NbS can also avoid or postpone the costs of building new, or extending existing, grey infrastructure. They can therefore help communities stretch their infrastructure investments further by providing multiple environmental, economic and social benefits.

Table 4.1. Hybrid water security strategies: combining NbS with grey infrastructure

Service	Gray Infrastructure Components	Examples of Green Infrastructure Components and their function
Water supply and sanitation	Reservoirs, treatment plants, pipe network	**Watersheds**: Improve source water quality and thereby reduce treatment requirements **Wetlands**: Filter wastewater effluent and thereby reduce wastewater treatment requirements
Hydropower	Reservoirs and power plants	**Watersheds:** Reduce sediment inflows and extend life of reservoirs and power plants
Coastal flood protection	Embankments, groynes, sluice gates	**Mangrove forests:** Decrease wave energy and storm surges and thereby reduce drain and pump requirements
Urban flood management	Storm drains, pumps, outfalls	**Urban flood retention areas:** Store stormwater and thereby reduce drain and pump requirements
River flood management	Embankments, sluice gates, pump stations	**River floodplains:** Store flood waters and thereby reduce embankment requirements
Agriculture irrigation and drainage	Barrages/dams, irrigation and drainage canals	**Agricultural soils**: Increase soil water storage capacity and reduce irrigation requirements

Source: Browder, et al. (2019); OECD (2020b; 2016b; 2015a; 2015d).

4.3. Harness additional sources of finance

Most Asia-Pacific countries would benefit from exploring options discussed in previous sections, to make the best use of existing assets and financial resources, and to minimise future financing needs. These options can contribute significantly to closing the financing gap, in particular in countries where this gap is widest. Still, additional finance will be required to close the gap.

A diversity of financing approaches will be needed to respond to the diverse risk-return profiles of water-related investments. Asia's investment deficit in water supply and sanitation, flood protection and irrigation infrastructure will require leveraging financial resources from all potential sources. Governments need to increase contributions from domestic funds, in addition to seeking funding from external agencies. Governments also need to put in place measures to increase user and beneficiary contributions, and to attract private investment; making the transition from concessional financing to crowding in commercial capital will be crucial.

The ensuing sections present policy insights and guidance on the following options to harness additional sources of finance:

- Ensure tariffs for water services reflect the costs of service provision
- Consider new sources of finance from users and beneficiaries
- Leverage funds to crowd-in commercial finance.

4.3.1. Ensure tariffs for water services reflect the costs of service provision

The discussion on tariffs usually focuses on tariff levels. Other dimensions of tariffs as policy and financing instruments are also valuable: the tariff setting process, the tariff structure and the collection of water bills; accompanying measures, to address social (affordability) issues matter as well. They are considered below.

Tariff setting remains a highly complex and politically charged issue. If tariff levels are set too high, then consumers may face affordability issues, reduce water use, or change their water access behaviours (e.g. seek water from informal/private and potentially unsafe sources), leading to reduced revenues for the service provider and possible public health implications. Conversely, if tariff levels are set too low then tariffs do not cover the operational and/or capital costs leading to a reduction in the quality of services and premature aging and replacement of costly infrastructure. These tariff challenges have a direct influence on the credit-worthiness of a utility and water agencies (AIIB, 2019).

In a number of countries (such as Tajikistan, Armenia, Kazakhstan and others) there is room for manoeuvre to increase water supply and sanitation tariffs, to better reflect the costs of service provision, without adversely affecting affordability. Increases of water supply and sanitation tariffs can ensure adequate funding for service providers and control water consumption.

In some countries (such as Mongolia, Viet Nam, the Philippines, Indonesia and Bangladesh) affordability concerns may act as a constraint on tariff increases. However, instead of acting as a barrier to tariff increases, affordability concerns can be (and are best) addressed outside of the water bill, through well-designed and targeted social measures (Leflaive, Hjort, 2020). These may take the form of cross-subsidies across water users or territories (from urban to rural areas). Aggregation of service providers or organising authorities can facilitate such transfers. Another option is to introduce seasonal tariffs in touristic areas, matching peak demand. Experience with sophisticated tariff structures, such as increasing block tariffs, has been less successful. They require a lot of information, which may not be available, and can end up being regressive, often benefitting higher income households that can afford water-efficient appliances and to pay more for water services, while disadvantaging the poor or vulnerable groups that may reside in crowded households (Leflaive, Hjort, 2020).

Income from water bills should be ring-fenced and earmarked to finance expenditures directly related to the service. At a minimum, it should cover operational and maintenance expenditure, and ideally (part of) the capital to improve resilience and levels of service. Economic regulation (see section 4.1) should ensure that the utilities are funded to deliver efficiently the breadth of its services to the required standard. For example, governments need to authorise service providers to collect bills and give them the autonomy to restrict service to non-paying customers (without breaching the human right to water). Such reforms in the early 2000s greatly improved the performance of service providers across Viet Nam, including in the city of Da Nang.

Box 4.4. Cost-Recovery Policy Catalyses Utility Turnaround in Viet Nam

At the start of the 21st century, service providers in Viet Nam, as state-owned enterprises, received financial support from the government that inadvertently promoted inefficiencies. DAWACO, one such state-owned enterprise serving the city of Da Nang (population 1 million), struggled with high levels of non-revenue water and was providing service to only half of the population. In 2005, the government started a reform process to commercialise the water sector and eliminated operating subsidies to state-owned enterprises. A government decree required full cost recovery to be achieved by 2015, and allowed service providers to propose tariff adjustments to cover costs.

These changes required a reform of DAWACO's operating plans and policies, and to raise its own private capital. The plan was supported by the ADB and a EUR 1.9 million grant for a Utility Support Partnership with Dutch firm Vitens Evides International. Vitens Evides International provided technical and operational training to DAWACO employees to increase managerial efficiency, lower operating costs and expand services, especially to the urban poor.

Today, DAWACO is a joint stock company with a mix of employee, government and private ownership. Between 2005 and 2014, the company more than tripled its connections (14,000 of which were to the urban poor), reduced non-revenue water to 17%, and lowered energy costs by 23%. DAWACO's strategy is now detailed in a business plan and a Water Master Plan, both conducted every three years. Success factors included DAWACO staff ownership of the turnaround process and cultural prioritisation of continuous learning and improvement.

Source: AIIB (2019); World Bank (2017).

The primary driver of future investment costs for irrigation is the extent of public support. Charges for irrigation water are commonly absent, despite the negative externalities (e.g. over-abstraction and water pollution) and opportunity costs often associated with irrigation. Subsidies for capital costs from government agencies or basin authorities are common even in high-income countries, such as Australia and New Zealand. In many LMICs, including China, India and Pakistan, all capital costs and part of O&M costs are subsidised by state agencies and water user organisations (Toan, 2016). Countries should transition to greater user contributions towards the cost of irrigation infrastructure and the value of water in order to generate revenue and incentivise water efficiency.

4.3.2. Consider new sources of finance from users and beneficiaries

For other infrastructure that does not easily generate cash flows (e.g. flood protection and irrigation), other sources will be needed to ensure that enough funds are allocated for operation, maintenance and replacement costs. Other sources may include self-financing from water users (e.g. decentralised management of local infrastructure to community user groups), various taxes (e.g. land, pollution) and property developers (e.g. through innovative land value capture techniques) (AIIB, 2019).

The potential of taxes and surcharges to increase public funds allocated to the water sector remains generally underexplored. Most countries would benefit from considering new economic instruments to raise additional revenue for water management and internalise pressures on water bodies (that result from abstraction or pollution). Better reflecting the value of water can act as a driver for improved water management and stimulate further investment. Converting the benefits of investments into revenue streams can increase the risk-return profile of investments to attract financiers.

This may include the introduction of fertiliser and pesticide taxes to reflect the costs of water pollution (and reduce drinking water treatment costs), stormwater taxes on property developers for impermeable surfaces that increase the risk of urban flooding, and payment for ecosystem services from utilities to farmers in exchange for the protection of catchments and drinking water sources. Stormwater taxes on property developers can raise revenue for flood protection measures and incentivise nature-based solutions, such as sustainable urban drainage systems. Other economic instruments are discussed in section 4.2. Box 4.5 describes the successful example of a land value capture instrument to raise revenue for water infrastructure in Casablanca, Morocco.

Revenue collected by way of such economic instruments could be earmarked for water and sanitation or flood protection, feeding into a dedicated water fund, or used by the relevant utility or authority. As with any taxation system, the setting up of environmental taxes requires not only legislation, but also the processes, human resources and finances to enforce them effectively.

Countries could also exploit synergies and combined investment opportunities with other sectors (e.g. urban development, food security, energy security, tourism) that reduce water-related risks (see section 4.2).

Box 4.5. Land value capture: a suite of tools to finance water-related investments. Experience from Casablanca, Morocco

According to the "beneficiary pays" principle, expressed in the Vancouver Declaration during Habitat I (UN, 1976), the beneficiaries of public investments that valorise their land should partly cover such costs or return their benefit to the public. The means by which beneficiaries can pay back include taxes, such as land taxes and betterment charges; development charges or permit fees; pricing and compensation policies; adequate assessment of land values; and leasing publicly owned land (UN, 1976).

Land value capture techniques can foster local urban development. Because public investments and planning decisions on urban development concern land in a very specific, localised manner, land value capture tools are a matter for local governments. Local governments may influence the direction of these projects to ensure the alignment with urban development and spatial planning goals.

Land value capture tools can fund a wide range of urban development projects. Even though they are not associated with any particular type of investment, some projects could particularly benefit from the adoption of such tools, such as urban renewal projects and Transit Oriented Development (TOD) projects, given the great potential to trigger land valorisation.

Experience in water-related projects is limited so far. Casablanca, Morocco, paved the way. Casablanca is characterised by rapid urbanisation; its population is expected to grow from 3.5 million to 5 million inhabitants by 2030. Extending the water network, securing access to the resource and protecting it against frequent floods are serious concerns for the local authority, which needs to finance these projects.

The city defined a new investment programme in 2007. Revenues from user tariffs cover operational and maintenance costs and the renewal of existing assets (accounting for 70% of total cost over the last decade). A dedicated account (fonds de travaux) covers the remaining costs (essentially land acquisition, network extension and social connections). Financed mainly by contributions from property developers, it has financed a growing share of total investment, from 7% in 2004 to 54% in 2014. Property developers also cover the costs of connecting to the network and in-house equipment. Their contribution varies depending on the type of housing (social housing, villas, hotels and industrial zones), and they pay additional costs for developments that do not feature in the master plan. Contributions are waived when the developments take place in underprivileged neighbourhoods and slums.

Source: OECD (2019c); OECD (2015a).

4.3.3. Leverage funds to crowd-in commercial finance

Blended finance can play a critical role in mobilising commercial finance as well as strengthening the financing systems upon which water–related investments rely (Box 4.6). Domestic commercial finance is available across Asia-Pacific countries. However, to date few countries have gained experience in mobilising it for water-related expenditures. A few transactions have been supported by international donors, but these have mostly been in middle-income countries, and they have so far failed to be replicated at scale (AIIB, 2019).

There is room of manoeuvre to attract commercial capital for creditworthy borrowers to finance water-related investments. This may require exploring how public budgets, including cohesion policy funds, and risk-mitigation instruments (e.g. guarantees, credit enhancement instruments) can be used strategically to improve the risk-return profile of investments that can attract commercial finance.

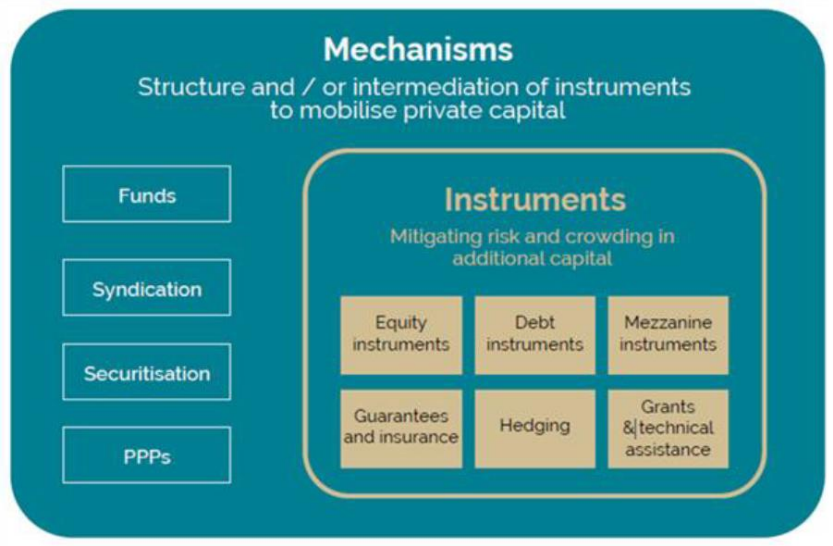
Box 4.6. Blended finance, defined

The OECD defines blended finance as the strategic use of development finance (such as ODA and funds provided by philanthropic foundations) for the mobilisation of additional commercial finance towards sustainable development in developing countries. Blended finance is not an asset class, rather it uses a range of instruments to calibrate the risk-return profile of projects and to address other barriers to private investment.

Blended approaches have a dual aim to: i) mobilise additional capital for investments, and ii) serve a market building role, to help strengthen the financing systems upon which investments rely through greater accountability.

Commercial investors, whether banks, investors, businesses or project developers, respond to, and are constrained by, returns and risks associated with investments. As a result, investments with important public good dimensions may be backed by a sound business case but cannot necessarily be financed by commercial investors due to high risks associated with projects or uncertainty related to returns. In these cases, public support can be used strategically through blended finance to improve the 'risk-return' profile of investments, effectively de-risking investments to borrowers to access commercial finance.

Figure 4.3. Blended finance instruments and mechanisms



Note: PPP = Public-Private Partnership.
Source: OECD (2019a; 2018d; 2017d).

A range of instruments are being used for blending, going beyond the more traditional loans and grants, to the use of guarantees, securitisation, currency hedging and political risk insurance. In this context, greater diversification of instruments could support better targeting of different risks and result in more commercial resources being targeted towards sustainable development outcomes. For instance, guarantees can cover loans from bank and other investors against risks of war and civil disturbance, expropriation, breach of contract, transfer restriction and inconvertibility. Amongst the different models, collective vehicles, such as funds, bring investors together to pool financing and offer opportunities for scaling up blended finance. In particular, structured funds allow donor governments to use concessional

finance in a first loss position to provide a risk cushion for commercial investors. Blending can also occur through equity or debt investments in projects and companies in developing countries.

Beyond guarantees, technical assistance at the transaction level plays a major role in water and sanitation. Technical assistance can have different entry points in blended finance transactions, including for project development, investees such as utilities, or financiers such as banks to set up new lending programmes for the water and sanitation sector. Technical assistance has a particularly crucial role to play in tailoring existing blended finance structures to local contexts.

Examples of the use of blended finance range from facilitating access to microfinance for households to invest in water supply and sanitation in Bangladesh (see Box 4.7 below), to the set-up of a revolving fund for providers in the Philippines (World Bank, 2016).

Box 4.7. Blended Finance to Reduce Rural Sanitation Costs in Bangladesh

Rural populations worldwide generally invest their own financial resources to purchase or build latrines or toilets. But the costs can be prohibitive, especially for poorer households or where there is a lack of competition between providers.

This is the case in rural Bangladesh, where despite high demand for sanitation facilities, households cannot afford to purchase them without paying in instalments. To address the issue, the country has embarked on a project to blend output-based aid and microfinance loans to lower the cost of a latrine and spread repayment out in weekly instalments over one year. The subsidy consists of about $15 per household and will reduce the weekly payment by 11%. A second benefit of the subsidy is that it reduces the risk of the microfinance institutions in their lending.

On the supply side, the financiers are also extending loans to microbusinesses that sell latrines and latrine construction. This work is augmented by World Bank technical assistance grants to train entrepreneurs for construction and help the financiers identify and reach poor households. The blending is expected to leverage USD 22 million in household contributions.

Source: World Bank (2017).

Green bonds have a significant revenue-raising capacity, and offer the opportunity to inject substantial private investment into the water sector. An example of green bonds used to finance nature-based solutions for flood protection in the Netherlands is described in below. In 2016, China launched its own domestic green and climate bond market, which is now the second largest globally. Japan and Korea are also large issuers of green bonds, and expansion of the market is spreading to South Asia (CBI, 2019; Matthews, 2019). Countries have become increasingly active in promoting green finance with national policy packages and localised initiatives. For example, China, Viet Nam, Indonesia and Bangladesh have all adopted their own green finance definitions and introduced sustainable guidelines and regulations (Volz, 2018).

Box 4.8. Green bonds: financing nature-based solutions for flood protection in the Netherlands

Innovative financing models such as green bonds are increasingly explored to attract additional finance. 'Green bonds' is the term that is often applied to environmentally related impact investing. Typical investors in green bonds are large institutional investors such as pension funds, which are interested in long-term, steady returns, and seek "green" credentials for their investments – typically low-impact infrastructure projects and/or climate mitigation and adaptation projects (Matthews, 2019). Repayment of the bonds can come either from public funding or from private funding, in the form of private organisations created to share benefits among members/funders.

In May 2019, the Government of the Netherlands issued a certified climate bond for EUR 5.98 bn to finance projects addressing current and future climate change impacts and an advanced low carbon economy. This is the largest certified green bond to date and the first certified nature-based solution. Much of the bond focuses on using coastal and river ecosystems as a safeguard for negative climate change impacts such as high flood risk, further supporting the Netherlands's "room for river" flood management approach.

The issuance came from the Dutch State Treasury Agency and was certified by Climate Bonds Initiative (CBI)[1]. The bond raised capital for water and flood defence infrastructure projects, as well as renewable energy facilities and low-carbon transportation systems. Projects being financed by the bond include traditional engineered "grey" water infrastructure as well as nature-based solutions, all of which are certified under the Water Infrastructure Criteria of the Climate Bonds Standard by CBI.

The Dutch bond offering has demonstrated a robust market for certified climate bonds. Within 90 minutes of the bond's issuance, investors had placed over EUR 21.2 bn worth of orders for the EUR 5.98 bn of certificates, making the bond oversubscribed by over three times. Investor interest, combined with the need to raise funds for climate resilience projects, means that more certified climate bonds are on the horizon.

Note: 1. The Climate Bonds Initiative (CBI) is an investor-focused not-for-profit, launched to increase investments contributing to the transition to a low-carbon and climate resilient economy. CBI have created a set of principles, verification standards, and sectoral criteria to ensure that investors can trust the climate promises made by issuers, and that the projects being financed have thoroughly accounted for climate risks.
Source: Matthews (2019).

Innovative green finance initiatives have been recently launched in Asia to bridge the finance gap, especially in high priority infrastructure subsectors, such as water supply and sanitation, which traditionally lack investment diversification. Among these is the ADB's pioneering Green Finance Catalyzing Facility (see Box 4.9 below).

Box 4.9. The ADB Green Finance Catalyzing Facility

The Green Finance Catalyzing Facility (GFCF) was designed by the ADB as a tool to create localised green finance solutions and vehicles to drive green growth leveraging public-private sectoral funds. The GFCF explicitly leverages catalytic funds through mixed finance including public funds from development partners, central and local governments, as well as private, institutional and commercial (PIC) finance. The GFCF is founded on the two main pillars of financial bankability and environmental sustainability. It focuses on proactively generating a bankable green project pipeline to attract PIC finance at the project level, rather than raising finance based on the financial strength of the project sponsors. Water-related initiatives eligible under the facility include: (i) water and sanitation to decrease the pollution of natural water bodies; (ii) climate change and disaster resilience; and (iii) land use with the aim of protecting the natural environment and biodiversity. This approach is being piloted in PRC through the Shandong Green Development Fund Project (see https://www.adb.org/projects/51194-001/main).

Another facility with similar characteristics – the ASEAN Catalytic Green Finance Facility – was recently launched (April 2019) to catalyse private capital by mitigating risks through blended instruments. The facility will mobilise USD 1 billion, pooling funds from different actors, including the ADB. The ACGF explicitly aims to derisk projects by using a two-step loan and other supports designed to enhance bankability and hence catalyze in commercial and private capital thus multiplying the impact of the public funds. The fact that ACGF has attracted 13 partners already shows the value of such derisking facilities in the world of blending and catalysing finance to sectors such as water and sanitation.

Source: Cardascia (2019); for more information see https://www.adb.org/publications/green-finance-catalyzing-facility.

The success of blended finance is dependent on the ability to mobilise local commercial investment. Blended finance for water-related investments reinforces the need for, and benefits from, tailoring blended finance to the local context. Water and sanitation services are, by definition, locally sourced and provided, and flood risks and irrigation are best managed at the basin scale. At the same time, the sector requires strong public regulation due to the public good dimension of water and sanitation services and the common pool nature of water resources. These characteristics emphasise the need to work closely with local actors and align with local development needs.

Pooling projects could be an effective way forward to address selected unfavourable project attributes. Providing commercial investors with access to a variety of different transactions in the water and sanitation sector can mitigate concerns around small ticket size, risk exposure, limited sector or regional knowledge, as well as high transaction costs. Pooling mechanisms such as blended finance funds tailor different risk and return profiles for individual investors, with development financiers often taking first loss and junior tranches buffering the risk for commercial investors in the senior tranches. Guarantees, moreover, can strategically mitigate portfolio risk.

Policy recommendations that aim to facilitate an uptake of blended solutions for sustainable development in the water sector include (OECD, 2019a):

- *Design blended finance in conjunction with efforts to improve the enabling environment*. Blended finance cannot compensate for an unfavourable enabling environment, but rather needs to be accompanied by efforts to promote a stable and conducive policy environment. A weak enabling environment characterised by poorly designed or absent regulation, policy settings (e.g. water prices and tariffs) or institutional arrangements, compounded by political interference in the management of (often public) utilities, constrains commercial investment.
- *Increase transparency to make a valid business case for commercial investment*. Commercial investors are cautious about uncertainty regarding any of the risks related to an investment opportunity. With adequate contractual arrangements or blended instruments and mechanisms, it is possible to mitigate a variety of risks, share the remainder with the public sector or commercial co-investors, or take a certain level of risk on the financier's own book. However, in order to make such an assessment, risks associated with an investment should be transparent and quantifiable.
- *Establish policy-level co-ordination and co-operation processes for blended finance*. An excessive reliance on concessional finance can inadvertently crowd out commercial finance, creating market distortions that impede greater accountability and financial sustainability of the sector. Co-ordination and co-operation among development finance actors on their blended finance engagements is a key for the market building aspect of blended finance, particularly when a concessional element is involved. Development financiers should co-ordinate more structurally beyond single transactions. While there is general agreement about the need for improved cooperation, actions on the ground may remain fragmented.

Challenges related to blending include the need for a good enabling investment environment, ensuring that development finance does not crowd out private finance and that the desired development outcomes are realised. Blended finance, starting with concessional elements, should phase out over time and ultimately exit in order to prevent market distortion. An analysis of the exit strategy should be integrated in any programme design (OECD, 2019a).

5 Concluding remarks

For the first time, the Asia Water Development Outlook explores the financing challenges and options countries in the Asia Pacific region face when it comes to water security. As mentioned above, data limitations are significant and affect the capacity to track existing financing flows (how much is being spent and by whom) and project future needs. In turn, data limitations hinder regional comparison, assessment and discussion of the robustness of existing financing strategies and mechanisms, and the relevance of alternative approaches.

This is a missed opportunity, because the region – building on its sheer diversity - has a lot to offer and gain from sharing experience, deciphering what works and what could be replicated and scaled. It has the capacity to inspire robust financing strategies and appropriate financing mechanisms, in other countries.

Financing water security will remain a multifaceted and major issue for countries in the Asia Pacific region. While we hope it provides a valuable contribution, this AWDO could only scratch the surface of the challenges and the opportunities available to national and local authorities and their partners. More work is required to build robust sets of policy-relevant data. Regional cooperation can contribute to a knowledge base that can inspire policy and institutional reforms that are conducive to enhanced water security at the least cost for the communities in Asia and the Pacific and beyond.

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Annex A. Methodological note: Estimating water-related investment needs and financing capacities in the Asia-Pacific

Context

Rationale

This methodological paper stems from the OECD's effort assess the investment needs of Asian Development Bank (ADB) member countries to cover the costs of water supply and sanitation, irrigation, and flood protection by 2030. This assessment aimed to inform the Water Finance chapter for the ADB's Asian Water Development Outlook (AWDO).

The work was mainly driven by desk research into the literature and existing datasets to assess and utilise models that project costs on investment.

The purpose of this methodological paper is to document the methods used to assess investment and ADB member country financing needs for water supply and sanitation, irrigation, and flood protection, with the ambition to replicate or expand the scope in future AWDOs.

Method

The greatest challenge in projecting future costs of water supply and sanitation, irrigation, and flood protection is the lack of baseline data from which to build models and project forward. There currently exists no unified, consistent, longitudinal or cross-sectional database that contains cost or investment data on water supply and sanitation, or on irrigation. Obtaining data from countries on an individual basis by utilising country statistics websites, or liaising directly with country officials to gather data is fraught with challenges relating to definitional consistency between countries, excessive time constraints, and the resulting output would likely not yield a viable data series. To overcome these challenges, we have made use of data and cost analysis produced by the World Bank Group, the Global Water Intelligence (GWI), World Resource Institute (WRI), and the OECD's own datasets.

Drivers and projections of future investment needs

When producing any forward-looking projections, it is necessary to produce and utilise consistent scenarios across various costing models and projections. To this end, we have elected to use the data produced by the International Institute for Applied Systems Analysis and their "Shared Socioeconomic Pathways 2: Middle of the Road" scenario (SSP2), combined with the Intergovernmental Panel on Climate Change (IPCC) Representative Concentration Pathway 8.5 (RCP 8.5). SSP2 represents what is likely to be the closest version of what would typically be a "business as usual scenario" in most projections (IIASA, 2019[1]). For flood risk analysis we make use of the RCP 8.5; RCP 8.5 is the high end of CO_2-equivalent parts per million projections, however our time horizon extends to 2030 and there is not a large difference

between Representative Concentration Pathways in 2030[7]. These choices are also convenient because they are the same scenarios utilised in the data, tools, and analysis in the various costing models from which our analysis draws upon.

The projections do not cover potential changes in the level of water security and associated costs (for example, pubic demand for increased level of flood protection), and do not consider the costs of adapting to climate change.

A summary of the data sources used to assess investment needs in water supply and sanitation, irrigation and flood protection is provided in Table A A.1 and described in more detail in the ensuring sections.

Table A A.1. Summary of data sources: Investment needs

	Description of analysis	Unit	Country coverage	Data sources
Water and Sanitation				
Cost of achieving SDG 6 + Safely managed connections	Model 2015-2030 annual average	$ and % GDP	39/49	WBG: Rozenberg and Fay (2019)
Irrigation				
Cost of irrigation	Model 2015-2030 annual average	% of GDP	Sub-regional estimates	WBG: Rozenberg and Fay (2019)
Flood protection				
GDP exposure of coastal flood risk with Subsidence	Model projected exposure in 2030	$ and % GDP/Population Exposed	44/49	World Resources Institute WRI (2020)
GDP exposure of riverine flood risk			44/49	WRI (2020)

Water supply and sanitation

To produce the water supply and sanitation costs we primarily examine two papers:

The costs of meeting the 2030 sustainable development goal targets on drinking water, sanitation and hygiene by Hutton and Varughese (2016) to estimate the capital costs of connecting a unit person to the appropriate level of water supply and sanitation (Hutton and Varughese, 2016[2]). This examines the broad literature to produce estimates of connection capital costs in under developed and under connected countries.

Beyond the Gap: How Countries can Afford the Infrastructure they need while Protecting the Planet (2019) by the World Bank's Rozenberg and Fay. This paper builds upon the above paper to produce capital, maintenance, and operational costs of connecting and maintaining infrastructure to connect people to safely managed connections of water supply and sanitation. This paper utilises the World Bank's costing model to produce total cost estimates for most of our target countries. These cost estimates are driven by the capital costs estimated by Hutton and Varughese (2016), local spending efficiencies, labour costs, material costs, and the prevalence of corruption (Rozenberg and Fay, 2019[3]).

The World Bank (2019) paper produces national average annual costs[8] for several scenarios by which countries might go about connecting their populations. For the purposes of this study, a scenario based on SSP2 was chosen, by which countries first connect their population with a basic water supply and sanitation connection before then giving their population a high quality, more safely managed connection to comply with SDG targets 6.1 and 6.2 by 2030.

[7] The IPCC Representative Concentration Pathways extend to 2100, which is where you see large differences. Our analysis extends to 2030 where each RCP is still within approximately 5% of each other, and for the purposes of this study, is only needed when projecting flood risk.

[8] These annual costs are not publicly available data.

Irrigation

The data availability of irrigation costs is exceedingly sparse and makes for a challenge. This lack of available data on a country level makes individual country estimates an unwieldy exercise, and projecting individual countries using those estimates a less than fruitful exercise. A more useful exercise is to project costs at the regional level. To this end we utilise the results published in the World Bank (2019) paper *Beyond the Gap: How Countries can Afford the Infrastructure they need while Protecting the Planet*. The authors produce their results using the GLOBIOM-irrigation module; the GLOBIOM is a recursive dynamic land-use and agriculture partial equilibrium model that uses geospatial and agricultural variables, such as crop production, irrigation land use, irrigation expansion, and irrigation efficiency, as its drivers (Rozenberg and Fay, 2019[3]). Projections of irrigation costs are made over the timeframe 2015 to 2030 and uses the Shared Socioeconomic Pathway 2 scenario (SSP2). This model produces regional estimates for capital and maintenance irrigation costs. Compared to capital costs, maintenance costs for irrigation are very small and are not reported in our report.

The scenario reflects moderate public investment support for capital costs for large scale dams, delivery systems, and some costs to expand irrigated areas or upgrade existing irrigated areas to more efficient irrigation systems. And assumes farmers will only expand irrigation or upgrade irrigation infrastructure, if it is profitable.

The scenario also assumes that farmers cover the costs of the parts and materials for farm irrigation equipment and that they face a water price that reflects the relative scarcity of water due to increasing demand from other sectors. So the scenario assumes farmers will only expand irrigation or upgrade irrigation infrastructure, if it is profitable.

Flood Risks

Flood projections cover riverine floods and coastal floods, and account for the compounding risk of land subsidence. Flood protection investment need is defined as the financial resources that are required to maintain actual (existing) flood risk at the same level up to 2030. This includes maintaining protection standards of existing flood defences. A country's flood risk is determined by existing flood protection standards, the corresponding expected economic damage (direct and indirect), and the corresponding expected number of victims (injuries and casualties).

The analysis from the World Resources Institute's Flood Analyser is currently the best available tool to determine exposed assets, and current and future level of flood risk. Their model uses a grid and basin approach to determine the amount of assets exposed and uses the SSP2/RCP8.5 forecasts to examine the assets and populations exposed in 2030. The key advantage of the WRI Flood Analyser is that it models out the increased risk to GDP and populations, and accounts for differences is projected flood protection.

The key drivers of increasing flood risk are climate change and socio-economic development, namely economic and demographic growth. These drivers are projected on three variables: the value of assets at risk of flooding, the number of people affected by floods, and the value of GDP affected by floods. This approach results from the paucity of data on baseline expenditures for flood protection.

River Flooding is modelled by the Global Flood Risk with IMAGE Scenarios (GLOFRIS) modelling framework (Winsemius et al., 2013[4])GLOFRIS simulates flooding using information on hazard, exposure, and vulnerabilities as its drivers, after which the existing level of protection is subtracted out. Similarly, using SSP2, the model simulates river floods and the assets exposed (in terms of GDP and population) after accounting for level of protection (World Resource Institute, 2020[5]).

Coastal Flooding is modelled using the Global Tide and Surge Reanalysis (GTSR) dataset (Muis et al. 2016) dataset. GTSR is a global dataset of daily sea levels (due to tide and storm surge) for1979–2014, based on the hydrodynamic Global Tide and Surge Model (GTSM). Surge is simulated using wind and

pressure fields from the European Centre for Medium-Range Weather Forecasts (ECMWF) Re-analysis-Interim (ERA-Interim) dataset (Dee et al. 2011). Tide is simulated using a separate model, the Finite Element Solution 2012 (FES 2012) model (Carrère and Lyard 2003). Using a similar grid approach as river flooding, changes due to subsidence is added in and projected levels of protection are subtracted out of exposure (World Resource Institute, 2020[5]).

Additional factors that could not be factored in for flood protection investment needs

Pluvial flooding, also termed surface water flooding, stormwater flooding or flash floods, which are triggered by intense local precipitation events, are likely to become more frequent throughout the Asia-Pacific region (and worldwide) due to climate change. This type of flooding has not been considered in this analysis but can be a significant source of future flood risk, and associated investment needs.

Sources of finance and financing capacities

A summary of the data sources used to identify sources of finance and financing capacities is provided in Table A A.2 and described in more detail in the ensuring sections.

Table A A.2. Summary of data sources: Financing capacity

	Description of analysis	Country coverage	Data sources
Financing strategies			
Respective role of revenue from tariffs, public finance	Anecdotal, GLAAS 2019 report	Limited	OECD 2019 survey; UN Water and WHO, 2019
ODA flows	WSS, Total ODA flows, 2010-2017	41 ADB countries	OECD 2017
Financing options			
Experience with commercial finance	Anecdotal	25 ADB countries	UN Water and WHO, 2019; ADB 2017
Equity			
Micro affordability	GWI survey of city tariffs, World Bank Debt Sustainability database	108 cities in 20 ADB countries	GWI 2019

Public expenditure and private infrastructure investment

For our analysis on public expenditure and experience with commercial finance we utilised data collected through a survey conducted with K-Water and the Asian Water Council, plus data from limited number of countries in the most recent GLAAS report (UN Water and WHO, 2019) and ADB report (2017).

ODA as a source of funding

OECD data, 2019, stats.oecd.org

Increasing tariffs for water supply and sanitation

To examine countries ability to raise tariff rates we analysed city water bills in the target countries. Data was sourced from the latest (2019) Global Water Intelligence (GWI) Global Water Tariff Survey, which compiles the water bill of representative users and estimates their total water expenditure on water supply and sanitation services (Global Water Intelligence, 2019[6]). In some cases, the data parses out difference between water supply and sanitation bills but most often times they are reported together. We report the total cost of WSS without separating them. Table A A.3 below shows the number of cities in ADB countries observed in the GWI Survey.

Table A A.3. Count of Cities in the GWI Survey

Country	Count of Cities
China, People's Republic of	38
India	21
Malaysia	9
Korea, Republic of	7
Pakistan	7
Australia	5
Indonesia	3
Philippines	3
Kazakhstan	2
Bangladesh	2
Viet Nam	2
Tajikistan	1
Armenia	1
Bhutan	1
Georgia	1
Sri Lanka	1
Thailand	1
Kyrgyz Republic	1
Mongolia	1
Myanmar	1

Source: Authors calculation based on GWI data.

Due to lack of data on WSS bills for rural users, this skews our data towards urban users, who likely face lower per unit costs of water (e.g. access to groundwater as drinking water), but also lower levels of service (e.g. inadequate access to safe sanitation services).

In our effort to make an apples to apples comparison, we use the share of income of the middle quintile of incomes to compare to the GWI water bills to incomes. The rationale is that the middle 20% of income is likely to reflect income urban populations and allow us to examine the relationship between water bills and urban users. However, in countries that are predominantly rural, it is likely the case that the income share may still capture some rural incomes. The share of income of the middle quintile is not collected annually by all countries, so we selected the most recently reported share for countries with data reported in the last 5 years (which ranged from 2012 – 2017).

References (methodology only)

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Annex B. Annual ODA for water-related infrastructure in Asia-Pacific countries

The table below features data that support Figure 3.6 above.

Table A B.1. Annual ODA for water-related infrastructure in Asia-Pacific countries

Average 2013-2017

Country	USD/Capita	Annual Average 2013-2017 Millions of USD
Afghanistan	0.03	0.99
Armenia	2.26	6.65
Azerbaijan	2.64	26.03
Bangladesh	0.23	36.35
Bhutan	0.71	0.53
Cambodia	0.45	7.25
China	0.21	291.69
Fiji	1.27	1.12
Georgia	1.59	5.91
India	0.19	257.24
Indonesia	0.71	189.13
Kazakhstan	0.59	10.70
Kiribati	1.10	0.13
Kyrgyzstan	0.31	1.90
Laos	0.68	4.70
Malaysia	1.06	33.07
Maldives	0.01	0.01
Marshall Islands	3.31	0.19
Micronesia	3.49	0.39
Mongolia	0.68	2.10
Myanmar	0.39	20.81
Nepal	0.58	16.12
Pakistan	0.39	81.42
Palau	0.00	0.00
Papua New Guinea	0.12	0.98
Philippines	0.80	83.94
Samoa	1.21	0.24
Solomon Islands	0.15	0.09
Sri Lanka	2.75	59.07
Tajikistan	0.28	2.48
Thailand	0.22	15.31
Tonga	0.16	0.02
Uzbekistan	0.16	5.28
Vanuatu	0.44	0.13
Viet Nam	0.76	71.91

Notes: Includes ODA disbursements for the following water-related infrastructure: water supply and sanitation, water storage, flood protection, irrigation. Data are in millions of USD, gross disbursements, constant 2017 prices. 2017 population figures.
Data issues for some countries prevented their inclusion in the graphic. Particularly: Brunei, Cook Islands, Nauru, Niue, Timor Leste, Turkmenistan, and Tuvalu.
Source: OECD (2019b). See Annex B for supporting data.